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Sodium Hypochlorite/Salicylic Acid Shampoo for Treatment of Canine Staphylococcal Pyoderma

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ABSTRACT

The emergence of methicillin-resistant *Staphylococcus pseudintermedius* has increased the interest in topical therapy for treating canine pyoderma. Shampooing with chlorhexidine followed by dilute bleach rinses are often recommended, but household bleach can dry the skin and is unpleasant to use. A shampoo formulated with sodium hypochlorite and salicylic acid was evaluated as sole therapy for dogs with superficial pyoderma associated with *S. pseudintermedius*, including methicillin-resistant strains. Client-owned dogs were recruited based on positive culture for methicillin-resistant staphylococci or prior failure of pyoderma to respond to antibiotics. This prospective, open-label pilot study assessed the efficacy of the shampoo when used three times weekly for 4 wk. Dogs were evaluated at baseline and at 2 and 4 wk by cytology, clinical examination, and owner assessment. Digital images were also obtained. Baseline bacterial counts, clinical assessments and owner scores were significantly improved at 2 and 4 wk. Clients completing the study reported excellent lathering and dispersion, reduction in odor, and brightening of white and light coats. No owners reported skin dryness or other adverse events during the study. We conclude that this shampoo containing sodium hypochlorite in a vehicle that avoids skin drying is an effective treatment for canine pyoderma. (*J Am Anim Hosp Assoc* 2019; 55:■■■-■■■. DOI 10.5326/JAAHA-MS-6628)

Introduction

Methicillin-resistant staphylococcal (MRS) infections are becoming more common in dogs, requiring us to rethink our approach to treating pyoderma.¹⁻⁴ Many of the methicillin-resistant *Staphylococcus pseudintermedius* (MRSP) organisms isolated from dogs show resistance to multiple antibiotics, leaving older and more toxic antibiotics such as amikacin, rifampin, and chloramphenicol as the only therapeutic choices.⁵ Topical therapy can be used in place of systemic antibiotics and bathing alone can resolve superficial pyoderma in many patients; however, determining which topical regimen is most effective is not completely clear.⁶ Currently published evidence suggests that chlorhexidine is the most effective antiseptic in vitro against *S. pseudintermedius* including MRSP, and numerous clinical studies comparing shampoos in dogs with pyoderma have confirmed this observation.⁷⁻¹⁴ Recently, Borio et al. showed that bathing twice weekly with a 4% chlorhexidine shampoo combined with daily application of 4% chlorhexidine solution resolved superficial pyoderma in dogs.¹⁵

Bleach baths are often recommended for human patients with infections caused by methicillin-resistant *Staphylococcus aureus*, including those affected with atopic dermatitis. In one study, 0.005% sodium hypochlorite (made by adding 1/2 cup or 120 mL of 6% bleach to 40 gal of water) was used twice weekly along with nasal mupirocin twice daily for 5 days per month over a 3 mo evaluation period.¹⁶ Significant decreases in both severity and extent of lesions were observed. These results were confirmed for patients with community-acquired skin and soft tissue *S. aureus* infections.¹⁹ Patients using dilute bleach baths containing 0.002–0.009% sodium hypochlorite were less likely to have positive cultures after 4 mo than those using 4% chlorhexidine (71% versus 56% negative cultures); however, more patients developed dry skin (25% versus 20%).

Although the efficacy of dilute bleach baths for the treatment of human cutaneous infections is not supported by a recent Cochrane literature review, it is reasonable to suggest that this may be due to a lack of publications supporting efficacy, rather than a true lack of

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HPF (high-power field); MRS (methicillin-resistant staphylococcal); MRSP (methicillin-resistant *Staphylococcus pseudintermedius*); SD (standard deviation)

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efficacy.²¹ Veterinary dermatologists have already adopted the use of topical therapy including dilute bleach baths for treating MRS infections in dogs. Although deemed effective by many, a number of problems exist including the lack of information about the optimal concentration and frequency of use, messiness, and the tendency to dry the skin and lighten coat color in black dogs. One study showed that the optimal in vitro concentration of sodium hypochlorite for

killing *S. pseudintermedius* was 0.00156%, a concentration roughly comparable to that reported for *S. aureus* (0.006%).^{22,23}

A recently developed human gel wash product containing 0.0061% sodium hypochlorite was effective for treating children with atopic dermatitis associated with *S. aureus* infections.²⁴ Eighteen children with moderate-to-severe atopic dermatitis and positive cultures for *S. aureus* were treated with the body wash three times

TABLE 1

Owner Questionnaire

1. Over the last 2 wk, how red are the lesions or bumps on your pet's skin?

- (0) There are no lesions on my pet's skin
- (1) The lesions on my pet's skin are mildly red
- (2) The lesions on my pet's skin are moderately red
- (3) The lesions on my pet's skin are severely red

2. Over the last 2 wk, how bad is your pet's odor?

- (0) My pet does not have a bad odor
- (1) My pet has a mildly bad odor, but it is not very noticeable
- (2) My pet has a moderately bad odor that is noticeable
- (3) My pet has a severely bad odor that is very noticeable

3. Over the last 2 wk, how bad is your pet's itch and discomfort?

- (0) My pet is not itchy
- (1) My pet is somewhat itchy and uncomfortable
- (2) My pet spends a noticeable amount of time licking or scratching
- (3) My pet will stop eating or playing to scratch and lick

4. Over the last 2 wk, how much emotional distress (worry, embarrassment, frustration) have you experienced due to your pet's skin problems?

- (0) None at all
- (1) A little
- (2) Quite a lot
- (3) Very much

5. Over the last 2 wk, how much physical distress (tiredness, exhaustion, sleep disturbance) have you experienced due to your pet's skin problems?

- (0) None at all
- (1) A little
- (2) Quite a lot
- (3) Very much

6. Over the last 2 wk, how much time have you spent (putting on creams, washing, giving medicines) due to your pet's skin problems?

- (0) None at all
- (1) A little, about one hr a week
- (2) Quite a lot, about 2-4 hr a week
- (3) Very much, more than 4 hr a week

7. Over the last 2 wk, how much household expense (travel costs, buying special products) have you spent due to your pet's skin problems?

- (0) None at all
- (1) A little
- (2) Quite a lot
- (3) Very much

These questions relate to the impact of your pet's skin disease on your quality of life over the last 2 wk. Please read the questions and check one box for each.

weekly for 12 wk. Clinical severity scores were significantly decreased, and the parents of the children found the body wash much easier to use than traditional bleach baths. Patients also preferred this treatment to traditional dilute bleach soaks because it was easier and less disruptive to their lifestyles. Furthermore, only 1/18 patients (5.6%) reported pruritus associated with skin dryness, suggesting that this therapy may have an improved safety profile.

Based on the success reported in humans, a shampoo was developed for use in dogs. It is formulated with sodium hypochlorite and salicylic acid.²⁵ It was designed as a shampoo for use in atopic dogs and/or dogs with staphylococcal or other skin infections to help reduce infection, itch, and odor. Initially used two to three times weekly, it can subsequently be used for weekly maintenance or changed to a formulation that does not contain salicylic acid. The purpose of this prospective, open-label pilot study was to evaluate the efficacy of this shampoo as sole treatment of superficial pyoderma in dogs, including those with MRSP.

TABLE 2**Demographic Characteristics and Culture Results of Enrolled Patients**

Breed	Gender	Age, yr	Atopic	Culture Results
Golden retriever	CM	6	Yes	MRSP
French bulldog	CM	3	Yes	MRSP
West Highland white terrier	SF	4	Yes	MRSP
Viszla	CM	5	Yes	MSSP
West Highland white terrier	CM	12	Yes	MRSP
Golden retriever	CM	4	Yes	MRSP
Dogo Argentino	SF	5	Yes	MRSP
Boxer	SF	2	Yes	MRSP
Labrador mix	CM	5	Yes	MRSP
Poodle*	SF	9	No	MRSP
Cavalier King Charles spaniel	SF	3	No	MRSP
Doberman pinscher	SF	7	Yes	MRSP
French bulldog	CM	2	Yes	MRSP
American cocker spaniel	CM	5	Yes	MRSP
Shih tzu	SF	3	No	MRSP
Maltese	CM	8	Yes	MRSP
Boston terrier*	CM	2	Yes	MSSP
German shepherd dog	M	3	Yes	MRSP
Welsh springer spaniel	CM	7	Yes	MRSP

*Withdrawn from study.

CM, castrated male; M, male; MRSP, methicillin-resistant *Staphylococcus pseudintermedius*; MSSP, methicillin-sensitive *Staphylococcus pseudintermedius*, SF, spayed female.

Materials and Methods

Test Material

The shampoo used in the study contains the bactericidal agent sodium hypochlorite, the keratolytic agent salicylic acid and, a proprietary mix of surfactants, moisturizers, and conditioners^a.

Patient Selection

Dogs with superficial pyoderma were selected for this study based on a confirmed culture of MRSP upon referral or a history of failing to respond to two different classes of antibiotic, which is suggestive of infection with MRSP; the skin of these dogs was cultured prior to entry into the study. The dogs could be of any age, sex, or breed. The presence of cocci was confirmed by cytology. Material for culture was collected with sterile culturettes moistened with saline, and three lesions were sampled. The cultures were submitted to the Texas Veterinary Medical Diagnostic Laboratory. Oxacillin resistance suggested a methicillin-resistant isolate, which was confirmed by latex agglutination for the presence of PBP2a. Informed consent was obtained from all owners to use the sodium hypochlorite shampoo topically.

Study Protocol

This was a prospective, open-label pilot study. The owners were asked to bathe their pet for 5 min three times weekly with the test product and return to the clinic for re-evaluation at 2 and 4 wk. Concurrent medications for atopic dermatitis or other medical conditions were permitted except for antibiotics or other shampoos.

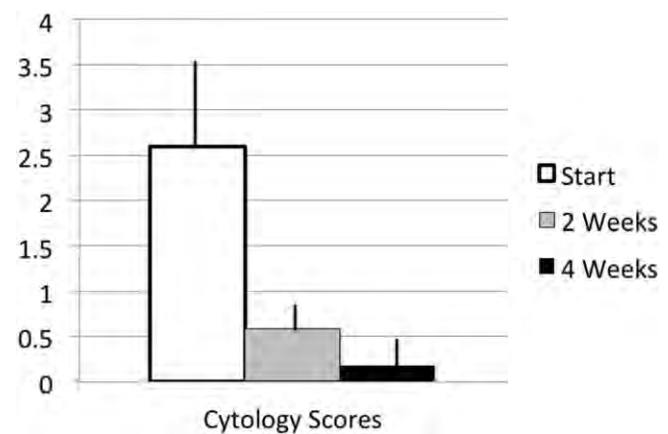


FIGURE 1 Effect of bathing three times weekly on bacterial load. Dogs were bathed three times weekly with the sodium hypochlorite/salicylic acid shampoo. Cytologies were taken at start, 2 wk, and 4 wk and assessed for bacterial counts as described in Materials and Methods. There was a statistically significant decrease in mean baseline bacterial counts at 2 and 4 wk (for each, $P < .0001$). The difference between 2 and 4 wk was not statistically significant. Means and standard deviations shown.

At the initial clinic visit and each subsequent visit, lesions were photographed, cytology samples were obtained to roughly quantitate bacterial numbers, and, if not previously done, samples were obtained for culture and sensitivity as described above. A semiquantitative assessment of clinical severity score was obtained by ranking erythema, crusting, odor, pruritus, and percent of affected body area from 0 (none) to 3 (severe) for a maximum severity score of 15. Each owner completed a questionnaire at each visit to determine their assessment of redness, odor, itch, and discomfort, as well as their own emotional, physical, and financial distress associated with their pet's skin disease (Table 1).

Cytology

Samples were collected using clear acetate tape or slides precoated with adhesive^b and stained using a modified Romanowsky stain, avoiding the initial methanol fixative, as it disrupts tape and the adhesive slides. Slides were examined using 100× oil immersion and a minimum of 10 fields assessed. A semiquantitative scale from 0 to 4 was used to estimate bacterial burden in which 0 = no bacteria found, 1 = 1–5 organisms/high-power field (HPF), 2 = 6–10 organisms/HPF, 3 = 11–15 organisms/HPF, and 4 = >15 organisms/HPF. The investigator that saw a patient initially performed each recheck exam and each cytology to reduce the potential for inter-investigator differences. The validity of the owner questionnaire was assessed as follows: the initial questionnaire was reviewed by five clinicians, and changes were made to improve clarity. Prior to its use in this study, it was given to owners of 10 dogs whose pyoderma was treated successfully with antibiotics. Reduction in questionnaire scores was found to correlate well with reduction of clinical scores.

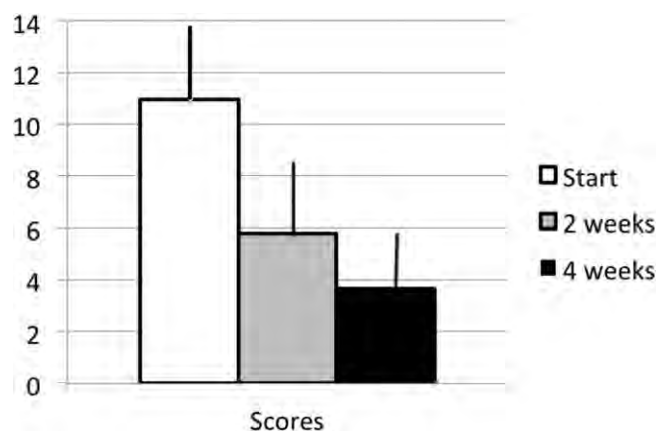


FIGURE 2 Effect of bathing three times weekly on clinical severity. Clinical severity was assessed as described in Materials and Methods. Mean baseline clinical severity scores significantly decreased at 2 and 4 wk (for each, $P < .001$). The difference between 2 and 4 wk was not statistically significant. Means and standard deviation shown.

Statistical Analysis

Because of the limited patient population of this pilot study, Kruskal-Wallis one-way analysis of variance was chosen as a conservative nonparametric test that was unlikely to over-interpret significance.

Results

A summary of the patients enrolled in the study is presented in Table 2. Among the 19 dogs enrolled in the study, the study was completed by 17 dogs. One dog with methicillin-sensitive *S. pseudintermedius* was lost to follow-up and one with MRSP dropped out as a result of escalating severity of pyoderma at the 2 wk evaluation. Seventeen dogs had confirmed MRSP infections, 2 had confirmed methicillin-sensitive *S. pseudintermedius* infections, and 16 had atopic dermatitis.

The effect of bathing three times weekly with the study product on cytological assessment of bacterial burden is shown in Figure 1. The mean (\pm standard deviation [SD]) cytology score at baseline was 2.59 (\pm 0.94), decreasing to 0.59 (\pm 0.51) at week 2 and 0.18 (\pm 0.39) at week 4 (for each, $P < .0001$ versus baseline). At week 2, 29% of the dogs (5/17) had negative cytology results, increasing to 82% (14/17) at week 4.

The change in clinical severity assessments is shown in Figure 2. The mean (\pm SD) baseline score was 10.95 (\pm 2.92), decreasing to 5.8 (\pm 2.7) at week 2 and 3.65 (\pm 1.85) at week 4 (for each, $P < .001$ versus baseline). As shown in Figure 3, the mean (\pm SD) total baseline owner assessment score was 12, decreasing to 7.3 at week 2 and 6.2 at week 4 (for each, $P < .0037$ versus baseline).

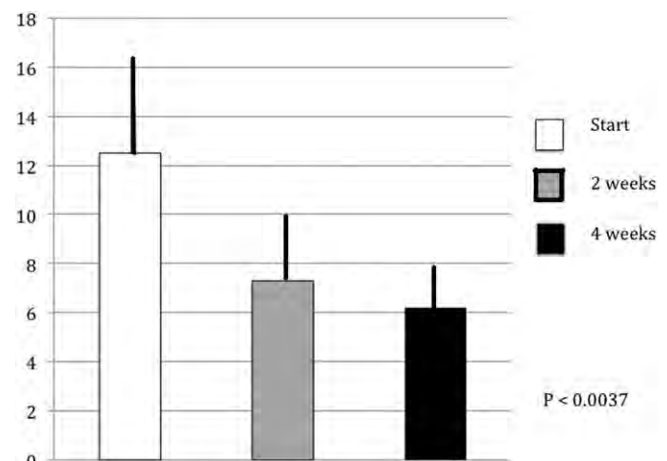


FIGURE 3 Effect of bathing three times weekly on owner assessments. Owner assessments were assessed by compiling the scores for each visit using the information obtained in Table 1. Mean baseline owner assessment scores were significantly decreased at 2 and 4 wk (for each, $P < .0037$). The difference between 2 and 4 wk was not statistically significant. Means and standard deviation shown.

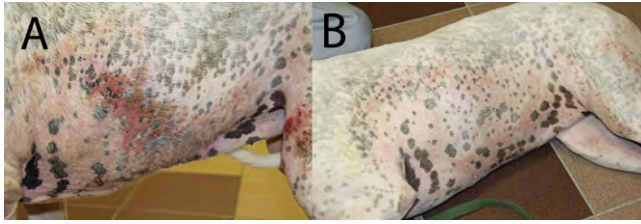


FIGURE 4 Clinical results on MRSP-associated pyoderma in an atopic Dogo Argentino. (A) The lesions at the beginning of treatment, and (B) the same area after 4 wk of bathing three times weekly. MRSP, methicillin-resistant *Staphylococcus pseudintermedius*.

Substantial clinical improvement was evident in the clinical photographs of all dogs in the study.

Discussion

The results of this pilot study demonstrate that bathing three times weekly using a shampoo formulated with sodium hypochlorite and salicylic acid can resolve superficial pyoderma caused by *S. pseudintermedius*, including methicillin-resistant strains, in most dogs. Scores from cytology examinations and clinical severity and owner assessments were significantly reduced after 2 wk. These results compared favorably with those reported for chlorhexidine.^{7,12,13}

The questionnaire we used was simple and easy for clients to use each visit. We assessed the validity by first having it reviewed by five clinicians and then by using it for the owners of 10 dogs with pyoderma successfully treated with antibiotics. The survey results seemed to track with clinical improvement and with cytology scores. We believe that the survey, as well as the clinical scores, was able to detect changes in pyoderma that would be expected at the 2 and 4 wk recheck appointments. Clinical improvement was also documented by photography, and we show three patient examples here. **Figure 4** shows the response to bathing in a Dogo Argentino with severe atopic dermatitis and MRSP. Bathing alone, without antibiotic

therapy, resulted in dramatic improvement at 4 wk. **Figure 5** shows the response to bathing in an atopic French bulldog with MRSP. Complete clearing of the infection with early hair regrowth was seen at 4 wk. **Figure 6** shows dramatic improvement in a German shepherd dog with severe MRSP infection. Within 2 wk, the dog was substantially improved and remained improved at 4 wk. Unsolicited comments from clients included improved reduction in odor compared with other shampoos and whitening and brightening of light coats. Many clients also reported that the shampoo lathered well and was easy to disperse across the body. This shampoo did not appear to be excessively drying compared with the daily use of bleach rinses or sprays.

It is clear that the emergence of MRS infections has required that we change our approach to the treatment of pyoderma.¹⁻⁴ We can no longer continue to use repeated long courses of oral antibiotics with impunity as we have done in the past. Pulse antibiotics are also no longer recommended, so it behooves us to find effective methods to control recurrent pyoderma. Although veterinary dermatologists have always advocated for topical therapy, we are now doing so with increased zeal. Our improved approach to recurrent pyoderma includes a determined effort for early identification and treatment, finding the underlying causes, good antibiotic stewardship, and the effective use of topical therapy. The product used in this study offers a new option that combines the power of shampooing with the antibacterial activity of sodium hypochlorite and salicylic acid. The physical action of washing and rinsing contributes greatly to removal of infectious materials, and sodium hypochlorite is a proven antimicrobial agent.^{16-18,22,23}

The mechanism of action of bleach on microbes is complex and begins with the following reactions: $\text{NaOCl} + \text{H}_2\text{O} \leftrightarrow \text{NaOH} + \text{HOCl} \leftrightarrow \text{Na}^+ + \text{OH}^- + \text{H}^+ + \text{OCl}^-$.

The sodium hydroxide saponifies fats, and the reactive oxygen radicals oxidize fatty acids, thus degrading the phospholipids in the

FIGURE 5 Clinical results on MRSP-associated pyoderma in an atopic French bulldog. (A) The lesions at the beginning of treatment. (B) shows the same area after 2 and (C) 4 wk. At 4 wk, the area on the left thorax was clipped and intradermal skin testing performed, accounting for the erythematous lesions seen in this photograph. MRSP, methicillin-resistant *Staphylococcus pseudintermedius*.



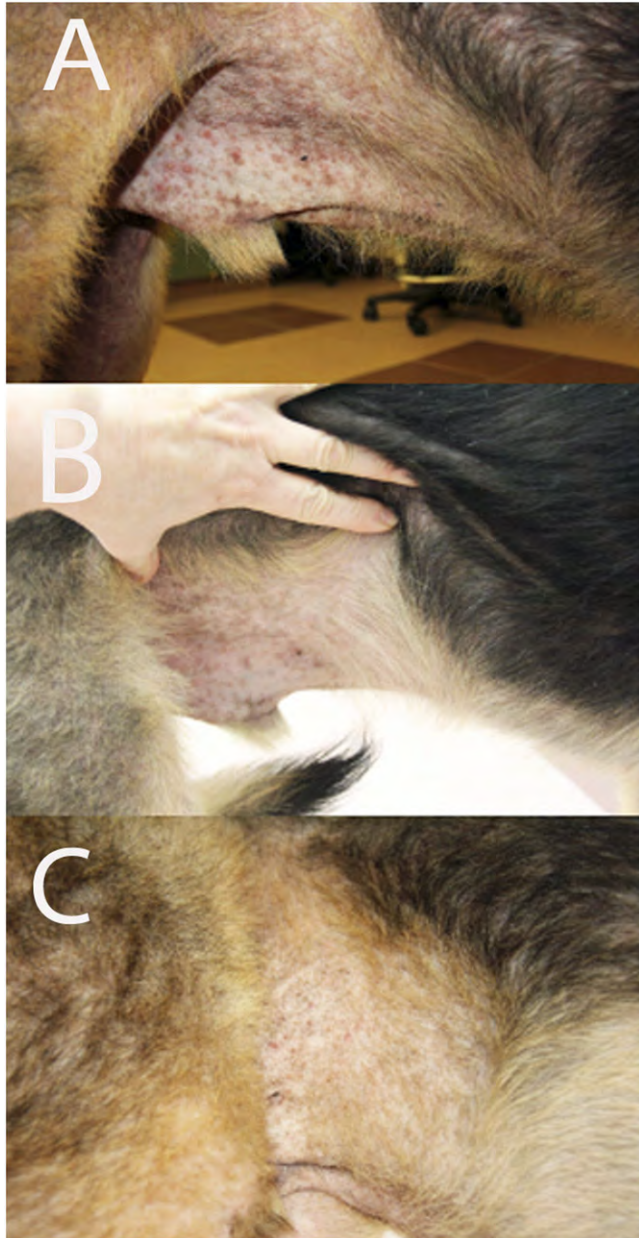


FIGURE 6 Clinical results on MRSP-associated pyoderma in an atopic German shepherd dog. (A) The abdominal and forelimb lesions at the start of treatment, (B) the same areas after 2 wk, and (C) the abdomen after 4 wk. MRSP, methicillin-resistant *Staphylococcus pseudintermedius*.

cell wall and cell membrane of bacteria. Sodium hydroxide also acts on amino acids to produce salts, altering bacterial proteins. Hypochlorous acid by virtue of the chloramine reaction also degrades amino acids within proteins, thus inhibiting essential bacterial enzymes that are found at the cell membrane. A major effect of low molar ratios of hypochlorous acid is the oxidative unfolding of bacterial proteins, which then aggregate, crippling and killing the

organism.^{26,27} The low concentration capable of killing microbes creates minimal and reversible damage to tissue.²⁸

Additional research is required to establish the product used in this study as the treatment of choice for the treatment of canine pyoderma associated with methicillin-resistant strains of *S. pseudintermedius*. A randomized multicenter study to compare the efficacy of the sodium hypochlorite/salicylic acid shampoo^a with a commercially available chlorhexidine-containing shampoo product would be ideal, as chlorhexidine shampoos are now considered the “gold standard.” An alternate to chlorhexidine that is just as efficacious would be desirable for dogs who experience drying of the skin or coat or topical irritant reactions associated with chlorhexidine shampoos.

Conclusion

The use of a new shampoo formulated with sodium hypochlorite and salicylic acid^a was found to decrease bacterial load, reduce clinical lesion severity, and improve owner assessment scores from dogs with superficial pyoderma associated with *S. pseudintermedius*, including infections caused by methicillin-resistant strains. It appears to be a viable alternate to chlorhexidine for the topical treatment of canine pyoderma. Further assessment by comparison with chlorhexidine shampoos should be done. ■

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FOOTNOTES

- ^a Splash Plush Shampoo; TopVet, Inc., Dallas, Texas, licensed as Command to VetriMax, College Station, TX
^b Duro-Tak; Delasco Dermatologic Lab and Supply, Inc., Council Bluffs, Iowa

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