Pyoderma: Topical and Systemic Treatment
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Overview of the Issue
The appropriate management of superficial and deep pyoderma requires the use of both topical and systemic therapy. Topical therapy is often used as an adjunctive to systemic antibiotics because it will speed the healing process, aid in the elimination of bacterial byproducts and generally make the patient feel better. Topical therapy can also be used as a preventative therapy in cases prone to recurrences and can be beneficial in the management of Methicillin-resistant staphylococci (MRS) infections. Systemic antibiotic therapy is needed in most pyoderma cases; even the most superficial pyodermas are best treated by systemic therapy. Extended antibiotic protocols or “pulse therapies” are unfortunately needed in some cases of chronic recurrent pyoderma. Knowing when and how to use these extended pulse protocols is also critical to reduce the development of Methicillin-resistant staphylococci (MRS) infections.

Objectives of the Presentation
- Become familiar with the key active ingredients found in commercial veterinary topical antibacterial agents. Understand their indications and how to use.
- Understand the common antibiotics that are available to empirically treat common and resistant bacterial skin infections. Gain familiarity of when to use which antibiotics, understanding their benefits, limitations and potential side effects.
- Know how to set up and treat chronic relapsing pyoderma cases with maintenance or pulse programs.
- Understand what Methicillin-resistant staphylococci (MRS) infections are and how to best treat them.

Key Therapeutic Points

Topical Therapy
Topical therapy can be used in all types of pyoderma. It will usually decrease bacteria counts and reduce surface recolonization of bacteria, helping to prevent recurrences. It can also be very helpful in the management of methicillin resistant Staph infections. There are many different topical antimicrobial vehicles: shampoos, whirlpools, soaks, rinses, sprays, lotions, gels, creams, and ointments. Shampoos are the most practical and effective. Whirlpools and soaks are more labor intensive and require additional equipment. For localized lesions, sprays, lotions, gels, creams and ointments can be used. The author prefers not to use heavy occlusive vehicles for moist exudative lesions, as these tend to slow healing and drying and may help spread infection.

Shampoos
Shampoo therapy is the author’s favorite topical antimicrobial therapy. It removes inflammatory and bacterial by products and can give immediate results. This is particularly important for some owners and cases. The owner without the need of any special equipment can also do it at home. The frequency depends on the severity of the case and the owner’s willingness to do the work. Deep pyoderma cases will benefit from frequent bathing (every 2 to 3 days) initially, followed by a weekly maintenance. Most cases will respond best if the overlying hair is clipped prior to bathing. This is particularly true for deep pyodermas.

The most common antibacterial agents found in shampoos include benzoyl peroxide with or without sulfur, chlorhexidine, ethyl lactate and triclosan. Benzoyl peroxide is considered the most effective for S. intermedius and was found to be superior to other antimicrobials. In addition to its antibacterial effects it is also an excellent follicular flushing agent, which promotes removal of inspissated...
debris and is comedolytic. It also has excellent keratolytic and degreasing effects. It is available in several different products. (OxyDex and Sulf/OxyDex, IVX, Pyoben, Virbac, Micro Pearls Benzoyl Peroxide, Vetoquinol, Benzoyl Peroxide Plus—DermaPet). It can be drying and irritating in some cases, but this is rare with the products listed as most add additional moisturizing agents to counteract this.

Another favorite antibacterial agent is chlorhexidine. It is less drying and irritating than benzoyl peroxide, but at the 2% concentration is not as effective. However, a newer 4% formulation has been quite impressive in clinical cases (ChlorhexiDerm, IVX, Hexadene and KetoChlor, Virbac, Douxo Chlorhexidine PS, Sogeval).

Two other antimicrobial agents that have antibacterial effects are triclosan and ethyl lactate. These products are considered non-irritating but the author does not routinely select these agents for most S. intermedius pyoderma cases due to the superior effectiveness of the above two products. These products are nice adjunctive agents in the management of keratinization defects when concurrent pyoderma is present. There are a few products that contain triclosan (SebaLyt and SeboRx, IVX) and ethyl lactate (Etiderm, Virbac). The newest shampoo to be released that has both antimicrobial and antiseborrheic effects is Keratolux, Virbac. Keratolux is a salicylic acid, zinc gluconate and B6 and fatty acid based shampoo and in a study comparing it to a salicylic—tar based shampoo it had similar antimicrobial and antiseborrheic effects. Cases that are complicated by concurrent Malassezia are best treated with a combination shampoo products that contain an antibacterial and anti-yeast agent such as chlorhexidine and miconazole (Malaseb, IVX) or chlorhexidine and ketoconazole (KetoChlor, Virbac) or chlorhexidine with phytosphingosine (Douxo Chlorhexidine PS, Sogeval).

**Soaks and Whirlpools**
The author rarely utilizes these forms of therapy, due to the labor and time required. They are a very effective way of debriding deeper pyoderma cases. When utilized, the author prefers chlorhexidine to povidone-iodine, due to its superior antibacterial property and non-staining quality. There is also some newer power bathing systems available that can produce the benefits of whirlpool without the same time commitment. These systems utilize a higher-pressure controlled delivery, which allows for more effective debridement with less shampoo and better rinsing capabilities. Some systems even allow for less shampoo to be used and conserve water (HydroSurge, San Diego, CA).

**Sprays, Gels, Creams and Ointments**
Localized topical therapy has limited use in most pyoderma cases. However some forms of pyotraumatic dermatitis, skin fold pyoderma and localized folliculitis and furunculosis cases can benefit by using this products. A number of companies that make chlorhexidine based shampoos also make topical sprays, wipes and towelettes that can be used in between or as an option for bathing. IVX products include: ChlorhexiDerm® Maximum 4% Spray, Malaseb® Pledgets (Chlorhexidine Gluconate 20 mg, Miconazole Nitrate 20 mg), Malaseb® Spray (Chlorhexidine Gluconate 2%, Miconazole Nitrate 2%), Malaseb® Towelettes (Chlorhexidine Gluconate 72 mg Miconazole Nitrate 72 mg). Virbac products: ResiChlor. Sogeval products: Douxo chlorhexidine microemulsion PS spray. Other commonly used products include gels that contain benzoyl peroxide (Pyoben Gel, Virbac and OxyDex Gel, IVX). These products can occasionally be irritating and should be discontinued if inflammation develops.

Another ingredient, mupirocin, an antibiotic developed from the fermentation of Pseudomonas fluorescens works very well for localized deep folliculitis and furunculosis cases. Mupirocin is available in a polyethylene glycol ointment base by compounding pharmacies. It functions by inhibiting bacterial protein synthesis and has excellent tissue penetration. It should not be used on mucosal surfaces or in areas where large amounts of polyethylene glycol can be absorbed due to potential for nephrotoxicity.

**Systemic Therapy**
When selecting antibiotic therapy for pyoderma the practitioner should keep in mind the basic principles of successful systemic antibiotic therapy. These include the proper choice of an antibiotic, establishment of effective dose and correct duration of therapy. Antibiotics are usually selected empirically or based on skin cytology. In more chronic, refractory cases or when gram-negative bacteria are seen on cytology, antibiotic selection should be based on culture and sensitivity. Empirical selection should include antibiotics that have a proven sensitivity towards S. intermedius. Optimum properties for an antibiotic
should also include: narrow spectrum of activity with no inactivation by beta-lactamases, lack of resistance, ability to penetrate scarred walled off infection, little to no side effects, relatively inexpensive and only need to be given once a day! Unfortunately it is impossible for one antibiotic to achieve all of these factors.

It is very important to follow recommended dosage regimes to obtain optimum results and to minimize side effects. There is also a wide range of dosing regimes depending on the severity, chronicity and scarring of the pyoderma. The author has used double the recommended dosages and even combined therapy with some antibiotics (cephalexin and enrofloxacin) for severe scarring deep pyoderma with excellent results. Side effects at these higher and combined regimes do not appear to be any greater than using these drugs separately and at the recommended dosing. Some antibiotics should not exceed recommended dosing, such as the potentiated sulfonamides due to the development of sulfonamide cystic urolithiasis in susceptible dogs.

Antibiotic therapy needs to be maintained until the pyoderma is gone and then 2 weeks beyond clinical cure for superficial pyoderma and 3–4 weeks beyond for deep pyoderma. This usually requires 3 to 6 weeks for superficial and 6 to 12 weeks or longer for deep pyoderma.

The following discussion is a brief overview of the most common antibiotics used for pyoderma in dogs and cats. Antibiotic selection should be based on proven sensitivity against *S. intermedius*. Penicillin, ampicillin, amoxicillin, tetracycline, and non-potentiated sulfonamides are considered poor choices for *S. intermedius* infections. Previous use of antibiotics may have negative effects on some sensitivity patterns but not with others. Staphylococcal sensitivity is diminished further when ampicillin, amoxicillin, tetracycline, and non-potentiated sulfonamides have been previously used. This is also seen with erythromycin and lincomycin. The author has seen this first hand in southern California several years ago when the use of lincomycin and erythromycin were common. Most staphylococcal referral cases at that time had a poor sensitivity to these antibiotics. Trimethoprim and ormetoprim potentiated sulfonamides, oxacillin, clavulanic and amoxicillin and cephalixin sensitivity patterns are less affected by previous use.

A comprehensive list of antibiotics with proven sensitivity for staphylococcal pyoderma is given (Table I). The author's personal choices will be discussed. Selection of antibiotics by the author is based on chronicity, degree of scarring, depth of infection, immune suppression, and client concerns, (cost, frequency of administration, and incidence of side effects. Commonly used antibiotics at the author’s practice include clindamycin, ormetoprim-potentiated sulfonamides, amoxicillin-clavulanate, cephalaxin/cefadroxil and fluoroquinolones. Chloramphenicol although bacteriostatic and requires three times a day dosing is gaining favor again particularly of methicillin resistant Staph infections.

The trimethoprim-potentiated sulfonamides have good efficacy for canine pyoderma. Major advantages are reduced expense with generics and twice a day dosing. The major disadvantages are its association with drug reactions, keratoconjunctivitis sicca (KCS) and thyroid gland hypoplasia. Cutaneous and non-cutaneous drug reactions can be seen. Cutaneous reactions include macular-papular eruptions, erythema multiforme (EM), toxic epidermal necrolysis (TEN) and vasculitis. Non-cutaneous reactions include blood dyscrasias, KCS, non-septic arthritis and polysystemic immune complex disease. The immune complex disease has a high incidence of occurrence in the Doberman breed and for this reason is contraindicated in the Doberman. The potentiated sulfonamide ormetoprim-potentiated sulfadimethoxine (Primor, Pfizer) has major advantages of once a day dosing, less potential for KCS and other drug reactions than trimethoprim-potentiated sulfonamides. The author has had very good success using this antibiotic with minimal side effects in his practices.

A broad-spectrum bactericidal antibiotic used at the author’s practices is amoxicillin-clavulanate. The author agrees with other skin specialists to use higher dosing above the manufacturer’s recommendation for better clinical results. The author uses this drug at 22mg/kg q 12h or 13.75mg/kg q 8h. It does come in individual foil wrapped tablets for maintaining potency and reducing moisture. The antibiotic is also tolerated well in cats and is a common choice for feline pyoderma. Occasional vomiting and diarrhea can be seen in both dogs and cats.

Clindamycin is a lincosamide, which differs from lincomycin only by the presence of a chloro substitution, which increases its antimicrobial activity. Unlike penicillin and cephalosporin, it does not have a beta-lactamase enzyme. Therefore bacteria that produce beta-lactamase enzymes are often
susceptible to clindamycin, making it a good choice for many methicillin resistant Staph pyodermas. It is bacteriostatic and resistance problems can occur. It has a high oral bioavailability and large volume of distribution and therefore penetrates tissues well. The author likes this antibiotic for deep scarring pyodermas but uses it at a higher dose (10mg/kg q12h). More recent studies show efficacy at 15-20mg/kg q 24h, making it more client user friendly. Side effects are minimal but can include gastrointestinal upsets.

Cephalexin is a broad-spectrum, first generation bactericidal cephalosporin. It is a twice a day antibiotic, with excellent tissue penetration, rarely creates resistance and the generics are inexpensive. It is by far the most common antibiotic prescribed at the author’s practices. Cefadroxil is similar to cephalexin but is more expensive. The author carries the smaller sizes 50mg and 100mg tablets to treat small dogs and cats. The classification of cephalosporins into first, second and third generations is based upon their increasing activity against beta-lactamase producing gram-negative bacteria. Cefpodoxime proxetil (Simplicef, Pfizer) an orally administered extended spectrum, semi synthetic cephalosporins class antibiotic has become available for dogs. It is classified as a third generation cephalosporins with increased gram-negative activity with still having good gram-positive activity with limited anaerobic spectrum. However, cefpodoxime has showed little or no activity against most strains of *Pseudomonas* spp and other oxidase-positive, non-fermentive, gram-negative bacilli. Previously this class was only available by parenteral administration. The pharmacokinetic and pharmacodynamic properties of cefpodoxime support once a day dosing with 5–10mg/kg q 24h as the dosage range. The current dosing maximum is 28 days. Tablets are available in 100 and 200mg. No toxicity has been seen in toxicity studies at 400mg/kg q 24h for 4 weeks in the canine. Toxicities have not been seen until extended studies at 6 month duration and above recommended dosing.

Cefovecin (Convenia®) is a new third generation cephalosporin developed by Pfizer Animal Health for the treatment of aerobic and anaerobic gram-negative and gram-positive infections. Cefovecin is a bactericidal against *Staphylococcus* and *Streptococcus* species, *Escherichia coli*, *Pasteurella multocida*, and *Klebsiella* and *Proteus* species, but is not active against *Pseudomonas* or *Enterococcus* species. Cefovecin has a long half-life of 6.9 days in cats and 5.4 days in dogs and demonstrates prolonged concentrations in extracellular fluid allowing for dosing every 14 days. If required, the dose of 8 mg/kg subcutaneously in dogs and cats can be repeated every 14 days for a total of three doses. Cefovecin is eliminated through renal excretion with up to 25% biliary excretion. No adverse reactions were noted in preliminary studies, but cefovecin should not be given to animals allergic to penicillins or cephalosporins, less than 8 weeks old, if they are pregnant or lactating, or have severe renal dysfunction. Controlled studies in both cats and dogs show good clinical efficacy. The author has seen good clinical responses and has generally reserved its use in cases where client compliance with oral administration has been difficult or oral absorption of antibiotics has been a concern.

Enrofloxacin, ciprofloxacin, orbifloxacin, difloxacin (5–10mg/kg q24h) and marbofloxacin (2–5mg/kg q24h) and other fluoroquinolones are broad-spectrum bactericidal antibiotics that have excellent activity against multiresistant organisms with very rapid killing activity. Their high lipophilicity allows penetration into gram-positive and gram-negative bacteria. Their mode of action is by inhibition of an enzyme called DNA gyrase. This enzyme cuts bacterial DNA allowing super coiling of the chromosome. The equivalent enzyme in mammals is topoisomerase, which is structurally different and is poorly inhibited. Advantages include once-daily dosing, excellent tissue penetration for *S. intermedius* and many gram-negative organisms (including *Pseudomonas* spp) and limited resistance. Differences have been seen among the fluoroquinolones for *P. aeruginosa* susceptibility. Lloyd reported differences in susceptibility by disc diffusion tests for enrofloxacin (mean 49%) and marbofloxacin (mean 90%) of 47 canine isolates of *Pseudomonas* spp. from the skin and ears of referral cases. The once a day dosing with most fluoroquinolones is preferred due to higher sustained concentrations. As mentioned potent tissue penetration is partially related to uptake into macrophages in chronic inflammatory tissue. Its major disadvantages are cost and it cannot be used in growing dogs because articular cartilage damage may occur. The author also has had success in treating feline pyoderma with fluoroquinolones. It is recommended when using enrofloxacin to not exceed 5mg/kg in the feline to avoid an idiosyncratic retinal reaction, which can lead to blindness. One of the best drug combinations for chronic scarred
pyogranulomatous pyodermas in dogs is enrofloxacin with cephalixin. The two antibiotics work synergistically to penetrate and eliminate walled off areas of infection.

Another antibiotic used for its ability to penetrate scarred walled off areas of infection is rifampin. Rifampin (5-10mg/kg q 24h) is a bactericidal antibiotic that not only has excellent tissue penetration but also is capable of killing Staphylococcus spp. intracellularly. Resistance is a major problem with rifampin, requiring concurrent use of other beta-lactamase resistant antibiotics. The author commonly uses cephalixin or potentiated sulfonamides with rifampin. The other disadvantage of using rifampin is the potential for hepatotoxicity. It is contraindicated in dogs with preexisting liver disease. The author is also aware of one case of autoimmune hemolytic anemia (AIHA) that was rifampin induced. Rifampin will commonly produce orange colored urine due to a metabolite. To monitor for potential toxicity’s, complete blood counts, liver screens, and a urinalysis should be performed every 2 to 3 weeks. It is generally used for 4–8 weeks.

**Maintenance Antibiotic Therapy**

Maintenance antibiotic therapy will occasionally be needed for chronic relapsing pyoderma. Prior to resorting to this type of therapy, an extensive work-up to identify the underlying disease should have already been performed. Other options should also be discussed with the owner. These should include more frequent and aggressive topical therapy and potential immunomodulation therapy. The likelihood of success and amount of time and effect of these options need to be thoroughly explained to each client. After all factors are considered a decision to utilize a maintenance antibiotic program can be made.

A maintenance program is established on an individual basis. Many cases will require full dosages continuously. Other cases will need treatment at 1/2 or 1/3 daily dosages; some can be maintained with a full dose pulse schedule i.e., several days on then several days off. To determine what schedule to use a detailed history and physical exam needs to be followed. The most important factor to monitor is the time it takes to relapse. If relapses occur within a few days of discontinuing antibiotics, a daily regime is likely to be needed. If relapses take 2–4 weeks to occur, an intermittent pulse dosing should be tried. This type of therapy is obviously not optimal. Concerns include induction of antibiotic resistance, development of resistant strains of bacteria i.e., methicillin resistant Staph (MRS), long-term drug side effects and cost. The author’s most common antibiotic used in maintenance programs is cephalixin. Other choices include amoxicillin-clavulanate and occasionally fluoroquinolones. Fluoroquinolones are the best choice for mixed infections. On occasion there are cases that will require antibiotic combination maintenance. In this situation combining cephalixin and fluoroquinolones works best. Maintenance antibiotic therapy has the potential to create a greater risk for drug side effects. At the author’s practices monitoring is done every 6 months. Owners are instructed to call if any problems develop. Cases are screened for signs of cutaneous drug reactions, gastrointestinal upsets; metabolic abnormalities and bacterial resistance (see next section).

**Methicillin-Resistant Staphylococci**

Methicillin-resistant staphylococci (MRS) have become an increasing problem in humans and animals. Although strains may appear sensitive to some beta-lactam antibiotics *in vitro*, including cephalosporins, they exhibit cross-resistance *in vivo*. In addition MRS may also be resistant to multiple non beta-lactam drugs like aminoglycosides, macrolides, tetracyclines, chloramphenicol and fluoroquinolones. *S intermedius*, the most common staphylococcal species isolated from the canine has a low incidence of methicillin resistance. However methicillin-resistant *S aureus* (MRSA) have been cultured from canine and feline skin, ears and surgical wound swabs. All were resistant to beta-lactam antibiotics, some to quinolones and macrolides and most were susceptible to potentiated sulfonamides, rifampin, oxytetracycline and chloramphenicol. All were susceptible to vancomycin, the antibiotic of choice in humans with MRSA. Vancomycin should not be used in veterinary MRSA infections as it should be limited only to the use of MRSA in humans. MRSA infections should be suspected when oxacillin-resistant or multi drug resistant staphylococci are isolated from clinical infections. Oxacillin should be used instead of methicillin because it is more stable and better standardized for disk diffusion susceptibility testing. Antibiotics treatment for MRS should be based on the results of a bacterial culture and susceptibility. The author has seen good success treating MRS in the canine with chloramphenicol, doxycycline, potentiated sulfamides, rifampin and clindamycin, with fluoroquinolones also used depending on the isolate.
As mentioned MRS isolates have been reported and published from the skin and ears of dogs with pyoderma and otitis. In one study (Kania, 2004) 26% (23/90) of the staphylococcal isolates from dogs with pyoderma were MSR. Most (17/23 cases) were \textit{S. schleiferi} isolates. Other resistant staphylococci included \textit{S. epidermidis} (3), \textit{S. intermedius} (2) and \textit{S. warneri} (1). Of interest was the finding that all \textit{S. schleiferi} and \textit{S. intermedius} MRS contained the \textit{mecA} gene and expressed PBP2a. The \textit{mecA} gene encodes the penicillin-binding protein 2a (PBP2a). A method of testing to help identify new emerging strains of MRS is to detect this \textit{mecA} gene by way of polymerase chain reaction (PCR) assay. It is important that pet owners be informed when their dog has been identified as a being infected with MRS especially if the isolate is identified in repeated bacterial cultures or if the owner is immunosuppressed or has another severe illness. There is concern that the causal use of antibiotics has helped to create the development of MRSA in humans and by reducing the use of antibiotics when not truly indicated has helped to lower the incidence of MRSA in humans. Similar precautions should be followed in veterinary medicine.

**Key Drugs, Dosages and Indications**

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Dosage</th>
<th>Advantages</th>
<th>Disadvantages</th>
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<tbody>
<tr>
<td>Amoxicillin-Clavulanic acid</td>
<td>12.5–22 mg/kg q12h</td>
<td>Bactericidal, Side effects rare</td>
<td>Expensive, Moisture sensitive, Occasional vomiting or diarrhea</td>
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<tr>
<td>Cephalexin/Cefadroxil</td>
<td>22–30 mg/kg q12h</td>
<td>Bactericidal, relatively inexpensive—generics</td>
<td>Occasional vomiting or diarrhea</td>
</tr>
<tr>
<td>Cefpodoxime Proxetil</td>
<td>5–10 mg/kg q 24h</td>
<td>Once a day dosing</td>
<td>Expensive</td>
</tr>
<tr>
<td>Cefovecin</td>
<td>8 mg/kg q 14 days</td>
<td>Once every 14 days</td>
<td>Injectable, expensive initially</td>
</tr>
<tr>
<td>Chloramphenicol</td>
<td>50 mg/kg q8h</td>
<td>Inexpensive</td>
<td>Bacteriostatic, Three times a day, Blood dyscrasia in humans</td>
</tr>
<tr>
<td>Clindamycin</td>
<td>5–10 mg/kg q12h</td>
<td>Penetrates scar tissue</td>
<td>Expensive, Bacteriostatic, Development of resistance</td>
</tr>
<tr>
<td>Enrofloxacin</td>
<td>5–10 mg/kg q24h</td>
<td>Bactericidal, Once a day</td>
<td>Expensive, Contraindicated in growing dogs, Cats not to exceed 5mg/kg/d</td>
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<tr>
<td>Orbifloxacin</td>
<td>5–10 mg/kg q24h</td>
<td>Great tissue, Penetration</td>
<td></td>
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<tr>
<td>Difloxacin</td>
<td>5–10 mg/kg q24h</td>
<td>Active against multiple gram-</td>
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<tr>
<td>Marbofloxacin</td>
<td>2.5–5 mg/kg q24h</td>
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<tr>
<td>Ciprofloxacin</td>
<td>5–10 mg/kg q12h</td>
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<td></td>
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<tr>
<td>Erythromycin</td>
<td>10–15 mg/kg q8h</td>
<td>Narrow spectrum</td>
<td>Bacteriostatic, Three times a day, Vomiting and diarrhea common</td>
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<tr>
<td>Drug</td>
<td>Dosage</td>
<td>Frequency</td>
<td>Mechanism/Properties</td>
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<tr>
<td>Lincomycin</td>
<td>22 mg/kg q12h</td>
<td>Twice a day</td>
<td>Bacteriostatic, Narrow spectrum, Resistance develops rapidly, Cross resist with erythromycin</td>
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<td>Ormetoprim-Sulfadimethoxine</td>
<td>55 mg/kg the 1st day, 27 mg/kg q24h</td>
<td>Once a day</td>
<td>Relatively expensive, Side effects less than Trim/sulfa’s, Suppresses thyroid function</td>
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<tr>
<td>Oxacillin</td>
<td>22 mg/kg q8h</td>
<td>Bactericidal</td>
<td>Resistance and side effects rare, Narrow spectrum</td>
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<tr>
<td>Rifampin</td>
<td>5-10 mg/kg q24h</td>
<td>Penetrates scar tissue</td>
<td>Resistance, Needs concurrent antibiotics, Hepatotoxic</td>
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<tr>
<td>Trimethoprim-Sulfadiazine or Sulfamethoxazole</td>
<td>30 mg/kg q 12h</td>
<td>Inexpensive (generics)</td>
<td>KCS, drug reactions, hepatic necrosis, suppress thyroid function, resistance problems</td>
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<tr>
<td>Doxycycline</td>
<td>2.5 mg/kg q 12h</td>
<td>Inexpensive, Anti-inflammatory, long term use</td>
<td>Esophageal ulceration, Vomiting – diarrhea</td>
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<tr>
<td>Azithromycin</td>
<td>5-15 mg/kg q 12h</td>
<td>New generation</td>
<td>Gastrointestinal side effect</td>
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**SUMMARY**

The appropriate management of superficial and deep pyoderma cases requires the use of both topical and systemic therapy. Having the basic knowledge of key active ingredients and the vehicles for delivering these to the skin will enable the practitioner to know when and how to select the appropriate topical product. Similarly, understanding antibiotic mechanisms, specific infection indications, side effects and toxicities will allow for better systemic antimicrobial selections.

**REFERENCES**