

Treating Multi-animal Facilities Infected with Dermatophytosis

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Treating dermatophytosis can be a frustrating endeavor especially in multi-animal facilities; animal shelters and catteries. Since dermatophytosis is one of the most commonly encountered zoonotic diseases in veterinary medicine, the importance of successfully eliminating infections while limiting human exposure is paramount.¹⁻³ Unfortunately, many of the multi-animal facilities have persistent infections that are difficult to resolve.

Microsporum canis is a highly contagious fungal organism that can cause clinical disease in any haired animal. *Microsporum canis* is not a normal part of the skin microflora and should always be considered as a pathogen.⁴⁻⁷ Animals that are group housed and are in poor health (malnutrition, parasitism, viral infections, other medical conditions, etc). have an increased risk for developing active infections.^{1,2} In some breeds, Persians and Jack Russells, genetic factors may contribute to an increased risk of infections.¹ Additionally, warm humid environments, either within a facility or regionally may encourage fungal growth.^{1,8,9} *Microsporum canis* organisms are shed from infected animals in the hair and scale and can remain infectious for over 12 to 24 months. ⁶ Due to the extreme pathogenicity of *Microsporum canis*, almost any physical object can serve to transfer organisms and spread the infection; brushes, cages, beds, clippers, clothing, fans, hands, and even other animals.

Due to the zoonotic nature of *Microsporum canis*, operators of multi-animal facilities should be educated and encouraged to thoroughly evaluate their individual situation and desire to continue with the operation of the facility.¹⁰ The ethical and legal issues associated with allowing a contagious zoonotic disease to persist are serious and must be considered.

The Problems

The multi-animal facilities that have chronic dermatophyte infections generally have several fundamental problems. Facilities that practice vigilant monitoring and have aggressive treatment and control practices typically do not develop chronic dermatophyte infections. The problem facilities are those that are financially challenged or have lax control practices. Facilities that have open door policies for new animals and are unable to isolate infected animals are destined to develop dermatophytosis. Since these facilities are often charitable animal care facilities, the resources to monitor (through cultures) and treat the infected animals and facility are lacking. Making the situation more challenging are the No kill@ policies that are becoming more prevalent. Many animals with cutaneous and systemic diseases are introduced into the facility. The effect of these problems is that once dermatophytosis is introduced into one of these facilities (which is just a matter of time) the operator is unable to eliminate the disease due to the limited resources. Insufficient planning and resources dedicated to the building of the facility leads to a poor design and operating practices which makes fundamental infection control practices impossible. Ideally, the facility should have at least 3 separate rooms that can adequately house animals. ¹¹ One room should be used for new animals and animals that are suspected of having a contagious disease. An isolation room should be used to house all of the animals that have confirmed dermatophytosis. The main room should only contain animals that are confirmed to be free of dermatophytosis. Most facilities that have chronic dermatophytosis infections have designs that do not adhere to this model. In the author=s

experience, problem facilities are usually established in an old home or building. In these facilities, the rooms are too small to contain adequate animal housing. To adapt, the animals are usually housed wherever there is room. Some cattery facilities are placed in a spare bedroom or basement of the operator's home. The limited space makes isolating new or infected animals impossible. These animals are usually mixed in with the noninfected animals creating a risk of contagion.

The ventilation systems in these facilities are usually inadequate and often detrimental to the practice of good infection control. In one study, 85% of homes with infected cats had airborne *Microsporium canis* organisms.¹² If the ventilation for each room is inter-connected, organisms can be spread from room to room even if the animals are properly isolated. In older facilities, ventilation systems are absent and the operators rely on fans and in-room units to control the climate. Fans are very efficient at dispersing infected hairs throughout an environment. In-room climate control units readily blow infectious material throughout the room. Even central heating and cooling units and the attached duct work can become contaminated. Using common techniques, it is impossible to adequately disinfect ventilation systems, fans, or in-room units.

The kennels used to house animals in these facilities are usually selected based on cost rather than the ability to clean and disinfect the cage. Even when high quality stainless steel cages are used, they are often arranged in a manner that makes them difficult or impossible to appropriately clean. Typically, the cages are placed to allow maximum housing space. This usually makes them impossible to remove for thorough washing with a pressure washer. Additionally, the cage tops are often used for storage of papers or other materials which make thorough cleaning even more difficult. (Figure 1-2) Often the stored material are contaminated and become a source for repeated infections.

Proper hygienic cleaning methods are generally lacking in most chronically infected facilities. The most common method used by caretakers to clean each animal's cage involves the care taker moving the animals to a different cage, then cleaning that animal's cage. When clean, the caretaker usually moves a different animal into the cage that was just cleaned. Even though this makes the cleaning process more efficient, it encourages the spread of contagious diseases from cage to cage and animal to animal. Additionally, the author has yet to find an infected facility that requires the caretakers to wear protective clothing or change clothes when cleaning and caring for the animals in the isolation area. Typically, there is free movement of people and supplies between the areas within the facility and a general lack of knowledge regarding basic infection control practices.

Many facilities allow the animals to have access to other work areas within the facility. The cat in (Figure 3) was the animal shelter's pet mascot and was allowed free access to the office and visiting areas. The cat's favorite place to rest was on top of the office copy machine. This practice improved employee moral but when the asymptomatic cat was found to be culture positive a dilemma developed. Not only had the cat contaminated the entire office, but, even the copy machine was contaminated. In the same facility, the dogs that had been diagnosed with dermatophytosis were isolated from the other dogs by keeping an empty kennel between animals. Unfortunately, one of the infected dogs was agile and readily climbed the kennel fence to move from kennel to kennel (Figure 4). During the author's visit, the dog moved from the isolated kennel to the kennel containing the noninfected dogs and back several times. Movement of animals,

people and supplies from area to area within the facility is responsible for much of the cross contamination within the infected facility.

Catteries often present a unique set of problems. Operators of these breeding facilities are often lacking in medical knowledge and do not have an understanding of basic hygiene practices. Catteries that are chronically infected often have operators that are unwilling to adhere to protocols necessary to control and eliminate dermatophyte infection. Typically, these cats are moved in and out of the facility for shows or as a normal part of the trade in breeding animals. The presence of pregnant queens and young kittens complicates any treatment protocol. When an animal is introduced into the facility it is almost never isolated or evaluated for dermatophyte infection. In the author's experience, these facilities usually exist in a single room that contains all of the animals. Usually, only the males are confined and several animals (the owner's favorites) are allowed access to other areas of the home. When the colony develops a dermatophyte infection the entire facility and operator's home are usually contaminated. Since the primary objective is breeding, the operators are unwilling to stop breeding and continue to actively show and sell their animals. Aggressive therapy often includes frequent topical treatments as well as systemic therapy for a treatment period of 6-12 months, most operators of infected facilities elect to manage the problem rather than aggressively treat to eliminate the disease. The author worked with a particular operator who was reluctant to pay for and provide the labor intensive treatments and finally decided to sell her home and move to a new clean house. Not only does this raise serious ethical concerns, but it is undoubtedly only a matter of time before the new facility becomes as contaminated as the original home.

Treatment Protocols that work

Assessment

The initial step in the successful treatment of a multi-animal facility infected with dermatophytosis is to determine the extent of the infection. This involves culturing every animal in the facility, including all other pets (dogs, ferrets, rabbits, etc) capable of being infected with dermatophytes. The clinical symptoms of dermatophytosis are extremely variable mimicking many other dermatoses. Infected animals can be completely asymptomatic, mimic allergy, have symmetrical alopecia, or appear to have pemphigus; therefore, clinical appearance becomes irrelevant when identifying infected animals. Hairs from any skin lesions should be sampled. In asymptomatic animals, a new toothbrush can be used to brush the animal. Alternatively, a 4x4 gauze is readily available and can be used to wipe the animal for collection. After culturing every haired animal in the facility, if only 1 or 2 animals are infected, the infections can likely be managed as individual infections and massive treatment protocols designed to treat the entire colony can be avoided. It is likely however, that most of the animals will have positive fungal cultures. Additionally, the household pets are often infected and facilitate the spread of organisms.

The use of Woods lamp and direct hair examinations are not sufficiently reliable to be used in the assessment process. If the strain of *Microsporum canis* is one of the few that does demonstrate positive fluorescence, then the Woods lamp can be used to select hairs for culture and for quick monitoring but should not be relied upon to determine

mycological cure. Only fungal cultures are reliable enough to provide accurate assessment.

The animals should be evaluated for underlying diseases that may be perpetuating the infection and will make them more susceptible to reinfection. A thorough physical examination of every animal usually identifies several individuals that require additional diagnostic tests. All animals should be screened for parasitic infections and cats should be screened for viral infections.

To fully evaluate the extent of environmental contamination, obtain samples from multiple sites and surfaces throughout the entire facility. A folded 4x4 gauze works well to wipe the area to be sampled. The gauze is readily available, economical, and disposable. By folding the square, the sampled material can be easily touched to the culture plate. Storage areas should be inspected to assess the likelihood for contamination of food bags, cage papers, and other commonly used materials. Particular attention should be paid to ventilation units as these can efficiently disseminate fungal organisms. By mapping the areas of contamination, operators will gain an appreciation for the severity of infection and realize the need to use good hygiene. The facility should also be surveyed to determine the methods used to clean cages and disinfect surfaces. Depending on the severity of contamination, the operator can be given an estimate of the effort and time necessary to clean the facility.

Obviously, to thoroughly evaluate a facility and all of its animals, numerous cultures will need to be acquired and monitored. The expense of performing the large number of cultures required can be minimized by finding a local source for culture plates. Many hospitals, universities, or community colleges have a microbiology media lab that routinely makes culture plates and may be willing to sell large quantities for a reasonable price. DTM media provides a relatively reliable color indicator that makes screening numerous culture plates more efficient. In difficult situations, the operator of the facility can be trained to screen culture plates looking for the immediate color change as soon as the nonpigmented fungal colony appears. Although this approach is not ideal and usually requires much instruction regarding hygiene and culture handling techniques, it may provide an economical alternative.

Deciding to Treat

Based on the initial assessment and determination of the extent of environmental contamination and the number of infected animals as well as the identification of unique issues contributing to the persistence of the infection, the facility operator will need to decide how to proceed. Due to the zoonotic nature of *Microsporium canis*, the continued sale or adoption of infected animals is an ethical and legal issue. It may be best to depopulate and close the facility, remembering that the premises will remain contaminated for years. The labor and cost of treating a multi-animal facility can be extreme and only committed operators should be encouraged to invest the resources. If the treatment protocol is discontinued before complete elimination of the infection, a relapse will be inevitable. Additionally, if the prevention methods are not adopted as normal operating procedures a relapse is likely. In the author's experience, most facility infection can be successfully treated with sufficient effort and duration.

Disinfecting the facility

One of the most important steps in the successful elimination of dermatophytosis in a multi-animal facility is the thorough disinfection and decontamination of the facility. Once the facility has been surveyed using fungal cultures, contaminated areas will be known. These areas should receive special attention; however, the entire facility should be managed in a manner to decrease the spread of fungal organism.

If the facility is globally contaminated, then all non-essential items should be disposed of properly. The more thoroughly the facility is cleared of clutter and stacks of stored items, the easier it will be to disinfect. Generally, areas where animals are housed should be sparse and completely void of any carpet, porous surfaces, and storage areas. All of the stored materials needed for the facility should be kept in a separate area which is off limits to the animals. If contaminated materials continue to be used, there is very little chance for the successful elimination of the infection.

The caretakers should be educated about basic infection control methods, contamination, and practical hygiene methods. The movement of individuals from area to area within the facility should be limited. Ideally, each discrete area should have a setup to allow the caretaker to change into coveralls and boots for that area. If this is not possible, then disposable shoe covers and smocks should be provided to prevent the carriage of organisms from area to area within the facility. All clothing and cleaning utensils should be laundered and bleached daily. One author has treated facilities that lacked running water sufficient to wash the caretaker's hands or equipment. Awareness of good hygiene and contagion control techniques will be an essential part of any treatment protocol.

If possible, all infected animals should be isolated in a building separate from noninfected animals. The animals should be housed in cages that are dedicated and assigned to each individual animal. If animals are effectively limited to their own areas within the facility, then treatment and disinfection of the animals and facility is made more efficient and effective. Protocols should be developed and enforced that eliminate the movement of animals from cage to cage. Ideally, infected animals should be removed from the cage or kennel and treated while the cage is properly cleaned and disinfected. Then the treated animal is replaced into the clean cage. Only animals that have been cultured and determined to be free of organisms should be allowed into common areas.

The best method for handling infectious diseases incorporates a three room isolation protocol.¹¹ In this approach, one room is dedicated for animals that are not infected based on multiple cultures. The movement of people and animals in this room is strictly controlled to limit the inadvertent introduction of infected material or animals. A second room is used for animals that are in transition into the clean room. Animals in this room may have been infected and successfully treated but have follow-up cultures pending and are thus still suspect. The third room is used to house all infected animals and animals new to the facility. These animals are considered contagious and should be undergoing treatment. The key to successful implementation of this approach is vigilant culturing of every animal along with strict control of animals, materials, and people from room to room. Unfortunately, most chronically infected facilities have insufficient space or resources to implement the three room isolation protocol and must rely on a more global approach.

The ventilation system should be evaluated and altered to prevent the dispersal of organisms through the air. Any fan or ventilation unit that could be easily removed should be disposed of and replaced once the facility is decontaminated. Central ventilation units should be turned off and the ductwork cleaned and disinfected. High efficiency air filters placed at both the intake and blow out vents may help reduce the circulation of organisms. If ventilation is needed, using a fan that pulls air through the facility exhausting it outside allows for air circulation without the risk of blowing organisms throughout the facility. The addition of a dehumidifier may help reduce the ambient humidity and reduce the ideal growing condition for *Microsporium canis*.⁹

An enilconazole smoke product (Clinafarm smoke) is available for the disinfection of areas and machinery that is difficult to treat with the liquid enilconazole; however, the use in companion animal facilities is off label. Additionally, the product is difficult to contain and easily leaks into adjacent areas and out of the intended treatment area.¹⁸ Inadvertent exposure of animals, humans, and unintended areas makes the smoke enilconazole impractical and even dangerous.

Selection of disinfectant

There are very few agents that effectively kill *Microsporium canis* in the environment. Research by Moriello et al, identified only 3 highly effective ingredients (bleach, 1% formalin, and enilconazole).^{13, 14} Chlorhexidine, miconazole, and iodine products have only minimal efficacy as topical disinfectants (Table X).^{13, 14} Enilconazole and lime sulfur are the most effective products but due to limitations in label indication and acceptance by operators their use is often limited.^{13, 14} Bleach is the most widely available and commonly used disinfectant that has reasonable efficacy against *Microsporium canis* although it can be irritating to the skin and mucous membranes. Bleach is not suitable for application to carpet, furniture, or clothing. The authors suggest using dilute bleach 1:10 or enilconazole. All surfaces (counters, cages, floors, walls, windows, ceilings, fans, etc.) within the contaminated areas should be wiped with the disinfectant as often as possible but at least twice each week. It is possible to disinfect the contaminated facilities; however, prolonged periods of diligent effort are often necessary.

Mechanical removal of infectious organisms is an efficient method to speed the disinfection process. Due to the contagious nature of *Microsporium canis*, only vacuum cleaners with Hepa filters or commercial steam cleaning services should be used. If a vacuum cleaner is used, a new bag should be installed before every use and when the environmental cultures indicate that the facility is being cleared, the entire vacuum cleaner should be discarded since it is impossible to decontaminate the fan unit. Commercial steam cleaning services that use a van mounted unit can be used but attention should be given to the location of contaminated water discharged from the unit. Smaller self contained steam cleaning units should not be used due to possible cross contamination of the reservoir tanks thus spreading organisms. Regardless of the type of steam cleaner, the temperature of the steam is insufficient to kill organisms but the mechanical removal may provide some benefit.^{1, 11} Steam cleaning transiently increases the humidity in the environment; however, the benefit of the mechanical removal of organisms outweighs the transient increase in humidity.

Treating the animals

Every infected animal in the facility should be aggressively treated with both topical and systemic therapies. 1-3,16-27 Topical treatments speed resolution of clinical lesions and may help prevent zoonotic contagion. Systemic therapies that have prolonged residual activity in the skin and hair provide the most effective treatments. Treatments should continue until 3 negative cultures are obtained and the patient should be monitored for several months to identify any relapses. Only after an animal has had several negative cultures over several months can they be considered cured.

Infected hairs that are shed and carried throughout the facility on fomites and air currents are the primary source for contagion. Clipping infected animals can dramatically reduce the number of infectious organisms on the hair coat. However, due to the risk of spreading active infection (lesions), contaminating the facility and clippers, and zoonosis, the animal should be treated for at least 2 treatments before clipping. Clipping an infected animal can heavily contaminate the entire room. If clipping is required, the animals should be removed from the facility and clipped in a well ventilated area preferably outside away from all animals and human foot traffic. The clipped hair should be collected and disposed of immediately. Ideally, inexpensive clippers should be used and discarded after the animal has been clipped. It is almost impossible to effectively disinfect electric clippers that are contaminated with *Microsporum canis*. Continuing to use contaminated clippers is an efficient means to spread dermatophytosis. The authors do not clip infected animals unless they have long hair that is matted.

Lime sulfur (4 oz/ gallon (25mg/l) applied every 3-7 days) and 0.2% enilconazole (applied twice each week) are the only active ingredients that have repeatedly demonstrated high efficacy in clinical studies. 15-18 Enilconazole is only available in the United States as a poultry facility disinfectant and off label use is not permitted by the EPA. Lime sulfur is readily available and non-toxic. Due to its noxious odor, many operators refuse its use. Other active ingredients have demonstrated some benefit. Particularly noteworthy are the products that combine antifungal agents miconazole and chlorhexidine to produce a synergistic effect.¹⁹ These may help physically remove organisms and provide some antifungal activity.

Systemic antifungals are highly efficacious and provide the best treatment modality. Many systemic antifungals are available which demonstrate good efficacy against *M. canis* (Table 1). 1-3,20-27 *Microsporum canis* is particular difficult to treat with some strains demonstrating elevated MIC to the commonly used antifungal agents.²⁸ New generation Imidazole antifungals demonstrate excellent activity and are the preferred treatment. Itraconazole and terbinafine are particularly effective and well tolerated even in cats. 20, 22-27 Both of these drugs have prolonged residual levels in the epidermis and hair and may help prevent the adherence of organisms to the skin.^{29,30} This allows for flexible drug dosing (pulse dosing) while maintaining antifungal tissue levels. 22, 23 Unfortunately, as of this writing, itraconazole and terbinafine are relatively expensive treatments. Ketoconazole is widely available as a generic but is not well tolerated by cats.

Lufenuron has received recent attention as a possible treatment for *M. canis*. 31, 32 In the original study, high doses demonstrated remarkable efficacy in both dogs and cats with dermatophytosis. 31 In more recent trials as well as anecdotal reports, lufenuron therapy has not provided sufficient antifungal activity to warrant its use as a sole

therapeutic agent.³³Lufenuron may provide some benefit but should be used as an adjunct to topical and systemic therapy.

Microsporium canis vaccines have been repeatedly evaluated in the hope that the patient's immune system could be stimulated to prevent infection, speed resolution of an active infection, and prevent relapse. Unfortunately, vaccine trials have not been successful and currently there is no commercial vaccine available in the United States. ³⁴⁻

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When to stop the treatments

Every animal as well as the facility should be treated until several negative fungal cultures have been achieved. Repeated environmental cultures should be performed throughout the treatment period to monitor the disinfection process. It often requires 6 to 12 months to completely eradicate infectious organisms from a facility. Once treatments have been discontinued, the animal should be monitored for several months to ensure complete resolution. Newly acquired animals should be cultured and isolated until their infection status is known. Empirical topical treatments can be used while cultures are pending to prevent inadvertent contamination of the facility and spread of infection. The facility should be continually cleaned and disinfected to prevent recurrence of contamination. Generally, infections of relatively short duration (months) can be cleared within 12 months (often after 6 months). Persian catteries or facilities with long existing infections (years) will require much longer periods of aggressive treatment, possibly as long as 1-2 years. Facilities that are not responding after 6 months of aggressive therapy should be closed.

To prevent future reinfection, the facility and animals should be periodically monitored through random culturing of the environment and animals. Additionally, any new animal or animals returning from an outside event (show or breeding loan) should be assumed to be infected and isolated until cultures are performed. Topical treatments can be initiated to prevent contamination and contagion. There is antidotal evidence that suggests that treating with itraconazole before and after exposure to *Microsporium canis* can prevent the adherence of the organisms and therefore prevent infections.²⁹ It is unclear of the ideal dosing protocol since it may take 3 weeks to reach steady state levels within the tissues.³⁰ The authors suggest treating for 1-3 weeks before possible exposure and for 1 week after in combination with 1-2 topical treatments once the animal returns to the facility.

Conclusion

With aggressive persistent treatment, most multi-animal facilities can be cleared of dermatophytosis; however, the process may require over a year to complete. Good communication and patience are essential to help the client navigate the multitude of therapeutic options and many frustrations.

Table 1: Steps to Assessing the Extent of Infection

Tour the facility to assess current practices

Animal housing

Individual cages

Common areas

Movement of animals within the facility

Movement of people

Storage areas

Methods for cleaning cages

Animal bathing and treatment areas

Isolation facility

Hygiene practices: hand washing, food baths, coveralls, etc.

Disinfectants used

Culture the animals

Collect hairs and crusts from any skin lesions

Use a new toothbrush or folded 4x4 gauze square to wipe all asymptomatic animals

Be sure to culture the operator's pets or facility mascots

Methodically label each plate with the animal's name

Create a chart of each animal's location within the facility

Culture the Facility

Use a folded 4x4 gauze square to wipe the surface of numerous areas

cages

walls

floors

counter tops

fans

ventilation ducts

stored materials

common areas

Create a chart of each culture sample's location to map the extent of contamination

Use the collected information to:

Determine the number and location of infected animals.

Determine the areas of environmental contamination.

Identify the problems unique to the facility that contribute to contagion.

Educate the operator regarding the severity of infection.

Create a treatment plan for the animals and facility.

Estimate the effort, cost, and time needed to resolve the infection.

Table 2: Treatments

Drug	Route	Dose	Frequency	Adverse Effects	Cost
Topicals					
Enilconazole	Topical	0.2% solution	Twice weekly	Corneal ulcers with concentrate Hepatitis Use E-Collar Contact reactions	inexpensive
Lime Sulfur	Topical	4 oz/gal	Weekly	Odor GI signs Use E-collar Contact reactions	inexpensive
Chlorhexidine combined with miconazole or ketoconazole	Topical	Shampoo	Before dips	Contact reactions	Moderate
Systemics					
Itraconazole	Oral	10mg/kg	Daily or Pulsed Daily for 1-4 weeks then either 2-3 consecutive days each week or a week on and a week off	Hepatitis Vasculitis	Expensive
Terbinafine	Oral	20-40mg/kg	Daily or Pulsed No available trials but likely effective	Hepatitis	Expensive
Ketoconazole (dogs only)	Oral	10mg/kg	Daily	Hepatitis high rate of adverse symptoms in cats.	Moderate
Disinfectants					
Bleach	Environment	1:10 dilution	Every 3 days	Contact reactions	Inexpensive
Enilconazole	Environment	Every 3 days	Contact reactions Corneal ulcers with concentrate Do not mist or vaporize		Inexpensive

Table 3: Author's Treatment Suggestions

Topical treatment

Speeds clinical response, prevents environmental contamination and zoonosis.

Apply lime sulfur (4 oz/gal) to the entire hair coat every 3 days

Alternatives:

Bathing with a miconazole/chlorhexidine or ketoconazole/chlorhexidine shampoo may be beneficial but requires additional cost, time, and effort.

Topical 0.2% enilconazole is well tolerated, highly efficacious, and economical when applied every 3 days.*

Systemic Treatment

Administer itraconazole (10mg/kg/day) orally until 3 negative cultures are obtained.

Options:

The daily dose of itraconazole can be lowered to 5mg/kg/day; however, the absorption of itraconazole in dogs and cats is variable making higher doses more reliable.

Pulse dosing of itraconazole has been used successfully in several different protocols.

Administer itraconazole daily for 28 days, followed by 7 days without treatment, followed by 7 days of daily treatment (loading daily dose for 28 days then one week off one week on daily dosing).

Administer itraconazole for 15 days followed by 15 days without treatment (two weeks on, two weeks off).²³

To prevent adherence of organisms before a known exposure, administer 10mg/kg/day for 1-3 weeks before and for 1 week after the exposure.²⁹

* Enilconazole is EPA regulated in the United States and its off-label use is prohibited.

Table 4: Disinfecting the facility

- Discard any clippers used on infected cats
- Remove and discard all nonessential items
- Remove all stored material from the areas where animals are housed
- Eliminate the free movement of animals and people through the facility
- Assign each animal to a unique cage
- Provide hand and foot wash station between separate areas
- Use disposable smocks or coveralls changed as caretakers move from area to area
- Try to establish a 3 room quarantine method
 - Move all actively infected animals into one isolation area
 - Move all clinically normal and culture negative animals into a distant area
 - Establish an intermediate area for clinically normal animals that have cultures pending or have finished treatments
- Dispose of any portable fans.
- Clean the ventilation ducts and install high efficiency filters
- Vacuum or steam clean all carpets and fabric surfaces (discard the vacuum)
- Wipe all surfaces (counters, cages, floors, walls, appliances, etc) with bleach every 1-3 days
- Install a dehumidifier
- Close the facility to the admission of any new animals until the infection is resolved
- Discontinue the sale or adoption of animals until the infection is resolved

Table 5: Monitoring and When to Stop

To minimize cost, repeat cultures every month
Culture animals that have resolved their clinical lesions
Culture asymptomatic animals being considered for movement into the uninfected area of the facility
Culture the facility (focus on several of the most frequently used areas and ventilation units).
Culture any fomites that are used on more than a single animal
Culture any new animals
Culture random animals in the uninfected area to confirm their culture status

Over 6-12 months the animals and facility will slowly begin to clear the infection
As the animals become clinically normal, they should be moved from the isolation area into the transition area
As the clinically normal animals become culture negative (repeated 2-3 time) they should be moved from the transition area into the uninfected area
As the facility becomes decontaminated, the frequency of cleaning can be reduced to weekly

Longterm monitoring once the infection is resolved
Perform cultures every few months
Random animals should be cultured to verify fungal free status
Common areas in the facility should be monitored
Any new animal should be assumed to be infected until cultures are performed
Maintain strict isolation of any new animal until culture results are known
Prophylactically treat any animal attending a show with itraconazole to help prevent organism adherence (10mg/kg/day for 1 week before and 1 week following the show)
Prophylactically treat any returning animals with topical treatments to decontaminate the haircoat
Assume the returning animal is infected and maintain strict isolation until cultures are performed

Table 6: Ineffective products¹³

Chlorhexidine as a sole therapy

Miconazole as a sole therapy

Captan

Iodine compounds

70% alcohol

Instant hand sanitizer (chlorhexidine combined with alcohol; Hibistat)

Alkyl dimethyl benzyl ammonium chloride 20% (Rocal)

Quaternary ammonium chloride 21.7% (3M Quat)

Potassium monosulfate (VirkonS)

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