INTRODUCTION
Demodectic mange has long been recognized in veterinary medicine as a cause of dermatitis and pruritus. There are over 65 different species of Demodex mites, with different animals having their own specie or species. There are two different species that commonly infest dogs and two different species found in cats. 30-40 years in the past, the diagnosis of demodectic mange in dogs was often a death sentence because effective medications were not readily available. Fortunately, several newer drugs are now available that makes management of these conditions more successful.

OVERVIEW OF MITES
The two most common Demodex mites that cause clinical disease in dogs are Demodex canis and Demodex injai. Both of these mites in dogs are follicular mites, and spend their life cycle in the hair follicles. This location protects them from physical removal and probably from the harmful effects of many insecticides commonly used for other ectoparasites of dogs. In addition, this location, deep in the follicles, offers one explanation for the lack of contagion observed in canine demodicosis. Other mites have been isolated from dogs, but their clinical relevance is not clear.

Cats have at least two Demodex mites that cause significant skin disease, Demodex cati and Demodex gatoi. The former is a follicular mite and disease caused by this mite is uncommon to rare. Demodex gatoi infestation appears to be localized to the stratum corneum and is common in some geographical areas.

<table>
<thead>
<tr>
<th>Mite</th>
<th>Location</th>
<th>Immunosuppression</th>
<th>Pruritus</th>
</tr>
</thead>
<tbody>
<tr>
<td>D. canis</td>
<td>follicle</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>D. injai</td>
<td>follicle</td>
<td>?</td>
<td>Variable</td>
</tr>
<tr>
<td>D. cati</td>
<td>follicle</td>
<td>?</td>
<td>No</td>
</tr>
<tr>
<td>D. gatoi</td>
<td>stratum corneum</td>
<td>?</td>
<td>Yes</td>
</tr>
</tbody>
</table>

CLINICAL FEATURES
Demodicosis caused by Demodex canis in dogs is a common, well-recognized disease. There are two common clinical syndromes: localized and generalized demodicosis. Localized demodicosis
is confined to 1-2 body areas (usually the head), smaller lesions, and an absence of secondary infection. Generalized demodicosis is defined as involvement of 2 or more body areas or diffuse skin involvement. Alopecia, follicular plugging and a blueish hue to the skin are common features. This disease has well-documented immunosuppression, resulting in secondary infections, the most common of which is pyoderma. Folliculitis and furunculosis are common features of generalized demodicosis in dogs, which will have patchy alopecia, papules, pustules, crusting, and draining tracts associated with bacterial infection. The most commonly isolated bacteria is *Staphylococcus pseudintermedius*. Pruritus is mild to absent...unless secondary infections are present.

*Demodex injai* is an uncommon cause of demodicosis in dogs, but the true incidence in unknown because the mites are present in low numbers in the skin and difficult to recover on diagnostic tests. These mites reside in the hair follicles and most often cause disease over the dorsal thoracolumbar region, resulting in a large greasy area of the hair coat, mild-to-moderate erythema, and mild thinning of the hair coat. Most of the dogs exhibit moderate pruritus and secondary infections are rare. This condition has been recognized most often in small breeds, including the wirehaired fox terrier and cairn terrier.

Demodicosis caused by *Demodex cati* is uncommon to rare and is characterized by alopecia, often symmetrical involving the head, extremities and trunk, and occasionally generalized scale and crust formation. Mites may be difficult to find with typical “deep” skin scrapings.

Demodicosis caused by *Demodex gatoi* is a common dermatologic condition, depending on the geographical region. These mites reside within the stratum corneum and induce moderate to severe pruritus, most often manifested as self-induced hair loss (licking).

**DIAGNOSIS**

Traditionally, the skin scraping is the diagnostic test of choice to isolate mites. Superficial scrapings are sufficient to recover *D. gatoi* mites, but without some adjustment, are not sufficient to recover follicular mites. Also traditionally, the deep skin scraping has been touted as the best diagnostic tool to recover follicular mites. However; this procedure results in unnecessary trauma to the skin...scraping until you see capillary (or any other) hemorrhage is not necessary. The key step in the skin scraping is the kneading (i.e., squeezing) of the skin to extrude mites from the follicle. A recent study from Australia showed that a technique using clear cellulose tape (e.g., “Scotch tape”) in which the skin is squeezed onto the tape, is superior to the traditional deep scraping.

The trichogram, microscopic examination of “plucked hair samples, is on par with the skin scraping as a diagnostic tool for follicular mites. It has low sensitivity for *D. gatoi*, because these mites reside on the surface of the skin (not in hair follicles).

Cytology of any papules or pustules is indicated to confirm secondary bacterial involvement. Culture and sensitivity of pustular lesions would be warranted if bacterial involvement is confirmed on cytology and has failed to respond to appropriate antimicrobial therapy, if/when the patient has received several courses of antibiotics and bacteria are still present, or if/when
new bacterial lesions are developing while the patient is receiving antibiotics. Biopsy with dermatohistopathology is not an appropriate test to diagnose demodicosis due to low sensitivity for most cases, with the possible exception of disease caused by *D. canis*.

**TREATMENT**

1. **Canine demodicosis caused by *D. canis***

The first priority is to control bacterial skin infections. This will reduce pruritus (dramatically) and clear up the open lesions and draining tracts. Cephalosporins are highly useful in patients that do not have a long history of antibiotic administration. If the animal has received numerous antimicrobials in the past or is developing new lesions while on a cephalosporin, selection of the antimicrobial should be based on culture and susceptibility results.

Options to kill the mites:

- **Amitraz rinses** (Mitaban-Zoetis): This remains the only approved drug to treat canine demodicosis in the USA. The protocol shown to be most effective is weekly rinses with 10 minute contact time, to be administered weekly and continued for two treatments past a second negative scraping (or trichogram).

- **Ivermectin**: Ivermectin remains unlicensed for the treatment of canine demodicosis but is highly effective. The recommended protocol is to give 0.4-0.6 mg/kg, orally, once daily to be continued for 30 days past a second negative diagnostic test (scraping or trichogram). The drug should be given in small doses initially (~10% of the calculated dose), slowly increasing the dose to the calculated amount over a 7-10 period of time while observing for any adverse reactions. Adverse reactions in dogs may include muscle tremors, mydriasis, blindness, ataxia, seizures, or sudden death. If any of these are observed, the drug should be discontinued and other options considered. The drug should not be given to dogs with the ABCB-1 mutation (MDR-1), which is commonly present in many breeds including (but not limited to) the collie dog, long-hair whippet, Australian shepherd, McNab, Silken windhound, Sheltand sheepdog, English shepherd, German shepherd dog, old English sheepdog, and other herding breed mix-breed dogs. A test to evaluate those breeds or any dog to whom any avermectin is administered should be performed prior to dosing.

- **Imidoclorid/moxidectin** (Advantage Multi-Bayer): Advantage Multi is labeled for flea, tick and heartworm control in the USA. The product has been extensively studied for use in canine demodicosis caused by *D. canis* and may be effective at the once monthly dosing in some dogs. However, studies have suggested that once weekly application (dosing) provides the most reliable killing of demodex mites.

- **Isoxazolines**: The isoxazoline compound available for use in dogs include fluralaner (Bravecto®-Merck), afoxolaner (NexGard®-Merial), and sarolaner (Simparica®–Zoetis). These products are labeled for flea and tick control in dogs and exert their antiparasitic effects through specific blockade of insect GABA and glutamate-gated chloride channels. All three of these products appear to be effective in treating demodectic mange in the dog. Limited studies are available for each product but those studies and clinical experience suggests that the number of demodex mites is reduce by >90% within 30 days of treatment. Additional studies are needed to document long-term effectiveness and potential for relapse; however, at this time, the isoxazolines appear to be excellent products to treat canine demodicosis.
TABLE Options for treating canine demodicosis

<table>
<thead>
<tr>
<th>Active ingredient / other ingredients</th>
<th>Product</th>
<th>Route of Administration</th>
<th>Age / weight</th>
<th>Labeled for canine demodicosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amitraz</td>
<td>Mitaban®</td>
<td>Topical (rinse)</td>
<td>&gt; 4 months of age</td>
<td>Yes</td>
</tr>
<tr>
<td>Ivermectin</td>
<td>Ivomec</td>
<td>Oral</td>
<td>NA</td>
<td>No</td>
</tr>
<tr>
<td>Moxidectin / imidacloprid</td>
<td>Advantage Multi®</td>
<td>Topical</td>
<td>&gt; 7 weeks of age &lt; 3 lbs</td>
<td>No</td>
</tr>
<tr>
<td>Fluralaner</td>
<td>Bravecto®</td>
<td>Oral</td>
<td>&gt; 6 months of age &gt; 4.4 lbs</td>
<td>No</td>
</tr>
<tr>
<td>Afoxolaner</td>
<td>NexGard®</td>
<td>Oral</td>
<td>&gt; 6 months of age &gt; 8 weeks of age</td>
<td>No</td>
</tr>
<tr>
<td>Sarolaner</td>
<td>Simparica®</td>
<td>Oral</td>
<td>&gt; 6 months of age</td>
<td>No</td>
</tr>
</tbody>
</table>

2. Canine demodicosis caused by *D. injai*

*Demodex injai* infestations are generally not associated with secondary infection; however, if they were, management of that problem would be appropriate. Active ingredients that may be effective for this form of demodicosis include: ivermectin, amitraz rinses, imidaclorid/moxidectin, and the isoxazolines. Studies to identify effective treatment, or the best treatment, are not available. At this time, the author recommends treatment with one of the isoxazoline products at labeled doses for flea control. Preliminary investigations by the author suggest these are effective for this form of demodicosis.

3. Feline demodicosis caused by *D. cati*

Feline demodicosis caused by the follicular mite, *Demodex cati*, is uncommon to rare and no treatment has been shown to be effective or is labeled to treat this infestation in cats. However, anecdotal information and clinical experience of the author have shown ivermectin to be effective. The target dosage is 0.4-0.5 mg/kg, which is given orally in a similar protocol as used for the treatment of canine demodicosis. Possible adverse effects in cats include: crying, anorexia, mydriasis, blindness, rear leg paralysis, muscle tremors, or disorientation. At this time, there is only one product licensed for cats that contains an active agent shown to be effective in canine demodicosis. That product contains the isoxazoline fluralaner (Bravecto® for Cats-Merck) and is labeled for flea control in cats. One report describes successful treatment of a cat with demodicosis using oral fluralaner (off label).

4. Feline demodicosis caused by *D. gatoi*

This is the most common form of demodicosis in cats and the incidence seems to vary geographically. Since this is a contagious condition, all cats in a household should be treated when diagnosed in one of the cats. At the present time, the most effective treatment is considered to be lime sulfur rinses, performed weekly for 4-8 weeks. Advantage multi has also been shown to be effective in some cases, but may require more frequent applications than labeled. Applications every 1-2 weeks appear to be significantly more effective than the label.
recommendation of once monthly for flea control. Studies using other active ingredients, such as fluralaner found in Bravecto® for Cats, have not been reported.

**SUMMARY**
The term “demodectic mange” now refers to many possible clinical scenarios. Proper selection of and performance of diagnostic tests to identify these parasites remains important. Newer treatment options, such as the isoxazolines for dogs and cats, have shown great promise for successful management of this common parasitic condition. More studies are needed to show their long-term effectiveness and safety.

**Selected Readings:**