ANTIBIOGRAM OF AEROBIC BACTERIAL ISOLATES OBTAINED FROM PATIENTS WITH EAR INFECTION IN A TERTIARY HEALTH CARE FACILITY AT BENIN CITY, EDO STATE, NIGERIA

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BY

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A PROJECT WORK SUBMITTED TO THE DEPARTMENT OF PHARMACEUTICAL MICROBIOLOGY AND BIOTECHNOLOGY, FACULTY OF PHARMACY, UNIVERSITY OF BENIN, BENIN CITY IN PARTIAL FULFILMENT OF THE REQIREMENTS FOR THE AWARD OF THE DOCTOR OF PHARMACY (PHARM.D) DEGREE

APRIL, 2024

CERTIFICATION OF THESIS ON PLAGIARISM

We the undersigned attest and declare that the thesis of Cyprian Osilama Ikolah

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DEDICATION

To my beloved parents Mr and Mrs Thaddeus Nasamu Ikolah and siblings for giving me the enablement to undertake this important journey and to God Almighty who has indeed kept and guided me all through this journey.

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LIST OF ABBREVIATIONS

N	Sample size
ENT	Earn Nose and Throat
UBTH	University of Benin Teaching Hospitall
MIC	Minium Inhibitory Concentration
IZD	Inhibition Zone Diameter
GPC	Gram-positive cocci
GPB	Gram-positive bacilli
GNB	Gram-negative bacilli

ABSTRACT

Introduction: Ear infections, particularly otitis media, represent a common health concern globally, impacting individuals across diverse demographics. In developing countries like Nigeria, the prevalence and incidence of ear infections and demographics is not well documented. This study aimed to investigate the prevalence, bacterial etiology, susceptibility patterns, and associated factors of ear infections among patients presenting with otitis symptoms thus contributing to the wealth of available knowledge on ear infections.

Methodology: This study evaluated 43 patients who visited the Ear, Nose and Throat clinic in the University of Benin Teaching Hospital for washing and check-up of their ear. Patient data and specimen were obtained at the study centre. Microbiology analysis as well as antimicrobial susceptibility and Minimum Inhibitory Concentration determination were carried out in the specimen at the Pharmaceutical Microbiology and Biotechnology laboratory of the Faculty of Pharmacy, University of Benin, Benin City, using standard techniques.

Results: *Staphylococcus aureus* and *Pseudomonas aeroginosa* accounted for the most predominant isolates from the specimens obtained from participants with vary susceptibility to commonly used antibiotics. Furthermore, results obtained revealed the presence of *Klebsiella oxytoca* and *Enteriobacteria* in the ear of respondents which is in contrast to what already exist in literature.

Conclusion: The study demonstrated the activity of specific antibiotics against bacteria isolates from ear infections both Gram-positive and Gram-negative present in the ear of patients in the study center.

Keywords: Otic infections, demographics, prevalence, antibiotic activity, antibacterial susceptibility, minimum inhibitory concentration

CHAPTER ONE

INTRODUCTION AND LITERATURE REVIEW

1.13Background of study

An ear infection is referred to as an inflammation of the ear usually caused by bacteria and other organisms such as fungi. In an ear infection, parts of the inner ear becomes inflamed or irritated, narrow tubes that run from the middle ear to high in the back of the throat (eustachian tubes) can become swollen and blocked. This can lead to mucus build-up in the middle ear. This mucus can become infected and cause ear infection symptoms. Also, in ear infection there could be an inflammation of the external auditory canal due to bacterial etiology which causes acute pain and discomfort in the ear.

1.14 Epidemiology of ear infections

Worldwide, there are more than 360 million people with disabling hearing loss. Over 60% of this hearing loss could be preventable, and infection is responsible for up to 40% of this preventable hearing loss (Getaneh et al, 2021). The presence of bacteria, fungi and virus in the human body has been of huge significance due to the different number of infections which these organisms cause and the effect which they have on the human population.

In 1968 Chandler described various aspects of the disease of external ear and organisms were found to be specific for a geographic location and hence a study that would measure common causative organisms of Acute Otitis External at a given time and a given place is necessary. Microorganisms can be cultured even from the normal external auditory canal, but their mere presence will not account to any pathology in the ear canal.

It is estimated that around 1 in 10 people will be affected by it at some point in their lives with the condition being slightly more common in women than men and is most often diagnosed in adults 45 to 75 years of age according to research. Also, it is estimated that

about 50% of all children will have at least one ear infection by the time they reach their second birthday (Caroline et al., 2020).

1.15Types of Ear Infection

There are several types of ear infections which include; otitis interna, otitis media (acute or chronic), otitis external. Others are; serous otitis media, infectious myringitis, acute mastoidis, vestibular neuronitis, herpes zoster of the ear. The term "inner ear infection" may refer to any condition that causes inflammation in your inner ear. Colds and flu can cause inflammation or it can develop when an infection in your middle ear spreads to your inner ear. Many people with inner ear infections experience problems with hearing and balance. The medical term for an inner ear infection is "otitis interna. Inner ear infections casn occur at any age, but they're most common in adults aged 30 to 60. Children can also develop inner ear infections as a symptom of bacterial meningitis. There are two primary types of inner ear infections: labyrinthitis and vestibular neuritis (Cleveland clinic medical professional et al, 2022). Labyrinthitis is an infection of the labyrinth, which is the part of your inner ear that controls hearing and balance, thus a disorder of balance and hearing. The condition is most commonly caused by viral infections, whereas Vestibular neuritis is an infection of the vestibular nerve, which is the part of your inner ear that controls balance and eye movement. Vestibular neuritis often develops before or alongside a viral infection (Cleveland clinic medical professional et al, 2022). People with inner ear infections may experience a wide range of symptoms associated with those senses. Signs of an inner ear infection may include: balance problems, vertigo, dizziness, hearing issues, nausea and vomiting, a feeling of fullness in your ear, ringing in your ear, headache, earaches (Cleveland clinic medical professional et al, 2022). Sometimes, an infection can spread to your inner ear from another area of your body, such as your airway. In these instances, you may also have a runny nose or generalized issues like fever. Oftentimes, your initial symptoms begin fading when your inner

ear symptoms begin. Most inner ear infections are due to a virus, such as influenza, herpes zoster oticus or Epstein-Barr. Less commonly, inner ear infections are the result of bacteria (Cleveland clinic medical professional et al, 2022). Inner ear infections are not contagious but the virus which causes the infection can spread from person to person.

Otitis media is the inflammation of the middle ear cleft and the tympanum with otorrhoea lasting from 2 weeks to more than 3 months, with permanent perforation mainly caused by bacteria (Adoga et al. 2010; Mesfin and Muluken 2014). It may be acute or chronic, with the acute otitis media (AOM) lasting between 2 days up to 3 months, whereas chronic otitis media lasts more than 3 months. Middle ear infections are the most common ear infections in children other than cold. The middle ear is the air-filled space between your eardrum and inner ear. It houses the delicate bones that transmit sound vibrations from your eardrum to your inner ear so you can hear. Eustachian tubes are canals that connect your middle ear to the back of your throat. They regulate air pressure in your ear and prevent fluid from accumulating in your middle ear space. If a Eustachian tube doesn't function well, fluid has a hard time draining from your middle ear space and can cause muffled hearing. Ear infections (from viruses and bacteria) also cause middle ear fluid. In these cases, the middle ear fluid is infected and often causes discomfort in addition to muffled hearing (Cleveland Clinic Medical Professional et al, 2022). Signs and symptoms of otitis media may include; ear pain, loss of appetite, feeling of fullness or pressure in the ear, trouble hearing in the ear that is blocked.

The external ear is exposed to various microbes and is a micro-environment in itself. It harbors various bacteria and the health of the external auditory canal is decided by the interplay of various factors like moisture, pH, cerumen and trauma to skin. Acute Otits Externa (AOE) is the inflammation of the external auditory canal mostly due to bacterial etiology that results in acute pain and discomfort in the ear. The first case of AOE was

described by Toulmousch in 1838 and later systematically described by Mayer in 1844. It was initially thought to be a fungal infection. Investigations initiated during World War II firmly established bacterial etiology of otitis externa. Otitis external refers is an infection in the ear canal which connects the middle ear to the external ear (Michelle et al., 2016). Also known as Swimmer's infection it is an outer ear infection which causes pain, swelling, redness, itching, ear drainage and loss of hearing. This infection is often caused by bacteria such as *Pseudomonas aeroginosa, Staphylococcus ureus* as well as fungi, viruses and allergies (Michelle et al., 2016). Symptoms of this infection includes; inflammation, tenderness and ear pain and this symptoms can occur within 48 hours of infection. Risk factors associated with the infection includes; swimming, injury to the ear canal, middle ear infection (Michelle et al., 2016). This condition can affect all age groups. However, children who spend a lot of time in the water are at greatest risk, particularly during the summer months when swimming is common.(James Myhre & Dennis Sifris, MD et all., 2023).

1.16Anatomy of the ear

The human ear is the organ responsible or hearing and plays a crucial role for maintaining balance. It consists of three main parts: the outer ear includes the visible part of the ear (pinna) and the ear canal. Its primary function is to collect sound waves and channel them into the ear canal. The middle ear is an Air-filled space located behind the ear drum (tympanic membrane). It contains the three smallest bones in the human body, the hammer, anvil, and stirrup. These bones transmit sound vibrations from the ear drum to the inner ear. The inner ear consist of the cochlea, a spiral-shaped, fluid-filled structure responsible for converting sound vibrations into electrical signals that can be interpreted by the brain. It is also responsible for balance and spatial orientation through structures like the semi-circular canal.

The human ear is not sterile but contains a limited and unique microbial flora with the microbial communities varying among individuals and is generally less diverse than those

found in other parts of the body such as guts or skin. The normal flora of our human ear includes both aerobic and anaerobic bacteria but for the purpose of this study our focus will be on the aerobic bacteria present in the ear.

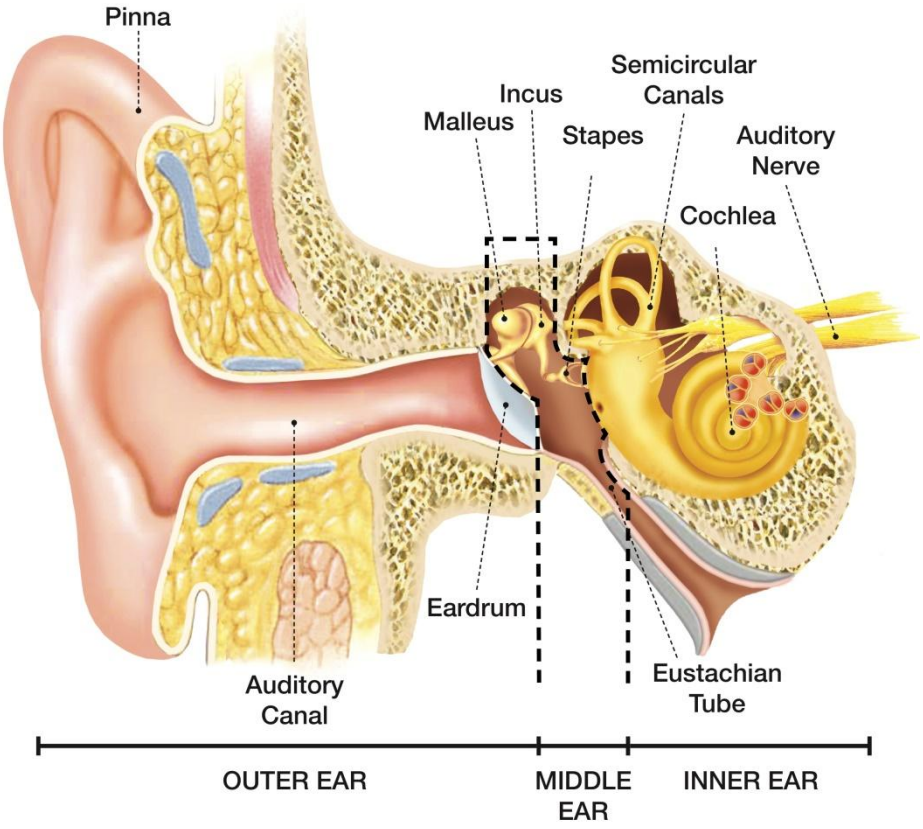

Figure 1.1 Structure of the human ear

1.17Pathophysiology of ear infection

Otitis interna results from extension of otitis media. It may occur with or without osteomyelitis of the petrous portion of the temporal bone. With time and severity, lesions progress retrograde through the internal acoustic meatus into the cranial cavity, resulting in meningitis, ventriculitis and encephalitis. The common symptoms associated with otitis interna include; dizziness, vertigo, a ringing sound in your ear (Kathryn Warson et Suzanne Falk 2017). Otitis media commonly develops in association with an infection of the upper respiratory tract that extends from the nasopharynx to the middle ear through the Eustachian tube. The primary symptom of acute otitis media is ear pain; other possible symptoms include fever, reduced hearing during periods of illness, tenderness on touch of the skin above the ear, purulent discharge from the ears, irritability, ear blocking sensation and diarrhea (in infants). Since an episode of otitis media is usually precipitated by an upper respiratory tract infection (URTI), there are often accompanying symptoms like a cough and nasal discharge. One might also experience a feeling of fullness in the ear.

Otitis externa, commonly known as "swimmer's ear," is an infection or inflammation of the ear canal, the tube that runs from the external ear to the eardrum. The pathophysiology of otitis externa involves several key factors which include Breakdown of the Skin Barrier. The ear canal's skin is normally a natural barrier that protects against infections, however, when this skin barrier is damaged or disrupted, it becomes more susceptible to infection. Factors that can contribute to this breakdown include water exposure, abrasions, or the use of objects like cotton swabs that can scratch or irritate the ear canal. Once the skin barrier is compromised, bacteria or fungi can invade the ear canal. The most common pathogens responsible for otitis externa include *Pseudomonas aeruginosa* and *Staphylococcus aureus* bacteria, as well as various fungi. These microorganisms proliferate in the warm, moist environment of the ear canal. In response to the microbial invasion, the body's immune

system initiates an inflammatory response. This leads to swelling, redness, and pain in the ear canal. The body may also produce excessive earwax as a protective mechanism. Patients experience symptoms such as ear pain (otalgia), itching (pruritus), and sometimes discharge from the ear. These symptoms can range from mild to severe. If left untreated, otitis externa can progress, leading to complications such as the spread of infection to nearby tissues, the development of an abscess, or damage to the eardrum (deafness).

The pathophysiology of otitis externa underscores the importance of preventing damage to the ear canal's skin barrier, especially in situations where water exposure is common (e.g., swimming). Proper ear hygiene, including keeping the ears dry and avoiding the insertion of foreign objects into the ear canal, can help reduce the risk of otitis externa. Treatment typically involves ear cleaning, topical antibiotics, and pain relief measures to resolve the infection and alleviate symptoms.

1.18 Risk factors associated with ear infections

Several risk factors are associated with the development of ear infection and they include: being male, being born prematurely (before 37 weeks' gestation), exposure to secondhand smoke, using a pacifier, having large adenoids, which may cause mouth breathing or night time snoring, having a personal or family history of otitis media, having a cleft palate, and having Down syndrome (the aforementioned being responsible for otitis internal).

Among the risk factors for development of otitis external include exposure to excessive moisture, injury or irritation of the external ear, ear wax build up, narrow or curved ear canals, pre-existing skin conditions, foreign bodies, chemical irritants, allergies, and immunosuppression.

Common causes of ear infection may include allergies, colds and sinus infections, excess mucus and saliva produced during teething in children (Kaneshiro et al., 2023), infected or overgrown adenoids as well as tobacco smoke.

1.19 Symptoms and complications of ear infection

Ear pain (otalgia), pruritus, ear discharge, impaired hearing, dizziness, or impaired balance, fever, redness in the outer ear, spinning sensation among others are the major symptoms associated with ear infection. Others include cough, lethargy, vomiting, diarrhea and loss of appetite (Kaneshiro et al., 2023).

Complications of ear infections include tearing o the ear drum, spreading of infection to nearby tissues such as infection of the bones behind the ear or infection of the brain, chronic otitis media, collection of pus in or around the brain among others (Kaneshiro et al., 2023), perichondritis, cellulitis among others.

1.20 Management of Ear infections

Most ear infections clear on their own without the use of antibiotics. Treating the pain and allowing the body enough time to heal is often all that is needed. Applying warm cloth or warm water bottle on the affected ear could help in the management of these infections (Kaneshiro et al., 2023), use of over the counter ear drops or drugs such analgesics are also important in the management of ear infection. Maintaining good otic health is also very important in maintaining the ear as well as regular medical check-up on the ear.

1.9 Minimum Inhibitory Concentration

MIC stands for Minimum Inhibitory Concentration. It refers to the lowest concentration of an antimicrobial agent (such as an antibiotic, antifungal, or antiviral drug) that inhibits the

visible growth of a microorganism in vitro under standardized conditions (Magiorakos et al., 2012). MIC testing is a key method used in microbiology laboratories to assess the susceptibility of microbial isolates to antimicrobial agents. By determining the MIC of a particular drug for a specific microorganism, clinicians can gauge the effectiveness of the drug against that organism and make informed decisions about antibiotic therapy. MIC values are usually reported in units of concentration, such as micrograms per milliliter (μg/mL) or milligrams per liter (mg/L). Lower MIC values indicate greater susceptibility of the microorganism to the antimicrobial agent, while higher MIC values may indicate resistance. MIC testing helps guide clinicians in selecting appropriate antibiotics for treating bacterial infections and monitoring trends in antimicrobial resistance.

1.10 Justification of study

Ear infection linked with frequent antibiotic prescription, hearing impairment, severe disability and death is a public health threat in developing countries. Ear infection may be acute or chronic purulent type (Wasihun and Zemene 2015). About 65–330 million people suffer from ear infection worldwide and 60 % of them had significant hearing loss (Woodfield and Dugdale 2008). However, there is scarcity of documented data in the study area. Therefore, this study aimed at determining bacterial etiologic agents and their antimicrobial susceptibility patterns among patients of all age groups. It is directed at analyzing the antimicrobial susceptibility profile of cultured aerobic bacteria cultures obtained from the external ear of patients with ear infection from the ear, nose and throat department of a health institution in Nigeria. This is aimed at ascertaining the susceptibility of these bacteria to different antibacterial agent to determine the best way to tackle ear infections.

1.11 Aim and objectives

This research evaluated the demographics of the study participant and the bacteria isolates from their ear as well as the various susceptibility patterns of these isolates to various antibiotics used in the management of ear infections in the ENT clinic of the University of Benin teaching hospital.

1.12 Specific objectives

1. To evaluate demographic data of participants.
2. To isolate and identify bacteria microbial cell from the obtained specimen.
3. To determine the various bacteria cells responsible for ear infections
4. To determine the antibacterial susceptibility profile of all isolates obtained.

CHAPTER TWO

MATERIALS AND METHOD

2.1 Materials

2.1.1 Reagents and Chemicals

Antimicrobial susceptibility test disc (perfloxacin, ofloxacin, azithromycin, levofloxacin, cefotaxime, streptomycin, ciprofloxacin, amoxicillin and amoxicillin –clavulinic acid combination) (Maxi-Medical laboratories, Nigeria), pure compounds (co-trimoxazole, amoxicillin, ciprofloxacin and amoxicillin-clavulinic acid combination), crystal violet and lugol's iodine (Bema scientific and chemical Co Ltd, Nigeria), oil of immersion (Sisco

Research Laboratories Pvt, Ltd, India), Methylated spirit (SPC Co. Ltd. Nigeria), Acetone, Safranin, (Loba Chem Pvt Ltd. India).

2.1.2 Culture Media

Sodium thioglycolate, Mueller Hinton agar, , nutrient agar, nutrient broth, sabaroud dextrose agar and mannitol salt agar (Titan biotech, India), Mac conkey agar (Hi flown Global Resources Ltd, Nigeria)

2.1.3 Equipment

Hot air oven and incubator (Gallenkamp UK), autoclave (Techmel and Techmel, UK), compound light microscope (olympus,Japan), refrigerator (Thermocool, UK), digital weighing scale (DFT Techlogies, Chennai-India).

2.1.4 Glassware and other apparatus

Beakers, conical flasks, bottles (MacCartney, Universal and Bijoux), measuring cylinders. glass stirrer, glass slides, Petri dishes and Pasteur pipette (All glass wares were products of Pyrex, England), Sterile syringes, Bunsen burner, cotton wool, sterile swab sticks, Surgical gloves, surgical blades, slide (Micropoint, China), foil paper, micropipette (OEM Manufacturers) and wire loop.

2.2 Methods

2.2.1 Study Area

The study was carried out at the Ear, Nose and Throat (ENT) Clinics of the University of Benin Teaching Hospital, a tertiary health care centre that has an ENT clinic attached to it that attends to both in-patient and out-patient.

2.2.2 Study Design

This was a prospective study of patients who visited the Ear, Nose, and Throat (E.N.T) unit of the University of Benin Teaching Hospital (UBTH) from January to February,2024. Sample size was estimated using a Kish Leslie formula (1965) for a cross-sectional study considering the prevalence of 62.1% reported previously by Mushi et al., 2016 in a study conducted in a tertiary hospital in Tanzania.

The research team collected only 43 samples due to time constraints and limited new patients. Since only previously evaluated patients returned for checkups, sample collection adhered to ethical guidelines with approval from the Institutional Review Board and informed consent from all participants.

2.2.3 Ethical Considerations

In the course of this study, informed consent was sought and obtained from participants, while assent was obtained from patients aged 17 years and below, through their parents. The study protocol was approved by the Health Research Ethics Committee of the University of Benin Teaching Hospital (PROTOCOL NUMBER: ADM/E22/A/VOL. VII/14838152180)

The principle of voluntary participation, maintenance of anonymity, and confidentiality was maintained throughout the study. Participants were given the right to decide whether to participate, withdraw at any point, or decline to provide information on unclear points.

Information provided by participants was treated confidentially, with no request for their address in the questionnaire.

2.2.4 Data Collection

A semi-structured questionnaire was employed to gather various details from each study participant. This information encompassed socio-demographic aspects such as name in code for confidentiality, gender, history of smoking and alcohol usage, swimming history, medication history, presence of hereditary or underlying health conditions (like diabetes,

hypertension, cardiovascular disease, etc.), frequency of anti-biotic use in a year, presenting ear infection symptoms, ear cleaning habit, usage of earrings, as well as the location of the ear infection.

Inquiries about patient habits covered the frequency of alcohol consumption, smoking, and ear cleaning, how they clean the ear. Furthermore, details were gathered about what they use in cleaning the ear.

2.2.5 Population of Study, exclusion and inclusion criteria.

The study was conducted among all eligible study participants across all ages who presented to the clinics for washing and check-up within the designated study period (from January 2024 to February 2024). Only patients who had been evaluated and confirmed to have ear infection by the medical doctor was included in the study while patients who had been on antibiotics 2-4 weeks prior to specimen collection and patients visiting the clinic for procedures other than washing and ear check-up were excluded from the study.

2.2.6 Specimen collection

The specimens which were collected using sterile swab sticks were collected with the aid of a mirror to visualize the internal ear. The contaminated sterile swab sticks containing the specimen was then placed into the swab stick holder containing 5ml thioglycolate broth. All specimens were transported within 2 hours to the Department of Pharmaceutical Microbiology laboratory for further microbiological investigations.

2.2.7 Characterization and Identification of Isolates

After incubation in sodium thioglycolate broth for 24 hours, the specimens were sub-cultured into 10% blood agar plate which was prepared by mixing 10ml of human blood with 90ml of

nutrient agar, sub culture was also made into prepared Mannitol salt agar plate by streaking the prepared plates with the specimen. MacConkey agar plates were also prepared by dissolving sufficient quantity of the powdered agar in sufficient quantity of water after which the resultant agar was sterilised by autoclaving allowed to cool and poured into the plates before it was allowed to dry, the specimen was sub-cultured into the dried plates. Plates labelled aerobes were incubated for 24 hours at 37^0C in an upright position. Isolates were chosen for subculture based on colony morphologies present. Where two or more colonies on the blood agar plate appeared to be identical, only one colony was sub-cultured in the nutrient agar plate and incubated for 18-24hours. Where two colonies appeared to be different on the blood agar plate, both were sub-cultured. Each of the isolates were identified with colonial characteristics, standard biochemical test methods and Gram staining in which to a standardized suspension of the organism heat-fixed to a glass slide, was added crystal violet, followed by iodine treatment, acetone decolourization, and then a safranin counterstain to differentiate bacterial cells into either Gram-positive (purple) or Gram-negative (pink) based on cell wall characteristics.

The Gram staining, catalase, coagulase, indole, and oxidase tests carried out were used to identify the isolates.

2.3 Determination of antimicrobial activity of several antibiotics on isolates

2.3.1 Inhibition zone diameter

This was carried out using the spread-plate technique with some modifications. Molten MullerHinton agar was poured into a petri dish plate, allowed to solidify; 1ml of subculture of the specimen in nutrient broth was the placed on the solidified agar plate using a sterile glass spreader while gently rotating the plate clock-wise. The plate was allowed to solidify further. A sterile antibiotic disc containing different grades of antibiotics that contained levofloxacin 20µg, cefotaxim 10µg, sparfloxacin 10µg, ciprofloxacin 30µg, amoxicillin 30µg,

amoxicillin-clavulanic acid 10µg, gentamycin 30µg, perfloxacin 30µg, and azithromycin 12µg was then gently placed on the surface of the solidified plate. The plates were incubated in an upright position for 18-24 hours at 37^0C. The width of the inhibition zone gives an indication of the relative activity of the various antibiotics present on the disc whereas organisms which are resistant did not show any zone of inhibition. The inhibition zone diameter was measured in mm.

2.3.2 Determination of minimum inhibitory concentration

This was carried out by carrying out various 1:20 serial dilutions on 0.001 gram of co-trimoxazole which is equivalent to 50µg, the serial dilutions was done five times to arrive at concentrations of 20µg, 10µg, 5µg, 2.5µg and 1.25µg of co-trimoxazole. 1:20 serial dilution were also done on 0.002grams (100µg) of amoxicillin and augmentin to arrive at concentrations of 50, 25, 12.5. and 6.25µg of both antibiotics respectively. 0.0004grams (5µg) of ciprofloxacin was also diluted to arrive at concentrations of 2.5, 1, 0.5, 0.25, and 0.125µg by carrying out 1:20 serial dilutions. All dilutions were carried out using Mueller Hilton nutrient agar. On preparations of the various concentrations, each concentration was poured single into different plates, allowed to set before being streaked by the specimens. The plates were incubated in an upright position for 18-24 hours at 37^0C. The plates were then observed for the presence of growth at the various concentrations and results were taken and recorded.

2.4 Method of Data Analysis

A total of five patient demographics variables were coded and entered from the semi structured questionnaire into the Statistical Package for Social Sciences (SPSS) version 27.0 software (SPSS Inc Chicago IL USA). These included age, sex, occupation, smoking history, alcohol history and weight. These variables were defined as either string or numeric variables

in the software. Additionally, multiple choice questions including those describing frequency of swimming, ear cleaning habit, wearing of earrings, instrument used in ear cleaning, piercing of ear, location of pain, previous ear infection, presence of pus, frequency of antibiotics use and duration of symptoms being set as numeric variables while present and past medication history were set as string variables. Inhibitory zone diameters were entered and defined as numeric data prior to the analysis with respect to EUCAST (2015) breakpoint. Minimum inhibitory concentrations were also entered as numeric data before analysis. Descriptive statistics were used to report percentage frequencies of patient demographics, medication history, presence of hereditary or underlying health conditions (like diabetes, hypertension, cardiovascular disease, etc.), prior history of ear infection with emphasis on the affected ear. Statistical difference between variables were calculated using One way analysis of variance (Chi square). Difference between groups was considered significant as P value < 0.05. Standard diagnostic indices including quantitative antibiogram (IZD) values, positive predictive diagnostic (Gram staining test) efficacies were all calculated according to standard procedures.

CHAPTER 3

3.0 RESULTS

This study investigates the antibacterial susceptibility profile of isolates obtained from patients with otitis infection. The tables presented below aim to provide a comprehensive analysis of various demographic and clinical factors associated with otitis infection, including age, occupation, smoking history, alcohol history, and previous microbial infections. These tables offer insights into the distribution of key variables among the study population and highlight significant trends and associations. The following sections introduce each table and summarize the key findings derived from the data analysis.

3.1 Association of sex with Patient Demographics

Table 3.1 presents the demographic characteristics of the study population, including age distribution, occupation, smoking history, alcohol history, and swimming habits. In this study the age distribution of patients with otitis infection shows a wide range, with the majority

falling between 16-25 (59.2%, n=45) years and a higher percentage of the study participants being unemployed. An examination of the social behaviour of the participants revealed that majority of the study participants had never smoked or taken alcohol with the percentage of study participants being 85% and 67.1% respectively. Analysis of swimming history of the participants revealed that majority of the respondents had no swimming history (88.2%) with majority of the patients (90.8%) cleaning their ear with cotton buds. Our findings shed light on the prevalence of previous ear infections, indicating that most of the study participants had previously been infected with ear infections (65.8%, n=50). Furthermore the table revealed that majority of the study participants had the infection in both ears with a major significance in the reported cases of pus discharge, while ear pain was predominantly located in the inner ear. Analysis of the duration of symptoms revealed that study participants had varying duration of symptoms as well as 82.9% of the respondents being previously treated for microbial infections.

TABLE 3.1 Association of sex with patient Demographics

Characteristics	Values	Male	Female	Total	P-value
Age of patient	0-15yrs	2	8	10	0
	16-25yrs	5	24	39	
	26-35yrs	2	6	8	
	36-55yrs	0	2	2	
	56-60yrs	0	3	3	
	>60yrs	11	3	14	
Occupation	Unemployed	5	34	39	0.002
	Self-employed	2	4	6	
	Employed	9	8	17	
	Retired	2	0	2	
	Student	2	10	12	
Smoking history	Never	13	52	65	0.003

	Stopped	7	3	10	
	Ongoing	0	1	1	
Alcohol history	Never	6	45	51	0
	Stopped	8	1	9	
	Ongoing	6	10	16	
Swimming history	Never	15	52	67	0.099
	Stopped	2	2	4	
	Ongoing	3	2	5	
Ear cleaning habit	Yes	11	26	37	0.586
	Often	6	24	30	
	Never	3	6	9	
Earring wearing	Randomly	0	3	3	0
	Everyday	5	43	48	
	Monthly	1	3	4	
	Never	14	7	21	
Location of pain	Inside ear	20	52	72	0.219
	Outer ear	0	0	0	
	Both	0	4	4	
Previous ear infection	Yes	13	37	50	0.931
	No	7	19	26	
Affected ear	Right ear	3	13	16	0.575
	Left ear	10	21	31	
	Both	7	22	29	
Pus discharge	Yes	5	30	35	0.028

	No	15	26	41	
Duration of symptoms	<1week	7	15	22	0.440
	≤2week	5	23	28	
	>21days	8	18	26	
Previous microbial infection	Yes	19	44	63	0.002
	No	1	12	13	

3.2 Association between patient demographic and bacterial isolates

The associations between patient demographics and bacteria isolates, provides insights into potential risk factors and patterns of bacterial colonization in patients with different characteristics. From this study a total of eight different bacteria both Gram-positive and negative were isolated, organisms isolated include *Enterobacteria, Corynebacterium, Klebsiella oxytoca, Bacillus cereus*, *Bacillus subtilis*, *Klebsiella pneumonia, Pseudomonas aeroginosa, Staphylococcus aereus*, and *Staphylococcus epidermidis* This association revealed that participants who swim tends to have more of *Staphylococcus aureus* (27.6% n=21) and *Pseudomonas aeroginosa* (26.3% n=20) with patients who clean their ears regularly having more of the bacteria isolates. Similarly, it is revealed that participants who clean their ear with cotton buds had more of the bacteria isolates (90.8% n=69) with more extensive isolates obtained from respondents who had long pierced their ears. Additionally it is observed that participants who wear earrings everyday tend to have more bacteria isolates. (Table 3.2)

Table 3.2 Association of patient demographics and bacteria isolates.

CHARACTERISTICS	VALUES	B.C	B.S	C.B	E.B	K.O	K.P	P.A	S.A	S.E
Swimming history	Never	4	5	3	1	1	2	18	17	15
	Stopped	1	0	0	0	0	0	1	1	1
	Ongoing	0	1	0	0	0	0	1	3	0
Ear cleaning habit	Yes	4	1	1	0	1	1	10	10	8
	Not often	1	3	1	1	0	1	8	7	8
	Never	0	2	1	0	0	0	2	4	0
Instruments used in cleaning	Cotton buds	5	6	3	1	0	2	17	21	13

	Biro tips	0	0	0	0	1	0	2	0	3
	Key	5	6	3	1	1	2	20	21	16
Recently pierced ear	Yes	0	0	0	0	0	0	1	0	1
	No	5	6	3	1	1	2	19	21	15
Ear wearing	Randomly	0	0	0	0	0	0	1	0	2
	Everyday	2	4	2	1	1	2	12	13	10
	Monthly	0	0	0	0	0	0	1	1	2

KEY: B.C= Bacillus cereus, B.S=Bacillus subtilis, C.B=Corynebacterium E.B= Enterobacterium,K.O=Klebsiella oxytocoa K.P= Klebsiella pneumonia P.A= Psuedomonas aeruginosa S.A= staphylococcus aerus S.E=Staphyloccus epidermidis

3.3 Association between bacterial isolates and patient symptoms

The relationship between the bacteria isolates and the symptoms such as ear pain, itching, pus discharge, dizziness, poor hearing and fever revealed that *Staphylococcus aureus* and *Pseudomonas aeroginosa* were associated with majority of the reported symptoms. Frequency distribution of the bacteria isolates revealed that *S. aureus* and *P. aeroginosa* are the two most abundant bacteria implicated in participants with ear infection (Table 3.3).

TABLE 3.3 Association of symptoms with bacteria isolates

ISOLATES	**SYMPTOMS**							
	Pain in the ear	Discharge	Poor hearing	Fever	Itching	Turning of eyes	Total	P-value
B. cereus	2	2	1	0	1	0	5	0.447
B. subtilis	0	3	1	1	1	0	6	
C. bacterium	0	0	1	0	2	0	3	
Eterobacterium	0	0	0	0	1	0	1	
K. oxytoca	1	0	0	0	0	0	1	
K. pneumonia	1	1	0	0	0	0	2	
P. aeroginosa	8	5	3	1	3	0	20	
S. aureus	6	4	1	6	3	1	21	
S. epididymis	11	4	0	0	1	0	16	

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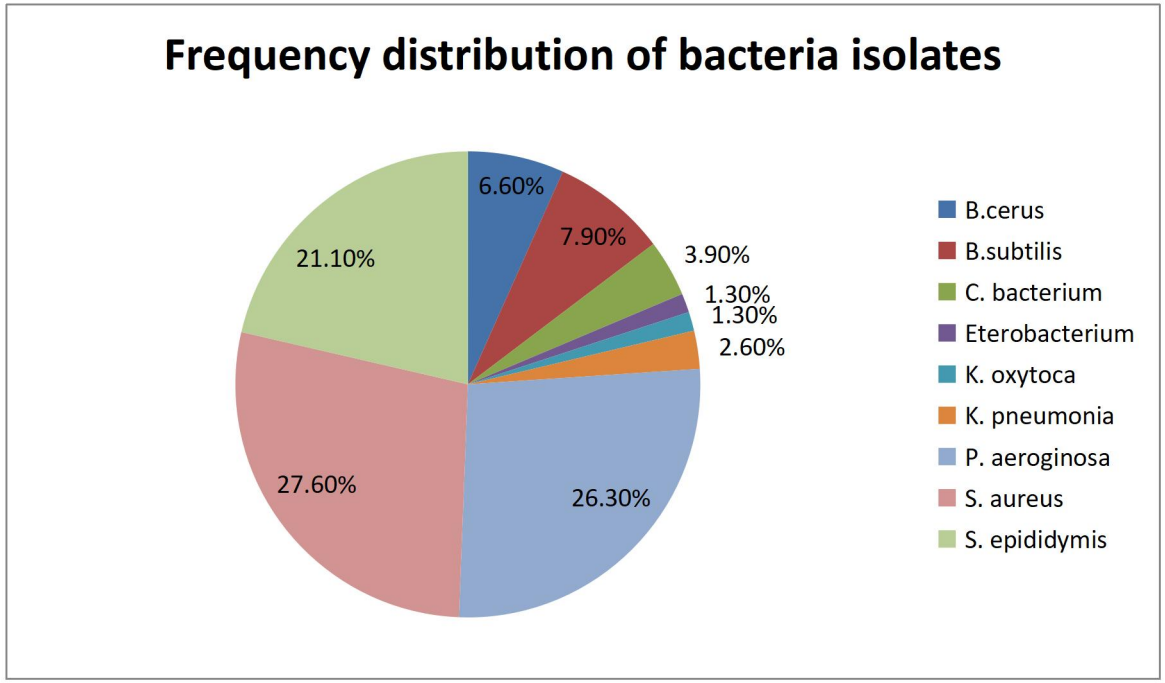

Fig 3.1. Frequency distribution of bacteria isolates

3.4 Morphological Characteristics of bacteria Isolates

Examining the morphological characteristics of the bacteria isolates, majority of the isolates were gamma haemolytic with a higher percentage of the bacteria being Gram-positive cocci. Biochemicaal test revealed that majority of the bacteria isolates were catalase positive making up 98.7% with only 1.3% of the isolates testing positive to indole. (Table 3.4)

TABLE 3.4 Morphological characteristics of aerobic bacteria isolates obtained from study population

MORPHOLOGICAL TEST	INFERENCE	B.C	B.S	C.B	E.B	K.O	K.P	P.A	S.A	S.E	TOTAL
Colonial characteristics	Alpha	0	4	1	1	1	0	7	10	4	28
	Beta	4	0	2	0	0	0	4	2	2	14
	Gamma	1	2	0	0	0	2	9	9	10	33
Gram staining	GPC	0	0	0	0	0	0	0	21	16	37
	GPB	5	6	3	0	0	0	0	0	0	14
	GNB	0	0	0	1	1	2	20	0	0	24
Catalase test	Positive	5	6	3	1	1	2	20	21	16	75 +VE
Coagulase test	Positive	0	0	0	0	0	0	0	21	0	21 +VE

Oxidase test	Positive	0	6	0	0	0	0	20	0	0	26 +VE
Citrate test	Positive	5	6	0	1	1	2	20	0	0	35 +VE
Indole test	Positive	0	0	0	0	1	0	0	0	0	1 +VE
Urease test	Positive	1	0	0	1	0	2	0	21	16	41 +VE

KEY: GPC=Gram positive cocci, GPB= Gram positive bacilli, GNB= Gram negative bacilli, B.C= *Bacillus cerus*, B.S=*Bacillus subtilis*, C.B=*Corynebacterium* E.B= *Enterobacterium,K.O=Klebsiella oxytocoa K.P= Klebsiella pneumonia P.A= Psuedomonas aeruginosa S.A= staphylococcus aerus S.E=Staphyloccus epidermidis*

3.5 Sensitivity pattern of bacteria isolates

Analysing the sensitivity of the isolates to the antibiotics used, table 3.5 revealed that *Pseudomonas aeroginosa* was the most sensitive to the test antibiotics showing >50% sensitivity to all the test antibiotics with both *Klebsiella oxytoca Bacillus subtilis* being the most resistant. Furthermore, it is revealed that majority of the bacteria isolates were sensitive to azithromycin (79.3 n=52) while 59.2% of the isolates were resistant to amoxicillin.

TABLE 3.5. Sensitivity pattern of bacterial isolates

Isolates	**SP**		**AZ**		**AUG**		**AM**		**CEF**	
	S	R	S	R	S	R	S	R	S	R
B. cereus (5)	3(60%)	2(40%)	4(80%)	1(20%)	3(60%)	2(40%)	2(40%)	3(60%)	0(0%)	1(100%)
B. subtilis(6)	2(33.3%)	4(66.7%)	2(30%)	4(70%)	4(66.7%)	2(33.3%)	3(60%)	2(40%)	3(100%)	0(0%)
C. bacterium (3)	1(33.3%)	2(66.7%)	2(66.7%)	1(33.3%)	2(66.7%)	1(33.3%)	3(100%)	0(0%)	3(100%)	0(0%)
Eterobacterium (1)	0(0%)	1(100%)	1(100%)	0(0%)	1(100%)	0(0%)	0(0%)	1(100%)	0(0%)	1(100%)
K. oxytoca (1)	1(100%)	0(0%)	1(100%)	0(0%)	1(100%)	0(0%)	0(0%)	1(100%)	1(100%)	0(0%)
K.pneumonia (2)	2(100%)	0(%)	2(100%)	0(0%)	1(50%)	1(50%)	1(50%)	1(50%)	1(50%)	1(50%)
P.aeroginosa (20)	15(75%)	5(25%)	14(73.7%)	5(26.3%)	9(45%)	11(55%)	3(15%)	17(75%)	8(40%)	12(60%)
S. aureus (21)	18(85.7%)	3(14.3%)	13(76.5%)	8(23.5%)	16(75%)	5(25%)	11(52.4%)	10(47.6%)	13(76.5%)	8(23.5%)
S. epididymis (16)	13(81.3%)	3(18.8%)	13(86.7%)	3(13.3%)	10(62.5%)	6(37.5%)	8(50%)	8(50%)	7(43.8%)	9(56.3%)
Average %	63.2%	36.8%	79.3%	20.7%	69.5%	30.5%	40.82%	59.2%	56.7%	43.3%

KEY: SP=Sparfloxacin, AZ=Azithromycin,AUG=Amoxicillin-clavulinic acid , AM=Amoxicillin, CEF=Ceftoxamine,

S=Sensitive,R=Resistant

3.6 Minimum Inhibitory Concentration (MIC)

Table 3.6 presents the minimum inhibitory concentration (MIC) assays for various antibiotics, Ciprofloxacin demonstrated potent bacteriocidal effects, with *Klebsiella oxytoca* completely inhibited at (0.0025µg), while all other organisms required the highest concentration of (5µg) for complete inhibition. At 25µg, (96.1%) of all organisms were inhibited, highlighting its broad-spectrum activity. Co-trimoxazole 's low efficacy was noteworthy, as even at the highest concentration of (50µg), it only achieved (98.7%) inhibition of all organisms. Additionally, *Enterobacter aerogenes* remained unaffected at all concentrations requiring the highest concentration of co-trimoxazole to achieve a kill of the organism, indicating potential resistance. Augmentin (Amoxicillin-clavulanic acid) exhibited varying degrees of inhibition, with lower concentration of 25µg effectively inhibiting 77.8% of the isolates with exception of *Klebsiella oxytoca* and *Enterobacteria.* However, complete inhibition of all organisms was achieved only at the highest concentration of (100µg). Similarly, Amoxicillin displayed differential efficacy, as the isolates were more susceptible to its lethal effects at (50µg).

Table 3.6: **Minimum Inhibitory Concentration of bacteria isolates**

Antibiotics	Conc.	*S.A*	*C.B*	*B.C*	*K.P*	*E.B*	*P.A*	*B.S*	*S.E*	% inhibition
	0.005mg	21	3	5	2	1	20	6	16	97.3%
	0.0025mg	21	2	4	2	1	20	6	16	94.7%
Ciprofloxacin	0.001mg	13	1	1	2	1	11	4	10	56.6%
	0.0005mg	7	0	0	1	0	5	1	6	26.3%
	0.000125mg	3	0	0	0	0	0	0	0	3.9%
	50mg	21	3	5	2	1	20	6	16	97.3%
	20mg	6	1	0	0	0	8	3	8	34.2%
Cotrimoxazole	10mg	1	0	0	0	0	0	0	0	1.3%

	5mg	0	0	0	0	0	0	0	0	0%
	2.5mg	0	0	0	0	0	0	0	0	0%
Augumentin	100mg	21	3	5	2	1	20	6	16	97.3%
	50mg	21	3	4	2	1	17	5	13	86.8%
	25mg	10	2	1	1	0	7	1	9	40.8%
	12.5mg	2	0	0	0	0	0	0	0	2.6%
	6.25mg	0	0	0	0	0	0	0	0	0%
Amoxicillin	100mg	21	3	5	2	1	20	6	16	97.3%
	50mg	15	3	4	2	1	13	3	12	69.7%
	25mg	5	0	0	0	0	0	1	8	18.2%
	12.5mg	1	0	0	0	0	0	0	0	1.3%

6.25mg	0	0	0	0	0	0	0	0	0%

KEY: *B.S=Bacillus subtilis, S.A= Staphylococcus aureus, S.E=Staphylococcus epidermidis, K.P=Klebsiella pneumonia, P.E=Pseudomonas aeroginosa, C.B=Corynebacterium, E.B=Enterpbacterium, B.C=Bacillus cereus, K.O=Klebsiella oxytoca*

CHAPTER FOUR

4.0 DISCUSSION

4.1 Epidemiology of study participants

4.1.1 Demographics of study participants

Understanding the aetiology of ear infections and resistance pattern is crucial in planning interventions and managing ear infections. The study found out that respondents aged between 16-25 years had a noticeable presence of ear infection which is in agreement to what exist in literature although it can also affect young children and the elderly (Prakash et al., 2013). The physical and social changes which take place throughout this age range may have played a key role in this. This age group are notorious for their increased engagement in unhealthy behaviours which include picking/cleaning of their ears with different materials (cotton buds, keys, biro tips etc) which make them prone to ear colonization by bacteria (Shangali et al., 2023). The level of education of those who are unemployed that participated in the study could have also played a huge role in this situation as they may have little or no awareness about proper ear hygiene practices like avoidance of ear cleaning with cotton buds which could have helped reduced the microbial load entering the ear, the dangers of using sharp objects to clean the ear which can cause damage to the Eustachian tube among this population. The study revealed that female participants were more predisposed to having this infections compared to their male counterparts (Raghu Kumar et al., 2014), this could be due to the difference in geographical region where past research has been conducted as there are not enough studies conducted in Nigeria to either justify or debunk this discovery. It could be deduced that individual who already have ear infections are more likely to redevelop such ear infection, this could be due to improper management of ear infections when it first

occurred, weakening and subsequent vulnerability of the ear canal to these organisms that are implicated in the infection, resistance of the bacteria isolates to ear drops, exposure of the ear to harmful agents as well as accumulation of fluid in the ear which does not go away. It is worthy of note and surprising that majority of participants (>70%) at the study centre had never smoked or had stopped smoking which is in contrasts to what we have in existing literature (CDC, 2022) with same applying to participants who had at a point in time taken alcohol or not (Hussain et al., 2018). Not so shocking was the fact that from the study population, majority of the participants who had ear infection were those who used cotton buds to clean their ear. This could be attributed to the fact that cotton buds could be source through which bacteria can enter the ear due to the ubiquitous nature of these organisms as they could find their way into the ear through these buds (Dreamz, 2023). Also, cotton buds possesses the capability of damaging the ear drum when improperly used to clean the ear as it could push the wax deeper into the ear, little wonder the doctors at the study center advised the patients to wash their ears in the hospital instead. From the results of the study, majority of the respondents reported to having no history of pus discharge which reduces their chances of having chronic supurative otitis media (Raghu Kumar et al., 2014), in addition to this was the fact that majority of the study participants had symptoms for two weeks. Majority of the participants who had ear infections reported with histories of previous microbial infections justifying the fact that being previously infected with microorganisms can be a potential risk factor in development of ear infection as these organisms can relocate from one any part of the body to the ear. The usage of earring and frequency of using it becomes important as participants who use earrings and who use it frequently tend to develop ear infections more as earring can become a source through which microorganisms enter into the ear. The study also found out that majority of the participants had no existing comorbidity. As microorganism flourish in moist environment, the presence of pus discharge and the entry of water into the

ear can worsen ear infection. One must take into consideration of the subjective responses given by the participants which may be incorrect because of the fear of being judged. Example include information on smoking history and alcohol drinking history.

4.1.2. Bacteria isolates and sex of study participants

As major objective of carrying out this research was to isolate and identify the bacteria responsible for ear infection in Nigeria especially Edo state. Following isolation and identification *Staphylococcus aureus*, *Pseudomonas aeroginosa*, *Bacillus cerus, B. subtilis, Klebsiella oxytoca, Klebsiella pneumonia, corynebacteria* and *Enterobacteria* were among the isolates with *S. aureus* and *P. aeroginosa* being the most predominant (27.60% and 26.30% respectively). Compared to male, female had a higher prevalence of all the isolated species from the ear of participants. This finding is in contrast to results from Ethiopia (Muluye et al. 2013) and Nigeria (Egbe et al. 2010). Hormonal differences as well as innate and adaptive immunity differences (Dias et al., 2022) between both sexes may be the reason for this disparity. The ear microbiota can be impacted by hormonal changes, particularly during puberty, menstruation, and pregnancy (Killian et al, 2016). *Staphylococcus aureus, Pseudomonas aeroginosa* were both common among both sexes. This is in accordance with already established literatures, (Nandhni et al., 2020), (Shangali et al,. 2023). However, higher percentage were seen in females than males. The least organisms isolated from the study were both *Klebsella oxytoca* and *Eterobacteria,. Klebsella oxytoca* normally from existing literature (Soraya, 2019) is found in the intestinal tract, mouth and nose. Its presence in the ear could be either due to the fact that no studies has been done to ascertain its presence in the ear or it could also be that the organism transited from the nose of infected individuals to the ear through the Eustachian tube or through the mucus as there is a link between the nose and the mouth and between the nose and the ear, little wonder just a single isolate was

obtained. Similarly, eterobacteria is normally not found in the ear rather in the intestine but from this study it has been shown to be present in the ear. This could be that as the bacterium was spreading, while it got to the throat, it made way into the Eustachian tube through the accumulated mucus. As this study was conducted in a different geographic region from that of existing literature especially as there are no robust studies conducted in Nigeria identifying the organisms present in the ear of individuals located in this region, it could be that the strain of *Eterobacteria* here could only be found in the ear among people of the geographic region around which this study was conducted. In general, the limited prevalence of these two organisms could be due to ecological circumstances and competition with previously described dominating microbes (*Staphylococccus aureus* and *Pseudomonas aeroginosa*).

4.2 Morphological characteristics of aerobic bacteria isolates

Several bacteria population make up the study specimen as indicated by the presence of alpha (28), beta (14) and gamma (33) subunits. The distinction between the three subunits as shown in the table gives a clear description of the haemolytic properties of the organisms telling us the level of pathogenicity of these isolates. Some factors such as bacteria species, strains, growth factors, environmental conditions and variation in genetics can all be responsible for the variation in haemolytic colonial morphology. Beta haemolytic organisms which were identified by the presence of clear zone around the colonies is indicative of complete haemolysis which corresponds very high level of pathogenicity of the organisms. Alpha haemolytic organisms were identified by the presence of green zone around bacteria colonies, this is indicative of partial haemolysis and hence these organisms have reduced pathogenicity when compared with the alpha haemolytic organisms. Gamma haemolytic organism showed no changes around the bacteria colonies, hence causing no haemolysis of the blood agar.

According to the morphology and composition of their cell wall, bacteria can be divided into Gram-positive and Gram-negative organisms through a technique known as Gram staining. Gram staining technique was invented in the 1880s by the Danish bacteriologist Hans Christian Gram and is still in use today to distinguish between various bacteria species. This classification affects the bacteria's resistance mechanism, susceptibility to drugs agents, and general cell wall composition. The ability of bacteria cell wall to retain crystal violet dye is the rationale for employing this technique (Tripathi and Sapra, 2020). Gram positive organisms such as Staphylococcus aureus have thick peptidoglycan layers (Pokhrel et al, 2022) and thus can retain the crystal violet colour and stain purple/blue when viewed a microscope whereas Gram-negative bacteria such as *Pseudomonas aeroginoosa* possess a thin peptidoglycan layer and tend to lose the crystal violet colour and stain pin/red when viewed under a microscope. The experimental results showed different gram staining profile for the different bacteria isolates with Gram-positive cocci (37) such as *Staphylococcus aureus* being the most dominant isolate from the ear of the participants. Gram-negative bacilli (GNB)(24) and Gram-positive bacilli (14) were also observed after isolation and identification. Gram-positive bacteria are generally more susceptibl to antimicrobial activity than Gram-negative bacteria (Ilbeigi et al., 2019) due to the higher levels of peptidoglycan in their cell walls. This peptidoglycan is a mesh like structure that allows chemical agents sip through the cell wall membrane and disrupt cellular activities or cause leakage of intracellular components leading to inhibition of cell growth or eventually cell death.

Biochemical tests have proven to be essential taxonomic tools in characterizing bacteria species based on their metabolic capacities (Franco-Duarte et al., 2019). A variety of assays, including those for catalase, coagulase, indole, oxidase, and citrate, can be used to learn more about the precise enzymatic and metabolic processes that bacteria employ for their growth and survival.

The Oxidase Test helps to identify oxidase positive bacteria by detecting the presence of Cytochrome C oxidase in bacteria. The deep purple coloration produced as a result of reduction of the dye by twenty-six (26) of the bacteria isolates (*Bacillus, Pseudomonas spp*.) in this study is indicative of a positive test. There are established studies showing these organisms above to be oxidase positive.

The Citrate Test helps identify members Of the *Enterobacteriaceae* family by assessing how well bacteria can use citrate as a carbon source. This test is used to confirm the ability of an organism to utilize inorganic ammonium hydrogen phosphate (NH4H2P04) as the sole nitrogen source and sodium citrate as the sole carbon source for identification purposes. 35 bacteria isolates (*Enterobacteria, Bacilllus, Klebsiella,* and *Pseudomonas*) were observed to be citrate positive. Previous studies confirm this result.

The Catalase Test identifies bacteria that produce the enzyme catalase, which degrades hydrogen peroxide, from those that do not. This catalase produced by the catalase producing microorganisms converts hydrogen peroxide (H_20_2) into water and oxygen gas while shielding the cell from oxidative damage. Peroxide facilitates the conversion of superoxide to other oxidizing compounds like hypochlorous acid which is utilized by phagocytes in killing bacteria. For the purpose of identifying different bacterial species, this variation is crucial. 75 bacterial isolates (*Staphylococcus, Bacillus, Pseudomonas, Enterobacteria, Corynbacterium* and *Klebsiella*) tested positive for catalase from the results obtained.

The coagulase test is specific for pathogenic Staphylococci like *Staphylococcus aureus*, *Staphylococcus aureus* (21) is recognized using the Coagulase Test. *Staphylococcus aureus* unlike other gram positive and catalase-positive cocci are capable of producing the enzyme coagulase which causes plasma to clot by conversion of fibrinogen to fibrin. It is a virulence

factor and may aid in shielding the organism from phagocytosis. There are well established and documented studies supporting this claim.

The Indole Test helps identify *Enterobacteriaceae* by detecting the capacity of bacteria to synthesize indole from the amino acid tryptophan by using the enzyme tryptophanase. *Klebsella* gave positive test results in this experiment.

The Urease test is a biochemical test that detects the alkaline fermentation of urine (urea) with the resultant production of ammonia by microorganisms. 41 isolates from *Bacillus*, *Staphylococcus* and *Enterobacteria* gave positive results in this experiment.

4.3 Frequency Distribution of Aerobic Isolates

The distribution of aerobic bacterial isolates in the ear of individuals has been a topic of interest in recent research. The data obtained from this study revealed that Staphylococcus was the most prevalent bacteria at a frequency of 48.7%, followed by *Pseudomonas, Bacillus, Corynbacterium, Klebsiella* and *Enterobacteria* was the least encountered bacterial isolate from the study population at 26.3%, 14.5%, 3.9%, 3.9% and 1.3% respectively.

The high prevalence of *Staphylococcus* in the ear of patients who visited the study center as shown in the results obtained may be related to its special traits; their exceptional adhesion ability, ability to strive in both aerobic and anaerobic conditions and are recognized as early colonizers of the ear. The high number of Staphylococcus isolates gives an insight to its significant role in the ear microbiome and may have implications on otic health such as development and progression of otic disease. This is in fact in agreement with previous studies which suggest that Staphylococcus spp especially S. aureus are indeed the most abundant in the ear together with Pseudomonas spp (Shangali et al., 2023).

Corynbacterium, *Klebsiella* and *Enterobacteria* are less prevalent aerobic bacterial isolates found in ear of the study participants suggesting they are not typical otic microbiota and even when present, they do so at relatively low frequency. In general, *Eterobacteria* and *Klebsiella* species are not considered as a significant component of the normal ear microbiota as previous studies have shown that they are only found in the intestine, nose and mouth. Its occurrences in the ear are typically seen to be unusual and could be attributed to factors like poor mouth, nasal and ear hygiene, or underlying medical issues. *Staphylococcus spp* such as *Staphylococcus aureus* are naturally associated with the skin and gastrointestinal tract and are recognized as a possible pathogen that can result in a variety of diseases, including skin and soft tissue infections (Zhang et al., 2018).

4.4 Antimicrobial activity of Various antibiotics on the isolates

Using the spread plate method, the presence of growth inhibitory zones demonstrates that the isolates were susceptible to the antimicrobial agent(s) being evaluated. These zones represent the action (cidal or static) of the antimicrobial agent against the test microorganism(s). The size of the zones is an indication of the antimicrobial agent's potency, that is, the larger the zones, the more potent it is against the test microorganism.

In the experimental study carried out using the various analytical grades of sparfloxacin, azithromycin, augmentin, amoxicillin, cefatoxim against the bacterial isolates obtained from the ear of patients visiting the study center, it was observed to be effective against both the aerobic bacterial isolates identified but to varying degrees. These chemical agents affect the bacteria by concentrating on the lipids and proteins that make up the cell membrane, which eventually results in bacterial cell death.

For the bacterial isolates, *Bacillus spp* offered the highest degree of resistance to the test antibiotics with *Klebsiella* species having the least resistance to the test antibiotics. A higher percentage of the isolates was most sensitive to azithromycin with Sparfloxacin coming next, cefotaxim showed the lowest percentage of susceptibility to the isolates. From existing literature it is worthy of note that Gram-positive organism are less resistance to antibiotics than Gram-negative, but from this study it is seen that *Bacillus* spp which is a Gram-positive bacteria is the most resistant. This could be that among all the Gram-positive bacteria, bacillus spp is an exception.

4.5 Minimum Inhibitory Concentration (MIC) of antibiotics on isolates

The Minimum Inhibitory Concentration (MIC) is a quantitative concentration index used to evaluate how effective an antimicrobial agent is against the test organism(s) or study population. It is expressed in milligrams (mg), milliliter (ml) or as a percentage (%). It shows the least possible concentration at which the antimicrobial agent can inhibit the growth or replication of the microorganism(s) but not necessarily kill them. In this study, the activity of various antibiotics (septrin, amoxicillin, augmentin and ciprofloxacin) against susceptible bacterial isolates obtained from the ear of the study participants was evaluated using the agar dilution method (Afolayan and Meyer, 1997).

The results Obtained showed varying MIC for aerobic isolates. It is worthy of note that for septrin, a concentration of 20µg is capable of inhibiting all the isolates while a concentration of 50µg of amoxicillin is capable of inhibiting the growth of the bacteria isolates. A concentration of 25µg of Augmentin and 0.25µg of ciprofloxacin is capable of inhibiting the growth of the isolates respectively.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

This study provides valuable insights into the epidemiology, microbiology, and antimicrobial susceptibility of ear infections among patients attending ENT clinic in UBTH. Our findings underscore the importance of understanding the demographic characteristics and risk factors associated with ear infections, as well as the prevalence of bacterial isolates and their resistance patterns as it evaluated the susceptibility of bacteria isolates from the ear of study participants who had ear infection to various antibiotics withe aim of obtaining relevant knowledge about the best antibiotics which could be used in treatment of individuals with the infection. Antibiotics such as azithromycin, sparfloxacin were viewed as positive and having huge effect on the isolates from the ears of study participants while *Bacillus spp* exhibited the highest resistance, contrary to existing literature.

The demographic analysis revealed a notable presence of ear infections among young adults aged 16-25 years, potentially influenced by lifestyle factors and improper ear hygiene practices. Female participants exhibited a higher predisposition to infections, suggesting potential hormonal and immune system differences. Recurrent infections were observed, highlighting the importance of proper management and preventive measures.

This study also established and supported claims which already exist which states that Staphylococcus aureus and *Pseudomonas aeroginosa* are the two most dominant bacteria present in the ear of persons with ear infection, with *S. aureus* being the dominant Gram-positive bacteria and *P. aeroginosa* being the dominant Gram-negative bacteria. This study adds to existing literature by discovering the presence of both *Klebsiella oxytoca* and *Enterobacteria* in the ear of study participants which is in contrast to what already exist in

literature. Gram staining and biochemical tests provided further characterization of these isolates, aiding in understanding their metabolic capacities and pathogenicity.

Hence, the findings in this study, can offer valuable information for individuals and healthcare professionals such as ENT doctors who are in the field of maintaining otic, nasal and throat as well as overall health.

5.2 Recommendation

One of the recommendations from this study is that individuals who are of the habit of cleaning their ears with cotton buds and other materials should desist from it. Also it is highly recommended that individuals visit the ENT clinic whenever they want to clean their ear. The use of azithromycin is highly recommended in the management of ear infection as results obtained supports this claim although it rarely causes ototoxicity but in cases where it may not be applicable, it is recommended that a sparfloxacin be used. It is highly recommended that more research be conducted to discover more organisms found in the ear especially on *Klebsiella oxytoca* and *Enterobacteria*.

Overall, this study contributes to the body of knowledge on ear infections in Nigeria and provides valuable data for healthcare practitioners to guide evidence-based interventions and treatment strategies. Future research should focus on longitudinal studies to monitor changes in bacterial epidemiology and resistance patterns over time, as well as the development of alternative treatment modalities to address emerging challenges in antimicrobial resistance.

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APPENDIX I

SEMI STRUCTURED QUESTIONNAIRE; PATIENTS WITH EAR INFECTION

Section A: Personal Information

1 .PATIENT I.D: _____ Date: _____

1. Age: 0-6yrs ☐ 7-15yrs ☐ 16-20yrs ☐ 21-25yrs ☐ 26-30yrs ☐

31-35yrs ☐ 36-45yrs ☐ 46-55yrs ☐ 56-60yrs ☐ >60yrs ☐

2. Sex:M ☐ F ☐ Phone: _____ Height: __ (cm) Weight:__(kg) Occupation:

_____

Section B: Health and Lifestyle History

1. Smoking history:

Never smoked ☐ Stopped smoking ☐ Still smoking ☐

2. Alcohol history:

Never drank ☐ Stopped drinking ☐ Still drinking ☐

3. Medical History: (Please provide details)

_____

Section C: Medication History

1. Past Medication History: (Please provide details)

_____

2. Present Medication History: (Please provide details)

_____

Section D; Social Activities

1. Swimming history

Never swam ☐ stopped swimming ☐ still swimming ☐

2. Ear cleaning habit;

Do you clean your ears?

Yes ☐ Not often ☐ Never ☐

3. What do you use in cleaning your ears

Cotton buds ☐ Biro tips ☐ feather ☐ other objects,please specify_____

4. Recently pierced your ears

Yes ☐ no ☐

5. How often do you wear earrings

Only for events ☐ everyday ☐ weekly ☐ once a month ☐

Section E; Ear infection symptoms

1. What are your present symptoms?

Pain in the ear ☐ discharge ☐ poor hearing ☐ fever ☐ Other symptoms,please specify

_____

2. Have you had previous ear infection?

Yes ☐ no ☐

If yes, which ear did it affect?

Right ☐ left ☐ both ears ☐

3. Have you experienced any change in air movement ?

Yes ☐ no ☐

4. Do you have any nasal congestion or discharge?

Yes ☐ no☐

Section F: Microbial Infection History

1. Have you had previous microbial infections that warranted the use of antibiotics?

Yes ☐ No☐ If yes,

what type of infection; respiratory infection☐

Peptic ulcer ☐urinary tract infection ☐wound infection ☐

others_____

2. how often do you use antibiotics for any infection in a year

Never ☐once ☐twice ☐three times ☐> three times ☐

3. do you complete your antibiotics therapy

yes ☐ no ☐I stop the drug once I feel better☐

4Have you used gentamycin,amikacin,streptomycin or tobramycin antibiotics injection before?

Yes ☐ no ☐

Section G; comorbidities

1. Do you have any existing medical conditions or comorbidity?

Asthma☐ COPD☐ rhinitis/sinusities☐ HIV ☐GERD ☐structural abnormality☐ others_____

Section H: Antimicrobial Susceptibility Profile

1. Have you previously undergone antimicrobial susceptibility testing prior to sinusitis treatment?

Yes ☐ No ☐

2. How effective was the treatment based on the results of the susceptibility test? Please describe.

_____

Section I: Additional Comments

1. Do you have any additional comments, concerns, or information you'd like to share regarding your experience with sinusitis or its treatment?

_____

2. Is there anything else you believe is important for the research team to know?

_____

Section J: Consent

3. do you agree to participate in this research study?

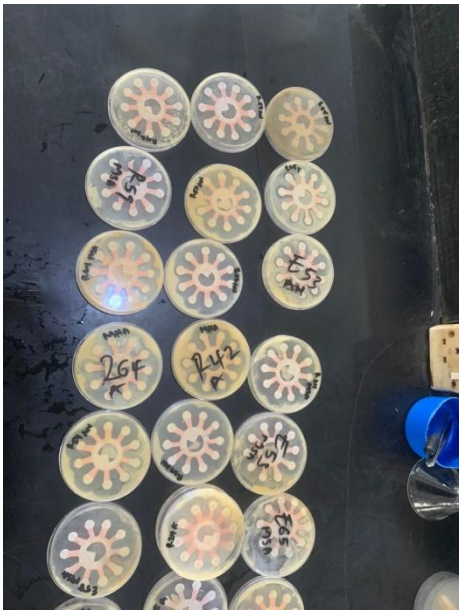
Yes ☐ No ☐

Signature: _____ Date: _____

APPENDIX II

Positive test result from the Citrate test.

Test results from Indole test

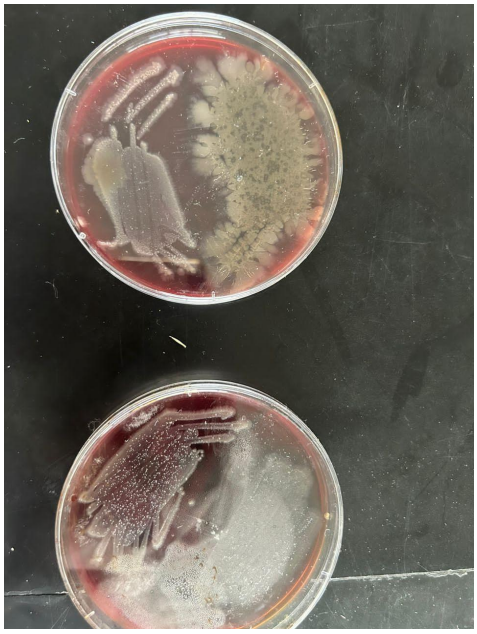


Plates for the determination of Sensitivity of antibiotics

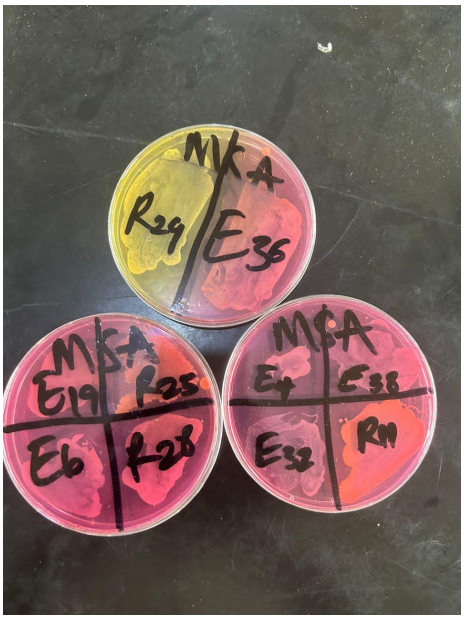
Plates for determination of MIC

Mac conkey Agar plates

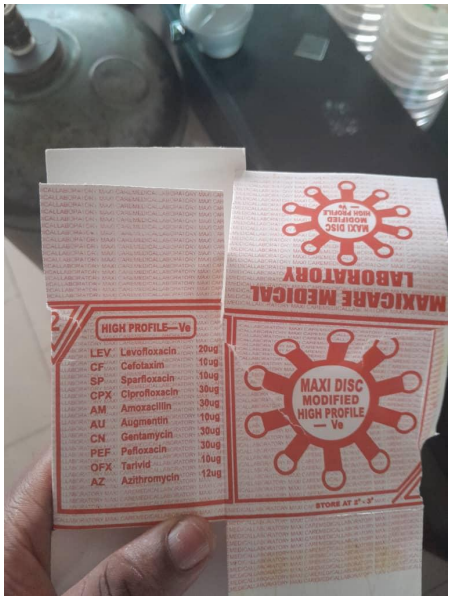
Reading of sensitivity results.



Blood agar plates



Mannitol salt agar plate.



Antibiotic disc.

FREQUENCIES VARIABLES=Organism id gram oxidase catalase coagulase citrate indole urease app_on_MSA

Lysis_on_BA pef ofx az lev cf sp cpx am au cn age sex occupation smoking_history alcohol_history

swimming_history ear_cleaning_habit instruments_used recently_pierced ear_rings pain_location

present_symptoms prev_ear_infection pus duration_symp prev_mcb_infection freq_antibi_use

exist_disease amoxicillin_100mg amoxicillin_50mg amoxicillin_25mg amoxicillin_12.5mg

amoxicillin_6.25mg augmentin_100mg augmentin_50mg augmentin_25mg augmentin_12.5mg augmentin_6.25mg

septrin_50mg septrin_20mg septrin_10mg septrin_5mg septrin_2.5mg septrin_1.25mg ciprofloxacin_5mg

ciprofloxacin_2.5mg ciprofloxacin_1mg ciprofloxacin_0.5mg ciprofloxacin_0.25mg ciprofloxacin_0.125mg

/FORMAT=DFREQ

/ORDER=ANALYSIS.

FREQUENCIES

Notes

Output Created		12-APR-2024 10:51:29
Comments		
Input	Data	C:\Users\user\Documents\400L Second semester\MERGED WORK.sav
	Active Dataset	DataSet1
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	Split File	<none>
	N of Rows in Working Data File	76
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.

Syntax	FREQUENCIES VARIABLES=Organism id gram oxidase catalase coagulase citrate indole urease app_on_MSA Lysis_on_BA pef ofx az lev cf sp cpx am au cn age sex occupation smoking_history alcohol_history swimming_history ear_cleaning_habit instruments_used recently_pierced ear_rings pain_location present_symptoms prev_ear_infection pus duration_symp prev_mcb_infection freq_antibi_use exist_disease amoxicillin_100mg amoxicillin_50mg amoxicillin_25mg amoxicillin_12.5mg amoxicillin_6.25mg

Resources	Processor Time	00:00:00.05
	Elapsed Time	00:00:00.07

Statistics

		organism detected	id	gram of isolates	oxidase test	catalase test
N	Valid	76	76	75	75	75
	Missing	0	0	1	1	1

Statistics

		coagulase test	citrate test	indole test	urease test	appearance on mannitol salt agar
N	Valid	75	75	75	75	76
	Missing	1	1	1	1	0

Statistics

		characteristics on blood agar	perfloxacin	ofloxacin	azithromycin	levofloxacin
N	Valid	75	76	76	76	76

	Missing	1	0	0	0	0

Statistics

		cefotaxime	sparfloxacin	ciprofloxacin	amoxicillin	augmentin	gentamicin
N	Valid	76	76	76	76	76	76
	Missing	0	0	0	0	0	0

Statistics

		age of patient	gender of patient	patients occupation	smoking history	alcohol history
N	Valid	76	76	76	76	76
	Missing	0	0	0	0	0

Statistics

		swimming history	patients ear cleaning habit	instrument used to clean ear	recently pierced ears	earring wearing
N	Valid	76	76	76	76	76
	Missing	0	0	0	0	0

Statistics

		location of pain	presenting symptoms	previous ear infection	pus discharge	duration of symptoms
N	Valid	76	76	76	76	76
	Missing	0	0	0	0	0

Statistics

		previous microbial infections	frequency of antibiotics use	existing disease condition	amoxicillin_ 100mg	amoxicillin_5 0mg
N	Valid	76	76	76	75	75
	Missing	0	0	0	1	1

Statistics

		amoxicillin_2 5mg	amoxicillin_ 12.5mg	amoxicillin_ 6.25mg	augmentin_1 00mg	augmentin_5 0mg
N	Valid	74	75	75	75	75
	Missing	2	1	1	1	1

Statistics

		augmentin_25mg	augmentin_12.5mg	augmentin_6.25mg	septrin_50mg	septrin_20mg
N	Valid	75	75	75	75	75
	Missing	1	1	1	1	1

Statistics

		septrin_10mg	septrin_5mg	septrin_2.5mg	septrin_1.25mg	ciprofloxacin_5mg
N	Valid	75	75	75	75	75
	Missing	1	1	1	1	1

Statistics

		ciprofloxacin_2.5mg	ciprofloxacin_1mg	ciprofloxacin_0.5mg	ciprofloxacin_0.25mg	ciprofloxacin_0.125mg
N	Valid	75	75	75	75	75
	Missing	1	1	1	1	1

Frequency Table

organism detected

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	S. aureus	21	27.6	27.6	27.6
	P. aeroginosa	20	26.3	26.3	53.9
	S. epidermis	16	21.1	21.1	75.0
	B. subtilis	6	7.9	7.9	82.9
	B. cerus	5	6.6	6.6	89.5
	Cornybacterium	3	3.9	3.9	93.4
	K. pneumonia	2	2.6	2.6	96.1
		1	1.3	1.3	97.4
	enterobacteria	1	1.3	1.3	98.7
	K. oxytoca	1	1.3	1.3	100.0
	Total	76	100.0	100.0	

Id

	Frequency	Percent	Valid Percent	Cumulative Percent

Valid	E12	3	3.9	3.9	3.9
	E18	3	3.9	3.9	7.9
	E3	3	3.9	3.9	11.8
	E39	3	3.9	3.9	15.8
	E10	2	2.6	2.6	18.4
	E13	2	2.6	2.6	21.1
	E14	2	2.6	2.6	23.7
	E17	2	2.6	2.6	26.3
	E2	2	2.6	2.6	28.9
	E21	2	2.6	2.6	31.6
	E22	2	2.6	2.6	34.2
	E24	2	2.6	2.6	36.8
	E27	2	2.6	2.6	39.5
	E32	2	2.6	2.6	42.1
	E34	2	2.6	2.6	44.7
	E37	2	2.6	2.6	47.4
	E38	2	2.6	2.6	50.0
	E40	2	2.6	2.6	52.6
	E48	2	2.6	2.6	55.3
	E49	2	2.6	2.6	57.9

	E5	2	2.6	2.6	60.5
	E53	2	2.6	2.6	63.2
	E56	2	2.6	2.6	65.8
	E58	2	2.6	2.6	68.4
	E65	2	2.6	2.6	71.1
	E67	2	2.6	2.6	73.7
	E7	2	2.6	2.6	76.3
	E70	2	2.6	2.6	78.9
	E8	2	2.6	2.6	81.6
	E1	1	1.3	1.3	82.9
	E11	1	1.3	1.3	84.2
	E15	1	1.3	1.3	85.5
	E16	1	1.3	1.3	86.8
	E19	1	1.3	1.3	88.2
	E20	1	1.3	1.3	89.5
	E23	1	1.3	1.3	90.8
	E29	1	1.3	1.3	92.1
	E30	1	1.3	1.3	93.4
	E36	1	1.3	1.3	94.7
	E4	1	1.3	1.3	96.1

	E6	1	1.3	1.3	97.4
	E68	1	1.3	1.3	98.7
	E71	1	1.3	1.3	100.0
	Total	76	100.0	100.0	

Gram of isolates

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	GPC	37	48.7	49.3	49.3
	GNB	24	31.6	32.0	81.3
	GPB	14	18.4	18.7	100.0
	Total	75	98.7	100.0	
Missing	System	1	1.3		
Total		76	100.0		

Oxidase test

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	negative	49	64.5	65.3	65.3

	positive	26	34.2	34.7	100.0
	Total	75	98.7	100.0	
Missing	System	1	1.3		
Total		76	100.0		

Catalase test

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	positive	75	98.7	100.0	100.0
Missing	System	1	1.3		
Total		76	100.0		

Coagulase test

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	negative	54	71.1	72.0	72.0
	positive	21	27.6	28.0	100.0
	Total	75	98.7	100.0	
Missing	System	1	1.3		

Total		76	100.0		

Citrate test

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	negative	40	52.6	53.3	53.3
	positive	35	46.1	46.7	100.0
	Total	75	98.7	100.0	
Missing	System	1	1.3		
Total		76	100.0		

Indole test

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	negative	74	97.4	98.7	98.7
	positive	1	1.3	1.3	100.0
	Total	75	98.7	100.0	
Missing	System	1	1.3		
Total		76	100.0		

Urease test

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	positive	41	53.9	54.7	54.7
	negative	34	44.7	45.3	100.0
	Total	75	98.7	100.0	
Missing	System	1	1.3		
Total		76	100.0		

Appearance on mannitol salt agar

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NA	38	50.0	50.0	50.0
	yellow	21	27.6	27.6	77.6
	pink	13	17.1	17.1	94.7
	Pink	3	3.9	3.9	98.7
		1	1.3	1.3	100.0
	Total	76	100.0	100.0	

Characteristics on blood agar

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	gamma	33	43.4	44.0	44.0
	alpha	28	36.8	37.3	81.3
	beta	14	18.4	18.7	100.0
	Total	75	98.7	100.0	
Missing	System	1	1.3		
Total		76	100.0		

Perfloxacin

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	S	58	76.3	76.3	76.3
	R	13	17.1	17.1	93.4
	I	4	5.3	5.3	98.7
		1	1.3	1.3	100.0
	Total	76	100.0	100.0	

Ofloxacin

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	S	55	72.4	72.4	72.4
	R	14	18.4	18.4	90.8
	I	6	7.9	7.9	98.7
		1	1.3	1.3	100.0
	Total	76	100.0	100.0	

Azithromycin

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	S	52	68.4	68.4	68.4
	R	17	22.4	22.4	90.8
	I	6	7.9	7.9	98.7
		1	1.3	1.3	100.0
	Total	76	100.0	100.0	

Levofloxacin

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	S	61	80.3	80.3	80.3
	I	7	9.2	9.2	89.5
	R	7	9.2	9.2	98.7
		1	1.3	1.3	100.0
	Total	76	100.0	100.0	

Cefotaxime

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	S	35	46.1	46.1	46.1
	R	22	28.9	28.9	75.0
	I	18	23.7	23.7	98.7
		1	1.3	1.3	100.0
	Total	76	100.0	100.0	

Sparfloxacin

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	S	35	46.1	46.1	46.1
	R	22	28.9	28.9	75.0
	I	18	23.7	23.7	98.7
		1	1.3	1.3	100.0
	Total	76	100.0	100.0	

Ciprofloxacin

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	S	57	75.0	75.0	75.0
	R	11	14.5	14.5	89.5
	I	7	9.2	9.2	98.7
		1	1.3	1.3	100.0
	Total	76	100.0	100.0	

Amoxicillin

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	R	37	48.7	48.7	48.7
	S	31	40.8	40.8	89.5
	I	7	9.2	9.2	98.7
		1	1.3	1.3	100.0
	Total	76	100.0	100.0	

Augmentin

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	S	47	61.8	61.8	61.8
	R	27	35.5	35.5	97.4
		1	1.3	1.3	98.7
	I	1	1.3	1.3	100.0
	Total	76	100.0	100.0	

Gentamicin

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	S	57	75.0	75.0	75.0
	R	12	15.8	15.8	90.8
	I	6	7.9	7.9	98.7
		1	1.3	1.3	100.0
	Total	76	100.0	100.0	

Age of patient

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	16-25yrs	45	59.2	59.2	59.2
	26-35yrs	11	14.5	14.5	73.7
	>60yrs	11	14.5	14.5	88.2
	0-15yrs	5	6.6	6.6	94.7
	36-60yrs	4	5.3	5.3	100.0
	Total	76	100.0	100.0	

Gender of patient

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	female	56	73.7	73.7	73.7
	male	20	26.3	26.3	100.0
	Total	76	100.0	100.0	

Patients occupation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	nill	39	51.3	51.3	51.3
	civil se	12	15.8	15.8	67.1
	student	9	11.8	11.8	78.9
	trader	5	6.6	6.6	85.5
	counsell	2	2.6	2.6	88.2
	retired	2	2.6	2.6	90.8
	sale rep	2	2.6	2.6	93.4
	Student	2	2.6	2.6	96.1
	business	1	1.3	1.3	97.4
	matron	1	1.3	1.3	98.7
	stuudent	1	1.3	1.3	100.0

	Total	76	100.0	100.0	

Smoking history

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	never smoked	65	85.5	85.5	85.5
	stopped smoking	10	13.2	13.2	98.7
	still smoking	1	1.3	1.3	100.0
	Total	76	100.0	100.0	

Alcohol history

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	never drank	51	67.1	67.1	67.1
	still drinking	16	21.1	21.1	88.2
	stopped drinking	9	11.8	11.8	100.0
	Total	76	100.0	100.0	

Swimming history

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	never swam	67	88.2	88.2	88.2
	still swimming	5	6.6	6.6	94.7
	stopped swimming	4	5.3	5.3	100.0
	Total	76	100.0	100.0	

Patients ear cleaning habit

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	37	48.7	48.7	48.7
	not often	30	39.5	39.5	88.2
	never	9	11.8	11.8	100.0
	Total	76	100.0	100.0	

Instrument used to clean ear

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	cotton_buds	69	90.8	90.8	90.8
	biro_tips	6	7.9	7.9	98.7
	key	1	1.3	1.3	100.0
	Total	76	100.0	100.0	

Recently pierced ears

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	74	97.4	97.4	97.4
	yes	2	2.6	2.6	100.0
	Total	76	100.0	100.0	

earring wearing

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	everyday	48	63.2	63.2	63.2
	never	21	27.6	27.6	90.8

	once a month	4	5.3	5.3	96.1
	only for events	3	3.9	3.9	100.0
	Total	76	100.0	100.0	

location of pain

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	inside ear	72	94.7	94.7	94.7
	both	4	5.3	5.3	100.0
	Total	76	100.0	100.0	

presenting symptoms

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	pain in the ear	29	38.2	38.2	38.2
	Discharge	19	25.0	25.0	63.2
	Itching	12	15.8	15.8	78.9
	Fever	8	10.5	10.5	89.5

	poor hearing	7	9.2	9.2	98.7
	turning of the eyes	1	1.3	1.3	100.0
	Total	76	100.0	100.0	

previous ear infection

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	50	65.8	65.8	65.8
	no	26	34.2	34.2	100.0
	Total	76	100.0	100.0	

pus discharge

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	41	53.9	53.9	53.9
	yes	35	46.1	46.1	100.0
	Total	76	100.0	100.0	

duration of symptoms

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	8-14days	28	36.8	36.8	36.8
	>21days	26	34.2	34.2	71.1
	<7days	22	28.9	28.9	100.0
	Total	76	100.0	100.0	

previous microbial infections

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	63	82.9	82.9	82.9
	no	11	14.5	14.5	97.4
	3.00	2	2.6	2.6	100.0
	Total	76	100.0	100.0	

frequency of antibiotics use

	Frequency	Percent	Valid Percent	Cumulative Percent

Valid	>three times	33	43.4	43.4	43.4
	never	12	15.8	15.8	59.2
	twice	12	15.8	15.8	75.0
	three times	11	14.5	14.5	89.5
	once	8	10.5	10.5	100.0
	Total	76	100.0	100.0	

existing disease condition

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	51	67.1	67.1	67.1
	GERD	23	30.3	30.3	97.4
	rhinitis/sinusitis	2	2.6	2.6	100.0
	Total	76	100.0	100.0	

amoxicillin_100mg

	Frequency	Percent	Valid Percent	Cumulative Percent

Valid	NG	75	98.7	100.0	100.0
Missing	System	1	1.3		
Total		76	100.0		

amoxicillin_50mg

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NG	53	69.7	70.7	70.7
	G	22	28.9	29.3	100.0
	Total	75	98.7	100.0	
Missing	System	1	1.3		
Total		76	100.0		

amoxicillin_25mg

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	G	60	78.9	81.1	81.1
	NG	14	18.4	18.9	100.0
	Total	74	97.4	100.0	

Missing	System	2	2.6		
Total		76	100.0		

amoxicillin_12.5mg

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	G	73	96.1	97.3	97.3
	NG	2	2.6	2.7	100.0
	Total	75	98.7	100.0	
Missing	System	1	1.3		
Total		76	100.0		

amoxicillin_6.25mg

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	G	75	98.7	100.0	100.0
Missing	System	1	1.3		
Total		76	100.0		

augmentin_100mg

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NG	75	98.7	100.0	100.0
Missing	System	1	1.3		
Total		76	100.0		

augmentin_50mg

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NG	67	88.2	89.3	89.3
	G	8	10.5	10.7	100.0
	Total	75	98.7	100.0	
Missing	System	1	1.3		
Total		76	100.0		

augmentin_25mg

		Frequency	Percent	Valid Percent	Cumulative Percent

Valid	G	44	57.9	58.7	58.7
	NG	31	40.8	41.3	100.0
	Total	75	98.7	100.0	
Missing	System	1	1.3		
Total		76	100.0		

augmentin_12.5mg

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	G	72	94.7	96.0	96.0
	NG	3	3.9	4.0	100.0
	Total	75	98.7	100.0	
Missing	System	1	1.3		
Total		76	100.0		

augmentin_6.25mg

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	G	75	98.7	100.0	100.0

Missing	System	1	1.3		
Total		76	100.0		

septrin_50mg

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NG	75	98.7	100.0	100.0
Missing	System	1	1.3		
Total		76	100.0		

septrin_20mg

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	G	48	63.2	64.0	64.0
	NG	27	35.5	36.0	100.0
	Total	75	98.7	100.0	
Missing	System	1	1.3		
Total		76	100.0		

septrin_10mg

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	G	74	97.4	98.7	98.7
	NG	1	1.3	1.3	100.0
	Total	75	98.7	100.0	
Missing	System	1	1.3		
Total		76	100.0		

septrin_5mg

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	G	75	98.7	100.0	100.0
Missing	System	1	1.3		
Total		76	100.0		

septrin_2.5mg

		Frequency	Percent	Valid Percent	Cumulative Percent

Valid	G	75	98.7	100.0	100.0
Missing	System	1	1.3		
Total		76	100.0		

septrin_1.25mg

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	G	75	98.7	100.0	100.0
Missing	System	1	1.3		
Total		76	100.0		

ciprofloxacin_5mg

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NG	75	98.7	100.0	100.0
Missing	System	1	1.3		
Total		76	100.0		

ciprofloxacin_2.5mg

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NG	62	81.6	82.7	82.7
	G	13	17.1	17.3	100.0
	Total	75	98.7	100.0	
Missing	System	1	1.3		
Total		76	100.0		

ciprofloxacin_1mg

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NG	44	57.9	58.7	58.7
	G	31	40.8	41.3	100.0
	Total	75	98.7	100.0	
Missing	System	1	1.3		
Total		76	100.0		

ciprofloxacin_0.5mg

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	G	54	71.1	72.0	72.0
	NG	21	27.6	28.0	100.0
	Total	75	98.7	100.0	
Missing	System	1	1.3		
Total		76	100.0		

ciprofloxacin_0.25mg

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	G	61	80.3	81.3	81.3
	NG	14	18.4	18.7	100.0
	Total	75	98.7	100.0	
Missing	System	1	1.3		
Total		76	100.0		

ciprofloxacin_0.125mg

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	G	75	98.7	100.0	100.0
Missing	System	1	1.3		
Total		76	100.0		

```
CROSSTABS
  /TABLES=Organism BY amoxicillin_100mg amoxicillin_50mg amoxicillin_25mg
amoxicillin_12.5mg
    amoxicillin_6.25mg augmentin_100mg augmentin_50mg augmentin_25mg
augmentin_12.5mg augmentin_6.25mg
    septrin_50mg septrin_20mg septrin_10mg septrin_5mg septrin_2.5mg septrin_1.25mg
ciprofloxacin_5mg
    ciprofloxacin_2.5mg ciprofloxacin_1mg ciprofloxacin_0.5mg ciprofloxacin_0.25mg
ciprofloxacin_0.125mg
  /FORMAT=AVALUE TABLES
  /STATISTICS=CHISQ
  /CELLS=COUNT
  /COUNT ROUND CELL.
```

Crosstabs

Notes

Output Created		12-APR-2024 10:52:52
Comments		
Input	Data	C:\Users\user\Documents\400L Second semester\MERGED WORK.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	76
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.

Cases Used	Statistics for each table are based on all the cases with valid data in the specified range(s) for all variables in each table.

Syntax	CROSSTABS /TABLES=Organism BY amoxicillin_100mg amoxicillin_50mg amoxicillin_25mg amoxicillin_12.5mg amoxicillin_6.25mg augmentin_100mg augmentin_50mg augmentin_25mg augmentin_12.5mg augmentin_6.25mg septrin_50mg septrin_20mg septrin_10mg septrin_5mg septrin_2.5mg septrin_1.25mg ciprofloxacin_5mg ciprofloxacin_2.5mg ciprofloxacin_1mg ciprofloxacin_0.5mg ciprofloxacin_0.25mg ciprofloxacin_0.125mg /FORMAT=AVALUE TABLES

Resources	Processor Time	00:00:00.13
	Elapsed Time	00:00:00.25
	Dimensions Requested	2
	Cells Available	524245

Warnings

No measures of association are computed for the crosstabulation of organism detected * amoxicillin_100mg. At least one variable in each 2-way table upon which measures of association are computed is a constant.

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
organism detected * amoxicillin_100mg	75	98.7%	1	1.3%	76	100.0%
organism detected * amoxicillin_50mg	75	98.7%	1	1.3%	76	100.0%

organism detected * amoxicillin_25mg	74	97.4%	2	2.6%	76	100.0%
organism detected * amoxicillin_12.5mg	75	98.7%	1	1.3%	76	100.0%
organism detected * amoxicillin_6.25mg	75	98.7%	1	1.3%	76	100.0%
organism detected * augmentin_100mg	75	98.7%	1	1.3%	76	100.0%
organism detected * augmentin_50mg	75	98.7%	1	1.3%	76	100.0%
organism detected * augmentin_25mg	75	98.7%	1	1.3%	76	100.0%
organism detected * augmentin_12.5mg	75	98.7%	1	1.3%	76	100.0%
organism detected * augmentin_6.25mg	75	98.7%	1	1.3%	76	100.0%
organism detected * septrin_50mg	75	98.7%	1	1.3%	76	100.0%
organism detected * septrin_20mg	75	98.7%	1	1.3%	76	100.0%
organism detected * septrin_10mg	75	98.7%	1	1.3%	76	100.0%

organism detected * septrin_5mg	75	98.7%	1	1.3%	76	100.0%
organism detected * septrin_2.5mg	75	98.7%	1	1.3%	76	100.0%
organism detected * septrin_1.25mg	75	98.7%	1	1.3%	76	100.0%
organism detected * ciprofloxacin_5mg	75	98.7%	1	1.3%	76	100.0%
organism detected * ciprofloxacin_2.5mg	75	98.7%	1	1.3%	76	100.0%
organism detected * ciprofloxacin_1mg	75	98.7%	1	1.3%	76	100.0%
organism detected * ciprofloxacin_0.5mg	75	98.7%	1	1.3%	76	100.0%
organism detected * ciprofloxacin_0.25mg	75	98.7%	1	1.3%	76	100.0%
organism detected * ciprofloxacin_0.125mg	75	98.7%	1	1.3%	76	100.0%

organism detected * amoxicillin_100mg

Crosstab

Count

		amoxicillin_100mg NG	Total
organism detected	B. cerus	5	5
	B. subtilis	6	6
	Cornybacterium	3	3
	enterobacteria	1	1
	K. oxytoca	1	1
	K. pneumonia	2	2
	P. aeroginosa	20	20
	S. aureus	21	21
	S. epidermis	16	16
Total		75	75

Chi-Square Tests

	Value
Pearson Chi-Square	.[a]
N of Valid Cases	75

a. No statistics are computed because amoxicillin_100mg is a constant.

organism detected * amoxicillin_50mg

Crosstab

Count

		amoxicillin_50mg		
		G	NG	Total
organism detected	B. cerus	1	4	5
	B. subtilis	3	3	6

	Cornybacterium	1	2	3
	enterobacteria	0	1	1
	K. oxytoca	0	1	1
	K. pneumonia	0	2	2
	P. aeroginosa	7	13	20
	S. aureus	6	15	21
	S. epidermis	4	12	16
Total		22	53	75

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	3.591[a]	8	.892
Likelihood Ratio	4.606	8	.799
N of Valid Cases	75		

a. 13 cells (72.2%) have expected count less than 5. The minimum expected count is .29.

organism detected * amoxicillin_25mg

Crosstab

Count

		amoxicillin_25mg		
		G	NG	Total
organism detected	B. cerus	5	0	5
	B. subtilis	5	1	6
	Cornybacterium	3	0	3
	enterobacteria	1	0	1
	K. oxytoca	1	0	1
	K. pneumonia	2	0	2
	P. aeroginosa	19	0	19
	S. aureus	16	5	21
	S. epidermis	8	8	16
Total		60	14	74

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	17.657[a]	8	.024
Likelihood Ratio	21.147	8	.007
N of Valid Cases	74		

a. 15 cells (83.3%) have expected count less than 5. The minimum expected count is .19.

organism detected * amoxicillin_12.5mg

Crosstab

Count

		amoxicillin_12.5mg		
		G	NG	Total
organism detected	B. cerus	5	0	5
	B. subtilis	6	0	6
	Cornybacterium	3	0	3
	enterobacteria	1	0	1
	K. oxytoca	1	0	1
	K. pneumonia	2	0	2
	P. aeroginosa	20	0	20
	S. aureus	20	1	21
	S. epidermis	15	1	16
Total		73	2	75

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2.188[a]	8	.975

Likelihood Ratio	2.922	8	.939
N of Valid Cases	75		

a. 14 cells (77.8%) have expected count less than 5. The minimum expected count is .03.

organism detected * amoxicillin_6.25mg

Crosstab

Count

		amoxicillin_6.25mg G	Total
organism detected	B. cerus	5	5
	B. subtilis	6	6
	Cornybacterium	3	3

	enterobacteria	1	1
	K. oxytoca	1	1
	K. pneumonia	2	2
	P. aeroginosa	20	20
	S. aureus	21	21
	S. epidermis	16	16
Total		75	75

Chi-Square Tests

	Value
Pearson Chi-Square	.[a]
N of Valid Cases	75

a. No statistics are computed because amoxicillin_6.25mg is a constant.

organism detected * augmentin_100mg

Crosstab

Count

		augmentin_100mg NG	Total
organism detected	B. cerus	5	5
	B. subtilis	6	6
	Cornybacterium	3	3
	enterobacteria	1	1
	K. oxytoca	1	1
	K. pneumonia	2	2
	P. aeroginosa	20	20
	S. aureus	21	21
	S. epidermis	16	16
Total		75	75

Chi-Square Tests

	Value
Pearson Chi-Square	.[a]
N of Valid Cases	75

a. No statistics are computed because augmentin_100mg is a constant.

organism detected * augmentin_50mg

Crosstab

Count

		augmentin_50mg		
		G	NG	Total
organism detected	B. cerus	1	4	5
	B. subtilis	1	5	6

	Cornybacterium	0	3	3
	enterobacteria	0	1	1
	K. oxytoca	0	1	1
	K. pneumonia	0	2	2
	P. aeroginosa	3	17	20
	S. aureus	0	21	21
	S. epidermis	3	13	16
Total		8	67	75

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	5.518[a]	8	.701
Likelihood Ratio	8.162	8	.418
N of Valid Cases	75		

a. 14 cells (77.8%) have expected count less than 5. The minimum expected count is .11.

organism detected * augmentin_25mg

Crosstab

Count

		augmentin_25mg		
		G	NG	Total
organism detected	B. cerus	4	1	5
	B. subtilis	5	1	6
	Cornybacterium	1	2	3
	enterobacteria	1	0	1
	K. oxytoca	1	0	1
	K. pneumonia	1	1	2
	P. aeroginosa	13	7	20
	S. aureus	11	10	21
	S. epidermis	7	9	16
Total		44	31	75

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	6.850[a]	8	.553
Likelihood Ratio	7.812	8	.452
N of Valid Cases	75		

a. 12 cells (66.7%) have expected count less than 5. The minimum expected count is .41.

organism detected * augmentin_12.5mg

Crosstab

Count

		augmentin_12.5mg		
		G	NG	Total
organism detected	B. cerus	5	0	5
	B. subtilis	6	0	6
	Cornybacterium	3	0	3
	enterobacteria	1	0	1
	K. oxytoca	1	0	1
	K. pneumonia	2	0	2
	P. aeroginosa	20	0	20
	S. aureus	19	2	21
	S. epidermis	15	1	16
Total		72	3	75

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	3.463[a]	8	.902
Likelihood Ratio	4.502	8	.809

N of Valid Cases	75		

a. 14 cells (77.8%) have expected count less than 5. The minimum expected count is .04.

organism detected * augmentin_6.25mg

Crosstab

Count

		augmentin_6.25mg G	Total
organism detected	B. cerus	5	5
	B. subtilis	6	6
	Cornybacterium	3	3
	enterobacteria	1	1

	K. oxytoca	1	1
	K. pneumonia	2	2
	P. aeroginosa	20	20
	S. aureus	21	21
	S. epidermis	16	16
Total		75	75

Chi-Square Tests

	Value
Pearson Chi-Square	.[a]
N of Valid Cases	75

a. No statistics are computed because augmentin_6.25mg is a constant.

organism detected * septrin_50mg

Crosstab

Count

		septrin_50mg NG	Total
organism detected	B. cerus	5	5
	B. subtilis	6	6
	Cornybacterium	3	3
	enterobacteria	1	1
	K. oxytoca	1	1
	K. pneumonia	2	2
	P. aeroginosa	20	20
	S. aureus	21	21
	S. epidermis	16	16
Total		75	75

Chi-Square Tests

	Value
Pearson Chi-Square	.[a]

N of Valid Cases	75

a. No statistics are computed because septrin_50mg is a constant.

organism detected * septrin_20mg

Crosstab

Count

		septrin_20mg		
		G	NG	Total
organism detected	B. cerus	5	0	5
	B. subtilis	3	3	6
	Cornybacterium	2	1	3
	enterobacteria	1	0	1

	K. oxytoca	0	1	1
	K. pneumonia	2	0	2
	P. aeroginosa	12	8	20
	S. aureus	15	6	21
	S. epidermis	8	8	16
Total		48	27	75

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	8.800[a]	8	.359
Likelihood Ratio	11.647	8	.168
N of Valid Cases	75		

a. 12 cells (66.7%) have expected count less than 5. The minimum expected count is .36.

organism detected * septrin_10mg

Crosstab

Count

		septrin_10mg		
		G	NG	Total
organism detected	B. cerus	5	0	5
	B. subtilis	6	0	6
	Cornybacterium	3	0	3
	enterobacteria	1	0	1
	K. oxytoca	1	0	1
	K. pneumonia	2	0	2
	P. aeroginosa	20	0	20
	S. aureus	20	1	21
	S. epidermis	16	0	16
Total		74	1	75

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2.606[a]	8	.957
Likelihood Ratio	2.581	8	.958
N of Valid Cases	75		

a. 14 cells (77.8%) have expected count less than 5. The minimum expected count is .01.

organism detected * septrin_5mg

Crosstab

Count

	septrin_5mg G	Total
organism detected B. cerus	5	5

	B. subtilis	6	6
	Cornybacterium	3	3
	enterobacteria	1	1
	K. oxytoca	1	1
	K. pneumonia	2	2
	P. aeroginosa	20	20
	S. aureus	21	21
	S. epidermis	16	16
Total		75	75

Chi-Square Tests

	Value
Pearson Chi-Square	.[a]
N of Valid Cases	75

a. No statistics are computed because septrin_5mg is a constant.

organism detected * septrin_2.5mg

Crosstab

Count

		septrin_2.5mg G	Total
organism detected	B. cerus	5	5
	B. subtilis	6	6
	Cornybacterium	3	3
	enterobacteria	1	1
	K. oxytoca	1	1
	K. pneumonia	2	2
	P. aeroginosa	20	20
	S. aureus	21	21
	S. epidermis	16	16
Total		75	75

Chi-Square Tests

	Value
Pearson Chi-Square	.[a]
N of Valid Cases	75

a. No statistics are computed because septrin_2.5mg is a constant.

organism detected * septrin_1.25mg

Crosstab

Count

	septrin_1.25mg	
	G	Total

organism detected	B. cerus	5	5
	B. subtilis	6	6
	Cornybacterium	3	3
	enterobacteria	1	1
	K. oxytoca	1	1
	K. pneumonia	2	2
	P. aeroginosa	20	20
	S. aureus	21	21
	S. epidermis	16	16
Total		75	75

Chi-Square Tests

	Value
Pearson Chi-Square	.[a]
N of Valid Cases	75

a. No statistics are computed because septrin_1.25mg is a constant.

organism detected * ciprofloxacin_5mg

Crosstab

Count

		ciprofloxacin_5mg NG	Total
organism detected	B. cerus	5	5
	B. subtilis	6	6
	Cornybacterium	3	3
	enterobacteria	1	1
	K. oxytoca	1	1
	K. pneumonia	2	2
	P. aeroginosa	20	20
	S. aureus	21	21
	S. epidermis	16	16

Total	75	75

Chi-Square Tests

	Value
Pearson Chi-Square	.[a]
N of Valid Cases	75

a. No statistics are computed because ciprofloxacin_5mg is a constant.

organism detected * ciprofloxacin_2.5mg

Crosstab

Count

		ciprofloxacin_2.5mg		
		G	NG	Total
organism detected	B. cerus	1	4	5
	B. subtilis	0	6	6
	Cornybacterium	1	2	3
	enterobacteria	0	1	1
	K. oxytoca	0	1	1
	K. pneumonia	0	2	2
	P. aeroginosa	3	17	20
	S. aureus	4	17	21
	S. epidermis	4	12	16
Total		13	62	75

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	3.433[a]	8	.904

Likelihood Ratio	4.993	8	.758
N of Valid Cases	75		

a. 15 cells (83.3%) have expected count less than 5. The minimum expected count is .17.

organism detected * ciprofloxacin_1mg

Crosstab

Count

		ciprofloxacin_1mg		
		G	NG	Total
organism detected	B. cerus	4	1	5
	B. subtilis	2	4	6
	Cornybacterium	2	1	3
	enterobacteria	0	1	1

	K. oxytoca	0	1	1
	K. pneumonia	0	2	2
	P. aeroginosa	9	11	20
	S. aureus	8	13	21
	S. epidermis	6	10	16
Total		31	44	75

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	7.152[a]	8	.520
Likelihood Ratio	8.640	8	.374
N of Valid Cases	75		

a. 12 cells (66.7%) have expected count less than 5. The minimum expected count is .41.

organism detected * ciprofloxacin_0.5mg

Crosstab

Count

		ciprofloxacin_0.5mg		
		G	NG	Total
organism detected	B. cerus	5	0	5
	B. subtilis	5	1	6
	Cornybacterium	3	0	3
	enterobacteria	1	0	1
	K. oxytoca	0	1	1
	K. pneumonia	1	1	2
	P. aeroginosa	15	5	20
	S. aureus	14	7	21
	S. epidermis	10	6	16
Total		54	21	75

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	8.036[a]	8	.430
Likelihood Ratio	10.367	8	.240
N of Valid Cases	75		

a. 13 cells (72.2%) have expected count less than 5. The minimum expected count is .28.

organism detected * ciprofloxacin_0.25mg

Crosstab

Count

	ciprofloxacin_0.25mg	Total

		G	NG	
organism detected	B. cerus	5	0	5
	B. subtilis	6	0	6
	Cornybacterium	3	0	3
	enterobacteria	1	0	1
	K. oxytoca	0	1	1
	K. pneumonia	1	1	2
	P. aeroginosa	17	3	20
	S. aureus	18	3	21
	S. epidermis	10	6	16
Total		61	14	75

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	13.274[a]	8	.103
Likelihood Ratio	14.127	8	.079
N of Valid Cases	75		

a. 15 cells (83.3%) have expected count less than 5. The minimum expected count is .19.

organism detected * ciprofloxacin_0.125mg

Crosstab

Count

		ciprofloxacin_0.125mg	
		G	Total
organism detected	B. cerus	5	5
	B. subtilis	6	6
	Cornybacterium	3	3
	enterobacteria	1	1
	K. oxytoca	1	1
	K. pneumonia	2	2

	P. aeroginosa	20	20
	S. aureus	21	21
	S. epidermis	16	16
Total		75	75

Chi-Square Tests

	Value
Pearson Chi-Square	.[a]
N of Valid Cases	75

a. No statistics are computed because ciprofloxacin_0.125mg is a constant.

```
CROSSTABS
  /TABLES=Organism BY pef ofx az lev cf sp cpx am au cn
  /FORMAT=AVALUE TABLES
  /CELLS=COUNT
  /COUNT ROUND CELL.
```

Crosstabs

Notes

Output Created		12-APR-2024 10:53:58
Comments		
Input	Data	C:\Users\user\Documents\400L Second semester\MERGED WORK.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	76

Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each table are based on all the cases with valid data in the specified range(s) for all variables in each table.
Syntax		CROSSTABS /TABLES=Organism BY pef ofx az lev cf sp cpx am au cn /FORMAT=AVALUE TABLES /CELLS=COUNT /COUNT ROUND CELL.
Resources	Processor Time	00:00:00.06
	Elapsed Time	00:00:00.07
	Dimensions Requested	2
	Cells Available	524245

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
organism detected * perfloxacin	76	100.0%	0	0.0%	76	100.0%
organism detected * ofloxacin	76	100.0%	0	0.0%	76	100.0%
organism detected * azithromycin	76	100.0%	0	0.0%	76	100.0%
organism detected * levofloxacin	76	100.0%	0	0.0%	76	100.0%
organism detected * cefotaxime	76	100.0%	0	0.0%	76	100.0%
organism detected * sparfloxacin	76	100.0%	0	0.0%	76	100.0%
organism detected * ciprofloxacin	76	100.0%	0	0.0%	76	100.0%
organism detected * amoxicillin	76	100.0%	0	0.0%	76	100.0%

organism detected * augmentin	76	100.0%	0	0.0%	76	100.0%
organism detected * gentamicin	76	100.0%	0	0.0%	76	100.0%

organism detected * perfloxacin Crosstabulation

Count

		perfloxacin			
		I	R	S	Total
organism detected		1	0	0	0	1
	B. cerus	0	0	1	4	5
	B. subtilis	0	0	1	5	6
	Cornybacterium	0	0	1	2	3
	enterobacteria	0	0	0	1	1
	K. oxytoca	0	0	0	1	1
	K. pneumonia	0	0	1	1	2
	P. aeroginosa	0	2	5	13	20
	S. aureus	0	1	3	17	21
	S. epidermis	0	1	1	14	16

Total	1	4	13	58	76

organism detected * ofloxacin Crosstabulation

Count

		ofloxacin			
		I	R	S	Total
organism detected		1	0	0	0	1
	B. cerus	0	0	1	4	5
	B. subtilis	0	0	1	5	6
	Cornybacterium	0	0	1	2	3
	enterobacteria	0	0	0	1	1
	K. oxytoca	0	0	0	1	1
	K. pneumonia	0	0	1	1	2
	P. aeroginosa	0	1	5	14	20
	S. aureus	0	2	3	16	21
	S. epidermis	0	3	2	11	16
Total		1	6	14	55	76

organism detected * azithromycin Crosstabulation

Count

		azithromycin			
		I	R	S	Total
organism detected		1	0	0	0	1
	B. cerus	0	0	1	4	5
	B. subtilis	0	0	4	2	6
	Cornybacterium	0	0	1	2	3
	enterobacteria	0	0	0	1	1
	K. oxytoca	0	0	0	1	1
	K. pneumonia	0	0	0	2	2
	P. aeroginosa	0	1	5	14	20
	S. aureus	0	4	4	13	21
	S. epidermis	0	1	2	13	16
Total		1	6	17	52	76

organism detected * levofloxacin Crosstabulation

Count

		levofloxacin	Total

			I	R	S	
organism detected		1	0	0	0	1
	B. cerus	0	0	1	4	5
	B. subtilis	0	1	0	5	6
	Cornybacterium	0	0	0	3	3
	enterobacteria	0	0	1	0	1
	K. oxytoca	0	0	0	1	1
	K. pneumonia	0	0	0	2	2
	P. aeroginosa	0	1	4	15	20
	S. aureus	0	2	1	18	21
	S. epidermis	0	3	0	13	16
Total		1	7	7	61	76

organism detected * cefotaxime Crosstabulation

Count

		cefotaxime			
		I	R	S	Total
organism detected		1	0	0	0	1
	B. cerus	0	3	2	0	5

	B. subtilis	0	2	1	3	6
	Cornybacterium	0	0	0	3	3
	enterobacteria	0	1	0	0	1
	K. oxytoca	0	0	1	0	1
	K. pneumonia	0	0	1	1	2
	P. aeroginosa	0	4	8	8	20
	S. aureus	0	4	4	13	21
	S. epidermis	0	4	5	7	16
Total		1	18	22	35	76

organism detected * sparfloxacin Crosstabulation

Count

		sparfloxacin			
		I	R	S	Total
organism detected		1	0	0	0	1
	B. cerus	0	0	2	3	5
	B. subtilis	0	2	2	2	6
	Cornybacterium	0	0	2	1	3

	enterobacteria	0	0	0	1	1
	K. oxytoca	0	1	0	0	1
	K. pneumonia	0	1	1	0	2
	P. aeroginosa	0	3	7	10	20
	S. aureus	0	8	4	9	21
	S. epidermis	0	3	4	9	16
Total		1	18	22	35	76

organism detected * ciprofloxacin Crosstabulation

Count

		ciprofloxacin			
		I	R	S	Total
organism detected		1	0	0	0	1
	B. cerus	0	0	1	4	5
	B. subtilis	0	1	1	4	6
	Cornybacterium	0	0	0	3	3
	enterobacteria	0	0	0	1	1
	K. oxytoca	0	0	0	1	1
	K. pneumonia	0	1	1	0	2

	P. aeroginosa	0	1	5	14	20
	S. aureus	0	1	2	18	21
	S. epidermis	0	3	1	12	16
Total		1	7	11	57	76

organism detected * amoxicillin Crosstabulation

Count

		amoxicillin			
		I	R	S	Total
organism detected		1	0	0	0	1
	B. cerus	0	1	2	2	5
	B. subtilis	0	0	3	3	6
	Cornybacterium	0	0	0	3	3
	enterobacteria	0	1	0	0	1
	K. oxytoca	0	0	1	0	1
	K. pneumonia	0	0	1	1	2
	P. aeroginosa	0	1	16	3	20
	S. aureus	0	2	8	11	21
	S. epidermis	0	2	6	8	16

Total		1	7	37	31	76

organism detected * augmentin Crosstabulation

Count

		augmentin			
		I	R	S	Total
organism detected		1	0	0	0	1
	B. cerus	0	0	2	3	5
	B. subtilis	0	0	2	4	6
	Cornybacterium	0	0	1	2	3
	enterobacteria	0	0	0	1	1
	K. oxytoca	0	0	0	1	1
	K. pneumonia	0	0	1	1	2
	P. aeroginosa	0	0	11	9	20
	S. aureus	0	0	5	16	21
	S. epidermis	0	1	5	10	16
Total		1	1	27	47	76

organism detected * gentamicin Crosstabulation

Count

		gentamicin			
		I	R	S	Total
organism detected		1	0	0	0	1
	B. cerus	0	0	1	4	5
	B. subtilis	0	0	0	6	6
	Cornybacterium	0	0	0	3	3
	enterobacteria	0	1	0	0	1
	K. oxytoca	0	0	0	1	1
	K. pneumonia	0	1	0	1	2
	P. aeroginosa	0	2	5	13	20
	S. aureus	0	1	3	17	21
	S. epidermis	0	1	3	12	16
Total		1	6	12	57	76

CROSSTABS

/TABLES=Organism BY swimming_history ear_cleaning_habit instruments_used ear_rings pain_location

prev_mcb_infection

/FORMAT=AVALUE TABLES

/CELLS=COUNT

/COUNT ROUND CELL.

Crosstabs

Notes

Output Created		12-APR-2024 11:14:55
Comments		
Input	Data	C:\Users\user\Documents\400L Second semester\MERGED WORK.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>

	N of Rows in Working Data File	76
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each table are based on all the cases with valid data in the specified range(s) for all variables in each table.
Syntax		CROSSTABS /TABLES=Organism BY swimming_history ear_cleaning_habit instruments_used ear_rings pain_location prev_mcb_infection /FORMAT=AVALUE TABLES /CELLS=COUNT /COUNT ROUND CELL.

Resources	Processor Time	00:00:00.03
	Elapsed Time	00:00:00.03
	Dimensions Requested	2
	Cells Available	524245

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
organism detected * swimming history	76	100.0%	0	0.0%	76	100.0%
organism detected * patients ear cleaning habit	76	100.0%	0	0.0%	76	100.0%
organism detected * instrument used to clean ear	76	100.0%	0	0.0%	76	100.0%
organism detected * earring wearing	76	100.0%	0	0.0%	76	100.0%
organism detected * location of pain	76	100.0%	0	0.0%	76	100.0%

organism detected * previous microbial infections	76	100.0%	0	0.0%	76	100.0%

organism detected * swimming history Crosstabulation

Count

		swimming history			
		never swam	stopped swimming	still swimming	Total
organism detected		1	0	0	1
	B. cerus	4	1	0	5
	B. subtilis	5	0	1	6
	Cornybacterium	3	0	0	3
	enterobacteria	1	0	0	1
	K. oxytoca	1	0	0	1
	K. pneumonia	2	0	0	2
	P. aeroginosa	18	1	1	20
	S. aureus	17	1	3	21
	S. epidermis	15	1	0	16

Total	67	4	5	76

organism detected * patients ear cleaning habit Crosstabulation

Count

		patients ear cleaning habit			
		yes	not often	never	Total
organism detected		1	0	0	1
	B. cerus	4	1	0	5
	B. subtilis	1	3	2	6
	Cornybacterium	1	1	1	3
	enterobacteria	0	1	0	1
	K. oxytoca	1	0	0	1
	K. pneumonia	1	1	0	2
	P. aeroginosa	10	8	2	20
	S. aureus	10	7	4	21
	S. epidermis	8	8	0	16
Total		37	30	9	76

organism detected * instrument used to clean ear Crosstabulation

Count

		instrument used to clean ear			
		cotton_buds	biro_tips	key	Total
organism detected		1	0	0	1
	B. cerus	5	0	0	5
	B. subtilis	6	0	0	6
	Cornybacterium	3	0	0	3
	enterobacteria	1	0	0	1
	K. oxytoca	0	1	0	1
	K. pneumonia	2	0	0	2
	P. aeroginosa	17	2	1	20
	S. aureus	21	0	0	21
	S. epidermis	13	3	0	16
Total		69	6	1	76

organism detected * earring wearing Crosstabulation

Count

		earring wearing

		only for events	everyday	once a month	never
organism detected		0	1	0	0
	B. cerus	0	2	0	3
	B. subtilis	0	4	0	2
	Cornybacterium	0	2	0	1
	enterobacteria	0	1	0	0
	K. oxytoca	0	1	0	0
	K. pneumonia	0	2	0	0
	P. aeroginosa	1	12	1	6
	S. aureus	0	13	1	7
	S. epidermis	2	10	2	2
Total		3	48	4	21

organism detected * earring wearing Crosstabulation

Count

		Total
organism detected		1
	B. cerus	5

	B. subtilis	6
	Cornybacterium	3
	enterobacteria	1
	K. oxytoca	1
	K. pneumonia	2
	P. aeroginosa	20
	S. aureus	21
	S. epidermis	16
Total		76

organism detected * location of pain Crosstabulation

Count

		location of pain		
		inside ear	both	Total
organism detected		1	0	1
	B. cerus	5	0	5
	B. subtilis	5	1	6
	Cornybacterium	3	0	3
	enterobacteria	1	0	1

	K. oxytoca	1	0	1
	K. pneumonia	2	0	2
	P. aeroginosa	20	0	20
	S. aureus	21	0	21
	S. epidermis	13	3	16
Total		72	4	76

organism detected * previous microbial infections Crosstabulation

Count

		previous microbial infections			
		yes	no	3.00	Total
organism detected		1	0	0	1
	B. cerus	5	0	0	5
	B. subtilis	6	0	0	6
	Cornybacterium	1	2	0	3
	enterobacteria	1	0	0	1
	K. oxytoca	0	1	0	1
	K. pneumonia	2	0	0	2
	P. aeroginosa	16	3	1	20

	S. aureus	20	0	1	21
	S. epidermis	11	5	0	16
Total		63	11	2	76

```
CROSSTABS
  /TABLES=age occupation smoking_history alcohol_history swimming_history
ear_cleaning_habit
    instruments_used recently_pierced ear_rings pain_location present_symptoms
prev_ear_infection pus
    duration_symp prev_mcb_infection BY sex
  /FORMAT=AVALUE TABLES
  /CELLS=COUNT
  /COUNT ROUND CELL.
```

Crosstabs

Notes

Output Created		12-APR-2024 11:19:14
Comments		
Input	Data	C:\Users\user\Documents\400L Second semester\MERGED WORK.sav
	Active Dataset	DataSet1
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	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	76
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each table are based on all the cases with valid data in the specified range(s) for all variables in each table.

Syntax		CROSSTABS /TABLES=age occupation smoking_history alcohol_history swimming_history ear_cleaning_habit instruments_used recently_pierced ear_rings pain_location present_symptoms prev_ear_infection pus duration_symp prev_mcb_infection BY sex /FORMAT=AVALUE TABLES /CELLS=COUNT /COUNT ROUND CELL.
Resources	Processor Time	00:00:00.03
	Elapsed Time	00:00:00.04
	Dimensions Requested	2

Cells Available	524245

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
age of patient * gender of patient	76	100.0%	0	0.0%	76	100.0%
patients occupation * gender of patient	76	100.0%	0	0.0%	76	100.0%
smoking history * gender of patient	76	100.0%	0	0.0%	76	100.0%
alcohol history * gender of patient	76	100.0%	0	0.0%	76	100.0%
swimming history * gender of patient	76	100.0%	0	0.0%	76	100.0%
patients ear cleaning habit * gender of patient	76	100.0%	0	0.0%	76	100.0%

instrument used to clean ear * gender of patient	76	100.0%	0	0.0%	76	100.0%
recently pierced ears * gender of patient	76	100.0%	0	0.0%	76	100.0%
earring wearing * gender of patient	76	100.0%	0	0.0%	76	100.0%
location of pain * gender of patient	76	100.0%	0	0.0%	76	100.0%
presenting symptoms * gender of patient	76	100.0%	0	0.0%	76	100.0%
previous ear infection * gender of patient	76	100.0%	0	0.0%	76	100.0%
pus discharge * gender of patient	76	100.0%	0	0.0%	76	100.0%
duration of symptoms * gender of patient	76	100.0%	0	0.0%	76	100.0%
previous microbial infections * gender of patient	76	100.0%	0	0.0%	76	100.0%

age of patient * gender of patient Crosstabulation

Count

		gender of patient		
		male	female	Total
age of patient	0-15yrs	2	3	5
	16-25yrs	5	40	45
	26-35yrs	5	6	11
	36-60yrs	2	2	4
	>60yrs	6	5	11
Total		20	56	76

patients occupation * gender of patient Crosstabulation

Count

		gender of patient		
		male	female	Total
patients occupation	business	0	1	1
	civil se	7	5	12
	counsell	0	2	2
	matron	0	1	1
	nill	5	34	39

	retired	2	0	2
	sale rep	2	0	2
	student	1	8	9
	Student	0	2	2
	stuudent	1	0	1
	trader	2	3	5
Total		20	56	76

smoking history * gender of patient Crosstabulation

Count

		gender of patient		
		male	female	Total
smoking history	never smoked	13	52	65
	stopped smoking	7	3	10
	still smoking	0	1	1
Total		20	56	76

alcohol history * gender of patient Crosstabulation

Count

		gender of patient		
		male	female	Total
alcohol history	never drank	6	45	51
	stopped drinking	8	1	9
	still drinking	6	10	16
Total		20	56	76

swimming history * gender of patient Crosstabulation

Count

		gender of patient		
		male	female	Total
swimming history	never swam	15	52	67
	stopped swimming	2	2	4
	still swimming	3	2	5
Total		20	56	76

patients ear cleaning habit * gender of patient Crosstabulation

Count

		gender of patient		
		male	female	Total
patients ear cleaning habit	yes	11	26	37
	not often	6	24	30
	never	3	6	9
Total		20	56	76

instrument used to clean ear * gender of patient Crosstabulation

Count

		gender of patient		
		male	female	Total
instrument used to clean ear	cotton_buds	20	49	69
	biro_tips	0	6	6
	key	0	1	1
Total		20	56	76

recently pierced ears * gender of patient

Crosstabulation

Count

		gender of patient		
		male	female	Total
recently pierced ears	yes	0	2	2
	no	20	54	74
Total		20	56	76

earring wearing * gender of patient Crosstabulation

Count

		gender of patient		
		male	female	Total
earring wearing	only for events	0	3	3
	everyday	5	43	48
	once a month	1	3	4
	never	14	7	21
Total		20	56	76

location of pain * gender of patient Crosstabulation

Count

		gender of patient		
		male	female	Total
location of pain	inside ear	20	52	72
	both	0	4	4
Total		20	56	76

presenting symptoms * gender of patient Crosstabulation

Count

		gender of patient		
		male	female	Total
presenting symptoms	pain in the ear	6	23	29
	discharge	5	14	19
	poor hearing	4	3	7
	fever	1	7	8
	itching	3	9	12
	turning of the eyes	1	0	1
Total		20	56	76

previous ear infection * gender of patient

Crosstabulation

Count

		gender of patient		
		male	female	Total
previous ear infection	yes	13	37	50
	no	7	19	26
Total		20	56	76

pus discharge * gender of patient Crosstabulation

Count

		gender of patient		
		male	female	Total
pus discharge	yes	5	30	35
	no	15	26	41
Total		20	56	76

duration of symptoms * gender of patient Crosstabulation

Count

		gender of patient		
		male	female	Total
duration of symptoms	<7days	7	15	22
	8-14days	5	23	28
	>21days	8	18	26
Total		20	56	76

previous microbial infections * gender of patient

Crosstabulation

Count

		gender of patient		
		male	female	Total
previous microbial infections	yes	19	44	63
	no	1	10	11
	3.00	0	2	2
Total		20	56	76