Skin infections with bacteria are often found in dogs secondary to other diseases such as seborrhea, endocrine diseases and allergic diseases. Many of these cases have abnormalities in skin barrier function or desquamation. When the primary disease is controlled if this defect is not corrected the dog may still be prone to recurrent infections though episodes may be less severe or less frequent. In chronic or recurrent infections other factors may develop which are referred to as perpetuating factors. The most common bacteria to cause skin infections in dogs is Staphylococcus pseudintermedius though occasionally other bacteria such as Staphylococcus aureus or schleiferi, Enterococcus, Corynebacteria, E. coli, and Pseudomonas may be pathogenic. The emergence of methicillin resistant Staphylococcus including pseudintermedius in dogs is now recognized around the world. Prior antibiotic therapy generally has been shown to be a risk factor for its occurrence though this was not the case in a recent study in Germany.[1] The Staph pseudintermedius associated with infections has very similar virulence factors with the only difference shown was increased protein A in dogs with pyoderma.

The diagnosis of pyoderma requires a skin lesion that has neutrophils with bacteria present that is preferably found intracellular within inflammatory cells. The classic primary lesions of pyoderma are: Pustules, furuncles, and fistula. Other lesions suggestive or compatible with pyoderma include: Crusts, papules, nodules, and lichenification. The spreading ring of scale (epidermal collarette) associated with some erythema, exudate or crusting is also very typical of pyoderma. If cocci are seen then most commonly the pyoderma is due to Staphylococcus though definitive identification requires a culture. Based on the simplest definition of a pyoderma I prefer to diagnose bacterial overgrowth when no inflammatory cells are present but bacteria are present in abnormally high numbers. High is greater than one cocci or 0.5 rods per OIF (1,000X) based on unpublished work by Dr Colombo. It has also been proposed that 5 cocci may be an appropriate number to use. Further work evaluating this is indicated and should look at various sites commonly involved with pyoderma. Histopathology is also helpful in diagnosing pyoderma though bacteria are not often seen. Histopathology is also used to identify primary diseases as well as perpetuating factors. Most suppurative folliculitis and perifolliculitis occur because of pyoderma. The presence of bacteria in a crust or the stratum corneum is also significant. Determination of resistance does require sensitivity testing and should be performed whenever cases have not responded to empiric therapy.

Predisposing and perpetuating factors
Since pyoderma is most often secondary successful long-term management will require that underlying primary diseases are identified and managed, but it is also important to realize other aspects of the dog may predispose such as inappropriate friction or alteration in skin microenvironment from things such as skin folds. Both friction and skin folds may be associated with genetically selected traits or obesity. Chronic trauma to the skin results in changes of the affected hair follicles. This is best exemplified by the formation of a callus. In some cases this response can predispose to pyoderma.

The role of chronic skin disease and the development of recurrent and also resistant pyoderma are well accepted. What is not often discussed is what role does the pyoderma have on causing recurrent pyoderma. Does the presence of a pyoderma result in changes that may perpetuate the development of chronic inflammation and more pyoderma. There are some clinical observations that support this but studies are needed to answer this question. These perpetuating factors occur because the pyoderma has damaged cutaneous structures. The histopathology of chronic pyoderma cases will often have follicular hyperkeratosis. What has not been studied is what causes the follicular hyperkeratosis, is it always just the primary disease or is it the pyoderma? Many atopic dogs that have had chronic pyoderma will have follicular hyperkeratosis, but that is not a classic lesion of atopic dermatitis. It is common for a dog with deep pyoderma to have a history of chronic superficial pyoderma that eventually progresses to a case with both superficial and deep lesions. Why does this occur? Other aspects than just the primary disease may be involved. In some cases maybe drugs the dog is on contribute. How do corticosteroids impact chronic pyoderma cases? Folliculitis often results in foci of alopecia. The loss of hair now exposes the skin to ultraviolet radiation and in some dogs they do not have the ability to pigment the skin. What role does the ultraviolet radiation have on the local immune response or even the hair follicle structure or cutaneous inflammation? When an infected hair follicle does rupture it releases keratin and hair shafts into the dermis. That material also stimulates inflammation and in some cases fibrosis and scarring. Though normally this material is broken down and eventually eliminated some cases develop persistent hair shaft sequestrum that appears to be associated with chronic or recurrent cases. In others it may not be hair shafts but remnants of corneocytes are found in the center of microabcesses or scars and the possibility of cocci that may adhere to corneocytes being protected inside a folded or rolled up corneocyte is another possible site for sequestering bacteria and protecting them from tissue levels of antibiotics or the body’s immune defenses. Abscess or granuloma formation may alter the ability of some antimicrobials to effectively reach or kill the microorganisms. Another pathologic change that may be less apparent is fibrosis unless
it occurs grossly. Fibrosis more often occurs at the microscopic and not the gross level. The fibrosis may be perifollicular or more diffuse throughout the dermis. Certain breeds (Doberman pinscher, bull and Staffordshire terriers, Rottweiler) seem more predisposed to excessive scarring that appears to make resolution of the pyoderma more difficult.

Clinically cases occur that the primary disease is well controlled or eliminated yet recurrent infections may continue for some time. One could argue in the atopic dog that this is because the barrier defect that was present even before the atopic disease is not really controlled. How does one explain in the testicular tumor dog that still gets recurrent pyoderma after the testicular tumor is removed? Studies evaluating causes of chronic recurrent pyoderma other than primary diseases are needed. If perpetuating factors are important then how we manage these cases may need to change. If we can prevent infections from causing perpetuating factors or find ways to reverse perpetuating factors we may improve the chances of eliminating recurrent infections.

Treatment
Success treating skin infections requires appropriate antimicrobial therapy and systemic antibiotic therapy has been the main emphasis of veterinarians for many years. Topical therapy though considered helpful can actually be essential to successful therapy and in some cases with resistant bacteria such as methicillin resistant Staph (MRS) may become the main or sole method to eliminate the infection. Even following therapy is it common to find Staphylococcus either persisting on the skin or in carriage sites and often these will still be resistant strains though fluctuations in this pattern are seen.

Additionally any pathologic changes in the normal anatomy or physiology of the skin that occur because of the inflammation from the infection need to be reversed or controlled. If any part of these components is not addressed then more antimicrobial therapy will be required and success will be limited. Some treatments may need to be directed at reversing pathologic changes or long-term therapy may be required until the body naturally remodels or reverses those changes. In others surgical correction or removal of localized fibrotic or granulomatous lesions can be an effective and cost saving procedure. Long-term pentoxifylline may help to reverse scarring in some cases with widespread lesions not amenable to surgical therapy. Glucocorticoids have been used in some cases with residual granulomas but this should only be done after antibiotic therapy has eliminated the bacteria and the granulomas are sterile based on culture of ground up tissue samples.

Cleaning the skin promotes desquamation, which removes surface bacteria and yeast as well as irritants and allergens. In some cases ingredients may be used to normalize keratinization or improve barrier function. Inflammation may be decreased by addition of anti-inflammatory ingredients or just the use of cool water. This along with moisturizing and cooling the skin will also decrease pruritus. Cleansing the skin is most readily accomplished by bathing the pet and is also the most effective way to topically treat large body areas. Bathing also lends itself to the use of rinses after the bath that may contain topical antimicrobials. In general the more frequent the bathing the better and in some cases 2-3 times a week is very effective in preventing recurrent pyoderma and bacterial overgrowth. Daily is required in some cases to get complete resolution then less frequent may maintain remission.

Antiseptics are often incorporated into shampoos and other topical therapies (leave on conditioners and gels, lotions, sprays and wipes) used to treat pyoderma. These are particularly useful for more localized areas such as the chin, paws and fold areas. Similar to antibiotics one might expect natural selection to eventually favor the development of resistant strains of bacteria. A group of gene mutations have been recognized that confer some resistance to a wide variety of lipophilic cationic compounds including quaternary ammonium compounds which is what the genes have been named after (QACs) though many other antiseptics are also seeing resistance due to these genes.[2] So the problem with resistance is not just to antibiotics but also antiseptics. These have not yet been found in canine S pseudintermedius.[3] Strategies for reducing resistance and mitigating the problems it can present have been described for parasites for a number of years. Integrated pest control is a process of using multiple different types of anti parasitic agents and rotating and or combining there use. Apparently this is a strategy that we should incorporate into out approach to canine recurrent pyoderma. This approach has been more used for years in dealing with chronic otitis cases and now that we see some similarities between chronic recurrent pyoderma chronic recurrent otitis we should be incorporating a similar approach.

The most common active antimicrobial ingredients used in veterinary medicine are: benzoyl peroxide, chlorhexidine, ethyl lactate, mupirocin, neomycin, polymyxin, phytosphenosine, salicylic acid, sulfur and triclosan. Multiple studies have shown chlorhexidine and benzoyl peroxide to be particularly effective though some have show benefit with other antiseptic ingredients. Based on how we approach ear cases it is preferable to use synergists or combinations of antiseptics as long as their effects are not antagonistic. In addition using systemic antimicrobials that target the bacteria by pathways that do not share the same gene mutations for resistance will be more similar to how integrated pest control is done, we should consider integrated antibacterial therapy as a way to try and minimize the risk of or slow down the development of even more resistant strains.

References