It is important to understand that ear disease is only a symptom (no more specific than “pruritus”). As Dr Flemming Kristensen stated “A patient showing ear problems is a dermatology case until proven otherwise”. It is appropriate therefore to approach the diagnosis of ear disease just as you would for any other skin disease.

Reviewing the signalment is the first step that must be taken when a dog is presented w/clinical signs of ear disease. Age, breed and sex can help point you in the right direction. For example, it has been reported that Labrador retrievers have a higher incidence of cutaneous adverse food reactions then does the general population. A puppy w/ear disease should have Otodectes, dermatophytosis and juvenile cellulitis (“puppy strangles”) on the list of differential diagnosis while a young adult dog would typically have environmental allergen induced atopic dermatitis and cutaneous adverse food reactions high on the differential diagnosis. A geriatric dog, w/o prior ear disease, would have neoplasia (eg adenoma, adenocarcinoma) or an endocrinopathy as important rule outs.

The next step may be the most important one, obtaining a detailed history! This starts by getting a copy of the dog’s medical record. If the dog has had previous skin or ear disease, getting a copy of the medical records may help tremendously in developing a differential diagnosis list. The very first thing is to tell the owners with a dog w/ear disease is that many ear diseases look the same; it is the underlying causes that vary. Therefore, just like in a good detective novel, we need to begin at the start and retrace the “footsteps” looking for clues along the way. Specific questions that should be asked include:

1. When did the symptoms first occur? This is an important question, because many owners will only tell you when this current episode of symptoms occurred, not the very first time it occurred;
2. Other than the problem the owner presents the patient for, you must ask all owners if the dog has EVER had problems with excessive licking, scratching, chewing, biting or rubbing. Has the dog ever had ear problems before this episode? If so, when, with what medication and what was the response to treatment;
3. Where does the dog live- indoor, outdoors, both? Describe the environment, especially the outdoor environment;
4. Is she on heartworm and flea preventative? If so, what product, how often is it administered and is it year round or seasonal?
5. Are there any other pets in the household? If so, what kind and are they symptomatic. If they are cats, do they go outside? ;
6. Are any of the humans in the household showing “new” skin problems? If so, what kind;
7. Do they board the dog, take him to obedience school, training or to the groomers? If so, when was the last time? ;
8. Do they know if the parents of the dog or any siblings have pruritic skin problems? If so, what was done and what was the response? ;
9. What does the dog eat?
10. How do the ears seem today- is today's presentation the best, worse or average since the problem began?
11. Do you notice if the symptoms were better, worse or no different or not sure between the different seasons.

After reviewing signalment and thoroughly questioning the owner, the next step is to do a complete physical examination – be sure to aware of any constitutional signs (i.e. pot belly, fever) that may be present.

This is followed by a complete dermatologic examination. This is especially important to remember when a dog is presented only for otic pruritus- frequently practitioners fail to examine the rest of the body. Please note- when a dog is presented for truncal pruritus be sure to do an otic examination.

Following the dermatologic examination an otic examination should be performed. In order not to miss an abnormality, an otic exam should be done in a systematic manner beginning w/the pinna. You should note any alopecia, erythema, ulceration, crusting, scaling or swelling. Then palpate the canals for pain, calcification or thickening. This is followed by an otoscopic examination of the ear canals. To evaluate the ear canals and the tympanic membrane, the tip of the cone of the otoscope should be placed in the opening of the external ear canal. The cone is advanced proximally by initially pulling straight up on the pinna. Due to the curve in the external ear canal, the ear canal must be straightened in order to see the horizontal canal and the tympanic membrane. This is done by pulling the pinna laterally (outward). By “stretching” the pinna laterally into a straight line horizontally the ear canal becomes straight. The otoscope is advanced into the horizontal ear canal as the canal is straightened.

The presence, degree and location of inflammation, ulceration & proliferative changes should be noted (i.e. cobblestone hyperplasia). Describing the size of both the vertical and horizontal canals along w/the type, location and quantity of debris or exudate should also be included in the medical record. Next it should be documented whether the tympanic membrane is visualized. If it is not then note why the membrane is not seen- is it due to swelling in the ear canal, the presence of a ceruminolith or is there just debris in the proximal horizontal canal obstructing the view?

Sometimes it is because the animal is too painful to allow deep examination of the ear canal. If you can visualize the tympanic membrane (TM) you need describe if it is normal in appearance or not. Changes that may be noted include discoloration or bulging.

It is important to then evaluate for concurrent middle or inner ear disease. This is because dogs with chronic recurrent otitis externa (OE) may have concurrent otitis media (OM). This step may require heavy sedation or general anesthesia. Evidence of middle ear involvement include a ruptured TM or an abnormal appearing TM (i.e. thickened, change in lucency (opaque), bulging or discolored. Even though it is stated that an intact TM DOESN'T rule out otitis media that statement should be followed by "but the TM is NOT normal in appearance". Supporting this statement is a study in which OM was diagnosed in 42 dogs via biopsy or necropsy of the middle ear. In this group of dogs they reported that the TM was rarely torn. (However this was before fiberoptic video enhanced otoscopy (FVEO) was used. It is possible that some of the dogs (many?) may have had tears in the TM that could not be appreciated w/o FVEO). The authors went on to state that the TM was often thickened, supporting this author's contention that having OM w/an intact NORMAL TM is very rare.

Horner’s syndrome (sympathetic nerve); keratoconjunctivitis sicca (parasympathetic) and facial nerve paralysis may be present in cases of OM due to the close association of the
respective nerves to the middle ear. Deafness may also be present with OM.

Some veterinarians will have their staff collect ear cytology samples prior to the examination (as a time saver) but this makes it difficult to evaluate the true appearance of the ear canal. Debris may be pushed into the horizontal canal thereby limiting visualization of the tympanic membrane due to the compacting of debris in the canals.

Now diagnostics and treatment needs to be pursued. The first step is to identify and treat the primary (underlying) cause(s) of the ear disease. These would include:

1. Parasitic (including Demodex, Otodectes, Sarcoptes);
2. Foreign bodies;
3. Hypersensitivities (atopy- NOTE OE may be the ONLY symptom in 3-5% of the atopic cases and it may be UNILATERAL!!; cutaneous adverse food reaction where it too may be the ONLY symptom in 20% of the cases and also may be unilateral; flea allergy dermatitis (but should have skin disease in addition to the OE);
4. Allergic or irritant contact dermatitis;
5. Endocrinopathies, keratinization or sebaceous gland disorders leading to an altered lipid layer in the epidermis, alteration in normal keratinization or glandular function; idiopathic seborrhea (is there such a disease?);
6. Autoimmune or immune mediated diseases (eg pemphigus complex, vasculitis- note these diseases involve the pinna >>> canals);
7. Zinc responsive dermatosis (not typically just pinna disease);
8. Juvenile cellulitis;
9. Immunosuppressive diseases (distemper, FeLV, FIV, parvo virus); neoplasia (adenoma, adenocarcinoma) and
10. Dermatophytosis (affects the pinna rather than the ear canal).

In addition to identifying the primary cause, secondary factors must be addressed if possible. Secondary factors don’t cause ear disease but increases the risk of developing ear disease and may make successful treatment more difficult. Secondary factors are: anatomical factors (eg- long pendulous ears in the Basset Hound or stenotic ear canals in Shar Peis); excessive moisture in ears (swimming); and iatrogenic trauma (plucking hairs from the ear canals, cleaning ear canals with cotton tip applicators).

Lastly perpetuating factors must be identified and treated. These factors don’t initiate the problem, but will cause the disease to continue, even with the elimination of the primary factor, once it has been established until these factors have also been addressed. Perpetuating factors include:

1. Bacteria (coci most commonly Staphylococcus intermedius (acute infections), beta hemolytic streptococci and rods most commonly E. coli, Pseudomonas spp (chronic infections); Proteus spp, Klebsiella spp and Corynebacterium spp);
2. Fungi (Malassezia pachydermatis (which may cause a hypersensitivity reaction so that small numbers may be significant)
3. Progressive pathological changes;
4. Otitis media;
5. Contact hypersensitivity/irritant;
6. Treatment errors (most commonly do to under treating the infection).

Laboratory tests are a necessary component to the proper workup of a case of canine ear disease. CBC, serum chemistry profile, urinalysis, skin scrapings, fungal culture, endocrine testing and skin biopsies may be necessary depending on what the differential diagnoses are for that patient.
Cytologic examination of a roll swab sample should be performed on any exudate being sure to quantitate numbers & type of bacteria, yeast and inflammatory cells. The question of what is an abnormal number of organisms, per oil field, in cases of OE has not been settled. Depending on the study, cutoff numbers, per oil immersion field (multiple by 2.5 to get per HPF), between normal and abnormal ears range from >1 Malassezia to >4 Malassezia and from >1 bacteria to >10 bacteria\textsuperscript{xi,\texttwocents xii} It is the author’s opinion that the number of organisms needed to present to be considered significant is not just a “number”. The author doesn’t perform cytology on normal ears – it is only done if the ears that are inflamed or have exudate. In those cases ANY organism seen will be treated as part of the therapy regardless of the number present. The only time a cytology is performed during therapy is when the ear is not improving clinically OR if the initial cytology had primarily or exclusively rods. If there is a mixed population of organisms present at the initial examination w/o rods and the ear is clinically normal at the recheck examination, follow-up cytology is not performed.

Bacterial culture and susceptibility (c/s) is (should only be) rarely, if ever, performed in cases of OE and when performed it is done in conjunction w/cytology\textsuperscript{xiii}. One reason that the author doesn’t perform cultures in cases of otitis externa is that with a culture the susceptibility is based on antibiotic levels (measured in microgram/ml) achieved systemically, not topically. Since topical medication has a 1000 fold (at least) higher concentration (milligrams/ml) the resistance reported on the culture is not interpretable.

Other concerns include poor reproducibility of c/s results when culturing the ear. In a study where two samples were taken for bacterial c/s from the same location in the external ear canal of dogs who had otitis externa, there were different bacterial isolates identified 20% of the time and the same isolate with different susceptibility patterns another 20% of the time\textsuperscript{xiv}. Eleven percent of the \textit{P. aeruginosa} isolates had different susceptibility patterns. In addition, the cytopathology and the culture results only agreed 68% of the time. A second study took triplicate samples and sent one of the samples to 3 different laboratories\textsuperscript{xv}. There were 18 samples that had identified \textit{Pseudomonas spp} but none of the samples had identical patterns of antibiotic susceptibility. All three laboratories agreed on the presence of \textit{Pseudomonas} in 15 (83.35) of the ears while 2 agreed on 2 (11.1%) of the samples and on one occasion (5.5%) only 1 lab identified \textit{Pseudomonas}. A 3\textsuperscript{rd} study was performed in which duplicate samples were sent to the same lab\textsuperscript{xvi}. Seventy percent of the \textit{Pseudomonas aeruginosa} had different susceptibility profiles.

These results should give you great pause as to the reliability of cultures. The author will only take a culture in cases of OE when there are proliferative changes present AND there are numerous rods present on cytology AND the dog has failed to respond to my empirical antimicrobial therapy (which is rare if ever). This approach is supported by a study in which the author evaluated if there was any correlation between topical antibiotic selection, \textit{in vitro} bacterial antibiotic sensitivity and clinical response in 16 cases of canine otitis externa complicated by \textit{Pseudomonas aeruginosa}.\textsuperscript{xvii} For these cases he empirically selected a topical antibiotic therapy after collecting bacterial cultures from the affected ears. All dogs had \textit{Pseudomonas aeruginosa} isolated on culture. In 10 cases, the antibiotic selected was deemed to be resistant based on the culture, yet 8/10 responded to the selected antibiotic. One of the 10 resistant cases needed to have a second antibiotic selected to successfully treat the infection. This supports the observation that there is no value to performing cultures in cases of canine otitis externa.

The MIC (broth microdilution technique) method is the “gold standard” for culture technique therefore if a c/s is submitted, the MIC method should be used to determine the susceptibility of the organism(s) rather than the disc diffusion method (Kirby-Bauer). This is
because the disk-diffusion susceptibility test (DDST) is only semi-quantitative. This means that the drug concentration achieved in the agar surrounding the disc can be roughly correlated with the concentration achieved in the patient’s serum. It will only report the organism’s susceptibility (susceptible, intermediate or resistant) based on an approximation of the effect of an antibiotic on bacterial growth on a solid medium. Tube dilution (MIC) is quantitative, not only reporting SIR but also the amount of drug necessary to inhibit microbial growth. This allows you to not only decide susceptible or resistant but also the proper dosage and frequency of administration of the antibiotic. Please be aware that a susceptible designation alone does not necessarily imply efficacy. Efficacy = MIC + dose x treatment frequency. The advantage of the MIC method is that not only does it indicate susceptibility, but it also implies the relative risk of emerging resistance (the higher MIC shows some resistance even though it is in the susceptible range) and thus the need for a high dose.

The other limitation to the Kirby-Bauer results in regards to *Pseudomonas* susceptibility is the discrepancy between it and MIC. In two studies, Kirby-Bauer underestimated *P. aeruginosa* sensitivity to enrofloxacin (when compared with MIC) whereas in 2 other studies Kirby-Bauer overestimated enrofloxacin susceptibility. Since *Pseudomonas* infections are one of the most common reasons cultures are performed in cases of otitis externa, and enrofloxacin is a commonly used antibiotic for this infection, this inability to properly identify susceptible vs resistance to enrofloxacin is an important limitation to in using Kirby-Bauer testing.

With the information gathered above, the treatment is directed toward the primary cause(s) (eg parasiticidal treatment, food trial, intradermal testing and allergen specific immunotherapy, etc) and perpetuating factors. Ear cleaning is performed in the clinic w/a bulb syringe, AuriFlush™ system or by retrograde tube flushing (under anesthesia). Ear cleaning may not be performed on the first visit if the ears are very swollen, preferring to use topical glucocorticoids (GC) +/- systemic GC for 10-14 days to decrease the swelling. Once the swelling has decreased it will be much easier to examine the ear canals and visualize the TM.

Cleaning agents contain substances that soften and emulsify wax and lipids. This initial cleaning is necessary in order to remove debris that may interfere with the effectiveness of topical agents and reduce inflammatory debris (bacterial toxins). The author doesn’t usually have the owner do cleaning after the initial exam since it seems that many owners have trouble with just medicating the ear, let alone cleaning too. Many of the cleaners have a low pH leading to discomfort if used in an inflamed ear. A study comparing 2 ear cleaners (original formulation and then a new formulation) noted that in 38% of the cases w/the old formulation and 37.5% of the cases w/the new formulation dogs had a moderate to marked avoidance to having the cleaner instilled. This behavior was believed to be due to either a reaction to the ear cleaner or just overall animal irritability. Also the base in the otic ointments/suspensions (mineral oil, liquid paraffin) acts as a ceruminolytic agent. In addition, a recent study calls into question whether any of the ear cleaners have any ceruminolytic activity. In this study the ceruminolytic activity of 13 ear cleansers was evaluated using a standardized synthetic cerumen (SSC) that mimics the composition and texture of canine cerumen. Of the tested products only Cerumene®, Epiotic® and VET ear cleaning solution are available in the US. The test products were incubated with mild agitation for 20 min with 500 mg of SSC previously compacted at the bottom of a test tube. Ceruminolytic activity was then assessed by quantifying the SSC removed by decantation. Overall, Otoclean® (OT) was most efficacious, reaching an activity of 86–90% followed by Netaural® (NET) with a 39%, Specicare® (SP) with a 23% and Cerumene® (CE) with an 8% ceruminolytic activity. None of the other products displayed any ceruminolytic activity. It was concluded that, in the experimental conditions used in this study, only 1/13 products had significant ceruminolytic activity. Please note that the company that
manufactures OT funded this study. A follow up study by Robson, et al using Australian and US products revealed that 15/24 cleaners had <5% efficacy while only 6/24 ear cleaners had >80% efficacy - none of which are available in the US.

There is frequently discussion of the ototoxicity of agents put into ears. In humans, because ofloxacin otic solution (Floxin Otic) is the only topical agent to be labeled by the U.S. Food and Drug Administration (FDA) for use when the tympanic membrane is perforated, oral antibiotics have traditionally been used in this situation. However, according to otolaryngologists because the risk of cochlear damage with the use of other topical medications seems quite small, perforation alone is not an indication for oral antibiotics. The author has only seen one ototoxic reaction that was suspected to be due to a topical agent and in that case the TM was intact! Therefore, agents are chosen more for their effectiveness than the concern about ototoxicity, especially since there are very few agents that have been proven to be safe in cases of a ruptured TM. It is more important to get rid of the infection than to avoid (effective) drugs because of ototoxicity concerns. Also, just because the TM is intact doesn’t mean that the barrier function is complete, therefore, even in the presence of an intact TM it is possible to get drugs into the middle ear.

After ear cleaning topical agents are dispensed. The author prefers ointments over drops because of the impression that ointments get the drugs to the region of the tympanic membrane better than drops do (this may be a volume issue more than the formulation- it has been reported that it takes 1.0 cc of medication to get down to the TM in a medium sized (40 pound) sized dog - personal communication) and also the base in the otic ointments (mineral oil/liquid paraffin) acts as a ceruminolytic agent.

Most topical products contain a combination of glucocorticoids, antibacterial and antifungal agents. Antibacterial agents used topically include:

1. Broad spectrum agents (gram positive and negative organisms) –
   a. Aminoglycocides
      i. Decreased effectiveness in an acidified ear
      ii. Inactivated by purulent debris (so they must be put in a clean ear)
   b. Neomycin

2. Narrow spectrum agents (gram negative rods) - reserved for resistant gram negative infections
   a. Polymyxin B - inactivated by purulent material
   b. Enrofloxacin - decreased effectiveness in an acidified ear
   c. Extended-spectrum penicillins (anti- Pseudomonas penicillins)
      i. Susceptible to beta lactamase
      ii. Penetrate *Pseudomonas* cell wall better than other antibiotics
      iii. Increase gram negative activity but less activity gram positive and anaerobes compared to other penicillins
iv. Carboxypenicillin
   a. Ticarcillin

v. Ureidopenicillins
   a. Piperacillin
   b. More effective against *Pseudomonas* than are the Carboxypenicillins

d. Aminoglycocide
   i. Amikacin and tobramycin
      a. Gram negative bacteria (including some *Pseudomonas*) have less resistance to amikacin or tobramycin then gentamicin or neomycin
      b. Decreased effectiveness in an acidified ear, also inactivated by purulent debris so they must be put in a clean ear

Antifungal agents used include thiabendazole (poor efficacy against Malassezia), nystatin (mixed efficacy against *Malassezia*), clotrimazole 1%, miconazole 1 or 2%, posaconazole 0.1% and ketoconazole 1 or 2%

When gram negative organisms are present in cases of OE, EDTA should be used. To understand the action of ethylenediaminetetraacetic acid (EDTA) solution we need to review some microbiology. A capsule surrounds bacteria. Under the capsule is the cell wall that contains peptidoglycans. Under the cell wall is the cytoplasmic membrane (plasma membrane, cell membrane). The cytoplasmic membrane surrounds the cytoplasm and nuclear body. Gram negative have 2 additional layers. The outer most is the outer cell membrane that lies between the capsule and the cell wall. The outer cell membrane is composed of lipopolysaccharides. The other additional layer is between the cell wall and cytoplasmic membrane, called the periplasmic space. This space contains a variety of enzymes and other proteins that help digest and move nutrients into the cell. Gram positives do not have the outer cell membrane (and therefore no lipopolysaccharides) or a periplasmic space but do have a thick layer of peptidoglycans in the cell wall (vs. gram negatives which only have a thin layer). Note the peptidoglycans are the site of action for beta-lactam antibiotics. (Figure 1)

Topical EDTA solution has a direct bactericidal action against bacteria by chelating metal ions important for the integrity of the bacterial cell wall. EDTA also stimulates the release of outer cell membrane lipopolysaccharides (LPS), proteins, and other cell contents. The end result of these actions is the leakage of cell solutes leading to cell death and better drug penetration and antimicrobial activity. Note - since EDTA stimulates the release of LPS from the outer membrane it is less effective at inhibiting gram-positive than gram-negative bacteria because gram-positive bacteria lack an outer membrane.

*Pseudomonas* bacteria have an efflux pump that is mediated by the *MEX* gene. This protein pumps the drugs out the bacteria, rendering the antibiotic ineffective. EDTA also blocks this pump thereby allowing the antibiotic to accumulate in the bacteria.

To maximize its bactericidal activity it is essential for EDTA to be in an environment w/an alkaline pH. Appropriate pH (8.0) is maintained by combining it with buffers such as tromethamine (TRIS) hydrochloride. This alkaline pH also decreases the bacterial MIC for an aminoglycocide or a fluoroquinolone. It is therefore useful to use TrizEDTA prior to instilling either of these antibiotics. Two commercial veterinary preparations are available - TrizEDTA, (Dechra) or Tris Flush (Sogeval). The ear canal should be filled with the solution prior to instilling the topical antibiotic (15-30 minutes before is ideal). This is done q 8-12 hrs. EDTA is
used primarily for treatment of otitis externa and/or media caused by gram-negative organisms especially *Pseudomonas*.

A product made by Dechra, Triz Chlor contains 0.15% chlorhexidene in addition to the trisEDTA. The combination of these 2 ingredients is beneficial due to the synergistic effect between EDTA and chlorhexidene. The addition of the chlorhexidene extends the antimicrobial spectrum to include cocci and *Malassezia*. There are 2 studies that support the effectiveness of this combination. \textsuperscript{xiii,xxiv} The limitations of these studies are they \textit{in vitro} studies and they used a 30 minute contact time. Whether these results can be repeated \textit{in vivo} has not been studied. Since the author uses this product in combination with other topical agents, it is impossible to draw an accurate conclusion.

In regards to safety of the chlorhexidene in otic products, a study reported the effects of instilling 0.2% chlorhexidene into the ear canals of dogs with experimentally ruptured tympanic membranes\textsuperscript{xxv} In this study, 0.2% chlorhexidene was instilled in greyhound’s ear canals bid for 21 days. At the end of the study there were neither clinical vestibular signs nor BAER changes noted. \textbf{THIS DOESN'T APPLY TO CATS!!!} A study instilling 0.05% chlorhexidene once every other day for 3 treatments into the middle ear of cats concluded that even this concentration of chlorhexidine may cause hearing loss in a cat\textsuperscript{xxvi}. The authors did a subsequent study\textsuperscript{xxvii} in which they evaluated vestibular effects of infusing chlorhexidene into the middle ear of cats. That study concluded that exposure of the middle ear to even dilute concentrations of chlorhexidene (0.05%) were likely to cause vestibular disturbances.

An otic cleaner PhytoVet Ket Flush (Butler Schein™ Animal Health) contains ketoconazole 0.1%, phytoposphingosine HCl 0.01% and EDTA-Tris while a product, TrizULTRA + keto (Dechra) contains ketoconazole 0.15% and EDTA-Tris. Both of these products would be used when otitis externa/media is complicated by both rod bacteria and *Malassezia*. An unanswered concern about using these products chronically as a maintenance treatment is whether (when?) resistance will to ketoconazole will develop. Also acidifying the ear canal is one of the best treatments/prevention for *Malassezia* otitis and these products alkalinize the ear.

Dechra has combined all three products (chlorhexidene, trisEDTA and ketoconazole-Malaket that would be appropriate when all three types of organisms are present (rods, cocci and yeast).

GC's are an essential component of topical treatment. Successful treatment of OE frequently requires topical GC and in fact the author has seen cases resolve where the only change in therapy was the addition of topical GC. GC are antipruritic, anti-inflammatory, decreases glandular secretions (cerumen), decreases pain and swelling and decreases hyperplasia- all properties that can help restore the normal barrier function to the epithelium of the ear canal. When using topical GC it is best to begin with the most potent form and if you need to use GC long term, go to less potent (and less side effects) forms (in decreasing potency- mometasone>betamethasone= hydrocortisone aceponate > flucinolone> triamcinolone>dexamethasone> prednisolone> hydrocortisone). Note- even though hydrocortisone aceponate is classified as an intermediate potent glucocorticoid, equal to that of betamethasone 17-valerate, it has an improved benefit/risk ratio due to its decrease incidence of skin atrophy\textsuperscript{xxviii}. \textbf{REMEMBER} topical steroids are systemically absorbed and can lower thyroid hormone concentrations; elevate liver enzymes, suppress the hypothalamus- pituitary-adrenal axis and even cause pu/pd.\textsuperscript{xxix}

Systemic antibiotics or antifungal agents are used only if otitis media w/bacteria, other than *Pseudomonas* (see below about *Pseudomonas*), or *Malassezia* are present on cytology and have severe proliferative changes in the ear canals that failed to respond to the author’s topical treatment (very rare occurrence). Empirical choices for cocci include cephalosporins,
amoxicillin–clavulanic acid, clindamycin and potentiated sulfas. Empirical choices for rods include cephalosporins, amoxicillin–clavulanic acid (use TID vs. BID for gram negative organisms) and potentiated sulfas. Fluoroquinolones should be reserved for culture-proven resistant gram-negative rods. The antifungal agents that the author prefers include ketoconazole (5 to 10 mg/kg sid, given with food to enhance absorption), fluconazole (10 mg/kg sid), and itraconazole (5 mg/kg sid).

If the OM infection is due to *Pseudomonas* it is unlikely that systemic antibiotics will be useful. This is because systemic administration of antibiotics, including the fluoroquinolones, can’t exceed the MIC for *P. aeruginosa* in the ear canal. Since *P. aeruginosa* is the most common pathogen associated w/OM in dogs, systemic administration of antibiotics will only select for more resistant organisms. Since it has been documented in humans that high drug concentration may be achieved in the middle ear when topical antibiotics are used, in cases of OM, topical treatment is the author’s mainstay therapy.

Systemic glucocorticoids are used if the ear canals are edematous, ulcerated and/or stenotic. Even proliferative changes may decrease with steroid administration since secondary edema may be present. Prednisone at 0.25-.50 mg/# bid for 7-14 days is dispensed. Reassessment is made in 7-14 days. At that time if the canals are completely open and the ulcers are healed, the prednisone can be discontinued. If the ears are better but not normal then make a clinical decision whether to maintain that dose or decrease the dose for another 7-14 days, Recheck again in 7-14 days. If the ear canals are not opened by this second recheck, a total ear canal ablation with a bullae osteotomy would most likely need to be performed.

Specific scenarios

1. Acute otitis (and/or infrequent) externa treatment overview. It is important to differentiate whether this is a first time occurrence, a recurrence or an unresolved previous infection. The only way to know this is to do follow-up examinations on ALL cases of OE. Be aware that the absence of symptoms is not synonymous with resolution of the disease. If this is the first episode, discuss the possible predisposing, primary and perpetuating causes and foreshadow the additional testing that may be necessary in the future. In this situation, begin with eliminating easily diagnosed primary causes (foreign bodies, parasites, masses, etc). Be sure to evaluate the status of the tympanic membrane. Then diagnosis and treat secondary infection and inflammation. Treatment should be for 7-14 days & then recheck examination should be performed!! Treatment should be continued for 7 days past clinical cure. More recently the author has begun to use a product with a unique delivery system- Easotic®. In contrast to the 7-14 day schedule as previously mentioned, only 5 days are used and then the dog is rechecked. This product has been very effective in the few cases that the author has used it on. Unless contraindicated, a topical GC containing product should be used as part of the therapy.
   a. In these cases the author uses for these cases is – if only yeast is present- miconazole 2 %-( Surolan®) or nystatin (Panolog®, Quadritop®, Animax®) or miconazole 1.5% (Easotic®). Since there is not an otic ointment that only contains steroids and antifungal the author will use the combination products.
   b. In cases of mixed infection (bacteria and yeast) once again, a nystatin-containing product (Panolog®, Quadritop®, Animax®) or a 1.5% (Easotic®), or a 2% miconazole containing (Surolan®) is selected. These are frequently effective, especially if it is an acute infection.
c. If cocci or cocci/rods are present I will use polymyxin (Surolan), neomycin (Panolog®, Quadritop®, Animax®) or gentamicin containing products (Easotic®, Otomax®).

d. If only rods are present, which is very rare in this scenario, I would use TrisEDTA and either gentamicin or polymyxin B (Surolan®) (see below – Pseudomonas).

e. If the dog is painful, systemic GC +/- analgesics (tramadol and/or Tylenol w/codeine) are added to the treatment.

2. If initially TM the is not visible due to swelling of the ear canals oral prednisone ½-1mg/#/day for 10-14 days will be added to the topical treatment. Because of the potency of fluocinolone or mometasone, Synotic® (fluocinolone w/DMSO) and/or Mometamax® (mometasone) will be included in the therapy. Many times an analgesic is added as previously described (NO NSAID!).

a. A recheck examination will be performed in 10-14 days. If the TM is visible and the swelling resolved, then only the prednisone can be stopped. All the other treatment should be continued.

b. If the TM is not visible but the swelling has resolved, then an ear lavage via FEVO under general anesthesia should be performed.

c. If at the 10-14 day recheck the TM is not visible and the swelling has NOT resolved, continue the prednisone for another 10-14 days and then recheck.

i. If the ear canals are still narrowed at the next recheck, perform (or refer) a total ear ablation w/a bullae osteotomy.

3. In cases of chronic (recurrent and/or unresolved) otitis externa, in addition to the above, it is essential that a very aggressive search is performed to identify and treat the primary, perpetuating and secondary factors. Treatment should be for a minimum of 30 days. As above, GC will be an important component of therapy.

a. If there is only yeast, then the depending on what products have already been used, consider using clotrimazole 1%, miconazole 2%,0.1% Posaconazole or 2% ketoconazole lotion compounded w/dexamethasone 0.1%.

b. If cocci are the only organism present then use gentamicin, mupirocin or 5% cefazolin (1 gm vial mixed w/20 cc Triz-Edta plus).

c. If rods +/- cocci are present then use Triz-Edta (+/- chlorhexidine if cocci are present) along w/ gentamicin or use polymyxin B.

d. Enrofloxacin (Baytril otic®- Bayer) or orbifloxacin (Posatex® –Merek) is rarely used in these cases unless the infection has failed to respond to the author’s aggressive therapy. The author prefers the later product due to the inclusion of steroids in the lotion. If using the former, dexamethasone should be added to achieve a final concentration if 0.1% dexamethasone.

Pseudomonas infections are especially challenging because of Pseudomonas’ intrinsic multidrug resistance (MDR).xxx. Many of the clinically relevant resistance mechanisms in Pseudomonas aeruginosa are attributed to synergy between its outer membrane that has a very low permeability to drugs and the presence of an active drug efflux pump (MEX). Because of the intrinsic MDR, Pseudomonas infections successful treatment must be aggressive before other resistance develops.

Griffin CE. Otitis externa and media. In: Griffin CE, Kwochka KW, MacDonald JM, eds. *Current Veterinary Dermatology*. St. Louis: Mosby-Year Book; 1993:244-262


Cook LB Neurologic evaluation of the ear in Matousek JL ed The Veterinary clinics of North America Small animal practice 2004, 34: 2;425-35


Griffin CE. Otitis externa and media. In: Griffin CE, Kwochka KW, MacDonald JM, eds. *Current Veterinary Dermatology*. St. Louis: Mosby-Year Book; 1993:244-262


Guardabassi, L., Ghibaudo, G. and Damborg, P. (2010), In vitro antimicrobial activity of a commercial ear antiseptic containing chlorhexidine and Tris–EDTA. Veterinary Dermatology, xxiv


Igarashi Y, Oka Y. Vestibular ototoxicity following intratympanic applications of chlorhexidine gluconate in the cat Arch Otorhinolaryngol 1985;242(2):167-76.

Igarashi Y, Oka Y. Vestibular ototoxicity following intratympanic applications of chlorhexidine gluconate in the cat. Arch Otorhinolaryngol. 1988;245(4):210-7


Aniya JS, Griffin CE. The effect of otic vehicle and concentration of dexamethasone on liver enzyme activities and adrenal function in small breed healthy dogs Vet Dermatol 2008:19:226-231