Staphylococcal skin infections can be stubbornly recurrent in some dogs. The client (and the veterinarian) must understand that staphylococcal bacteria are normal flora; infection cannot occur unless something has gone wrong with the skin or its defense systems. Thus, particularly in recurrent infections, the first step is to attempt to define the underlying cause with appropriate diagnostic investigation. In younger dogs with recurrent infections, common causes of recurrence include external parasites and allergic disease. Older animals can also develop recurrent infections from hypothyroidism or any other underlying systemic disease. Despite thorough testing, some patients with recurrent infections defy diagnosis—their infections respond completely to antibiotic treatment, yet continue to recur soon after such treatment is discontinued. For such patients with “idiopathic recurrent pyoderma,” there are several measures that may help to prevent or limit recurrence.

**Important Factors in Pathogenesis**

Advanced techniques have allowed for a more careful examination of the host factors and bacterial factors that may be important in the pathogenesis of recurrent pyoderma. The first step in infection is adherence of the bacterium to the cells or tissue of interest. Recent studies have shown that it is much easier for staphylococci to adhere to canine skin cells than to feline skin cells. Perhaps this helps explain why infection occurs more often in dogs. As another example, the epidermis, as part of its normal defense system, secretes bactericidal peptides called defensins. It is now well established in humans that individuals with atopic dermatitis may have decreased production of these substances compared with nonallergic people; this may explain the predisposition to recurrent infection in atopic human patients. These factors are currently being studied in dogs. With regard to bacterial factors, several studies have attempted to find some characteristic of the organism itself (for example, the particular species or strain of *Staphylococcus*) that makes it particularly virulent or prone to cause recurrent infection. So far, these factors have not been uncovered, leading one to speculate that the most important factors may be those associated with the host. There has been a recent increase in reports of multidrug-resistant staphylococcal strains. In particular, the methicillin-resistant staphylococci (MRS) are of concern, and, of course, the presence of a highly resistant bacterial strain may complicate treatment.

In some cases of recurrent pyoderma, there are complicating factors. We must consider several forms of pyoderma in which additional factors contribute to the pathogenesis and make treatment difficult. Examples include German Shepherd Dog pyoderma/cellulitis—a special form of deep pyoderma in which there is evidence of a genetically determined cellular immunodeficiency—and interdigital pyoderma, in which, in addition to staphylococcal infection, the deep infection that occurs between the toes is, in part, a foreign-body reaction to hair shafts, perhaps entrapped in scar tissue. Recent evidence suggests that at least some cases of interdigital pyoderma truly begin as cystic structures that become secondarily infected.

**Assessing Patients with Recurrent Pyoderma**

From a clinician’s perspective, the main underlying causes of a recurring pyoderma can be divided into four groups, depending on the response to antibiotic treatment. Routine procedures, such as skin scrapings for mites, dermatophyte culture, careful history, and physical examination, should be conducted first to eliminate common and obvious causes of recurrence. Following this, the patient’s response to antibiotic treatment is a valuable clue to underlying factors and will aid greatly in planning logical diagnostic evaluation to uncover the predisposing factors for each patient. The clinician must treat with antibiotics alone for 3 to 4 weeks and observe the clinical response. We can examine the four groups of underlying causes more carefully, depending on response.

1. **If the response is a complete clearing of lesions, yet with substantial remaining pruritus,** allergic causes should be strongly considered as underlying causes.
2. **If the response is a partial clearing of the lesions,** but the skin is not totally normal and pruritus remains, underlying factors to consider include inadequate treatment, parasitism, food allergy, primary seborrhea, and dermatophytosis. Diagnostic steps in this case might include repeated skin scrapings, empirical treatment for scabies mites, a hypoallergenic diet trial, fungal culture, and skin biopsy.
3. **If there is little or no clinical response** to antibiotic treatment, factors such as antibiotic resistance or poor client compliance should be considered. It is also possible that the diagnosis is wrong—nonpyoderma pustular diseases such as pemphigus foliaceus may be present. Bacterial culture and sensitivity testing, fungal culture, and skin biopsy would be indicated with this response pattern.
4. *If the response is a complete clearing of both lesions and pruritus,* the main underlying factors to consider include systemic disease, very early allergic disease, and idiopathic recurrent superficial pyoderma. In this event, diagnostic evaluation consists of evaluation for systemic disease with blood and urine analyses and possible evaluation for allergic disease. If a specific cause is not found, the diagnosis of “idiopathic recurrent pyoderma” can be made; several treatment options are available for attempting long-term control and prevention of recurrence.

**Methicillin-Resistant Staphylococci: An Added Complication**

There has been a recent increase in reports of multidrug-resistant staphylococcal strains and MRS in canine pyoderma. In some areas of the United States, more than 50% of skin cultures performed at dermatology specialty practices are MRS. These strains include the methicillin-resistant *Staphylococcus pseudintermedius* species (canine infections, referred to as “MRSP”) and methicillin-resistant *Staphylococcus aureus* species (human infections, referred to as “MRSA” and, fortunately, much less common). Veterinarians should endeavor to use correct terminology when discussing these infections with clients; incorrectly referring to a canine MRSP infection as “MRSA” may be alarming to the client. If laboratory testing indicates the presence of MRS, the isolate will be *clinically resistant to all penicillins and cephalosporins.*

What is the significance of these organisms? First, if you treat a dog with staphylococcal pyoderma with a beta-lactam antibiotic (cephalosporin or penicillin) and there is limited or no response, *culture and susceptibility testing is now mandatory.* Fortunately, most veterinary strains of MRS are still susceptible to routine antibiotics such as trimethoprim-sulfamethoxazole, clindamycin, or a fluoroquinolone such as enrofloxacin or marbofloxacin. However, it is important to note that it is impossible to predict with any certainty which antibiotics are indicated without performing a susceptibility test. Empirical “antibiotic hopping” is hazardous, as with each cycle of treatment, multiple drug resistance becomes more likely.

Second, if you do identify an MRS organism, especially if it appears to be very resistant, *you should order a staph speciation test.* If you have a patient with MRSP (i.e., the canine strain) in your hospital, you need not have the dog under full isolation procedures, but you should isolate the patient to the extent you can and eliminate traffic from this patient to other dogs in the clinic, especially the surgery and critical care areas. If the organism turns out to be a methicillin-resistant, human-origin *S. aureus* (MRSA), the owner should be notified of this fact so they can discuss the situation with their own health-care provider and gloves should be worn when examining the patient. This patient is a *potential* human health hazard and should be considered so until all lesions have completely resolved. The concern here is that without proper precautions, the MRSA could colonize the owner, you, your staff, or others. It is important to understand that merely becoming colonized with MRSA is not inherently dangerous. After all, 3% to 5% of people are already colonized at any given moment, and colonization is dynamic and transient. Where the situation becomes potentially dangerous is if the colonized person becomes injured or immunosuppressed.

Third, the emergence of MRS in the veterinary world suggests that we must redouble our efforts to use antibiotics wisely and judiciously and reconsider all efforts to use alternative, nonantibiotic treatments, if possible, in the face of recurrent infections.

**Reducing Antimicrobial Use and Preventing Infection**

Antimicrobial topicals are the first line of defense with recurrent skin infections. Shampoos containing 2% to 4% chlorhexidine appear especially helpful for preventing new lesion development when used twice weekly and allowed to remain on the pet for 5 to 10 minutes before rinsing. Any patient with a history of recurrent pyoderma, even if it is bathed infrequently, should have a chlorhexidine-based routine cleansing shampoo. Other ingredients, such as benzoyl peroxide, are also effective but tend to be drying and irritating with prolonged use. Products that are formulated to remain on the skin may have a longer duration of action on the skin than a shampoo and, in many cases, are easier for the owner to apply frequently. For localized areas, treatment with a cream, ointment, or wipe may suffice. For broader regions of the skin, spray-on products, mousse formulations, or “leave-on” conditioner products are recommended. To help prevent relapse of recurrent pyoderma, begin with every-other-day application. If effective, the applications may be tapered down to every 3 or 4 days in many patients. The overall principle here is to limit, to the extent possible, prolonged or repeated courses of antibiotic treatments to minimize the potential for development of antibiotic resistance.

Increasingly, dermatologists understand that it is frequently very possible to *eliminate* active superficial staphylococcal infections from the skin by using topical products as the primary treatment without antibiotics. This
can be done as a “safety precaution” to avoid yet another course of systemic antibiotics; alternatively, it can be used for very resistant MRS strains for which antibiotic choices are limited or nonexistent. For primary treatment of an existing superficial pyoderma, daily treatment is necessary until the infection is cleared, which typically takes four weeks or more.

Whether used daily as primary treatment or every few days as preventive maintenance, the following ingredients are useful in topical products:

- **Mupirocin 2% ointment**—applied daily to areas of local infection as a primary treatment; not for prevention.
- **Chlorhexidine**—spray, mousse, or gel formulation, for treatment or prevention.
- **Nisin wipes** (Preva Wipes, DVM)—a “generally recognized as safe” antimicrobial peptide that is commonly used in some areas of the world as a disinfectant teat wipe for dairy cattle and is even used as a food preservative. Preliminary studies in dogs demonstrated that use of these wipes twice daily could limit bacterial colonization and slightly accelerate healing of existing pyoderma in addition to having potential as preventive therapy.
- **Use of oxidizing disinfectants** such as very dilute sodium hypochlorite solutions (“bleach baths”) has become very popular in human atopic dermatitis recently, as this treatment greatly helps to limit secondary bacterial colonization of skin. Veterinary products with similar actions (basically solutions with stabilized hypochlorite ions, usually in spray formulation) are gaining popularity with some dermatologists (e.g., Vetericyan, Innovacyn), although critical studies are lacking.
- **Peroxide** is an excellent oxidizing disinfectant. The most recently popular products contain “accelerated hydrogen peroxide,” which is simply hydrogen peroxide with added stabilizers and surfactants to enhance its efficacy. Again, we await critical “on-patient” studies of efficacy for these products.

Immunomodulatory therapy can be remarkably effective for some patients with idiopathic recurrent superficial pyoderma. Its use for recurrent deep pyoderma, or for recurrent pyoderma associated with allergic disease, is less well studied. In particular, staphylococcal bacterin products are very useful. These “staph vaccines” are either available commercially (SPL, Delmont) or are prepared by a local laboratory as autogenous bacterins. They generally must be used long-term to prevent recurrence; however, their use avoids the necessity of prolonged antibiotic treatment in some pets. SPL has a variety of immunomodulatory actions; unfortunately, these have mostly been studied in mouse models or in vitro and rarely in dogs. Recent gene-expression microarray studies in dogs suggest that SPL may exert its effect via upregulation of interferon-gamma production. SPL is administered at 0.5 cc subcutaneously, twice weekly, for a trial period of 10 weeks. During the first 6 weeks of injections, antibiotics are administered concomitantly. After 6 weeks, the antibiotics are stopped and the injections continued. Success is manifested as failure to relapse, much milder relapse, or infrequent relapse compared with before use of the SPL. If SPL is effective, it can usually be reduced to once-weekly injection, and sometimes once every 2 weeks.

Continuous antibiotic treatment via “pulse therapy” has always been a last-resort treatment for recurrent pyoderma, but with the current resistance situation, it should be avoided at all costs. The emergence of MRS has virtually guaranteed that such treatment will eventually result in colonization by a resistant strain, a phenomenon that is growing worldwide.

**References and Further Reading**


