
UNIVERSITI PUTRA MALAYSIA

# A RETROSPECTIVE STUDY ON THE IDENTIFICATION AND ANTIMICROBIAL SUSCEPTIBILITY OF BACTERIA ISOLATED FROM DOGS AND CATS WITH OTITIS EXTERNA

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# A RETROSPECTIVE STUDY ON THE IDENTIFICATION AND ANTIMICROBIAL SUSCEPTIBILITY OF BACTERIA ISOLATED FROM DOGS AND CATS WITH OTITIS EXTERNA

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## CERTIFICATION

It is hereby certified that we have read this project paper entitled “A Retrospective Study on the Identification and Antimicrobial Susceptibility of Bacteria Isolated from Dogs and Cats with Otitis Externa”, by Tan Ying Qi and in our opinion it is satisfactory in terms of scope, quality, and presentation as partial fulfillment of the requirement for the course VPD 4999 – Project.

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## ABSTRAK

Abstrak daripada kertas projek yang dikemukakan kepada Fakulti Perubatan Veterinar untuk memenuhi sebahagian daripada keperluan kursus VPD 4999 - Projek.

**KAJIAN RETROSPEKTIF MENGENAI PENGENALAN DAN KEBERKESANAN ANTIMIKROBIAL UNTUK BAKTERIA YANG DIISOLASI DARI ANJING DAN KUCING YANG MENGHIDAP OTITIS EKSTERNA**

**Oleh**

**Tan Ying Qi**

**2023**

**Penyelia: Dr. Chan Wei Yee**

Otitis eksterna (OE) merupakan masalah yang sering dihadapi di klinik veterinar di kalangan anjing dan kucing. OE adalah penyakit multifaktorial yang menimbulkan cabaran untuk mengenalpasti punca patogenik dan menentukan rawatan yang sesuai. Kajian ini bertujuan untuk (i) mengenal pasti bakteria yang diisolasi daripada anjing dan kucing yang menghidap OE; (ii) menentukan kerentanan antimikrob bagi bakteria yang dikenal pasti. Laporan makmal mengenai kultur bakteria dan identifikasi daripada swab telinga anjing dan kucing dengan OE telah diperolehi dari makmal bakteriologi, Unit Perkhidmatan Makmal Veterinar selama tempoh 5 tahun (Ogos 2017 hingga Julai 2023). Maklumat yang hilang telah diperolehi daripada rekod pesakit perubatan di Hospital Veterinar Universiti. Data telah dianalisis melalui statistik deskriptif dan keputusan ditunjukkan dalam frekuensi dan peratusan. Secara keseluruhan, daripada145 kes, 55% kes anjing (n=80) dan

45% kes kucing (n=65) telah dikenalpasti menghidap OE. Sebilangan bersar anjing dengan OE ini adalah berumur sepuluh hingga sebelas tahun (29%), jantan (74%), belum dikembiri (78%), telinga jenis berdiri (53%), dan berbaka German Shepherd Dog (23%). Sebaliknya, kucing dengan OE, majoritinya berumur kurang dari satu hingga dua tahun (29%), jantan (69%), belum dikembiri (51%), dan berbaka Domestic Shorthair (26%). OE yang hanya menglibatkan salah satu telinga sering dijumpa dalam kebanyakan anjing (69%) dan kucing (8%) pada konsultasi pertama. Tanda klinikal utama OE merupakan discaj telinga (41% anjing; 43% kucing) seperti discaj purulen (53% anjing; 48%kucing) dan discaj mukopurulen (16% anjing; 18% kucing). Bakteria patogenik yang kerap diisolasi daripada anjing adalah *Pseudomonas aeruginosa* (27%), *Proteus mirabilis* (17%), dan *Staphylococcus* spp. (*S. intermedius* dan *S. pseudintermedius*) (10%). Bagi kucing, *Staphylococcus* spp. (28%), *P. aeruginosa* (19%), dan *Streptococcus canis* (13%) biasanya diisolasikan. Melalui ujian sensitiviti antimikrob, kebanyakan anjing (65%) dan kucing (56%) telah menunjukkan status ketahanan terhadap pelbagai ubat ataupun *multidrug-resistant* (MDR). Untuk kedua-dua kucing dan anjing, bakteria Gram-negatif, khususnya *P. aeruginosa*, menunjukkan 100% ketahanan terhadap pelbagai antibiotik yang diuji, termasuk amoxicillin/clavaluinc acid, cephalexin, dan cefixime. Antibiotik empirik yang biasanya digunakan adalah ubat telinga topikal yang mengandungi polymyxin B (28% pada kedua-dua anjing dan kucing) dan amoxicillin/clavalunic acid sebagai antibiotik sistemik (24% anjing; 25% kucing). Dalam kajian ini, *P. aeruginosa* merupakan kebimbangan besar kerana ia diidentifikasi sebagai bakteria MDR dalam 98% kes. Kemunculan MDR secara serius membataskan pilihan terapi yang tersedia. Oleh itu, kepentingan kultur bakteria dan ujian sensitiviti antimikrob perlu ditekankan dalam membimbing pengunaan rawatan yang muktamad.

Kata Kunci: anjing, kucing, otitis eksterna, MDR, bakteria, ujian sensitiviti antimikrob

## ABSTRACT

An abstract of the project paper presented to the Faculty of Veterinary Medicine in partial fulfilment of the course VPD 4999 -Project.

**A RETROSPECTIVE STUDY ON THE IDENTIFICATION AND ANTIMICROBIAL SUSCEPTIBILITY OF BACTERIA ISOLATED FROM DOGS AND CATS WITH OTITIS EXTERNA**

**By**

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**2023**

**Supervisor: Dr. Chan Wei Yee**

Otitis externa (OE) is a commonly encountered problem in veterinary clinics among dogs and cats. It is a multifactorial disease that poses challenges to identifying its underlying pathogenic causes and determining the appropriate course of treatment. This study aimed to (i) identify the bacteria isolated from dogs and cats with OE; and (ii) determine the antimicrobial susceptibility of the identified bacteria. The laboratory reports of bacteria culture and identification from ear swabs of dogs and cats with OE were retrieved from the bacteriology laboratory of the Veterinary Laboratory Services Unit over 5 years (August 2017 to July 2023). Missing information was retrieved from medical patient records at the University Veterinary Hospital. Data were analysed through descriptive statistics and the results were presented in frequencies and percentages. Overall, 145 cases with 55% in dogs (n=80) and 45% in cats (n=65) were diagnosed with OE. Predominantly, dogs with

OE were ten to eleven years of age (29%), male (74%), intact (78%), erected ears (53%), of German Shepherd Dog (23%). In contrast, cats with OE were less than one year to two years of age (29%), male (69%), intact (51%), and of Domestic Shorthaired cats (26%). Unilateral OE was observed in most dogs (69%) and cats (68%) at the initial presentation, showing the main clinical sign of otorrhea (41% of dogs, 43% of cats) such as purulent discharges (53% of dogs, 48% of cats) and mucopurulent discharges (16% of dogs, 18% of cats). Pathogenic bacteria frequently isolated from dogs were *Pseudomonas aeruginosa* (27%), *Proteus mirabilis* (17%), and *Staphylococcus* spp. (*S. intermedius* and *S. pseudintermedius*) (10%). In cats, *Staphylococcus* spp. (28%), *P. aeruginosa* (19%), and *Streptococcus canis* (13%) were commonly identified. Through antimicrobial sensitivity testing (AST), there was a significant proportion of dogs (65%) and cats (56%) exhibited multidrug-resistant (MDR). For both cats and dogs, Gram-negative bacteria, specifically *P. aeruginosa* exhibited 100% resistance to many tested antibiotics, including amoxicillin/clavulanic acid, cephalexin and cefixime. The most commonly prescribed empirical antibiotic was polymyxin B as a topical ear preparation (28% in both dogs and cats) and amoxicillin/clavulanic acid as a systemic antibiotic (24% in dogs and 25% in cats). In this study, *P. aeruginosa* is a significant concern as it was identified as MDR bacteria in 98% of cases. The emergence of MDR has severely limited the availability of therapeutic choices and underscored the importance of performing bacterial culture and AST in guiding definitive treatment decisions.

Keywords: dogs, cats, otitis externa, MDR, bacteria, AST

## 1.0 INTRODUCTION

Otitis externa is a commonly encountered problem to be presented in veterinary clinics among dogs and cats. It is defined as an inflammatory condition that affects the external ear canal from the pinna to the tympanic membrane (Jackson and Marsella, 2012). Clinical signs commonly presented include head shaking, foul smell, pain, erythema, and swelling in the external ear canal (Woodward, 2023).

The prevalence rate of canine otitis externa was higher than feline otitis externa. A few studies had found that 10-20% of the dogs population was affected, meanwhile, within 2-10% of cats were affected with otitis externa (August, 1988; Angus, 2004; Cole, 2004; Hill *et al*., 2006; Topala, 2007; Perego *et al*., 2013; De Martino *et al*., 2016).

Otitis externa is a multifactorial disease that poses challenges to identifying its underlying pathogenic causes and determining the appropriate course of treatment. Several studies have been published on various species of bacteria isolated from dogs and cats with otitis externa and assessing their antimicrobial sensitivity profiles which are crucial for guiding effective treatment choices for different types of infection (Lilenbaum *et al*., 2000; Henneveld *et al*, 2012; Bourély *et al*, 2019). Antimicrobial resistance (AMR) is a serious global public health threat and has become a great concern worldwide. Household pets can potentially transmit AMR to humans through direct contact with otitis patients during treatment such as cleaning and administering medication (Jin *et al.,* 2023). Therefore, antimicrobial sensitivity testing (AST) plays an important role in precisely selecting an appropriate antimicrobial therapy.

This study aimed to (i) identify the bacteria isolated from dogs and cats with OE; and (ii) determine the antimicrobial susceptibility of the identified bacteria.

There are two hypotheses in this study. Firstly, the bacteria commonly isolated from dogs and cats with otitis externa are *Staphylococcus* spp., *Pseudomonas aeruginosa and Streptococcus* spp.. Secondly, the bacteria isolated from dogs and cats with otitis externa have an increased frequency of multidrug-resistant to antimicrobial drugs given.

## 2.0 LITERATURE REVIEW

### 2.1 Normal ear anatomy and physiology

The ears of dogs and cats are made up of three compartments which are the external ear, the middle ear and the inner ear (Moriello, 2023). The external ear canal includes the pinna and the external auditory meatus where they are function for the location and collection of sound waves. The external ear canal of dogs is usually covered with few fine hairs and breeds with hairy ear canals like Cocker Spaniels may have profuse hair growing along the whole ear canal (Harvey and Paterson, 2014). Cats usually lack hair in the external ear canal and have good ventilation therefore this is one of the reasons that cat has a lower incidence rate of otitis (Themes, 2016). The middle ear consists of the tympanic membrane, the ossicles, the auditory tube (Eustachian tube) and the tympanic cavity. The tympanic membrane is a membrane that separates the external ear from the middle ear. Besides, the ossicles are made up of tiny bones which are malleus, incus and stapes and the Eustachian tube is a tube that connects the middle ear to the nasal-sinus cavity. The inner ear contains the cochlea which supports hearing and the vestibule system which supports balancing.

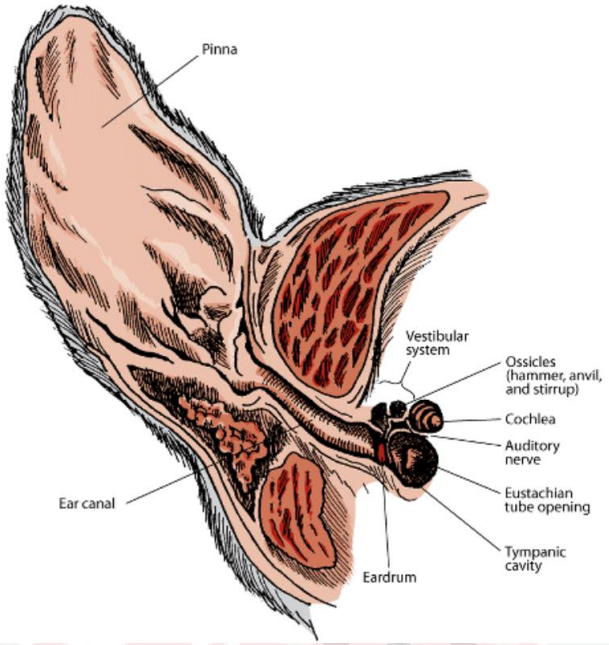


**Figure 1: Schematic diagram with the labelled structure of a normal dog's ear (Moriello, 2023).**

## 2.2 Normal flora of the ear

The normal commensal of the ears of dogs and cats includes various types of bacteria, fungi and yeast living in the external ear canal. Bacteria are found to be isolated from 46% of the normal dogs' ear swab samples and 19% of the isolates are Staphylococci (Matsuda *et al.,* 1984). The normal flora isolated from the external ear canal of healthy dogs includes *Staphylococcus* spp., *Staphylococcus aureus, Streptococcus* sp., and *Corynebacterium* spp.; with *Staphylococcus* spp. being the most prevalent isolates (Matsuda *et al*., 1984; Aoki-Komori *et al*., 2007). In normal healthy ear swabs of dogs and cats, Gram-positive cocci were presence in 42% and 71% respectively, in dogs and cats, whereas rods will not be seen (Tater *et al*., 2003).

## 2.3 Aetiology of otitis externa

Otitis externa is a multifactorial disease and has been classified based on the PSPP system that is proposed by Griffin (2010). PSPP system is known to categorize the aetiology of otitis externa into **p**rimary cause, **s**econdary cause, **p**redisposing factor and **p**erpetuating factor.

The primary cause is the factor that has a direct effect on the external ear canal of dogs and cats and may lead to otitis. Firstly, otic parasites such as *Otodectes* species and *Demodex* species are common triggers in young age dogs and cats (Paterson, 2016; Ordeix, 2016). Next, hypersensitivity disease especially atopic dermatitis is the primary cause of otitis externa, where around 75% of reported cases are atopic dermatitis (Paterson, 2002). Based on the previous study by Rosser (2004), more than 90% of the cases presented with chronic bilateral otitis externa are due to the factor of atopic dermatitis or food allergy in dogs (Rosser, 2004; Coyner, 2020). In addition, endocrine diseases such as hypothyroidism and hyperadrenocorticism also may lead to otitis externa. This is due to the alteration of the keratinization process and cerumen production in the external ear canal leading to ceruminous and seborrheic forms of otitis externa (Themes, 2016). Neoplasia is also one of the primary causes of the disease. For example, ceruminous gland tumours where the growth will cause blockage in the external ear canal and cause otitis. Both neoplasia and polyp are usually found at the unilateral ear, and the polyp is common in younger pets especially cats while neoplasia is found in older pets (Coyner, 2020). Squamous cell carcinoma is recognised as a skin tumour that commonly affects the ear pinna especially in cats, whereas histiocytoma is the most important tumour in dogs (van der Gaag, 1986).

Secondary causes of otitis externa are usually developed by primary factors and in combination with predisposing and perpetuating factors. The secondary cause is the infection with yeast or bacteria. The yeast that is frequently isolated is *Malassezia* yeast.

The predisposing factor is the factor that will change the external ear canal environment and increase the risk of the animals developing otitis externa (Bajwa, 2019). These factors include anatomy and conformation of the ear, excessive moisture, obstructive ear disease and treatment effect (Paterson, 2016; Bajwa, 2019; Woodward, 2023). Firstly, the anatomy and conformation of the ear are different between species, as some have pendulous ear pinnae and some have erected ear pinnae. For instance, Labrador Retrievers, Beagles, Poodles and Cocker Spaniels have pendulous ears while German Shepherd dogs and Huskies have erect ears. However, breeds with pendulous ears are not necessarily being predisposed to otitis externa but they are susceptible to progressive infection of otitis (Harvey and Paterson, 2014). Whereas cats usually have erected ear pinnae and only Scottish Fold have pendulous ear pinnae. The incidence of otitis externa is found in various breeds of cats, but Himalayan and Persian cats are more commonly predisposed to otitis externa (Baba and Fukata, 1981). Next, excessive moisture in the ear canal may also predispose dogs and cats to otitis externa. Ears which are frequently wet and moist can activate the production of ceruminous glands which will then lead to ceruminous otitis externa (Rosser, 2004). Obstructive ear disease is also mentioned above and it is also the primary cause of disease. Furthermore, the treatment effect may also predispose animals to otitis. It can be iatrogenically from an inappropriate selection of cleaning solution or traumatic effect from rough cleaning technique and also from the overuse of topical antibiotics such as repeatedly using the same course

of treatment may lead to a change in microorganisms, leading to the development of multidrug resistance (Paterson, 2016).

The perpetuating factor itself will not cause otitis externa but will make the condition worsen and it will prevent the resolution of the disease even if the primary cause has been corrected (Paterson, 2016; Bajwa, 2019). Pathological changes in the external ear canal may prevent the resolution of otitis such as ear canal stenosis, proliferative change or ruptured tympanic bulla (Paterson, 2016; Bajwa, 2019; Woodward, 2023). Besides, otitis media which is the infection in the middle ear cavity also acts as an important perpetuating factor. It develops as an extension infection from otitis externa to the tympanic bulla causing treatment to become ineffective (Paterson, 2016; Bajwa, 2019; Woodward, 2023).

**2.4 Diagnostic approach to otitis externa**

Initially, the diagnosis approach will be started by taking a thorough history of the patient and clinical examination. A general examination and dermatological examination need to be carried out to rule out possible dermatology-related disease and a careful ear examination should be done to obtain the signs observed such as otorrhea, foul smelling, foreign body, erythema, pruritus and so on. Having a thorough history during presentation is crucial to investigating the possible underlying factors contributing to otitis. Different types of otorrhea have different indications of findings. For instance, dark brown waxy discharge indicates ceruminous otitis; purulent discharge indicates staphylococcus-infected otitis; mucopurulent discharge indicates Pseudomonal otitis (Harvey and Paterson, 2014).

Next, otic cytology is essential to enable clinicians to correctly identify the infection and allow a more appropriate and accurate treatment (Jackson, 2021). From cytological examination of the ear, the type of microorganisms present can be identified. For instance, cocci bacteria (Staphylococci, Streptococci), rods (*Pseudomonas* spp., *Proteus* spp. and other Gram-negative bacteria) and yeast (*Malassezia* spp.). The previous studies proposed that the cytological result has a higher sensitivity and specificity compared to the culture result (Huang, 1993; Tater *et al.,* 2003).

After cleaning of ear canal, an otoscopic examination is required for further examination into the ear canal lining and tympanum. It is advised that both ears should be examined even though a unilateral problem is suspected (Harvey and Paterson, 2014). Appearance of the external ear canal should be assessed on the amount of discharge, foreign body, presence of ulcer and erosion, erythema and luminal stenosis. In addition, a minimal amount of yellowish-brown ear discharge is expected to be seen in a normal healthy ear canal (Merchant, 2005; Harvey and Paterson, 2014).

Furthermore, antimicrobial susceptibility testing (AST) is required in cases of chronic or refractory otitis externa (Malayeri *et al.*, 2010). It is a laboratory procedure that is performed to find out the antimicrobial susceptibility pattern of the isolated bacteria. The results of AST are categorized into susceptible, intermediate and resistant. Susceptible isolates indicate that they will be responding to the antibiotic given; intermediate isolates may be treatable with the antibiotic but require a higher dosage; resistant isolates cannot be treated with the drug (Jorgensen, 2009; Glossary of terms related to antibiotic resistance, 2019).

## 2.5 Treatment approach of otitis externa

Treatment of otitis is aimed at resolving the primary cause of otitis, cleaning, reducing inflammation and eliminating microbial infection by performing ear cleaning, and topical therapy of anti-inflammatories and antibiotics (Greene, 2006; Harvey *et al*., 2001; Jackson, 2021).

For acute otitis externa, the clinician is recommended to administer first-line topical treatment which is aminoglycosides or polymyxin B while second-line topical treatment is fluoroquinolones (Coyner, 2020). However, it is suggested that aminoglycosides should not be used in ruptured tympanum as they will potentially cause ototoxicity (Harvey and Paterson, 2014; Coyner 2020). In cases of chronic or relapse otitis externa, it is crucial to identify and treat the primary cause of otitis, flush out the accumulated exudate and treat the infection with either topical or systemic medication (Coyner, 2020).

Glucocorticoids are commonly used as an anti-inflammatory drug in topical otic preparation (Harvey and Paterson, 2014; Bajwa, 2019; Jackson 2021). It is beneficial for short-term therapy to aid in reducing pain and swelling, however, it is not encouraged for long-course management of otitis (Bajwa, 2019).

Surgical intervention is proven to aid in end-stage otitis externa, recurrent otitis media, ear canal polyp or neoplasia (Coyner, 2020). The common surgical procedures performed are Total Ear Canal Ablation with Lateral Bulla Osteotomy (TECALBO) and Vertical Ear Canal Ablation (VECA) (Harvey and Paterson, 2014; Jackson, 2021).

## 2.6 Multi-drug Resistant (MDR)

Multi-drug resistant (MDR) is defined as an isolate that is resistant to more than one antibiotic in three or more than three of the antimicrobial classes (Magiorakos *et al.*, 2011; Glossary of terms related to antibiotic resistance, 2019). The risk of MDR is a significant concern due to the high involvement of bacteria in otitis cases. Factors contributing to poses risk of antibiotic resistance are the overuse or misuse of antibiotics, failure to identify the underlying causes, recurrent and persistent infection and inadequate treatment compliance. Among all of the isolates in dogs and cats with otitis externa, 90% of them were susceptible to topical ear preparation of gentamycin (Hariharan *et al.*, 2006). The presence of multidrug-resistant of *P. aeruginosa* is a significant concern as it poses challenges for treatment. Based on a study by Hariharan *et al.* (2006), *P. aeruginosa* has a high susceptibility rate of 85% to gentamycin and 100% to polymyxin B; whereas for other bacteria isolated, they have the highest susceptibility to amoxicillin with clavulanic acid.

## 2.7 Pathogenic bacteria causing otitis externa

### 2.7.1 Pathogenic bacteria causing canine otitis externa

Pathogenic bacteria isolated from acute and chronic otitis externa are different. In acute cases of canine otitis externa, Gram-positive bacteria *Staphylococcus* spp., *Streptococcus* spp. and *Corynebacterium* spp. are isolated; in chronic cases of canine otitis externa, Gram-positive bacteria *Enterococcus* spp. and Gram-negative bacteria such as *Pseudomonas* spp., *Proteus* spp. and *Escherichia coli* are more likely to be isolated (Merchant, 2005; Paterson, 2016).

### 2.7.1 Pathogenic bacteria causing feline otitis externa

Pathogenic bacteria isolated from feline otitis externa, most frequently isolated were *Staphlylococcus intermedius* and *Pasteurella multocida* (August, 1988).

## 3.0 MATERIALS AND METHODS

### 3.1 Selection of data

The data of this study were selected based on several specific criteria as described below. It included the cases of otitis externa in dogs and cats that were presented to the University Veterinary Hospital (UVH) of Universiti Putra Malaysia (UPM) in which ear canal swabs were taken as part of the diagnostic procedure. These ear swab samples were then sent to the Bacteriology Laboratory of the Veterinary Laboratory Services Unit (VLSU), UPM for bacteria isolation and identification followed by antibiotic sensitivity testing (AST). The selection of cases was based on keywords of swab and ear swab, and 281 cases were screened initially.

### 3.2 Data Collection

A period of 5 years retrospective study was conducted on the cases of otitis externa in dogs and cats which had ear swabs sent for culture and AST at the bacteriology laboratory of the VLSU, UPM from August 2017 to July 2023. Log books and request forms in the bacteriology laboratory were screened for cases of ear swab samples received from dogs and cats with otitis externa and then further retrieving information on bacteriology laboratory reports. Information retrieved from the request form submitted to the laboratory included signalment, historical data, and the description of ear secretions (colour). From the laboratory reports, the type of bacteria identified and antibiotic sensitivity profiles were recorded.

After collecting data from the bacteriology laboratory, we proceeded to collect further information from case files from UVH, UPM. Furthermore, missing information in the request form to the laboratory was taken from case files from UVH such as

signalment, historical data and diagnosis. Data on signalment includes breed, age, sex, neuter status, and type of ear pinnae. Historical data consist of a brief history, living management (multi-household or single household dog or cat, managed indoor or outdoor), and findings during the presentation (unilateral/bilateral). Other data retrieved from case files include antibiotics used before the AST result, changes of antibiotic used after the AST result, and history of surgical procedure done, if available.

### 3.3 Exclusion criteria

The exclusion criteria for the data selected in this study were as follows:

i. Dogs and cats with ear swab taken, but from healthy patients' ear
ii. Any cases not related to otitis externa were omitted such as otitis media and otitis interna.
iii. Cases with ear swab samples were taken, but no bacteria growth was found.

A total of 121 cases were excluded from this study with the consideration of the exclusion criteria above. In addition, there were missing of 15 case files to confirm if they were cases relevant to otitis externa, therefore these cases were also eliminated. Hence, a final number of 145 cases of otitis externa from dogs and cats in which ear swab samples had been sent to the bacteriology laboratory of VLSU, UPM were included in this study.

### 3.4 Data Tabulation and Analysis

Data collected was tabulated in a Microsoft Excel spreadsheet and descriptive statistics was performed. The results were analysed and presented in frequencies and percentages. Besides, IBM® SPSS® Statistics version 27 was used to perform further data analysis including modes, medians, and the risk association between type of bacteria and their MDR status.

## 4.0 RESULT

Within five years period of time, there were a total of 145 ear swab samples from cases diagnosed with otitis externa sent to the bacteriology laboratory in VLSU, UPM; 80 cases of dogs and 65 cases of cats. Throughout the year, the number of cases increased significantly for both dogs and cats.

### 4.1 Signalment

The age distribution of dogs and cats with otitis externa are shown in **Figure 2 and Figure 3**, respectively. Out of the 80 dogs, 29% (n = 23/80) of the dogs were 10 to 11 years old with the median age of dogs with otitis externa being 10 years old. Among 65 cases of cats, 26% (n = 21/65) of cats presented were less than one year old to two years old with the median age of cats with otitis externa being 4 years old (range, <1 to 16 years old).

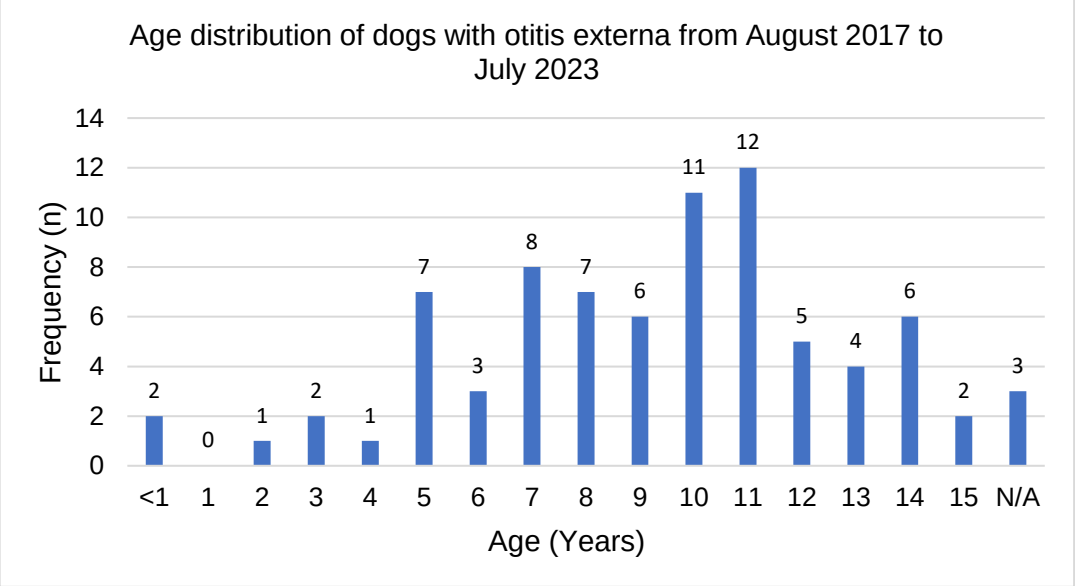


**Figure 2: Age distribution of dogs with otitis externa from August 2017 to July 2023.**

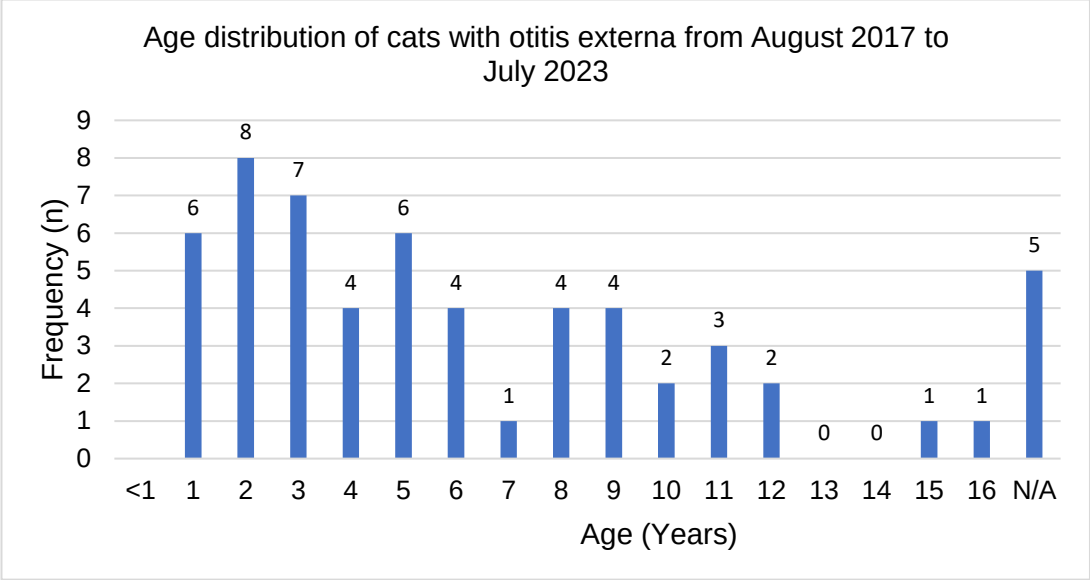


**Figure 3: Age distribution of cats with otitis externa from August 2017 to July 2023.**

Dog breeds that were frequently presented with otitis externa in this study were German Shepherd (23%, n = 18) followed by local breed dogs (14%, n = 11), Poodle (9%, n = 7), Beagle (9%, n = 7), Labrador (8%, n = 6), West Highland White Terrier (6%, n = 5), Shih Tzu (6%, n = 5), and Siberian Husky (6%, n = 5). The other breeds with a frequency of 3 or less are shown in **Table 1**.

**Table 1: Breeds distribution of dogs with otitis externa from August 2017 to July 2023.**

| Breed of Dogs | Frequency (n) |
|---|---|
| German Shepherd | 18 |
| Local | 11 |
| Beagle | 7 |
| Poodle | 7 |
| Labrador Retriever | 6 |
| Siberian Husky | 5 |
| Shih Tzu | 5 |
| West Highland White Terrier | 5 |
| Cocker Spaniel | 3 |
| French bulldog | 3 |
| Golden Retriever | 3 |
| Chihuahua | 1 |
| Dachshund | 1 |
| Pit bull | 1 |
| Pug | 1 |
| Rottweiler | 1 |
| Schnauzer | 1 |
| Shar Pei | 1 |
| **Total** | **80** |

Breeds frequently diagnosed with otitis externa in cats (**Table 2**) were Domestic Shorthair (26%, n = 17/65), Maine Coon (22%, n = 14/65), and Persian or Persian cross (15%, n = 10/65). These were followed by mixed breed (14%, n = 9/65), Bengal (6%, n = 4/65), American Shorthair (%, n=3), Exotic Persian (%, n=2), Ragdoll (%, n=2) and Munchkin (% n=1). Most of the cats have erected ears and only Scottish fold has pendulous ears. Therefore, the type of pinnae of cats was not analysed.

**Table 2: Breeds distribution of cats with otitis externa from August 2017 to July 2023.**

| Breed of Cats | Frequency (n) |
|---|---|
| Domestic Shorhair | 17 |
| Maine Coon | 14 |
| Persian/ Persian X | 10 |
| Mixed Breed | 9 |
| Bengal | 4 |
| American Shorthair | 3 |
| Domestic Longhair | 2 |
| Exotic Persian | 2 |
| Ragdoll | 2 |
| Munchkin | 1 |
| Scottish Fold | 1 |
| **Total** | **65** |

Signalments of dogs and cats with otitis externa are shown in **Table 3** and **Table 4**, respectively. Interestingly, male was predominantly presented with 74% (n = 59/80) and 69% (n = 45/65), respectively for dogs and cats. Of these, 77% (n = 62/80) dogs and 51% (n = 33/65) cats were sexually intact. Dogs with erect ear pinnae have a higher incidence rate compared to pendulous ear pinnae which was 52% (n = 42/80). See **Figure 5**.

Regarding the management of dogs, 38% (n = 23) lived outdoors followed by 12% (n = 10) semi-roamer and 10% (n = 8) kept indoors. However, nearly half of the cases were not recorded. The majority of cats were kept indoors (63%, n=40). There were only 3% of cats managed as semi-roamers and 34% (n=22) of cases were unidentified. No outdoor cat was recorded. For cats, they were frequently housed together. In this study, 46% (n=31) of cats were from a multi-cat household and 6%

(n=4) were kept as a single cat. However, nearly half of the cases, the management of cats were unidentified.

**Table 3: Signalment of dogs with otitis externa.**

| Dogs' Signalments | | Frequency (n) | Percentages (%) |
|---|---|---|---|
| Sex Distribution | Male | 59 | 74% |
| | Female | 20 | 25% |
| | Unidentified | 1 | 1% |
| Neuter Status | Intact | 62 | 78% |
| | Neutered | 18 | 22% |
| Type of Ear Pinnae | Erect | 42 | 52% |
| | Pendulous | 38 | 48% |
| Living Management | Outdoor | 23 | 29% |
| | Semi-roamer | 10 | 12% |
| | Indoor | 8 | 10% |
| | Unidentified | 39 | 49% |
| Classification of Otitis Externa at the First Presentation | Unilateral | 55 | 69% |
| | Bilateral | 25 | 31% |

**Table 4: Signalment of cats with otitis externa.**

| Cats' Signalments | | Frequency (n) | Percentages (%) |
|---|---|---|---|
| Age Distribution | Male | 45 | 69% |
| | Female | 18 | 28% |
| | Unidentified | 2 | 3% |
| Neuter Status | Intact | 62 | 78% |
| | Neutered | 18 | 22% |
| Type of Ear Pinnae | Erect | 42 | 52% |
| | Pendulous | 38 | 48% |
| Living Management | Indoor | 40 | 63% |
| | Semi-roamer | 2 | 3% |
| | Outdoor | 0 | 0% |
| | Unidentified | 22 | 34% |
| Type of Household | Multi-cat household | 30 | 46% |
| | Single cat | 4 | 6% |
| | Unidentified | 31 | 48% |
| Classification of Otitis Externa at the First Presentation | Unilateral | 44 | 68% |
| | Bilateral | 17 | 26% |
| | Unidentified | 4 | 6% |

### 4.2 Clinical presentation

Upon the first presentation, otitis externa cases can be classified as unilateral or bilateral (**Table 3 and 4**). In cats, there were more than two-thirds of the cases diagnosed with unilateral otitis externa which is 68% (n = 44/65).

The clinical presentation of otitis externa in dogs and cats is depicted in **Table 5**. Otorrhea was the most significantly observed in 41% (n = 72) and 43% (n = 56) of

dogs and cats, respectively. The next common sign presented by dogs with otitis externa were erythema (13%, n = 22) followed by mass or nodules (12%, n = 21), stenosis (7%, n = 13), foul smelling (7%, n = 13), pruritus (3%, n= 6), head tilt (3%, n = 5), head shaking (3%, n = 5), scabs (2%, n = 3), and lichenification (1%, n = 1). For cats, mass and nodules (18%, n = 23) were the second most presented clinical signs, followed by foul smelling (11%, n = 15), pruritus (15%, n = 10), stenosis (3%, n = 4), scabs (3%, n = 4), erythema (3%, n = 3), ear mites infestation (3%, n = 3), head shaking (2%, n = 2), and head tilt (1%, n = 1).

**Table 5: Clinical presentation of dogs and cats with otitis externa.**

| | **Dogs** | | **Cats** | |
|---|---|---|---|---|
| **Clinical presentation** | **Frequency (n)** | **Percentage (%)** | **Frequency (n)** | **Percentage (%)** |
| Otorrhea | 72 | 41% | 56 | 43.4% |
| Erythema | 22 | 13% | 3 | 2.3% |
| Mass/Nodules | 21 | 12% | 23 | 17.8% |
| Stenosis | 13 | 7% | 4 | 3.1% |
| Foul smelling | 13 | 7% | 15 | 11.6% |
| Pruritus | 6 | 3% | 10 | 7.8% |
| Head tilt | 5 | 3% | 1 | 0.8% |
| Head shaking | 5 | 3% | 2 | 1.6% |
| Scabs | 3 | 2% | 4 | 3.1% |
| Lichenification | 1 | 1% | 0 | 0% |
| Ear mites infestation | 0 | 0% | 3 | 2.3% |
| Unidentified | 13 | 7% | 8 | 6.2% |
| Total clinical presentation | 174 | 100% | 129 | 100% |
| Total patients | 80 | | 65 | |

Several types of otorrhea were observed during the clinical presentation, such as purulent, mucopurulent, ceruminous, hemopurulent and serosanguineous ear discharges in dogs and cats (see **Table 6**). Nearly half of the cases showed purulent otorrhea, which was 53% (n = 38/72) cases for dogs and 48% (n = 27/56) cases for cats. The next type of otorrhea observed in dogs was purulent followed by mucopurulent, ceruminous, hemopurulent, and serosanguineous discharges; otorrhea observed in cats were purulent followed by mucopurulent, ceruminous serosanguineous, and hemopurulent discharges.

**Table 6: Type of otorrhea during clinical presentation of dogs and cats with otitis externa.**

| Type of Otorrhea | Dogs Frequency (n) | Dogs Percentage (%) | Cats Frequency (n) | Cats Percentage (%) |
|---|---|---|---|---|
| Purulent | 38 | 53% | 27 | 48% |
| Mucopurulent | 12 | 17% | 10 | 18% |
| Ceruminous | 11 | 15% | 8 | 14% |
| Hemopurulent | 4 | 6% | 3 | 5% |
| Serosanguineous | 2 | 3% | 7 | 13% |
| Unidentified | 5 | 7% | 1 | 2% |

### 4.3 Bacteria isolated from dogs and cats with otitis externa

From the 80 cases of otitis externa in dogs, 23 different species of bacteria were found with a total of 177 bacteria isolated (see **Table 7**). Moreover, isolates from dogs were mostly Gram-negative bacteria 57% (n=100) compared to Gram-positive bacteria 43% (n = 77).

**Table 7: All isolated bacteria from dogs with otitis externa.**

| Bacteria Isolated from Dogs | Frequency (n) | Percentages (%) |
|---|---|---|
| **Gram-positive** | | |
| *Staphylococcus pseudintermedius* | 18 | 10.2% |
| *Staphylococcus intermedius* | 17 | 9.6% |
| *Streptococcus canis* | 11 | 6.2% |
| *Corynebacterium* sp. | 10 | 5.6% |
| *Enterococcus faecalis* | 6 | 3.4% |
| *Corynebacterium auriscanis* | 5 | 2.8% |
| *Staphylococcus schleiferi* ssp. *coagulans* | 4 | 2.3% |
| *Bacillus* sp. | 2 | 1.1% |
| *Enterococcus* group | 2 | 1.1% |
| *Streptococcus dysgalactiae* ssp. *equisimilis* | 1 | 0.6% |
| **Gram-negative** | | |
| *Pseudomonas aeruginosa* | 49 | 27.7% |
| *Proteus mirabilis* | 30 | 17.5% |
| *Escherichia coli* | 6 | 3.4% |
| *Chromobacterium* sp. | 5 | 2.8% |
| *Aeromonas* sp. | 2 | 1.1% |
| *Alcaligenes faecalis* | 1 | 0.6% |
| *Enterobacter aerogenes* | 1 | 0.6% |
| *Enterobacter cloacae* | 1 | 0.6% |
| *Klebsiella penumoniae* | 1 | 0.6% |
| *Moraxella canis* | 1 | 0.6% |
| *Pasteurella canis* | 1 | 0.6% |
| *Proteus vulgaris* | 1 | 0.6% |
| *Providencia* sp. | 1 | 0.6% |
| **Total** | **177** | **100.0%** |

The seven most common bacteria isolated from dogs with otitis externa were *Pseudomonas aeruginosa, Staphylococcus* spp. (*S. pseudintermedius* and *S. intermedius), Proteus mirabilis, Corynebacterium* spp., *Streptococcus canis* and *Escherichia coli* (**Figure 4**). The distribution of bacteria is presented in **Table 7**.

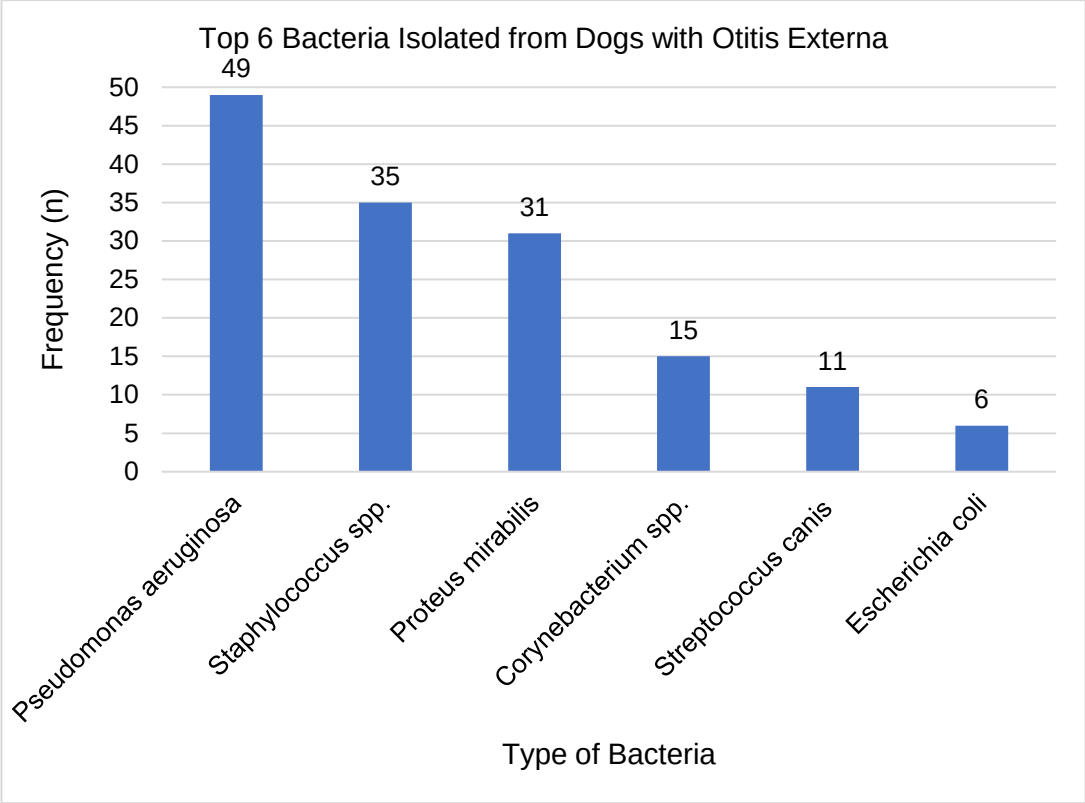


**Figure 4: Most frequent bacteria isolated from dogs with otitis externa.**

There were 21 different species of bacteria with a total of 132 bacteria isolated from 65 cat cases with otitis externa (see **Table 8**). Isolates from cats were mostly Gram-positive bacteria 58% (n = 76) compared to Gram-negative bacteria 42% (n = 56).

**Table 8: All isolated bacteria from cats with otitis externa.**

| Bacteria Isolated from Cats | Frequency (n) | Percentages (%) |
|---|---|---|
| **Gram-positive** | | |
| *Staphylococcus intermedius* | 19 | 14.4% |
| *Staphylococcus pseudintermedius* | 18 | 13.6% |
| *Streptococcus canis* | 17 | 12.9% |
| *Corynebacterium* sp. | 10 | 7.6% |
| *Enterococcus faecalis* | 4 | 3.0% |
| *Actinomyces* sp. | 3 | 2.3% |
| *Bacillus* sp. | 1 | 0.8% |
| *Corynebacterium auriscanis* | 1 | 0.8% |
| *Enterococcus* sp. | 1 | 0.8% |
| *Staphylococcus aureus* ssp. *aureus* | 1 | 0.8% |
| *Streptococcus* sp. | 1 | 0.8% |
| | | |
| **Gram-negative** | | |
| *Pseudomonas aeruginosa* | 25 | 18.9% |
| *Pasteurella multocida* | 10 | 7.6% |
| *Proteus mirabilis* | 8 | 6.1% |
| *Escherichia coli* | 6 | 4.5% |
| *Enterobacter aerogenes* | 2 | 1.5% |
| *Acinetobacter baumannii* | 1 | 0.8% |
| *Chromobacterium* sp. | 1 | 0.8% |
| *Klebsiella pneumoniae* | 1 | 0.8% |
| *Pasteurella dagmatis* | 1 | 0.8% |
| *Pasteurella pneumotropica* | 1 | 0.8% |
| **Total** | **132** | **100.0%** |

The eight most frequently isolated bacteria from cats with otitis externa were *Pseudomonas aeruginosa, Staphylococcus* spp. (*S. pseudintermedius* and *S. intermedius), Streptococcus canis, Pasteurella multocida, Corynebacterium* spp., *Proteus mirabilis* and *Escherichia coli* (**Figure 5**).

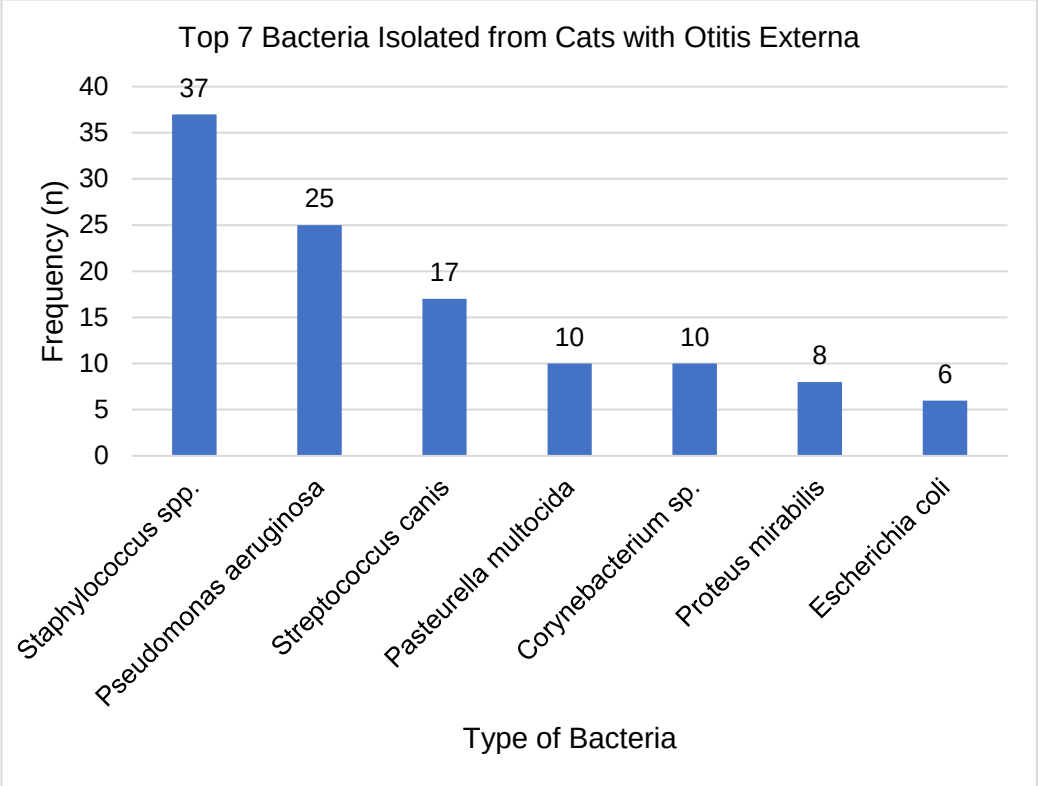


**Figure 5: Most frequent bacteria isolated from cats with otitis externa.**

### 4.4 Antimicrobial sensitivity test profiles

#### 4.4.1 Antimicrobial sensitivity test profiles of dogs with otitis externa

**Table 9** shows the result of antimicrobial sensitivity tests of the most frequently isolated strains from dogs with otitis externa. *P. aeruginosa* presented with multidrug-resistant profiles, with mostly 100% resistant to most of the antibiotics tested. This isolate was 100% resistant to many classes of antibiotics such as penicillins (amoxycillin, amoxycillin with clavulanic acid, ampicillin, penicillin G, and oxacillin), cephalosporins (cefovecin, ceftriaxone, cephalexin and cefixime), sulfonamide (sulfamethoxazole and trimethoprim), fusidic acid, amphenicol (florfenicol), chloramphenicol and nitroimidazole (metronidazole).

The *Staphylococcus* spp. mentioned below was represented by *S. intermedius and S. pseudintermedius*. Fluroquinolones (ciprofloxacin, marbofloxacin, enrofloxacin, and norfloxacin) had more than 50% susceptibility rate for *Staphylococcus* spp.

Next, another highly isolated bacteria was *P. mirabilis*. It was 100% resistant to tetracyclines (doxycycline and tetracycline). Fluoroquinolones (marbofloxacin, enrofloxacin and norfloxacin) were still highly susceptible with 100% to 62% and aminoglycosides (gentamycin and neomycin) nearly 75% susceptibility rate for P. mirabilis.

Furthermore, *E. coli* was 100% resistant to gentamycin, cefovecin and clindamycin in dogs with otitis externa. It was still susceptible to most of the antibiotics tested for E. coli such as penicillins (amoxycilin and amoxycilin with clavulanic acid) cephalosporins (ceftriaxone and cefixime), fluoroquinolones (enrofloxacin and norfloxacin), aminoglycosides (neomycin and streptomycin), macrolide (azithromycin), glycopeptides (polymyxin B), amphenicol (florfenicol) and chloramphenicol (chloramphenicol).

The other most common isolates were *S. canis*, which is highly resistant to marbofloxacin (100%), polymyxin B (83%), neomycin (75%) and gentamycin (75%) in dogs with otitis externa. It is highly susceptible for *S. canis* ranging from 0% to 30% for penicillins (amoxicillin and amoxicillin with clavulanic acid), cephalosporins (cefovecin, ceftriaxone, cephalexin and cefixime), fluoroquinolones (enrofloxacin and norfloxacin), tetracycline (doxycycline), macrolides (azithromycin), lincosamide (clindamycin), amphenicols (florfenicol) and chloramphenicol.

Lastly, *Corynebacterium* spp. had a high resistant rate of more than 50% resistant to many of the antibiotics listed here, like penicillin (amoxicillin and ampicillin), cephalosporin (cefovecin and cefixime), fluoroquinolones (marbofloxacin, enrofloxacin and norfloxacin), sulphonamide (sulfamethoxazole and trimethoprim), fusidic acid, lincosamides (clindamycin) and nitromidazole (metronidazole).

**Table 9: Antimicrobial susceptibility of the most frequently isolated bacteria from dogs with otitis externa.**

| | **Percentage of Resistance (%) of the Top 6 Isolated Bacteria in Dogs** | | | | | |
|---|---|---|---|---|---|---|
| **Antibiotic** | *P. aeruginosa* (n=49) | *Staphylococ* -*cus* spp. (n=35) | *P. mirabilis* (n=31) | *Corynebacte* -*rium* spp. (n=15) | *S. canis* (n=11) | *E. coli* (n=6) |
| Amoxicillin | 100% | 60% | 60% | 50% | 0% | 0% |
| Amox/Clav | 100% | 21% | 46% | 13% | 0% | 17% |
| Ampicillin | 100% | 29% | NA | 100% | NA | NA |
| Penicillin G | 100% | 0% | NA | NA | NA | NA |
| Oxacillin | 100% | 0% | NA | NA | NA | NA |
| Cefovecin | 100% | 0% | 50% | 50% | 0% | 100% |
| Ceftriaxone | 100% | 67% | 80% | 33% | 0% | 0% |
| Cephalexin | 100% | 15% | 69% | 15% | 25% | 67% |
| Cefixime | 100% | 71% | 29% | 100% | 25% | 0% |
| Ciprofloxacin | 60% | 20% | NA | NA | NA | NA |
| Marbofloxacin | 80% | 33% | 0% | 50% | 100% | NA |
| Enrofloxacin | 66% | 43% | 38% | 57% | 30% | 33% |
| Norfloxacin | 29% | 25% | 0% | 100% | 0% | 0% |

| | | | | | | |
|---|---|---|---|---|---|---|
| Gentamycin | 13% | 11% | 27% | 11% | 75% | 100% |
| Kanamycin | 100% | 100% | NA | NA | NA | NA |
| Neomycin | 64% | 23% | 25% | 0% | 75% | 33% |
| Streptomycin | 50% | 100% | NA | NA | NA | 0% |
| Doxycycline | 86% | 14% | 100% | 0% | 0% | 50% |
| Tetracycline | 75% | 33% | 100% | 100% | 100% | NA |
| Erythromycin | 100% | 0% | NA | NA | NA | NA |
| Azithromycin | 71% | 0% | 100% | 0% | 0% | 0% |
| Polymyxin B | 17% | 30% | 95% | 20% | 83% | 17% |
| Vancomycin | 100% | 0% | NA | NA | NA | NA |
| Sulfazole/Trime | 100% | 14% | NA | 100% | NA | NA |
| Clindamycin | 100% | 0% | 100% | 67% | 20% | 100% |
| Imipenem | 0% | 0% | NA | NA | NA | NA |
| Fusidic Acid | 100% | 0% | NA | NA | NA | NA |
| Florfenicol | 100% | 0% | 50% | 0% | 0% | 0% |
| Chloramphenicol | 100% | 25% | 60% | 25% | 0% | 0% |
| Metronidazole | 100% | 100% | NA | 100% | NA | NA |

Notes: NA=Not assayed; Amox/Clav=amoxicillin/clavulanic acid; Sulfazole/Trime= sulfamethoxazole/trimethoprim

### 4.4.2 Antimicrobial sensitivity test profiles of cats with otitis externa

**Table 10** shows the result of antimicrobial sensitivity tests of the most frequently isolated strains from cats with otitis externa. The most isolated bacteria in cats with otitis externa was *Staphylococcus* spp. which was represented by *S. intermedius* and *S. pseudintermedius*. They were still susceptible to penicillin (amoxicillin with clavulanic acid and oxacillin), cephalosporins (cefovecin and cephalexin), fluoroquinolones (enrofloxacin and norfloxacin), aminoglycosides (gentamycin and neomycin), tetracyclines (doxycycline and tetracycline), glycopeptides (polymyxin B) and so on.

*P. aeruginosa* otic isolates were found to be 100% resistant to penicillin (amoxicillin, amoxicillin with clavulanic acid and ampicillin), cephalosporin (ceftriaxone and cefixime), tetracycline (tetracycline), macrolides (erythromycin), sulphonamide (sulfamethoxazole and trimethoprim), lincosamide (clindamycin), amphenicols (florfenicol) and nitromidazole (metronidazole).

Next, *S. canis* was still highly susceptible to penicillin (amoxicillin with clavulanic acid), cephalosporin (ceftriaxone, cephalexin and cefixime), fluoroquinolones (enrofloxacin and norfloxacin), aminoglycosides (gentamycin and neomycin) and tetracycline (doxycycline and tetracycline).

*P. multocida* was only isolated from cats' ear swab samples which were still 100% susceptible towards penicillin (amoxicillin with clavulanic acid), fluoroquinolones (enrofloxacin and norfloxacin), macrolides (erythromycin and azithromycin), lincosamide (clindamycin) and chloramphenicol (chloramphenicol).

Furthermore, *Corynebacterium* spp. had a high susceptibility rate of 100% to many of the antibiotics listed here. For example, aminoglycosides (gentamycin), tetracycline (doxycycline and tetracycline), sulphonamide (sulfamethoxazole and trimethoprim), amphenicol (florfenicol) and chloramphenicol (chloramphenicol). However, it was 100% resistant to cephalosporin (cefovecin, ceftriaxone and cefixime), macrolides (azithromycin), lincosamide (clindamycin) and nitromidazole (metronidazole).

**Table 10: Antimicrobial susceptibility of the most frequently isolated bacteria from cats with otitis externa.**

| Antibiotic | Percentage of Resistance (%) of the Top 7 Isolated Bacteria from Cats | | | | | | |
|---|---|---|---|---|---|---|---|
| | *Staphylococcus* spp. (n=37) | *P. aeruginosa* (n=25) | *S. canis* (n=17) | *P. multocida* (n=10) | *Corynebacterium* sp. (n=10) | *P. mirabilis* (n=8) | *E. coli* (n=6) |
| Amoxicillin | NA | 100% | NA | NA | NA | NA | NA |
| Amox/Clav | 19% | 100% | 6% | 0% | 45% | 33% | 17% |
| Ampicillin | 60% | 100% | NA | NA | NA | NA | NA |
| Penicillin G | 60% | NA | NA | NA | NA | NA | NA |
| Oxacillin | 20% | NA | NA | NA | NA | NA | NA |
| Cefovecin | 20% | NA | NA | NA | 100% | NA | NA |
| Ceftriaxone | 100% | 100% | 0% | 100% | 100% | 50% | 0% |
| Cephalexin | 15% | 100% | 7% | 13% | 40% | 75% | 60% |
| Cefixime | 75% | 100% | 0% | 0% | 100% | 33% | 0% |
| Ciprofloxacin | 60% | NA | NA | NA | NA | NA | NA |
| Marbofloxacin | 60% | NA | NA | NA | NA | NA | NA |
| Enrofloxacin | 25% | 50% | 31% | 0% | 63% | 40% | 20% |
| Norfloxacin | 0% | 0% | 0% | 0% | 50% | NA | 0% |
| Gentamycin | 23% | 33% | 60% | 0% | 0% | 0% | 0% |
| Kanamycin | NA | 0% | 100% | NA | NA | NA | NA |
| Neomycin | 24% | 69% | 100% | 0% | 29% | 0% | 50% |
| Streptomycin | NA | NA | NA | NA | NA | NA | NA |
| Doxycycline | 20% | 91% | 0% | 0% | 0% | 100% | NA |
| Tetracycline | 36% | 100% | NA | 0% | 0% | NA | NA |
| Erythromycin | 50% | 100% | 0% | 0% | NA | NA | NA |
| Azithromycin | 60% | 17% | 0% | NA | 100% | 100% | NA |
| Polymyxin B | 26% | 7% | 77% | 17% | 17% | 67% | 0% |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Vancomycin | 0% | NA | NA | NA | NA | NA | NA |
| Sulfazole/Trime | 50% | 100% | NA | 0% | 0% | NA | NA |
| Clindamycin | 25% | 100% | 0% | NA | 100% | NA | 100% |
| Imipenem | 0% | NA | NA | NA | NA | NA | NA |
| Fusidic Acid | 25% | NA | NA | NA | NA | NA | NA |
| Florfenicol | 0% | 100% | NA | NA | 0% | NA | NA |
| Chloramphenicol | 50% | 67% | 0% | NA | 0% | 0% | 0% |
| Metronidazole | 100% | 100% | 100% | 100% | 100% | 0% | 100% |

Notes: NA=Not assayed; Amox/Clav=amoxicillin/clavulanic acid; Sulfazole/Trime= sulfamethoxazole/trimethoprim

### 4.5 Multidrug–resistance (MDR) Status

Among all of the most isolated bacteria, *P. aeruginosa* had an extremely high MDR status with 98% and 100% in dogs and cats respectively. Next, the MDR profile of *P. mirabilis* was 83% MDR in dogs while 29% MDR in cats isolates*. S. canis* had 70% and 56% of MDR in bacteria isolates in dogs and cats, respectively. Moreover, *E. coli* had 67% of MDR profile in both dogs and cats (See **Table 11**).

**Table 11: Multidrug-resistance status of the most frequently isolated bacteria from dogs and cats with otitis externa.**

| | Dogs | | Cats | |
|---|---|---|---|---|
| **Bacteria Isolated** | **Not MDR** | **MDR** | **Not MDR** | **MDR** |
| *P. aeruginosa* | 2% | 98% | 0% | 100% |
| *Staphylococcus* spp. | 62% | 38% | 50% | 50% |
| *P. mirabilis* | 17% | 83% | 71% | 29% |
| *S. canis* | 30% | 70% | 44% | 56% |
| *E. coli* | 33% | 67% | 33% | 67% |
| *Corynebacterium* sp. | 87% | 13% | 55% | 45% |
| *P. multocida* | NA | NA | 90% | 10% |

*P. aeruginosa*, *P. mirabilis*, *S. canis* shown 16% to 39% of increase in MDR status (See **Table 12**).

**Table 12: Comparison of MDR status of previous study and current study in dogs with otitis externa.**

| **Bacteria Isolated** | **MDR Status of Previous Study (Nursyazana *et al.*, 2020)** | **MDR Status of Current Study** |
|---|---|---|
| *P. aeruginosa* | 82% | 98% |
| *Staphylococcus* spp. | 43% | 38% |
| *P. mirabilis* | 44% | 83% |
| *S. canis* | 50% | 70% |
| *E. coli* | - | 67% |
| *Corynebacterium* spp. | 38% | 13% |

According to the Chi-square test result, this supported that *P. aeruginosa* otitis isolates was significantly found to be multidrug resistant in comparison to other bacteria in both cats and dogs (See **Table 13 and 14**).

**Table 13: Chi-square test of dogs with otitis externa.**

| Bacteria Isolated | MDR Status | | P value (95% CI) |
|---|---|---|---|
| | Not MDR | MDR | |
| *P. aeruginosa* | 1 | 46 | Fisher's Exact Test = <0.001 |
| *Staphylococcus* spp. | 21 | 13 | |
| *P. aeruginosa* | 1 | 46 | Fisher's Exact Test = 0.015 |
| *S. canis* | 3 | 7 | |
| *P. aeruginosa* | 1 | 46 | Fisher's Exact Test = 0.031 |
| *E. coli* | 2 | 4 | |
| *P. aeruginosa* | 1 | 46 | Fisher's Exact Test = 0.031 |
| *P. mirabilis* | 5 | 25 | |
| *P. aeruginosa* | 1 | 46 | Fisher's Exact Test = <0.001 |
| *Corynebacterium* spp. | 13 | 2 | |

**Table 14: Chi-square test of cats with otitis externa.**

| Bacteria Isolated | MDR Status | | P value (95% CI) |
|---|---|---|---|
| | Not MDR | MDR | |
| *P. aeruginosa* | 0 | 25 | Fisher's Exact Test = <0.001 |
| *Staphylococcus* spp. | 18 | 18 | |
| *P. aeruginosa* | 0 | 25 | Fisher's Exact Test = <0.001 |
| *S. canis* | 7 | 9 | |
| *P. aeruginosa* | 0 | 25 | Fisher's Exact Test = 0.032 |
| *E. coli* | 2 | 4 | |
| *P. aeruginosa* | 0 | 25 | Fisher's Exact Test = <0.001 |
| *P. mirabilis* | 5 | 2 | |
| *P. aeruginosa* | 0 | 25 | Fisher's Exact Test = <0.001 |
| *Corynebacterium* spp. | 6 | 4 | |
| *P. aeruginosa* | 0 | 25 | Fisher's Exact Test = 0.286 |
| *P. multocida* | 1 | 9 | |

### 4.6 Empirical Treatment

The empirical antibiotic treatment was categorised into two types which were systemic antibiotic and topical ear preparation (**Table 15** and **Table 16**). Based on this study, more than half of the empirical treatment used was systemic antibiotics (52%) in dogs while in cats topical ear preparation (57%) was used.

**Table 15: Categories of empirical treatment use in dogs and cats with otitis externa.**

| | Dogs | Cats |
|---|---|---|
| **Empirical Treatment** | **Percentages (%)** | |
| Systemic Antibiotic | 52% | 43% |
| Topical Ear Preparation | 48% | 57% |

The most frequently used systemic antibiotics in dogs were amoxicillin with clavulanic acid (46%) followed by enrofloxacin (25%), cephalexin (15%) and doxycycline (6%). While amoxicillin with clavulanic acid (58%), marbofloxacin (19%), and cephalexin (7%) were systemic antibiotics used in cats.

Generally, the common topical ear preparation active ingredient used was polymyxin B (58%), marbofloxacin (33%) and neomycin (7%) in dogs; active ingredient used in cats were polymyxin B (48%), neomycin (26%) and marbofloxacin (26%).

**Table 16: Type of empirical systemic antibiotic and topical ear preparation used in dogs and cats with otitis externa.**

| Empirical Treatment | Dogs Percentages (%) | Cats |
|---|---|---|
| **Systemic Antibiotics** | | |
| Amoxycillin/Clavulanic Acid | 46% | 58% |
| Enrofloxacin | 25% | 4% |
| Cephalexin | 15% | 7% |
| Doxycycline | 6% | 4% |
| Metronidazole | 2% | - |
| Marbofloxacin | 2% | 19% |
| Cefixime | 2% | 4% |
| Amoxycillin | 2% | - |
| Azithromycin | - | 4% |
| **Topical Ear Preparation** | | |
| Polymyxin B | 58% | 48% |
| Marbofloxacin | 33% | 26% |
| Neomycin | 7% | 26% |
| Florfenicol | 2% | - |

## 5.0 DISCUSSION

### 5.1 Signalment

Present study found that dogs with otitis externa were 10 to 11 years old while otitis externa were more commonly found in cats less than one year old to two years old. Besides, this study suggested that predominantly intact male dogs and cats were presented with otitis externa. On the other hand, Topala (2007) and Kasai *et al.* (2020) found that there was no age and sex predisposition towards otitis externa.

Next, breeds that were commonly associated with otitis externa were German Shepherd dogs, local dogs and Poodles. This is consistent with Topala (2007) and Zur *et al.* (2011) which suggest that German Shepherd dogs were more predisposed to otitis externa among the erected ear dogs due to its conformation abnormalities. In our findings, cat breeds that were commonly associated with otitis externa were Domestic Shorthair, Maine coon and Persian or Persian cross. Our results had similar findings to Baba and Fukata (1981), where Persian cats had a breed predisposition to otitis externa. However, Kennis (2013) suggested that there was no breed predisposition to developing otitis in cats. Furthermore, it was found that dogs with erected ear pinnae are associated with otitis externa, whereas Huang and Huang (1999) and Lehner *et al.* (2010) found that dogs with pendulous ear pinnae were over-presented.

In our study, the majority of dogs and cats were presented with unilateral otitis externa at the first presentation compared to bilateral otitis externa. Chronic bilateral otitis externa was commonly associated with primary causes such as hypersensitivity and allergic disease while unilateral otitis externa was often a result of underlying neoplasia or polyps (Rosser, 2004; Coyner, 2020). Additional retrospective data

collection and association analysis can be done in future studies to investigate the association of the type of otitis externa and its aetiologies.

### 5.2 Clinical Presentation

The common signs of otitis externa in dogs and cats during clinical presentation were otorrhea, erythema, mass or nodules, and foul smelling. (Nursyazana *et al.*,2020; Rosser, 2004). Various types of otorrhea might be observed during clinical presentation and the most frequently found otorrhea were purulent, followed by mucopurulent and ceruminous otorrhea. Purulent otorrhea is the ear discharge that contains pus or fluid; mucopurulent otorrhea contains both mucus and pus; ceruminous otorrhea is the waxy ear discharge in brownish or yellowish colour. Generally, in dogs, purulent otitis was secondary to the complication of primary causes that involve particularly rod-shaped bacterial infections by *P. aeruginosa*; while ceruminous otitis was mainly due to *Malassezia* yeast and cocci bacteria, especially *S. pseudintermedius* (Jasmin, 2011).

### 5.3 Bacteria Isolated from Dogs and Cats with Otitis Externa

In the present study, we found out that *Staphylococcus* spp., *P. aeruginosa, P. mirabilis, S. canis*, *Corynebacterium* spp., and *E coli* were the common isolates in both dogs and cats. Our findings are consistent with previous studies (Kowalski, 1988; Hiblu *et al*., 2020; Kasai *et al*., 2020). However, there is an additional bacteria found only in cats with otitis externa which was *P. multocida*. Based on August (1988), it is one of the pathogenic bacteria that causes feline otitis externa. Among all the isolated bacteria, *P. aeruginosa* and *Proteus* sp. are frequently isolated from infected ear

swabs from dogs and cats (Kowalski, 1988). Though *Staphylococcus* spp. is a normal flora, but possibly pathogenic bacteria for both dogs and cats with otitis externa. (Merchant, 2005; Malayeri *et al.,* 2010).

### 5.4 Antimicrobial Sensitivity Test Profiles of Dogs and Cats with Otitis Externa

The presence of multidrug-resistant *P. aeruginosa* is of significant concern as it poses challenges for treatment. Based on previous studies, fluoroquinolones, gentamycin and polymyxin B were effective against *P. aeruginosa* (Hariharan, 2006; Secker *et al*., 2023). In contrast to our findings, *P. aeruginosa* were highly resistant to fluoroquinolones such as marbofloxacin (80%), enrofloxacin (66%) and ciprofloxacin (60%); while gentamycin (13%) and polymyxin B (17%) have a lower resistance rate for *P. aeruginosa* isolated from dogs with otitis externa.

Besides, for *Staphylococcus* spp. the susceptibility rate to gentamycin was 89% for dog isolates which was similar to the findings of a previous study (Lilenbaum *et al*., 2000). It was found that most of the tested antibiotics were proven to be susceptible to *Staphylococcus* spp., which shared similarities with Hassan *et al*. (2023) findings. This study found that *Staphylococcus* spp. had a low to moderate resistance rate (lesser than 25%) to antibiotics tested such as marbofloxacin, gentamicin, tetracycline, doxycycline and amoxicillin with clavulanic acid.

*S. canis* is found to be resistant to neomycin (100%) and gentamycin (62%) which is in complete agreement with our study. Bourély *et al*. (2018) claim that the level of resistance to fluoroquinolones was high for *Streptococcus* spp.. The current study does not support the earlier findings as *S. canis* was moderately resistant to enrofloxacin (30%).

Next, our results share similarities with the findings by Henneveld *et al.* (2012) in which the antibiotics that were susceptible for *Corynebacterium* spp. were tetracycline (93%) and gentamicin (85%). Furthermore, *P. mirabilis* was highly resistant to polymyxin B (89%), but 0% resistant to marbofloxacin (Nursyazana *et al*., 2020). This was in good agreement with an earlier study (Nuryazana *et al.,* 2020). Based on Kowalski (1988), *Proteus* was inherently resistant to polymyxin B which was consistent with the present study. In our study, *P. mirabilis* had a resistance rate ranging from 67% to 95% in both dog and cat isolates.

Based on the study by Hariharan *et al.* (2006), most of the bacteria isolates of both dogs and cats were highly susceptible to gentamycin and enrofloxacin. This was consistent with our study, except for *S. canis* which was highly resistant in both dogs and cats and *E. coli* was 100% resistant to gentamycin in dog isolates.

**5.5 Multidrug-Resistance (MDR) Status**

Multidrug-resistant is common in cases of chronic recurrent otitis externa. Among the most isolated bacteria in dogs with otitis externa, *P. aeruginosa, P. mirabilis, S. canis* and *E. coli* had more than 50% of MDR status in the present study. As proposed by Nursyazana *et al*. (2020), *P. aeruginosa* had an MDR rate of 83% in the year 2020 which had increased to 98% resistance to most of the antibiotics tested in our study. Besides, it also proved that the MDR status in dogs with otitis externa has a significant increase as compared to previous findings and posed more challenges in selecting appropriate treatment.

### 5.6 Empirical Treatment

Empirical treatment based on cytology findings was recommended to be performed in acute cases of otitis externa. On the other hand, in chronic recurrent otitis externa, bacterial culture and antimicrobial sensitivity testing were suggested to determine the choice of definitive treatment (Jacobson, 2002). In the present study, polymyxin B and marbofloxacin were commonly used as topical ear preparation while amoxicillin with clavulanic acid was a common systemic antibiotic used as empirical treatment.

From the present study in canine otitis externa, marbofloxacin was found to be an effective antibiotic for *Staphylococcus* spp. and *P. mirabilis*; polymyxin B is moderately effective for *P. aeruginosa, Staphylococcus* spp., *Corynebacterium* spp. and *E. coli*; amoxicillin with clavulanic acid was found to be highly to moderately effective for *Staphylococcus* spp., *Corynebacterium* spp., *S. canis* and *E. coli*.

While for cats with otitis externa in our study, though marbofloxacin was not assayed in 6 out of 7 most isolated bacteria, we found that it was moderately resistant for *Staphylococcus* spp. Furthermore, polymyxin B was moderately to highly effective antibiotic for *Staphylococcus* spp., *P. aeruginosa, P. multocida, Corynebacterium* spp. and *E. coli*; amoxicillin with clavulanic acid is partially effective for *Staphylococcus* spp., *S. canis, P. multocida, P. mirabilis* and *E. coli*.

## 6.0 CONCLUSION

The six most commonly isolated bacteria from dogs with otitis externa were *P. aeruginosa*, *Staphylococcus* spp., *P. mirabilis, Corynebacterium* spp., *S. canis* and *E. coli*. While the top seven bacteria commonly isolated from cats with otitis externa were *Staphylococcus* spp., *P. aeruginosa*, *S. canis*, *P. multocida, Corynebacterium* spp., *P. mirabilis* and *E. coli*. Furthermore, *P. aeruginosa, P. mirabilis* and *S. canis* had a significant increase in the frequency of multidrug-resistant (MDR) in dogs**.**

In dogs with otitis externa, Gram-negative bacteria especially *P. aeruginosa* was moderately susceptible to polymyxin B but highly resistant to many of the other antibiotics. Gram-positive bacteria, *Staphylococcus* spp. showed high to moderate susceptibility to marbofloxacin, polymyxin B as well as amoxicillin with clavulanic acid. While for cats with otitis externa, Gram-negative bacteria, *P. aeruginosa* was effective towards polymyxin B. Gram-positive bacteria especially *Staphylococcus* spp. was moderately resistant to marbofloxacin, but it had high to moderate effectiveness to polymyxin B and amoxicillin with clavulanic acid.

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# APPENDICES

## APPENDIX A: LIST OF DOGS CASES IDENTIFIED

| No. | Year | Date | Laboratory Ref Number | Case Number (UVH) / Clinic name | Name |
|---|---|---|---|---|---|
| 1 | 2017 | 5/7/2017 | M2017/505 | 057819 | Brownie |
| 2 | 2017 | 26/10/2017 | M2017/767 | 079304 | Malik |
| 3 | 2017 | 4/12/2017 | M2017/858 | 080132 | Wolfie |
| 4 | 2018 | 6/2/2018 | M2018/093 | 080132 | Wolfie |
| 5 | 2018 | 17/4/2018 | M2018/271 | 057226 | Atom |
| 6 | 2018 | 4/6/2018 | M2018/392 | 083928 | Devil |
| 7 | 2018 | 21/9/2018 | M2018/617 | 084755 | Brucie |
| 8 | 2019 | 23/4/2019 | M2019/276 | 074991 | Tiger |
| 9 | 2019 | 2/5/2019 | M2019/301 | 039889 | Lucky |
| 10 | 2020 | 19/2/2020 | M2020/184 | 039889 | Lucky |
| 11 | 2019 | 25/6/2019 | M2019/385 | 058318 | Jeike |
| 12 | 2021 | 20/4/2021 | M2021/281 | 058318 | Jeike |
| 13 | 2019 | 31/7/2019 | M2019/476 | 090676 | Aishu |
| 14 | 2019 | 9/10/2019 | M2019/654 | 072637 | Pug |
| 15 | 2019 | 17/10/2019 | M2019/673 | 090059 | One Eye |
| 16 | 2020 | 29/1/2020 | M2020/109 | 090059 | One Eye |
| 17 | 2019 | 28/10/2019 | M2019/711 | 092202 | Buster |
| 18 | 2020 | 29/1/2020 | M2020/110 | 058404 | Suria |
| 19 | 2020 | 6/4/2020 | M2020/312 | 058404 | Suria |
| 20 | 2020 | 15/7/2020 | M2020/423 | 055910 | Tony |
| 21 | 2020 | 28/7/2020 | M2020/458 | 094564 | Venus |
| 22 | 2020 | 1/9/2020 | M2020/567 | 094780 | Xiao Hei |
| 23 | 2020 | 3/9/2020 | M2020/569 | 094701 | Zoran |
| 24 | 2021 | 6/12/2021 | M2021/1244 | 094701 | Zoran |
| 25 | 2020 | 24/9/2020 | M2020/732 | 094716 | Hero |
| 26 | 2020 | 30/9/2020 | M2020/766 | 082279 | Casper |
| 27 | 2020 | 23/10/2020 | M2020/883 | 094941 | Charlie |
| 28 | 2020 | 4/11/2020 | M2020/919 | 082926 | Grimble |
| 29 | 2021 | 7/10/2021 | M2021/715 | 082926 | Grimble |
| 30 | 2021 | 5/1/2021 | M2021/005 | 096476 | Mocha |
| 31 | 2021 | 3/3/2021 | M2021/113 | 096609 | Tommy |
| 32 | 2021 | 9/3/2021 | M2021/120 | 096522 | Rocky |
| 33 | 2021 | 1/7/2021 | M2021/470 | 092542 | Mark |
| 34 | 2023 | 28/2/2023 | M2023/166 | 092542 | Mark |
| 35 | 2021 | 14/7/2021 | M2021/486 | 061812 | Tory |
| 36 | 2021 | 22/7/2021 | M2021/501 | 092476 | Kansas |
| 37 | 2021 | 29/7/2021 | M2021/510 | 096909 | Kiki |
| 38 | 2021 | 27/10/2021 | M2021/750 | 096944 | Lucky |
| 39 | 2021 | 27/10/2021 | M2021/751 | 097163 | Trixie |
| 40 | 2023 | 11/5/2023 | M2023/360 | 097163 | Trixie |
| 41 | 2021 | 15/11/2021 | M2021/776 | 097129 | Baby |
| 42 | 2021 | 17/11/2021 | M2021//860 | 097047 | Didi |
| 43 | 2021 | 23/12/2021 | M2021/1281 | 098760 | Baby |
| 44 | 2022 | 21/1/2022 | M2022/034 | 082794 | Artemis |
| 45 | 2022 | 26/1/2022 | M2022/049 | 082879 | Casper |
| 46 | 2022 | 20/4/2022 | M2022/262 | 082879 | Casper |
| 47 | 2022 | 27/1/2022 | M2022/053 | 098853 | Sheba |
| 48 | 2022 | 12/4/2022 | M2022/252 | 098994 | Lao Wu |
| 49 | 2022 | 20/4//2022 | M2022/263 | 099049 | Lucky |
| 50 | 2022 | 25/5/2022 | M2022/368 | 099110 | Bobo |
| 51 | 2022 | 26/5/2022 | M2022/370 | 056961 | Nash |
| 52 | 2023 | 27/2/2023 | M2023/159 | 056961 | Nash |
| 53 | 2023 | 24/5/2020 | M2023/400 | 056961 | Nash |
| 54 | 2023 | 31/5/2023 | M2023/417 | 056961 | Nash |
| 55 | 2022 | 21/7/2022 | M2022/445 | 099258 | Zestina |
| 56 | 2022 | 9/8/2022 | M2022/475 | 099280 | Baby |
| 57 | 2022 | 11/8/2022 | M2022/480 | 099508 | Bum Bum |
| 58 | 2022 | 18/8/2022 | M2022/488 | 074177 | Popeye |
| 59 | 2022 | 22/9/2022 | M2022/561 | 099412 | Captain |
| 60 | 2022 | 5/10/2022 | M2022/603 | 099119 | Happy |
| 61 | 2022 | 13/10/2022 | M2022/629 | 067897 | Coco |
| 62 | 2022 | 14/10/2022 | M2022/630 | 099467 | Alex |
| 63 | 2022 | 9/11/2022 | M2022/775 | 085967 | Achus |
| 64 | 2023 | 12/7/2023 | M2023/624 | 085967 | Achus |
| 65 | 2022 | 23-Nov | M2022/800 | 099432 | Ceazer |
| 66 | 2023 | 4/1/2023 | M2023/004 | 099432 | Ceazer |
| 67 | 2022 | 5/12/2022 | M2022/821 | 099469 | Lemon |
| 68 | 2022 | 6/12/2022 | M2022/823 | 043412 | Cherry |
| 69 | 2022 | 6/12/2022 | M2022/824 | 100737 | Gimi |
| 70 | 2023 | 3/2/2023 | M2023/091 | 431307 | Kingsley |
| 71 | 2023 | 7/2/2023 | M2023/098 | 100883 | Jojo |
| 72 | 2023 | 24/2/2023 | M2023/156 | Cyberlynx Animal | Peanut |
| 73 | 2023 | 6/3/2023 | M2023/200 | 100941 | Rover |
| 74 | 2023 | 30/3/2023 | M2023/265 | 044139 | May Mei |
| 75 | 2023 | 10/4/2023 | M2023/294 | 098841 | Kobe |
| 76 | 2023 | 18/5/2023 | M2023/377 | 101130 | Girl-gild |
| 77 | 2023 | 12/7/2023 | M2023/623 | 101130 | Girl-gild |
| 78 | 2023 | 9/6/2023 | M2023/430 | 101191 | Lilo |
| 79 | 2023 | 28/6/2023 | M2023/553 | 101104 | Dedione |
| 80 | 2023 | 3/7/2023 | M2023/581 | 101247 | Echo |

## APPENDIX B: SIGNALMENT OF DOGS WITH OTITIS EXTERNA

| No. | Dog ID | Breed | Age | Sex | Neuter Status | Management |
|---|---|---|---|---|---|---|
| 1 | Brownie | Local | 5yrs | SF | Spayed | 4 dogs, 4cats, in compound, rice once a wihle + biscuit |
| 2 | Malik | Local | Adult | M | N/A | stray dog |
| 3 | Wolfie | West Terrier | 7 yrs | CM | Castrated | indoor with another dog |
| 4 | Wolfie | West Terrier | 7 yrs | CM | Castrated | indoor with another dog |
| 5 | Atom | Local | 5yrs | M | N/A | N/A |
| 6 | Devil | Siberian Husky | 9 yrs | M | N/A | 2 dogs, semiroamer, RC kibbles kidney diet |
| 7 | Brucie | Schnauzer | 5yrs | M | N/A | canned dry food + chicken |
| 8 | Tiger | German Shepherd | 8 yrs | M | N/A | N/A |
| 9 | Lucky | Beagle | 13 yrs | M | N/A | hyopoallergenic diet, house compound with another dog |
| 10 | Lucky | Beagle | 14 yrs | M | N/A | hyopoallergenic diet, house compound with another dog |
| 11 | Jeike | German Shepherd | 9 mth | M | N/A | N/A |
| 12 | Jeike | GSD | 10yrs | M | N/A | N/A |
| 13 | Aishu | Sharpei X | 4 yrs | F | N/A | turkey diet, 2 more, compound |
| 14 | Pug | Pug | 14 yrs | M | N/A | N/A |
| 15 | One Eye | Local | 10 yrs | SF | Spayed | N/A |
| 16 | One Eye | Local | 11 yrs | F | N/A | N/A |
| 17 | Buster | Labrador | 7 yrs | M | N/A | N/A |
| 18 | Suria | Local | 5 yrs | M | N/A | indoor and outdoor, with another geriatric dog, pedigree wet & dry food+chicken soup |
| 19 | Suria | Local | 5yrs | M | N/A | indoor and outdoor, with another geriatric dog, pedigree wet & dry food+chicken soup |
| 20 | Tony | German Shephard | 6yrs | M | N/A | indoor fed with kibbles |
| 21 | Venus | Golden Retriever | 5 yrs | SF | Spayed | indoor, only release outdoor for walk, fed with pork liver, carrot and spinach |
| 22 | Xiao Hei | Pitbull | 9yrs | M | N/A | home cooked meal |
| 23 | Zoran | GSD | 12yrs | M | N/A | PDRM |
| 24 | Zoran | GSD | 13yrs | M | N/A | PDRM |
| 25 | Hero | Husky | 7yrs | M | N/A | outdoor & indoor |
| 26 | Casper | W.H. Terrier | 9yrs | CM | Castrated | N/A |
| 27 | Charlie | Golden retriever | 9yrs | M | N/A | fully indoor, alone |
| 28 | Grimble | Beagle | 12yrs | M | N/A | only dog at home, stay within house compound, fed with kibbles, out for walk daily |
| 29 | Grimble | Beagle | 14yrs | M | N/A | only dog at home, stay within house compound, fed with kibbles, out for walk daily |
| 30 | Mocha | Local | 10yrs | F | N/A | N/A |
| 31 | Tommy | Local | 8yrs | M | N/A | N/A |
| 32 | Rocky | Poodle | 11yrs | M | N/A | N/A |
| 33 | Mark | GSD | 2yrs | M | N/A | PDRM |
| 34 | Mark | GSD | 5yrs | M | N/A | PDRM |
| 35 | Tory | Rottweiller | 7yrs | F | N/A | N/A |
| 36 | Kansas | GSD | 3yrs | M | N/A | PDRM |
| 37 | Kiki | GSD | 11yrs | F | N/A | N/A |
| 38 | Lucky | Local | 10yrs | M | N/A | indoor, fed with home cooked food |
| 39 | Trixie | Shih Tzu | 14yrs | F | Spayed | kibbles + wet food |
| 40 | Trixie | Shih Tzu | 15yrs | SF | Spayed | N/A |
| 41 | Baby | GSD | 6yrs | F | N/A | indoor, only dog, fed kibbles |
| 42 | Didi | French Bulldog | 7yrs | M | N/A | semi-indoor, biscuit, carrot, chicken liver |
| 43 | Baby | Chihuahua | 11yrs | F | Spayed | indoor, 3 dogs |
| 44 | Artemis | GSD | 13yrs | SF | Spayed | outdoor, only dog in house |
| 45 | Casper | W.H. Terrier | 11yrs | CM | Castrated | N/A |
| 46 | Casper | W.H. Terrier | 11yrs | CM | Castrated | N/A |
| 47 | Sheba | GSD | 7yrs | SF | Spayed | fully indoor, home cooked food |
| 48 | Lao Wu | GSD | 8yrs | M | N/A | PDRM |
| 49 | Lucky | Beagle | 9.5yrs | M | N/A | only dog, homecooked food |
| 50 | Bobo | Mix | 10yrs | SF | Spayed | keep indoor, fed with rice mix with steam chickent |
| 51 | Nash | Labrador | 10yrs | M | N/A | dog detector, indoor, RC kibbles & wet food |
| 52 | Nash | Labrador | 11yrs | M | N/A | dog detector, indoor, RC kibbles & wet food |
| 53 | Nash | Labrador | 11yrs | M | N/A | dog detector, indoor, RC kibbles & wet food |
| 54 | Nash | Labrador | 12yrs | M | N/A | dog detector, indoor, RC kibbles & wet food |
| 55 | Zestina | Spaniel | 12yrs | SF | Spayed | N/A |
| 56 | Baby | Shih Tzu | 10yrs | M | N/A | indoor, only dog |
| 57 | Bum Bum | Shih Tzu | 10yrs | M | N/A | indoor, only dog |
| 58 | Popeye | Toy poodle | 14yrs | M | N/A | fully indoor, only dog, fed with kibbles |
| 59 | Captain | GSD | 7yrs | M | N/A | N/A |
| 60 | Happy | Toy poodle | 15yrs | M | N/A | only dog, indoor, night at compound, fed with rice and bread |
| 61 | Coco | Golden retriever | 11yrs | F | N/A | indoor, kibbles and home cooked food, stay with a cat |
| 62 | Alex | Siberian Husky | 6yrs | M | N/A | indoor, fed with kibbles, with 5 other dog |
| 63 | Achus | Sibenan Shepherd | 9yrs | M | N/A | only dog, homecook food, semi indoor dog |
| 64 | Achus | Siberian Husky | 10yrs | M | N/A | only dog, homecook food, semi indoor dog |
| 65 | Ceazer | Cocker Spaniel | 10yrs | CM | Castrated | N/A |
| 66 | Ceazer | Cocker Spaniel | 11yrs | CM | Castrated | N/A |
| 67 | Lemon | Beagle | 8yrs | M | N/A | pedigree chicken + beef |
| 68 | Cherry | Bulldog | 12yrs | SF | Spayed | outdoor, diet chicken+kibbles |
| 69 | Gimi | Poodle | 8yrs | M | N/A | fully indoor, fed with dry kibbles |
| 70 | Kingsley | Miniature poodle | 13yrs | M | N/A | indoor, only dog |
| 71 | Jojo | Mix | 5yrs | M | N/A | N/A |
| 72 | Peanut | Dachshund | N/A | M | N/A | N/A |
| 73 | Rover | Labrador retriever | 11yrs | M | N/A | N/A |
| 74 | May Mei | Shih Tzu | 12yrs | SF | Spayed | N/A |
| 75 | Kobe | French Bulldog | 3yrs | M | N/A | N/A |

| | | | | | | |
|---|---|---|---|---|---|---|
| 76 | Girl-gild | GSD | 8yrs | F | N/A | total 2 dogs, semi roamer, fed with kibbles |
| 77 | Girl-gild | GSD | 8yrs | F | N/A | total 2 dogs, semi roamer, fed with kibbles |
| 78 | Lilo | Toy poodle | 6m | M | N/A | indoor, only dog, kibbles |
| 79 | Dedione | Poodle | 10yrs | M | N/A | 2 other dog at home, hypoallergenic kibbles |
| 80 | Echo | German Sheppard | 11yrs | M | N/A | only dog at home, outdoor |

## APPENDIX C: CHARACTERISTICS OF THE EAR, CLINICAL SIGNS AND EAR DISCHARGES IN DOGS WITH OTITIS EXTERNA

| No. | Type of Ear Pinnae | Bilateral/ Unilateral | Clinical Signs | Use of Medication before AST |
|---|---|---|---|---|
| 1 | Erect | unilateral | L ear post aural hematoma, very waxy ear, ear hyperaemic | ciproplus, clavamox, chloramine |
| 2 | Erect | unilateral | Stenotic esr canal, R ear thick mucopurulent discharge + hyperemic | clavamox, danzen, tramadol, melox, metronidazole |
| 3 | Erect | unilateral | mucopurulent ear discharge, mass | surolan, chloramine, danzen, uphalexin |
| 4 | Erect | unilateral | dried brownish discharge, mass | clavamox, surolan |
| 5 | Erect | unilateral | N/A | N/A |
| 6 | Erect | bilateral | smelly bilaterally, reduced R ear canal size | aurizon, baytril |
| 7 | Pendulous | unilateral | slight yellowish discharge from L ear canal, bilateral ear pinnae slight erythematous | baytril, chloramine, papase, surolan |
| 8 | Erect | unilateral | mucopurulent discharge, vertical canal opening narrowing | gentamycin cream, oridermyl |
| 9 | Pendulous | unilateral | L slightly narrowed, R purulent otic discharge, foul smelling, painful, inflammed, narrowed, scratching | clavamox, oridermyl |
| 10 | Pendulous | unilateral | mucopurulent disch, severe reddening, small red nodules in ear with pus, Severe inflammation and presence of mucopurulent disch on R ear | danzen, chloramine, surolan, marbocyl |
| 11 | Erect | bilateral | N/A | N/A |
| 12 | Erect | bilateral | N/A | N/A |
| 13 | Pendulous | unilateral | greenish discharge, inflammed + painful ear | augmentin, pred, aurizon |
| 14 | Erect | unilateral | Mucopurulent ear discharge on L ear | clavamox, papase |
| 15 | Erect | bilateral | bilateral Purulent otorrhea, inflammed ear canal, | aurizon, chloramine |
| 16 | Erect | bilateral | R ear purulent discharge (otitis media + externa), mucopurulent ocular discharge due to chronic otitis externa since last year | aurizon, cephalexin, rheumocam |
| 17 | Pendulous | bilateral | yellowish discharge | clavamox, doxy, papase, taheebo, |
| 18 | Erect | unilateral | purulent discharge, slight moist, reddened with narrowing of ear canal, some brownish wax and white opaque like material in the canal | N/A |
| 19 | Erect | unilateral | presence of fresh wound | gentamicin, aurizon, pred, chlorphenramine |
| 20 | Erect | bilateral | maggot inside R ear canal with foul smelling, dried blood observed on the R ear pinnae, presence of circular well demarcated wound on the outer ear pinna, mild head tilt to the R | augmentin |
| 21 | Pendulous | unilateral | R ear inflammed, oily, waxy, > L ear, R severely waxy with pus, L ear waxy and erythematous | surolan |
| 22 | Erect | bilateral | bilateral otitis | cefixime, danzen, chloramin, aurizon, ketonazole |
| 23 | Erect | unilateral | thick yellow discharge, head tilt & lose of bballance (falling), got growth (swelling & whitish pus) in ear canal (horizontal), ear infection result in vestibular syndrome | baytril |
| 24 | Erect | bilateral | pus discharge | baytril |
| 25 | Erect | unilateral | stenotic canal, ear discharge | chloramine, augmentin, papase, tramadol |
| 26 | Erect | unilateral | no swelling or discharge, stenosis ear canal | surolan, augmentin, danzen, tramadol |
| 27 | Pendulous | bilateral | L ear shrunken, shake head but no tilting, bilateral erythematous with yellowish discharge, foul smelling | rheumocam |
| 28 | Pendulous | bilateral | bilateral brownish ear discharge, presence of mass at L ear base, | tramadol, melox, osurnia ear ointment, pred, baytril, ranitidine |
| 29 | Pendulous | bilateral | ulcerated mass with yellow discharge and size around 6cmx6cm at the base on the L ear | tramadol, surolan, augmentin, chloramin, |
| 30 | Erect | unilateral | straw colour pus, painful, mass, bleeding | chloramine, augmentin, surolan |
| 31 | Erect | unilateral | bleeding & purulent discharge from L ear, occlusive mass in the L ear canal, bleeding | augmentin, tramadol, melox, ranitidine, omeprazole |
| 32 | Pendulous | bilateral | R - yellowish discharge, L - ulceration,waxy discharge | N/A |
| 33 | Erect | unilateral | inflammed canal, waxy, thick minimal yellowish discharge, itchy & head shaking, | danzen, surolan, aoxycillin |
| 34 | Erect | Unilateral | ear canal appeared wet/yellowish discharged but not inflammed | pred, cimetidine, chloramine, oridermyl |
| 35 | Pendulous | unilateral | L ear mass | enrofloxacin, rannitidine, melox, |
| 36 | Erect | bilateral | bilateral thick ear discharge, blackish + | becarin cream, surolan, danzen, amoxycillin |
| 37 | Erect | unilateral | stenotic ear, ulcerated, ear discharge with pus | augmentin, papase, tramadol, B comp |
| 38 | Erect | unilateral | R ear appear moist with pus discharge， head shaking persist | surolan, cephalexin, danzen, chloramine |
| 39 | Pendulous | unilateral | L yellowish ear discharge, & yellow scab both ear | apoquel |
| 40 | Pendulous | unilateral | R -yellowish discharge, erythema around ear concave | cephalexin |
| 41 | Erect | bilateral | erythematous, greenish-yellowish discharge, foul odour on bilateral ear, head shaking persist | surolan, melox, chloramine, |
| 42 | Pendulous | unilateral | itchy, scratch,L ear discharge | chloramine, azodyl, ranitidine,metoclopramide, doxy, cimetidine, vit B co |
| 43 | Erect | unilateral | L sided ear wax, sometimes have pus | N/A |
| 44 | Erect | bilateral | R stenotic ear, foul smelling, L ear discharge,with head tilt, with vulvular mass additionally | surolan, baytril, |
| 45 | Erect | unilateral | chronic purulent ear discharge | doxycylin, gentamycin cream |
| 46 | Erect | unilateral | purulent discharge, mass | chloramine, augmentin |
| 47 | Erect | unilateral | white purulent discharge with blood, odour smell, refuse to handle | metacam, surolan (after metacam), danzen, tramadol |
| 48 | Erect | unilateral | R ear pinna swelling with fluid filled consistency | chloramine, aurizon |
| 49 | Pendulous | bilateral | erythema & swelling presence of white brownish discharge bilateral, Swinging ear and scratching ear | surolan |
| 50 | Erect | unilateral | crusty yellowish discharge, head tilt to R, mass | enrofloxacin,papase, |
| 51 | Pendulous | bilateral | Grenish purulent discharge R ear, yellowish discharge L ear | Aurizon, papase |

| | | | | |
|---|---|---|---|---|
| 52 | Pendulous | Unilateral | R blackish stain in some clearly discharge | surolan |
| 53 | Pendulous | unilateral | R ear foul smelling, blackish purulent ear discharge, horizontal ear canal narrowed, erythematous & inflammed, persisitently mucopurulent discharge | surolan, danzen, |
| 54 | Pendulous | unilateral | purulent discharge obversed 1 month, horizontal ear canal narrowed, erythematous & inflammed | surolan augmentin |
| 55 | Pendulous | unilateral | L ulcerated mass + bleed, foul smelling | epiotic |
| 56 | Pendulous | unilateral | L very smelly, L discharge > R, mass | amoxyclav |
| 57 | Pendulous | unilateral | N/A | cephalexin, papase, surolan, besame |
| 58 | Pendulous | unilateral | mass 1cmx1cm size of bum of R ear, bleeding | tramadol, baytril, prednisolone, vit B |
| 59 | Erect | unilateral | R ear purulent discharge , Itchy and dischagre on R ear. Head tilt on R side, changing hips on R side | aurizon, aumentin, chloramine |
| 60 | Pendulous | unilateral | post cutaneous myiasis at R external auditary canal, grey yellowish foul smelling odour, slight bleeding from the mass observed, blood clot at mass | baytril, B com, pred, fortekor, |
| 61 | Pendulous | unilateral | R ear got pus | Epiotic, aurizon |
| 62 | Erect | bilateral | R yellowish diacharge+narrowing of ear canal, L thick yellowish discharge in inflammed canal, mass | aurizon, augmentin, danzen |
| 63 | Erect | unilateral | Purulent discharge at L ear white dried crusty dark debris, remnant of epithelial tissue at L ear port TECA, presence of pus from middle ear forming fistula | augmentin |
| 64 | Erect | Unilateral | crusty thick greenish ear discharge, painful | surolan, cephalexin, pred |
| 65 | Pendulous | unilateral | horizontal ear canal still have pus discharge | N/A |
| 66 | Pendulous | unilateral | L pinnae weverly reddened & painful, foul smelling, suppurative discharge | epiotic, surolan, vetsporin, tear naturale |
| 67 | Pendulous | unilateral | R ear slimy yellowish discharge (biofilm like), L brownish wax, bonth ear concave erythematous + inflammed | aurizon |
| 68 | Pendulous | unilateral | ear discharge at R ear | surolan |
| 69 | Pendulous | unilateral | L ear mild wax, R purulent ear discharge - thick mucopurulent yellowish | aurizon, tramadol, danzen, samilyn |
| 70 | Pendulous | Bilateral | R ear pinna severly reddened, severe pus at both ear canal, painful | metacam, surolan, baytril |
| 71 | Erect | Bilateral | yellowish pus observed when swabbed, bilateral ear reddening with dried skin at the ear opening | surolan, metacam |
| 72 | Pendulous | Unilateral | ceruminous discharge from right ear | N/A |
| 73 | Pendulous | bilateral | Bilateral ear with yellowish discharge, smelly + wards | surolan, ,mirtozapine, cimetidine |
| 74 | Pendulous | unilateral | N/A | Aurizon |
| 75 | Pendulous | bilateral | both ear canal & pinnae lichenified, scaly with waxy discharge | N/A |
| 76 | Erect | unilateral | L no inflammation, R ear canal constrict + pus, moist dermatitis | clavaseptin, chloramine, danzen |
| 77 | Erect | Unilateral | large ulcerated wound at R ear base extending to neck + sloughing of skins | cephalexin, pred, beavate-N |
| 78 | Pendulous | unilateral | L ear clean, R ear moist with dark ear mass, scratching | surolan |
| 79 | Pendulous | bilateral | 2 masses at L ear pinnae 1.5cmx2cm, 0.4cmx0.4cm, 1 mass at R ear pinnae - 0.5cmx0.4cm | aurizon, baytril, rheumocam |
| 80 | Erect | Unilateral | R ear erythematous with mild purulent discharge | Aurizon |

## APPENDIX D: LIST OF CATS CASES IDENTIFIED

| No. | Year | Date | Lab Ref Number | Case Number (UVH) / Clinic name | Name |
|---|---|---|---|---|---|
| 1 | 2018 | 20/2/2018 | M2018/116 | 082640 | Lucias |
| 2 | 2018 | 28/2/2018 | M2018/142 | 082757 | Putra |
| 3 | 2018 | 19/7/2018 | M2018/475 | 085305 | Casper |
| 4 | 2018 | 23/10/2018 | M2018/669 | 086790 | Harry |
| 5 | 2019 | 15/3/2019 | M2019/213 | 089150 | Laura |
| 6 | 2019 | 25/4/2019 | M2019/286 | 089550 | Micu |
| 7 | 2020 | 18/8/2020 | M2020/533 | 089550 | Micu |
| 8 | 2019 | 4/7/2019 | M2019/403 | 062948 | Timmy |
| 9 | 2020 | 15/1/2020 | M2020/035 | 093563 | Thor |
| 10 | 2020 | 29/1/2020 | M2020/108 | 076517 | Okie |
| 11 | 2020 | 2/6/2020 | M2020/347 | 093095 | Clover |
| 12 | 2020 | 23/6/2020 | M2020/373 | 095548 | Bilbo |
| 13 | 2021 | 9/3/2021 | M2021/121 | 095548 | Bilbo |
| 14 | 2020 | 10/7/2020 | M2020/411 | 095757 | Hero |
| 15 | 2020 | 23/7/2020 | M2020/447 | 095433 | Puteri |
| 16 | 2020 | 27/8/2020 | M2020/559 | Klinik Vet Ziyad | Mochin |
| 17 | 2020 | 3/9/2020 | M2020/570 | 095953 | Looniey |
| 18 | 2020 | 24/9/2020 | M2020/734 | 096009 | Max |
| 19 | 2020 | 10/12/2020 | M2020/1041 | 095896 | Sunquick |
| 20 | 2021 | 26/3/2021 | M2021/242 | 097975 | Ghost |
| 21 | 2021 | 5/10/2021 | M2021/708 | 100258 | Nana |
| 22 | 2021 | 13/10/2021 | M2021/724 | 100360 | Duke |
| 23 | 2021 | 23/11/2021 | M2021/871 | 100601 | Starsky |
| 24 | 2022 | 5/1/2022 | M2022/004 | 100601 | Starsky |
| 25 | 2021 | 7/12/2021 | M2021/1246 | 102058 | Munir |
| 26 | 2022 | 11/1/2022 | M2022/021 | 093064 | Tam Tam |
| 27 | 2022 | 22/3/2022 | M2022/210 | 102452 | Kontot |
| 28 | 2022 | 29/3/2022 | M2022/230 | 102650 | Kiki |
| 29 | 2022 | 6/4/2022 | M2022/243 | 102718 | Silver |
| 30 | 2022 | 28/4/2022 | M2022/276 | 102718 | Silver |
| 31 | 2022 | 29/4/2022 | M2022/277 | 102825 | Manis |
| 32 | 2022 | 10/5/2022 | M2022/280 | 102839 | Wira |
| 33 | 2022 | 15/6/2022 | M2022/403 | 103063 | Chelsea |
| 34 | 2022 | 8/7/2022 | M2022/433 | 103229 | Moku |
| 35 | 2022 | 14/7/2022 | M2022/436 | 103247 | Kecik |
| 36 | 2022 | 4/8/2022 | M2022/468 | 103402 | Jovie |
| 37 | 2022 | 23/8/2022 | M2022/493 | Klinik Ziyad | Bruno |
| 38 | 2022 | 9/9/2022 | M2022/534 | 103623 | Popo |
| 39 | 2022 | 20/9/2022 | M2022/554 | 103668 | Amad |
| 40 | 2022 | 4/10/2022 | M2022/595 | 103447 | Mochi |
| 41 | 2022 | 11/10/2022 | M2022/618 | 103206 | Boboi |
| 42 | 2022 | 1/11/2022 | M2022/749 | 103898 | Kiko |
| 43 | 2022 | 11/11/2022 | M2022/779 | 103978 | Putih |
| 44 | 2022 | 15/11/2022 | M2022/780 | 104000 | Odin |
| 45 | 2022 | 17/11/2022 | M2022/792 | 103941 | Mama |
| 46 | 2022 | 8/12/2022 | M2022/830 | 102593 | Titi |
| 47 | 2022 | 27/12/2022 | M2022/877 | 098632 | Smokey |
| 48 | 2022 | 28/12/2022 | M2022/881 | 104320 | Cosmo |
| 49 | 2023 | 22/2/2023 | M2023/149 | 104320 | Cosmo |
| 50 | 2023 | 3/1/2023 | M2023/002 | 104361 | Bibi |
| 51 | 2023 | 13/1/2023 | M2023/033 | 103934 | Lagenda Kashmir Kencana |
| 52 | 2023 | 30/1/2023 | M2023/080 | 104254 | Tiger |
| 53 | 2023 | 7/2/2023 | M2023/093 | 104627 | Matcha |
| 54 | 2023 | 24/2/2023 | M2023/154 | 104786 | Mar |
| 55 | 2023 | 3/3/2023 | M2023/194 | 104858 | Nana |
| 56 | 2023 | 3/4/2023 | M2023/271 | 103177 | Rocky |
| 58 | 2023 | 5/4/2023 | M2023/279 | 106397 | Sundae |
| 59 | 2023 | 3/5/2023 | M2023/346 | 106397 | Sundae |
| 60 | 2023 | 10/4/2023 | M2023/299 | 106511 | Boboi |
| 61 | 2023 | 26/4/2023 | M2023/334 | 106606 | Teddy |
| 62 | 2023 | 18/5/2023 | M2023/375 | 106741 | Kiki |
| 63 | 2023 | 17/7/2023 | M2023/628 | 041157 | Ariel |
| 64 | 2023 | 27/7/2023 | M2023/665 | 107014 | Milo |
| 65 | 2023 | 27/7/2023 | M2023/667 | 107206 | Happy |

## APPENDIX E: SIGNALMENT OF CATS WITH OTITIS EXTERNA

| No. | Name | Breed | Age | Sex | Neuter Status | Management |
|---|---|---|---|---|---|---|
| 1 | Lucias | Maine coon | 1yr | M | N/A | 3 other cat, kept in enclosure, fed with RC mainecoon + urinary + fur and skin |
| 2 | Putra | Maine coon | 2yrs | M | N/A | N/A |
| 3 | Casper | Persian | 5yrs | M | N/A | N/A |
| 4 | Harry | Maine coon | 1.5yrs | CM | Castrated | indoor |
| 5 | Laura | Maine coon | 4yrs | F | N/A | N/A |
| 6 | Micu | DSH | 1yrs | F | N/A | indoor 3 cats, purina kibbles |
| 7 | Micu | DSH | 2yrs | F | N/A | indoor 3 cats, purina kibbles |
| 8 | Timmy | DSH | 4yrs | M | N/A | indoor, kibbles, 10 cats |
| 9 | Thor | Maine coon | 2yrs | M | N/A | Indoor with another 3 cats, fed with wet & dry food |
| 10 | Okie | Maine coon | 7yrs | CM | Castrated | indoor, managed with other 2 cats, fed with kibbles |
| 11 | Clover | Persian X | 2yrs | M | N/A | indoor with 1 other cat, fed with dry food (RC urinary) |
| 12 | Bilbo | Persian | 8yrs | CM | Castrated | indoor |
| 13 | Bilbo | Persian | 9yrs | M | Castrated | indoor |
| 14 | Hero | Persian | 11yrs | CM | Castrated | N/A |
| 15 | Puteri | Maine coon | 5yrs | F | N/A | indoor |
| 16 | Mochin | DSH | 4yrs | F | Spayed | N/A |
| 17 | Looniey | Mix | 6yrs | CM | Castrated | N/A |
| 18 | Max | Bengal | 3yrs | M | N/A | indoor, R/C kibbles |
| 19 | Sunquick | DSH | 9yrs | SF | Spayed | N/A |
| 20 | Ghost | Maine Coon | 3yrs | M | N/A | indoor with 6 other cat, fed with kibbles |
| 21 | Nana | DSH | 3yrs | F | Spayed | N/A |
| 22 | Duke | Mix Persian | 10yrs | M | Castrated | indoor, blackwood & RC kibbles, managed with other cat |
| 23 | Starsky | ASH | Adult | M | N/A | indoor, with 1 adult + 1 kitten seperately |
| 24 | Starsky | ASH | Adult | M | N/A | indoor, with 1 adult + 1 kitten seperately |
| 25 | Munir | Maine Coon | 1yrs | M | Castrated | 4 cat, indoor, fed with kibbles, fresh chicken, daging |
| 26 | Tam Tam | Ragdoll | 3yrs | M | N/A | indoor, total 2 cats, kibbles |
| 27 | Kontot | DSH | 5yrs | SF | Spayed | indoor, 3 other cat, wet food + dry kibbles |
| 28 | Kiki | Persian | 11yrs | CM | Castrated | |
| 29 | Silver | Exotic Persian | 5yrs | M | N/A | indoor multicat, RC hair&skin kibbles |
| 30 | Silver | Exotic Persian | 5yrs | M | N/A | indoor multicat, RC hair&skin kibbles |
| 31 | Manis | Mix | 2yrs | F | N/A | indoor 4 cat, kibbles + wet food |
| 32 | Wira | Bengal | 6yrs | CM | Castrated | indoor |
| 33 | Chelsea | Mix | 12yrs | M | N/A | fed with RC kibbles, indoor cat |
| 34 | Moku | DSH | 5yrs | CM | Castrated | indoor |
| 35 | Kecik | DSH | N/A | N/A | N/A | N/A |
| 36 | Jovie | Bengal | N/A | N/A | N/A | N/A |
| 37 | Bruno | DSH | 2yrs | CM | Castrated | N/A |
| 38 | Popo | DSH | 1yrs | M | N/A | fully indoor, 2 cat, fed with kibbles, |
| 39 | Amad | Munchkin | 2yrs | M | N/A | N/A |
| 40 | Mochi | Scottish fold | 11mo | SF | Spayed | indoor, total 6 cat, kibbles |
| 41 | Boboi | Mixed | 6m | M | N/A | N/A |
| 42 | Kiko | DSH | 6m | M | N/A | fed with kibbles, manage indoor, multicat household |
| 43 | Putih | Mix | 1yrs | F | N/A | multicat household, indoor & outdoor |
| 44 | Odin | Maine Coon | 9m | M | N/A | indoor, 3 more cat, dry feed |
| 45 | Mama | DSH | 9yrs | SF | Spayed | indoor, multicat household, prodiet, sometimes nasi & sardine |
| 46 | Titi | Mix | 6yrs | SF | Spayed | semi roamer, with 3 other cats, RC |
| 47 | Smokey | Maine Coon | 4yrs | M | N/A | only cat, fed RC hair & skin + treat |
| 48 | Cosmo | Mix | 3yrs | CM | Castrated | indoor, RC hair & skin |
| 49 | Cosmo | Mix | Adult | CM | Castrated | indoor, RC hair & skin |
| 50 | Bibi | Maine Coon | 8m | F | N/A | RC M coon kibbles mix kitten wet food, fully indoor, only cat |
| 51 | Lagenda Kashmir Kencana | Maine Coon | 8yrs | CM | Castrated | fully indoor, 4-5cat, dry and wet food, broiled chicken |
| 52 | Tiger | Mix | 9yrs | M | N/A | indoor only cat, RC urinary diet |
| 53 | Matcha | Maine Coon | 5m | M | N/A | N/A |
| 54 | Mar | DSH | 10yrs | CM | Castrated | N/A |
| 55 | Nana | ASH | 16yrs | SF | Spayed | indoor, RC kibbles |
| 56 | Rocky | Bengal | 6yrs | CM | Castrated | N/A |
| 58 | Sundae | DSH | 8yrs | SF | Spayed | 3 cats at home, 1 cat has FIP, fully indoor |
| 59 | Sundae | DSH | 8yrs | SF | Spayed | 3 cats at home, 1 cat has FIP, fully indoor |
| 60 | Boboi | DSHX | 3yrs | CM | Castrated | N/A |
| 61 | Teddy | Persian | 15yrs | CM | Castrated | N/A |
| 62 | Kiki | DLH | 2yrs | SF | Spayed | 4 other cat, fed with anti-hairball paste +RC urinary care, |
| 63 | Ariel | Persian/Siam | 12yrs | M | N/A | N/A |
| 64 | Milo | DLH | 7m | CM | Castrated | fully indoor with 50 other cats |
| 65 | Happy | Ragdoll | 3yrs | M | N/A | indoor, only cat, wet food |

## APPENDIX F: CHARACTERISTICS OF THE EAR, CLINICAL SIGNS AND EAR DISCHARGES IN CATS WITH OTITIS EXTERNA

| No. | Type of Ear Pinnae | Bilateral/ Unilateral | Clinical Signs | Use of Medication before AST |
|---|---|---|---|---|
| 1 | Erect | unilateral | pus discharge noted on external ear canal, got lump | N/A |
| 2 | Erect | N/A | N/A | N/A |
| 3 | Erect | bilateral | multiple blackish nodular lesion and ulcerated bilateral ear canal with mucopurulent discharge | surolan, danzen, clavamox |
| 4 | Erect | unilateral | L ear wax | clavamox, papase |
| 5 | Erect | N/A | N/A | N/A |
| 6 | Erect | unilateral | L purulent discharge, swollen horizontal canal, unable to observe ear drum | clavamox, oridermyl, pred |
| 7 | Erect | unilateral | 2.5x2.5cm polyp observed on L ear canal, purulent discharge | N/A |
| 8 | Erect | bilateral | bilateral serosanguineous discharge | aurizon + oridermyl |
| 9 | Erect | bilateral | R yellowish discharge on the base of ear, L brownish discharge, occasionally bleeding from both, polyp both ear | papase, enrofloxacin |
| 10 | Erect | unilateral | purulent discharge on L ear polyps | clavamox, tramadol, rheumocam |
| 11 | Erect | bilateral | bilateral smelly ear, L side has discharge, multiple greenish-blue nodules in ear canals, mass in ear since 3 week ago and bleeding since 1 week ago | marbocyl, danzen, tramadol, |
| 12 | Erect | unilateral | greenish bloody discharge | rheumoram, surolan |
| 13 | Erect | unilateral | purulent otorrhea, ear polyp | augmentin, pred, tramadol, solucortef |
| 14 | Erect | unilateral | L ulcerated mass | cefixime, chloramine, danzen, aurizon |
| 15 | Erect | unilateral | thick purulent discharge | cephalexine, papase |
| 16 | Erect | unilateral | N/A | N/A |
| 17 | Erect | bilateral | multiple greyish nodule bilaterally | N/A |
| 18 | Erect | unilateral | L ear smelly + purulent discharge 1cmx1cm L otitis externa + polyp | N/A |
| 19 | Erect | unilateral | BAR | N/A |
| 20 | Erect | unilateral | purulent ottorhea, ear canal intact, inflammed, | Augmentin, danzen, tramadol |
| 21 | Erect | unilateral | N/A | N/A |
| 22 | Erect | unilateral | 2cmx2cm mass like structure, foul odour with greenish discharge, keep scratching ear | Danzen, chloramine, aurizon |
| 23 | Erect | unilateral | R ear polyp easily bleed, smelly have ear mites history on right ear, dark brwon colour, easily bleed + iitchy | danzen, surolan |
| 24 | Erect | unilateral | sof bleeding mass at ear canal, ear bleeding when cat scratch ear | oridermyl, danzen |
| 25 | Erect | unilateral | brown wax on both ear, pus on R ear | surolan, danzen, |
| 26 | Erect | unilateral | foul smelling, pus | oridermyl, chloramine, doxy, marbocyl |
| 27 | Erect | unilateral | R ear black wax and slight crusting, L ear resolved | aurinzon, chloramine |
| 28 | Erect | unilateral | dark yellow purulent discharge with foul smelling | N/A |
| 29 | Erect | unilateral | pus + blood discharge from R polyps | Surolan, augmentin, danzen |
| 30 | Erect | bilateral | dirty ear blackish | Surolan, augmentin, danzen, aurizon |
| 31 | Erect | unilateral | itching on L ear, R ear slight blackish discharge, shaking ear after checking | augmentin, chloramine, danzen |
| 32 | Erect | unilateral | L ear purulent discharge + polyp, mucopurulent ear discharge on both ear however L ear severe than R, present of mass inside the L ear canal | Aumentin, oridermyl |
| 33 | Erect | unilateral | L crusty ear wax with foul smell, R look clean w some brownish wax, frequently scratch ear, brownish-yellowish ear wax | surolan, danzen |
| 34 | Erect | unilateral | R ear thick ear + pus | danzen, aurizon, epiotic |
| 35 | Erect | bilateral | mucopurulent discahrge, halithiosis, thick & foul smelling, yellowish | surolan, papase, epiotic, tramadol, vit B-co |
| 36 | Erect | bilateral | both foul smell +pus discharge | surolan, papase |
| 37 | Erect | N/A | N/A | N/A |
| 38 | Erect | unilateral | Suppurative discharge, ear scratching | oridermyl chloramine |
| 39 | Erect | bilateral | yellowish dischargel, R ear swab found mites, ear scratching | Surolan, chloramine |
| 40 | Pendulous | unilateral | purulent discharge, diagnosed with R middle ear polyp and non healing mild R otitis since July2022, R otitis externa + susp ear polyps, L ear mite infestation | danzen, cephalexin, oridermyl, metacam syrup, augmentin |
| 41 | Erect | N/A | Pus discharge | N/A |
| 42 | Erect | bilateral | ear dirt, dry scab, discharge | Surolan, augmentin |
| 43 | Erect | unilateral | non symmetrical shape (L ear stenosis) | surolan, danzen |
| 44 | Erect | unilateral | R ear purulent yellowish discharge, granulated mass, odor present | danzen, chloramine |
| 45 | Erect | unilateral | mucopurulent discharge, 1cm x 1cm firm mass in L ear | surolan, danzen, theophylline, vit B-co |
| 46 | Erect | unilateral | foul smelling from both ear, yellowish brown discharge in R ear, brown dry waxy at R ear, mass | amoxyclav, danzen, tramadol |
| 47 | Erect | bilateral | bilateral ear itchiness, L ear become inflammed ear pinna, debris on both side with crusts, had itchy ear until bleed due to scratch before this, and ear become inflammed & puritus 2-3mo ago | surolan, augmentin syrup |
| 48 | Erect | unilateral | foul smell with greenish discharge | oridermyl |
| 49 | Erect | Unilateral | L ear waxy greenish exudate, purulent ear discharge | resolved |
| 50 | Erect | bilateral | dry on outer ear, pus present, prutitus observed with ear shaking, | Surolan |
| 51 | Erect | unilateral | foul smell, mucopurulent discharge | aurizon, chloramine |
| 52 | Erect | bilateral | waxy moist with foul smell | oridermyl |
| 53 | Erect | unilateral | black discharge on R | aurizon |
| 54 | Erect | Unilateral | mucopurulent discharge from L ear, L ear pinnae reddened | N/A |
| 55 | Erect | bilateral | bilateral ear got purulent discharge | surolan |
| 56 | Erect | unilateral | R brownish mucopurulent discharge | N/A |
| 58 | Erect | unilateral | mass inside ear canal, swollen at ventral area of R ear, scratching of R ear, yellowish disccharge | marbocyl, rheumocam |
| 59 | Erect | unilateral | suture on R ear with some scabs on ear back pinnae, yellowish discharge from R ear | clavaseptin, azithromycin |
| 60 | Erect | unilateral | brown waxy ear discharge, pus (yellowish) discharge in L ear, foul smelling, head tilt, flea infested, | N/A |
| 61 | Erect | unilateral | Small nodules at ear pinnae. Bloody discharge from R ear. | N/A |

| | | | | |
|---|---|---|---|---|
| 62 | Erect | unilateral | brownish waxy discharge + scabs, polyp | marbocyl, pred, |
| 63 | Erect | bilateral | L - purulent discharge, R- a lot of wax | N/A |
| 64 | Erect | bilateral | dirty | N/A |
| 65 | Erect | bilateral | brown waxy ear discharge | Surolan |