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CLINICAL REVIEW

# FELINE DERMATOPHYTOSIS
# Steps for investigation of a suspected shelter outbreak

**Sandra Newbury and Karen Moriello**

## Why such concern over 'outbreaks'?

Dermatophytosis is the most common contagious and infectious skin disease of cats.[1] It is of particular importance in shelters because it is highly contagious; affects kittens, which are one of the most sought-after populations in a shelter; and may also be a public health concern. This article will focus primarily on outbreaks caused by *Microsporum canis*, which is the most common cause of dermatophytosis in cats,[1] and the most commonly isolated pathogen from cats in shelters. Infections with *Microsporum gypseum*, *Trichophyton* species and *Microsporum persicolor* have been reported,[2,3] but do not present as treatment challenges in shelters.[2,3] *M gypseum* is a geophilic dermatophyte; infections are inflammatory and cure rapidly with appropriate treatment. *Trichophyton* species infections are uncommon in cats but, when found, tend to be seen on the ear margins or face of adult cats in winter and/or in kittens and cats surrendered from a farm or stable where large animals are housed.[4,5] In the authors' experience, infections with *Trichophyton* species cure rapidly with appropriate treatment.

The term 'outbreak' refers to the occurrence of a disease in excess of what is normally expected. Thus, even a single case of a contagious disease that has been absent from a population or not previously diagnosed could be considered an 'outbreak'. With respect to dermatophytosis in shelters, any suspicion should be taken seriously as this disease may evoke a negative response in staff that is disproportionate to the pathogenesis of the disease. This stems from the fear of contagion, environmental contamination and the potential for human infection. In the shelter setting, the fear of increased euthanasia is also a concern. Although dermatophytosis is a self-limiting, non-fatal disease, the resources required to treat numerous animals may not be available. Hence, rapid response to even a single possible infection can be life-saving for the cat and may prevent a widespread outbreak.

**Practical relevance:** Dermatophytosis (ringworm) is the most important infectious and contagious skin disease of cats in shelters. Its importance relates to the fact that it can affect all cats, but tends to affect those which would otherwise have good chances for adoption. Although many diseases in shelters fit this description, dermatophytosis is of particular significance because of associated public health concerns.

**Clinical challenges:** Disease management in animal shelters is challenging because new animals are frequently entering the population, numerous animals are often housed together, and resources are almost always limited.

**Global relevance:** Outbreaks of dermatophytosis occur worldwide and no animal shelter is completely shielded from possible introduction of the disease into the population.

**Audience:** This article offers a flexible stepwise approach to dealing with a known or suspected outbreak of dermatophytosis in an animal shelter. It is based on the authors' experiences spanning more than a decade of responses and/or consultations. While primarily aimed at veterinarians involved in shelter medicine, the principles largely apply to other group-housing situations, such as catteries and breeding establishments.

**Aims:** The goals in dealing with a potential dermatophytosis outbreak are to ascertain if the 'outbreak' is actually an outbreak, to develop a shelter-specific outbreak management plan and to implement a long-term plan to prevent recurrences.

**Key aspects pertinent to treatment**

An accompanying article on pages 419–431 of this issue reviews aspects pertinent to the management of dermatophytosis in both single and multiple cat situations.

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**Stepwise approach**

To follow is a series of practical steps for a veterinarian to use when asked to investigate a suspected outbreak of feline dermatophytosis in a shelter. 'Days' have been assigned to the steps to help give the clinician and shelter staff a perspective on a possible timetable for the investigation and response. Timelines may vary for each organization or for each case depending on the resources (time and finances) available. In some cases, several steps may be accomplished in just a few days.

## STEP 1: **Initial contact (day 1)**

An oft-heard, but erroneous, statement in feline dermatology is: 'It's ringworm until proven otherwise.' Because of this, any skin lesion not easily explained is assumed to represent dermatophytosis. When contacted about a suspected 'outbreak', therefore, the most important task is to collect information to confirm the disease is present – or, at least, that a plausible explanation exists.

Since many initial contacts are via telephone or email, the focus is on obtaining answers to some key questions, as outlined in the box below.[6] Before asking any questions, however, it is helpful to allow the caller to describe the circumstances that led them to believe the disease is present, as this may reveal information that might not otherwise be shared; the caller may, for example, reveal that they are not certain they are interpreting fungal cultures properly. It is important to note that the caller may or may not have all of this information readily available and several conversations may be necessary.

It is possible that the answers to these questions will confirm the shelter has a true outbreak in many cats. Or, findings may indicate that only one or two cats are affected and the disease is contained. Conversely, the interview may lead to a suspicion that there is, in fact, no outbreak. Frequently, in the authors' experience, misinterpretation of diagnostic tests (eg, color change in dermatophyte test medium [DTM]) has led to the assumption of an outbreak.

## STEP 2: **Shelter staff first response (day 1 or 2)**

If the level of suspicion for an outbreak is very high based on initial discussions, it may be important to alter the flow pattern for cats entering a shelter in such a way that unexposed cats are protected from exposure. This is commonly referred to as a 'clean break' and is described in Step 5.

If additional information is needed before making a risk assessment, the following steps are recommended to contain or limit any further spread of disease pending collection of that information and/or a site visit.

- **Isolate any highly suspect cats** (ie, lesional and/or Wood's lamp positive) while awaiting veterinary examination.
- **Limit movement of animals within the shelter** to that directed by a veterinarian or the shelter manager.
- **Aggressively clean and disinfect the shelter:**

– Remove any unnecessary items or clutter from hallways or wards to facilitate cleaning.

– Mechanically remove debris via sweeping or vacuuming, then scrub the hard or non-porous surfaces with a detergent until they are visibly clean and rinse with clean water. This is referred to as a 'hard clean'. Organic debris must be removed and surfaces pre-cleaned before disinfection, as most disinfectants will not work in the presence of organic debris. Rinsing of the surface with water is necessary because detergent residue may inactivate some disinfectants. Excess water should be removed from the surface prior to application of a disinfectant; the surface does not need to be dry but puddles of water should not be present.

– Apply a disinfectant to properly prepared (ie, visibly clean) surfaces and allow a 10 min wetting time. This is the minimum time stipulated on most disinfectant labels to ensure sporicidal activity.

**Key questions in response to a report of a suspected outbreak**

- Are both cats and dogs affected?
- What clinical signs are present and when were they first noticed or reported?
- What ages are the affected cats? (In general, dermatophytosis is a disease of pediatric patients and, if the disease being described involves both cats and well as adult dogs, it is reasonable to suspect multiple problems may be present)
- How many cats are affected?
- Have the affected animals been examined by a veterinarian? Did a veterinarian diagnose the disease in a recently adopted cat?
- What diagnostic tests have been performed (when, where and by whom)?
- Was a Wood's lamp used? Describe the findings. Were the hairs examined microscopically?
- Was a fungal culture performed? If so, how was the sample collected? What fungal culture medium was used? How and where was the sample incubated?
- Were the fungal culture results reported as simply positive or negative, or were colony-forming units/plate (cfu/plate) reported? What color changes were noted in the medium and when?
- Was microscopic examination of growth performed? If so, where, when and by whom? Is the fungal culture plate still available?
- Were any of the animals treated? If so, when, where, by whom and how?
- What was the response to treatment?
- Have staff members or pet owners reported skin lesions?

## Cleaning recommendations

**Key facts**
- Spores do not multiply in the environment
- Spores do not 'invade' building structures like mildew or black mold
- Daily removal of debris and organic material will minimize environmental contamination
- Control of environmental contamination minimizes problems with false-positive fungal culture results

### General recommendations
- Remove unnecessary clutter
- Store supplies in cabinets or closed containers
- Store bedding in closed containers
- Place soiled bedding into plastic bags for transport to laundry

### Soft surfaces
- Discard items that have large amounts of hair on them or trapped in fibers
- Wash exposed laundry separately
- Hot or cold water can be used
- Bleach is optional
- Do not overfill laundry tub; mechanical agitation removes spores
- Use longest wash cycle possible

### Hard surfaces
- Mechanically remove debris via sweeping or vacuuming
- Wash hard surfaces with a detergent to remove organic debris; this mechanically removes spores and is the most important part of disinfection
- Wash until visibly clean
- Rinse surface to remove detergent residue
- Apply disinfectant, allow for 10 min wetting time
- Effective cage/kennel disinfectants: accelerated hydrogen peroxide 1:16, enilconazole, sodium hypochlorite 1:32, 2% potassium peroxymonosulfate
- Effective ready-to-use products: any product with label claim for efficacy against *T mentagrophytes*

High levels of sanitation are important first lines of defense against the spread of disease in shelters, and should be maintained daily. A common misconception, and often a cause of great concern to staff, is that dermatophyte spores multiply in the environment. It is important to emphasize that this is not the case and that the source of spores is naturally infected hairs. Hence, the most important part of disinfection and prevention of the spread of spores is continual mechanical removal using routine cleaning methods.[7]

The term 'one step' is found on many commercial products listed as sanitizers or disinfectants and refers to a 'pattern' of use. In order to obtain this label claim, the product needs to be able to clean a lightly soiled surface and sanitize it in one wipe. Studies to support efficacy claims as a 'sanitizer' require documentation of 99% efficacy within 5 mins against selective bacteria (eg, *Staphylococcus*), but not fungal spores.[8] Careful reading of products labelled as 'one step' cleaners will reveal recommendations to apply only to surfaces that have been thoroughly cleaned (ie, pre-cleaned to remove organic material).

If organic debris is removed, many common disinfectants with label claim for efficacy against *Trichophyton mentagrophytes* are effective against *M canis* when used liberally and allowed a 10 min contact time.[9] Commonly used disinfectants in shelters include accelerated hydrogen peroxide, enilconazole, sodium hypochlorite and potassium peroxymonosulfate.

**It is important to emphasize that the source of dermatophyte spores is naturally infected hairs. Spores do not multiply in the environment.**



## STEP 3: **Assessment of suspect animals (days 1 to 3)**

As with any suspected disease occurrence, animals that are presumed to be affected require veterinary assessment.

- **Examine highly suspect cats** or examine an adequate sampling of cats to confirm the suspected diagnosis.
- **Collect diagnostic samples** to confirm disease presence. This includes Wood's lamp examination (see box on page 410 and accompanying article); determine if electrical extension cords are available or if, say, materials are needed to darken the examination room. Note that it is important that a Wood's lamp examination is repeated on cats each time they are moved to a new location.
- **Perform a walk-through** to assess space for housing and/or isolation of the cats, if needed.
- **Examine any previous fungal cultures,** if available. Ask how samples were interpreted and by whom, and whether microscopic examinations were performed. Perform microscopic examinations of suspect colonies to confirm *M canis*, or of colonies that were used to determine that disease was present. In the authors' experience, many suspected outbreaks are not caused by disease but rather by misinterpretation of color change on DTM, lack of microscopic confirmation, and/or misdiagnosis of fungal species on microscopic examination.

Whenever possible, it is best to avoid moving cats throughout the facility. This will minimize spread of infectious material in the event that true infection is present. The risk of cross-contamination can be minimized by examining each cat on a clean towel or fresh newspaper, which is then put aside for washing or disposed of properly, with the surface being disinfected prior to examining the next cat. Everyone involved in animal examinations should wear gowns and gloves, making sure to change gloves between cats; gowns should be changed between wards and rooms or after handling a highly suspect cat. If known, cats should be examined in reverse order of likelihood of infection (ie, those thought to be free of infection should be examined first).

Cats are first examined in 'white light' (ie, room light or with a flash light if room lighting is poor). This is followed by examination with a Wood's lamp (Figure 1). Although the sensitivity of this test is considered low,[1] the authors have found Wood's lamp examination to be very useful because it will often identify lesions or fluorescing hairs not seen in room light or help confirm suspicion in cats with obvious skin lesions. Fluorescing hairs are often masked by crusts, so it is important to gently avulse crusts to look for these hairs. It is also important to spread the hair to find positively fluorescing hairs (Figure 2). In addition to examining obvious lesions, it is common to find fluorescing hairs on the face and near the ears in early infections (Figure 3). In kittens, fluorescing hairs are often found in the axilla.

Hairs for direct examination can be collected into red top serum tubes or in the center fold of paper that is then placed in an envelope or self-sealing plastic bag. On-site examination of hairs is easily performed using mineral oil; clearing agents are not needed.

## Wood's lamp examination

### What you need

- Long wave plug-in Wood's lamp
- Electrical extension cords
- Material to darken the room
- Forceps and containers
- Adequate number of people to help restrain cats

### What you need to do

- Allow adequate time for your eyes to light adapt before starting the examination (2–3 mins)
- Hold the lamp close to the hair and skin (4–10 cm)
- Move the lamp slowly from site to site during the examination. If lesions were found in room light, examine these first
- Examine the entire cat paying special attention to the face, ears, interdigital area and axillary area
- Lift crusts to look for fluorescing hairs

### What you need to know

- A Wood's lamp does not need to warm up; it is ready to use as soon as it is turned on
- Fluorescence is seen on the shafts of hairs; crust, skin and nails do not fluoresce
- If hairs are broken, fluorescence may appear as 'specks' because of the short stubble of remaining hairs
- Positive fluorescence is apple-green, but may appear blue-green to some observers

**A Wood's lamp examination is repeated on cats each time they are moved to a new location in the shelter.**

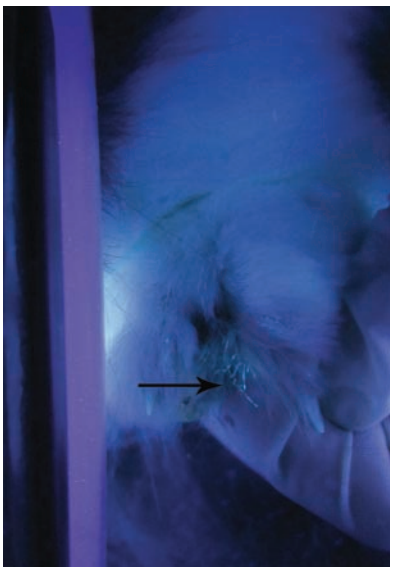


**Figure 1** Wood's lamp positive interdigital hairs. These hairs were not seen at all and, therefore, not noted to be infected/suspicious on examination in room light

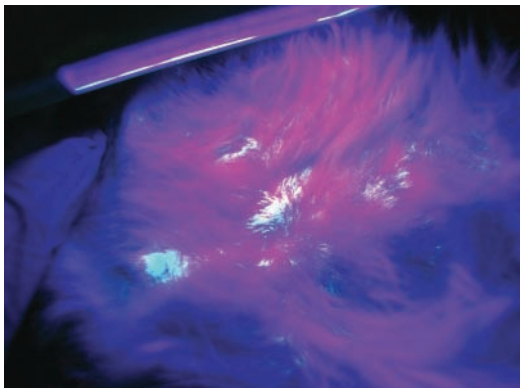


**Figure 2** Wood's lamp positive hairs. These hairs were only found after spreading the overlying hair

**Wood's lamp examination commonly reveals infection sites not visible on room light examination.**

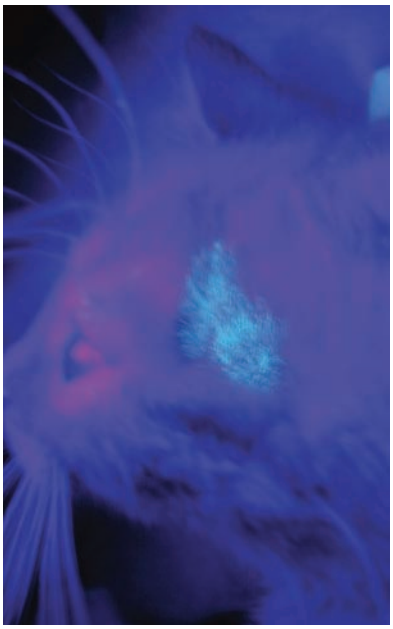


**Figure 3** Wood's lamp positive lesion

Samples for fungal culture should be collected from cats with suspected inflammatory lesions, cats that have been in close contact with lesional cats, and cats that have been in suspected contaminated environments. Ideally, collect as many samples as possible from suspect cats from these categories. It is important to sample the face and within the ear canal, as these are early infection sites. Areas with visible lesions should always be sampled last. If large numbers of cats are involved it may be more important to confirm a trend than to identify each affected individual since it may not be possible to evaluate every cat in one day.

The question as to what is an adequate number to sample needs to be considered on a case-by-case basis and the practitioner will need to rely on their clinical acumen to make this determination. For example, the disease may be confirmed by examination of highly suspect cats. However, if the staff cannot identify such cats then the focus may be the most likely affected populations (ie, kittens and newly admitted cats) or cats with obvious skin lesions. It is not possible to be prescriptive here – this is the 'art' of clinical practice.

Any newly discovered highly suspect cat should be moved to isolation. Otherwise, all cats are kept in their location until Step 8.

In the authors' opinion, if suspicion of dermatophytosis is high, it is not necessary to obtain fungal cultures simply to document contamination of the environment, which is expected. Rather, environmental sampling is important to assess the efficacy of cleaning because of the risk of false-positive fungal culture results. Environmental samples should only be obtained during this step if staff members have had adequate time to clean and disinfect; otherwise it is advisable to wait until appropriate cleaning has been done.

## Culturing of the environment

### Why and when to culture

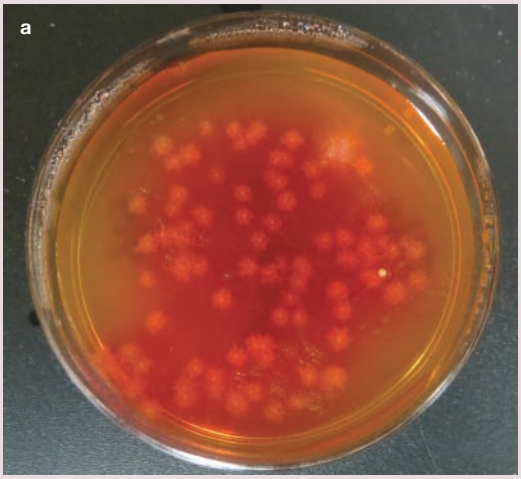
- It is not cost-effective to sample a known contaminated environment simply to document contamination
- Environmental cultures are needed to assess the efficacy of cleaning
- Environmental cultures are helpful when persistent culture-positive status is due to fomite carriage
- Plan to obtain samples after staff members have had adequate time to clean thoroughly

### On the day of sampling

- Obtain samples only after surfaces have been cleaned and allowed to dry, but within 1 h of cleaning
- Samples are best obtained using a commercial disposable dusting sheet (eg, Swiffer Duster Sheet; Proctor & Gamble) or similar material such as gauze
- To minimize cost, obtain only two samples from the room: one from the floor and one from surfaces above floor level that cats can reach
- Inoculate culture plates by pressing the sample side firmly against the surface of the fungal culture medium
- Place environmental samples in a self-sealing plastic (eg, sandwich) bag to minimize cross-contamination

### Interpretation

- It is important to examine plates daily because other environmental contaminants may overgrow plates. Cultures are most likely to show positive growth between days 7 and 10 of culture, though often sooner if there is substantial contamination
- Too-many-to-count cfu/plate (Figure 4) indicate poor compliance with cleaning or sites that have not been thoroughly cleaned
- When contamination is high, often the only organism that grows is *M canis*
- The goal is no growth of the pathogen. Growth of non-pathogens is very common



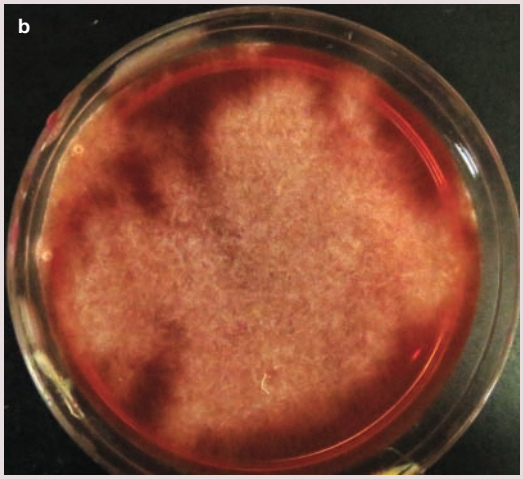




**Figure 4** Positive *M canis* growth on DTM using the toothbrush culture technique. These images show examples of 'too-many-to-count' colonies on a plate. (a) This is typical of a culture from a truly infected cat, but equally may indicate poor compliance with cleaning. Note that individual colonies can still be seen. (b) In comparison, this plate appears to be 'swarmed'. Development of mature macroconidia may be delayed in these plates due to competition for nutrients

## STEP 4: **Planning the response (days 3 to 4)**

Dermatophytosis can often be confirmed via positive Wood's lamp examination and positive direct examination of fluorescing hairs while confirmatory fungal cultures are pending. Indeed, it would be very unusual for there to be an outbreak of *M canis* dermatophytosis without any Wood's lamp positive cats. Thus the information collected in Steps 1 and 3 is usually sufficient in terms of making a preliminary plan.

Plans are situation-specific. The plan for managing an outbreak that is contained to a newly admitted litter of kittens will clearly differ from a plan to manage endemic dermatophytosis.

Even though dermatophytosis is a treatable and curable disease, not all shelters will treat infected cats. Some shelters may elect to treat some and euthanize others. Other shelters may elect to euthanize all cats with documented infections. Only by working with the shelter to institute appropriate screening at intake and educating staff on how to both identify suspect cats and make a definitive diagnosis can future outbreaks be prevented or identified sooner.

**Key considerations when planning the response**

- What is the capacity of the organization to respond to the disease outbreak?
- What is the overall impact on the animals, resources, operations and public image of the facility?
- What will the shelter do to prevent a recurrence or future outbreaks?

### What is the capacity of the organization to respond to the disease outbreak?

**Cost of drugs and fungal cultures**
Providing a medication protocol along with an estimate for the 'per animal' cost of medication is the best way for shelters to make decisions about investing resources in treatment. This cost will depend on the drugs available; in many cases there may be more than one alternative, with variable costs. There are many opinions on the schedule of fungal cultures used to monitor treatment but, irrespective, these need to be included in the treatment costs.

**Veterinary costs** Animals with dermatophytosis require the continued involvement of a veterinarian. If one is not on staff, monies must be allocated for veterinary care.

**Housing costs** The cost of housing an animal in the shelter during treatment should be factored into the cost of treatment. It is reasonable to estimate that it will take a minimum of 6 weeks to treat a cat.[1] Is this extended length of stay in the shelter feasible, and, if so, for how many cats? Can animals be humanely housed and cared for throughout the duration of treatment?

**Personnel** The treatment of cats with dermatophytosis requires staff time, either that of paid staff or trained volunteers. If the latter, there may still be costs associated with supervising the training and monitoring of volunteers. Other often-overlooked costs to consider are additional staff/time for cleaning and disinfecting exposed areas, dealing with laundry, and monitoring of fungal cultures.

**Isolation materials costs** The costs of disposable gloves, gowns and purchase of disinfectants are likewise often overlooked.

**Space** If in-house fungal cultures are going to be performed, an appropriate space for this must be designated. However, more critical is housing and treatment space. This is often at a premium in shelters, so this planning step requires problem solving to try to identify both an area free of contamination or exposure risk for incoming animals and an appropriate treatment area. Having a map of the layout of the facility and an outline of animal movement through the shelter will help. Several authors have described successful treatment and/or eradication of dermatophytosis from shelters;[10–14] one unifying feature is the availability of treatment space. If the outbreak is contained, extra space requirements may not have a large impact. However, if significant numbers of cats are affected, and either infected or uninfected cats continue to enter the shelter, creating an area for treatment as well as maintaining separation between uninfected/non-exposed, exposed but not infected, and infected cats may become more difficult. In some cases, prioritizing space to prevent infection may be the most life-saving measure.

### What is the overall impact on the animals, resources, operations and public image of the facility?

**Shelter intake and live release for adoption** Limiting or discontinuing admissions can be challenging but may also be key if disease is widespread. While a full discussion of the pressures and benefits of managing intake is beyond the scope of this article, average daily intake varies widely from shelter to shelter as does the pressure, both internal and external to the organization, to continue intake. The rate of turnover and live release also vary. For shelters with low turnover and limited or managed intake, a decision to curtail intake may have few ramifications, while limiting intake for a high-intake shelter with government contracts may

**Key questions regarding shelter intake and outflow**

- How will the flow of animals into/out of the shelter affect the response plan?
- Can a plan be implemented to keep incoming animals safe from exposure?
- Is the shelter able and willing to limit or discontinue new admissions?
- How will the needs of other animals requiring sheltering in the community be affected?
- Can animals be safely sent into the community for foster care, transfer or adoption?
- Will the shelter need to limit or stop animals leaving?
- How will holding animals in the shelter affect the life-saving capacity

be almost impossible. Organizations are likely to be unwilling to close what they perceive to be a safety net for animals in their community. Certain key questions will need to be carefully considered and the risks and benefits of limiting the flow of animals out of the shelter should also be weighed (see box above). While some shelters may be comfortable closing outflow for a short period of time, for other shelters, limiting outflow may lead quickly to illness, crowding or euthanasia.

**Treatment decisions** If a decision is made to provide treatment, what impact will this resource investment have on the shelter's medical budget? Will other conditions go untreated or will other animals be euthanized as a result? If personnel hours are diverted to treat cats for dermatophytosis, what will these individuals not be able to do? Are positive outcomes likely to be available for cats once recovered? If the shelter decides to treat in this case, will treatment be an option in the future? If the shelter does not provide treatment what will happen to infected cats? The shelter has a moral obligation to protect the public from zoonotic disease; however, what will the public and media perception be to euthanasia or depopulation of cats and kittens for a low-level zoonotic disease that is non-lethal and treatable and curable? How will the euthanasia of affected cats affect volunteers and staff? If cats are left untreated and in a sanctuary, what animal welfare issues does this raise?

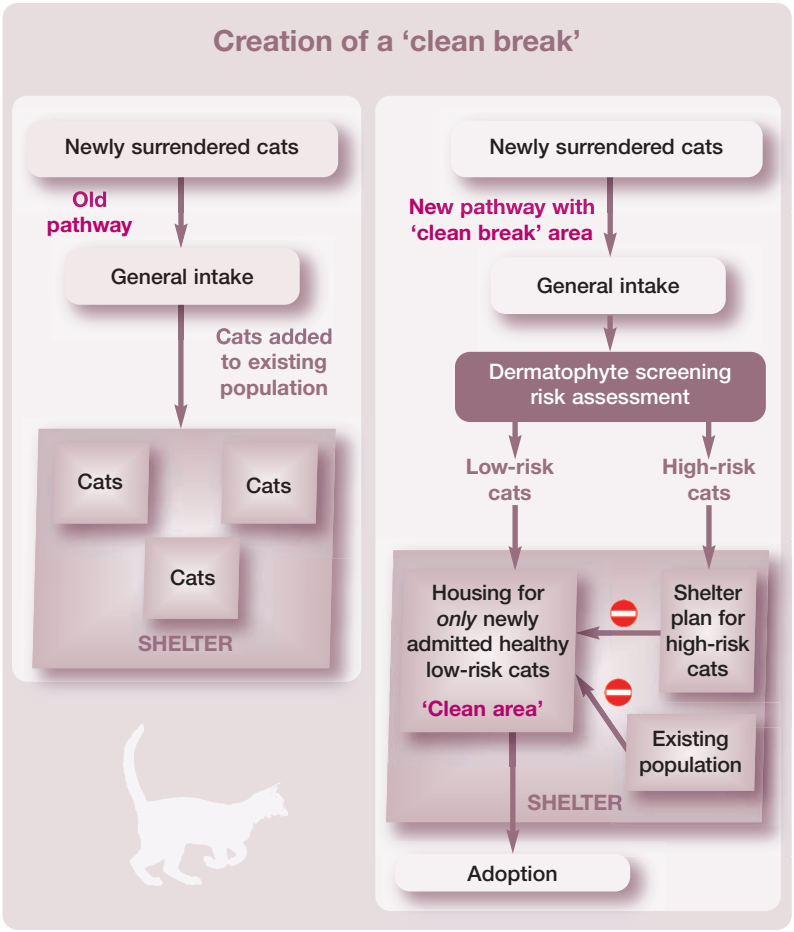
### What will the shelter do to prevent a recurrence or future outbreaks?

It is likely that many cats present to shelters already infected with dermatophytosis. Effective screening is a strong preventive measure since cases identified at intake or before other critical movement (eg, to foster homes, off-site adoption areas, adoption centers or within the facility) can be managed much more easily and are less likely to cause spread of disease than unrecognized cases.

## STEP 5: **Establishment of a 'clean break' (days 2 to 5)**

If shelter intake will continue, a clean break should be implemented quickly. As mentioned earlier, clean break is a term used to describe a strategy that alters the flow pattern for cats entering a shelter in such a way that unexposed cats are protected from exposure to disease.

At the time of surrender, in addition to routine admission procedures, cats are carefully examined for skin lesions in room light and with a Wood's lamp. If cats are low risk (no lesions and Wood's lamp negative) and otherwise deemed healthy, they are diverted into a designated housing area (ie, clean break area) that has been disinfected and is separated from other areas housing exposed or potentially exposed ('dirty') cats in the shelter. These cats become the adoptable population until the outbreak is contained. All other cats are diverted into housing for cats in the shelter. The question of what happens to truly infected cats depends on the shelter's planned response. Cats can leave the clean break area if adopted or if they need medical care. The only cats that can enter the clean break area are newly admitted cats, as illustrated below.



Establishing and maintaining a clean break strategy contains an outbreak while the shelter mobilizes for the remaining steps of the response and allows for safe continuation of admission. Depending on the severity of the concerns regarding exposure, varying degrees of separation can be considered. If concerns are minimal, then the designated clean break area may continue to hold animals considered to be low risk for contagion. However, if the risk is high, even cats that *may* have been exposed must be removed from the clean break area; in these circumstances, the 'clean' areas should be reserved for new unexposed animals entering the facility as determined by intake screening (examination, Wood's light examination, examination of fluorescing hairs). Shelter resources will determine if fungal cultures are performed on all new admissions or subpopulations (eg, Wood's lamp positive cats, kittens, Wood's lamp negative but lesional cats). Separate equipment and staff should be dedicated to the clean break area.

In order to maintain the clean break area, intake staff members need to be trained to screen incoming animals for suspicious clinical signs. An unidentified infection in an incoming animal could contaminate the clean break area. Animals that are suspect on screening should not be admitted into the clean break area. If necessary, an intermediate area may be established to allow time to confirm or clear suspects before deciding on which pathway they should follow. This area would house cats with pending fungal cultures/direct examinations and/or cats with skin lesions that cannot otherwise be explained.

## STEP 6: **Screening of the entire suspect population (days 3 to 5)**

Screening should include thorough examination in both room light and with a Wood's lamp, direct examination of fluorescing hairs, and selective use of fungal cultures. Since fungal cultures will be the greatest cost, other than investment in veterinary care, strategic and selective culturing can be the difference between an affordable response and overwhelming resource expenditure.

Fungal culture remains the 'gold standard' for diagnosis of dermatophytosis in individual animals. Shelter-wide screening can provide a global overview of the culture status of cats and provides a safety net by helping to identify infected animals with lesions that were missed on examination. In shelter practice, the cost of an in-house fungal culture rarely exceeds the cost of other point-of-care diagnostics (eg, feline leukemia and feline immunodeficiency virus testing) that are frequently performed routinely before adoption.

### Cost-effective screening – shelter-wide or targeted?

The most cost-effective screening is one that balances resources and time investment with minimizing ongoing risk. If the shelter population is very small, it may be entirely reasonable to screen all of the cats. If the affected population has only had limited contact with other cats it may only be necessary to screen those cats. However, it is important to consider that even if the cats have not had direct contact with other subpopulations in the shelter, infectious material may have been spread by staff to other populations. There are no cost savings in minimal screening if unidentified infections persist so that the outbreak continues or recurs.

The pros and cons of shelter-wide screening versus a more targeted approach should be discussed with the organization. Experience has shown the authors that the most at-risk cats are those with clinical signs of disease (lesions), while those with no lesions and negative Wood's lamp examination findings are far less likely to be of concern.

**Strategic and selective fungal culture can be the difference between affordable and overwhelming resource expenditure.**



Arguments against shelter-wide fungal culturing are many. First, unless the number of cats in the shelter is very small or the organization's resources almost inexhaustible, shelter-wide screening of cats may simply not be feasible. Secondly, to be most useful, fungal cultures need to be examined daily so, ideally, are performed in-house (Figure 5). This requires dedicated space and (potentially multiple) trained staff. Thirdly, it is a misconception that culturing the population of cats is 'better' or 'time saving'. In every case, an investment must be made in thorough evaluation of the skin and hair coat. Fungal culture data can only be interpreted in conjunction with knowledge about the presence or absence of skin lesions. So, even if shelter-wide screening is possible, cats still need to be examined. Fourthly, even though this is a disease of public health concern, evidence is lacking that culturing without a concurrent examination that screens for lesions is a superior method of protecting staff compared with rapid identification of suspect animals via examination, appropriate isolation, cleaning, proper staff hygiene and use of gowns and gloves. Finally, there is no evidence-based data to prove that shelter-wide screening versus a more targeted approach results in a better outcome for the cats or the shelter.

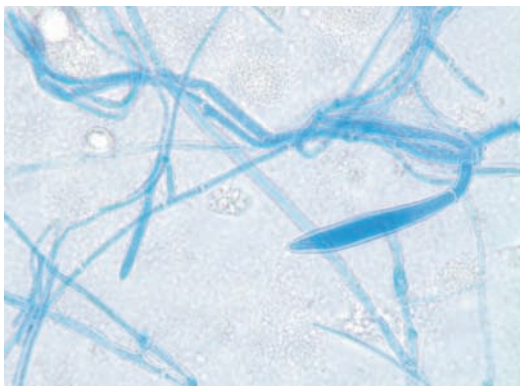


**Figure 5** Early growth of *M canis* from the culture plate shown in Figure 4b. Note the ends of the hyphae are thickened and sporulation is just starting. This is a classic finding to recognize when reading fungal cultures

### Resource-sparing approaches to fungal culture screening of at-risk cats

There are two common resource-sparing approaches to fungal culture screening of at-risk cats. Both involve intensive examination of cats in room light and with a Wood's lamp, to detect subtle/early lesions that are so easily missed on examination in room light, and microscopic examination of fluorescing hairs.

In the first approach, fungal cultures are reserved for exposed cats that have negative Wood's lamp examinations, regardless of lesion status. The assumption here is that lesional, Wood's lamp positive cats with microscopically confirmed infections are 'truly positive' and fungal culture is not necessary. This approach is dependent on the skill of the examiner and could potentially lead to treatment of some cats that are not truly infected.

In the second approach, fungal cultures are reserved for cats with skin lesions. In this approach, positive Wood's lamp examinations and confirmatory direct examinations can be used to identify cats with strong enough suspicion to start treatment pending fungal culture results.

In-house fungal cultures are strongly recommended because daily examination can rapidly detect culture-positive status of cats.

## STEP 7: **Use of clinical data to group cats based on risk (days 5 to 6)**

Although definitive culture results are usually not available for 7–14 days, by this point in the investigation there should be a great deal of information to hand on which to base treatment decisions.

Essentially, it should be possible to group cats as follows:

- **Truly infected/high risk:** Lesions present, Wood's lamp positive and direct examination positive.
- **Suspicious/moderate risk:** Lesions present, and Wood's lamp negative/awaiting culture results.
- **Non-lesional/low risk:** No apparent lesions present and Wood's lamp negative.

Daily examination of cultures may reveal signs of fungal culture growth as early as 3–4 days (Figure 6), which may be sufficient for a cat to be moved to a different risk category.

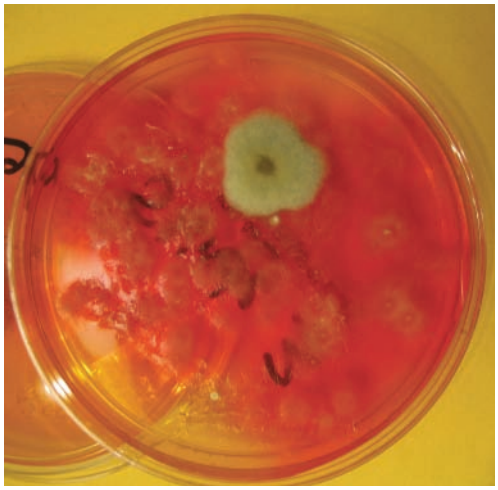


**Figure 6** This culture plate shows a classic presentation of early growth of *M canis* on DTM, and, pending microscopic confirmation, would be considered suspicious. The darkly pigmented colony is a contaminant

'Shuffle' has more positive connotations than 'segregation', and is a more accurate description of what actually happens!

## STEP 8: **First cat 'shuffle' and assessment of environmental cleaning (days 5 to 6)**

Step 8 is the first of two cat 'shuffles', in which cats are moved within the facility so that they are housed according to the risk groups they were sorted into in Step 7. (A second shuffle [Step 10] is often needed once further information or confirmation is available.) When working with staff in shelters, the authors prefer to talk in terms of cat 'shuffle' rather than 'segregation' because it has a more positive connotation. It is also a more accurate description of what actually happens!

Since open, unused housing space is often not available, 'shuffling' may involve cleaning and disinfecting many cage areas or wards if large numbers of cats need to be moved from one area to another. Truly infected/high risk cats should ideally be physically separated in a ward or room away from the rest of the population. If a dedicated room is not available a separate area within a room/ward can be created, though this approach is associated with a greater risk of spread of dermatophytosis.

In group housing set-ups, at-risk cats (ie, exposed but not lesional) should be physically separated from low-risk cats. If animals are housed in individual housing units, and separate rooms are not available, at-risk animals may be identified via cage cards. These animals would be cared for after non-suspect animals. This requires training and compliance to be successful but minimizes cage shuffling, which may be stressful for cats. One practical

**Priorities for the first 'shuffle'**

- Maintaining the clean break area, which separates new incoming cats from the general population. Cats in the clean break area are not normally part of the 'shuffle', since these cats are presumed to be free from exposure or disease
- Separating truly infected/high-risk cats in a designated isolation or treatment area or removing them from the general population
- Pending fungal culture, establishing separation between moderate-risk cats (lesions present, Wood's lamp negative, fungal culture pending) and low-risk cats
- The ideal situation is to house all three risk groups separately but, if screening has been done effectively and cats are housed in individual housing units or cages, the actual risk of dermatophytosis contagion from at-risk cats (ie, exposed but not lesional) housed individually is typically very low

solution is to hang numbers on the cages that correspond to the order in which cats should be cared for.

It is critical to assess the efficacy of environmental decontamination after cleaning and disinfecting because fomite carriage can contribute to positive culture results, making it difficult to interpret screening and/or monitoring cultures. If preliminary culture results are showing >10 colony-forming units per plate (cfu/plate), this is compatible with poor compliance with cleaning protocols and/or the presence of actively infected cats. It is important to remember that the results being assessed may be from 1 week prior. If environmental cultures are showing heavy contamination of spores, cleaning protocols on the day of sampling were inadequate and should be reviewed and corrected as needed. The most common weakness is an insufficient hard clean (see pages 408–409). If repeat fungal cultures are showing a decrease in the number of cfu/plate this is indicative of decontamination. The ultimate goal is no growth of pathogens.

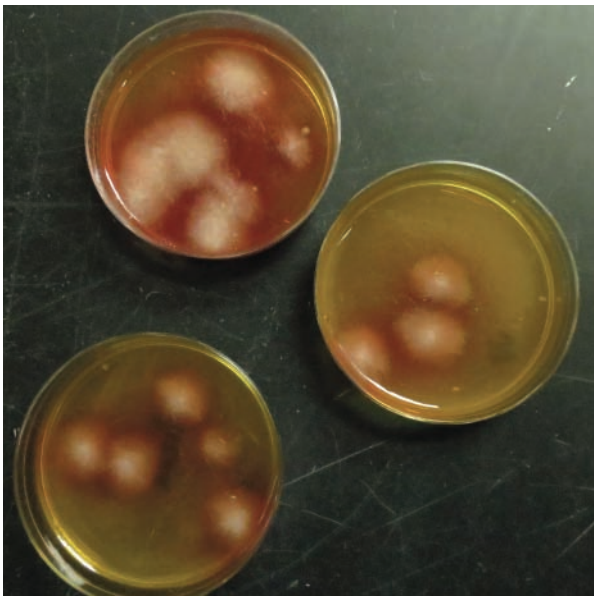


**Figure 7** Three examples of *M canis*-positive fungal plates from cats determined to be culture positive due to fomite carriage. Note the low numbers of cfu/plate. On re-examination these cats were still lesion-free and Wood's lamp negative. In all three cases, repeat fungal cultures were negative

## STEP 9: **Evaluation of fungal culture results (days 7 to 14)**

Shelters not performing fungal cultures in-house should work with laboratories that will report preliminary culture results at least every 7 days. They need only report whether the culture is suspect, positive or negative and the number of cfu/plate up to 10. While not an onerous task, it is critical to be sure that the laboratory knows how to properly inoculate a fungal culture plate when a toothbrush sample is submitted. Often laboratories will simply select hairs to culture rather than stab the bristles into the culture plate. If the bristles are not stabbed onto the surface of the plate, cfu/plate cannot be reported.

Ideally, as discussed, fungal cultures should be processed in-house (see accompanying article). A search of the organization's volunteer base may well reveal individuals with laboratory expertise who are more than able and willing to monitor these cultures. Alternatively, training volunteers to carry out daily screening of cultures, looking for red media color change and characteristic fungal growth, can save enough staff time to make in-house processing possible.

**Shelters not performing fungal cultures in-house should work with laboratories that will report preliminary culture results at least every 7 days.**



An important advantage of performing in-house cultures is that it allows the plates to be observed daily; results are available more rapidly and cfu/plate can be counted. In the authors' approach to outbreak management, the number of cfu/plate, combined with the presence or absence of lesions, is used for the final determination of risk assessment and decisions about treatment, as follows:

✣ **Low-risk cats** These are cats that, at the time of initial examination, had no lesions present, were Wood's lamp negative and produced cultures with fewer than 10 cfu/plate (Figure 7). On re-examination they are still lesion-free and Wood's lamp negative. These cats are considered fomite carriers. If they were truly infected and incubating an infection at the time of initial screening, obvious lesions would be expected to be present at re-examination 7–14 days later.[15] True fomite carriers rapidly become culture negative once they are removed from a contaminated environment. The options for treating these 'low-risk' cats are either no topical treatment or a single topical treatment with an antifungal shampoo or rinse.

✣ **High-risk cats** These are cats that, at the time of initial examination, had no skin lesions, were Wood's lamp negative and produced cultures with more than 10, and typically too-many-to-count, cfu/plate (Figure 4). Re-examination for lesions in room light and under Wood's lamp may determine if the fungal culture status on the day of sampling was due to fomite carriage or true infection. In the authors' experience, *M canis*-infected cats are more often than not Wood's lamp positive. If the infection site was subclinical at the time of first examination, lesions are typically obvious at this time. If there is any doubt, these cats should be treated as 'truly' infected because of the high fungal load on the hair coat. Weekly fungal cultures are recommended for these cats. If they are fomite carriers, they will rapidly become fungal culture negative.

✣ **Truly infected cats** These are cats with confirmed infections. They are lesional, culture positive and commonly Wood's lamp positive.

## STEP 10: **Second cat 'shuffle' as culture results are confirmed (days 7 to 14)**

Over the next 7 to 14 days, as fungal culture results become available, it will be necessary to shuffle cats again as their risk/infection status is confirmed. In the laboratory of one of the authors, 99% of culture-positive infected cats were identified within 14 days (KA Moriello, University of Wisconsin, unpublished data 2003–2013). Although the recommendation is to hold plates for 21 days, in a shelter situation treatment decisions can be made by day 14 if there is growth of *M canis*.

Plates can be discarded once they are positive and the number of cfu/plate has been recorded. Plates should also be discarded if there is rapid and heavy overgrowth of contaminants; it may be necessary to re-culture some cats. All plates from cats under treatment or that show no growth on screening should be held for 21 days.

It is important to emphasize that each time cats are moved, they should be examined for skin lesions and re-examined with a Wood's lamp.

## STEP 11: **Long-term response plan**

Institution of a screening program at shelter intake is the key to preventing future outbreaks in the shelter. Even if treatment is not within the organization's capabilities, screening at intake is a crucial and very cost-effective tool to prevent future outbreaks.

When resources allow, providing the option of treatment for at least some animals can be a preventive tool in itself. When staff know treatment may be an option, identification and reporting of problems improves.

**Key elements in the long-term response plan**

- Staff should be trained to perform thorough examinations of the skin at the time of intake and each time cats are moved
- The intake room should be organized so that it is possible to perform a careful and thorough examination of the skin in white light and with a Wood's lamp. Battery-operated lamps and 'black lights' are not suitable and will not produce fluorescence. There are many durable medical models available, but any lamp used should be one that plugs into a wall socket
- Funds should be allocated to allow for fungal cultures on all cats with inflammatory skin lesions that cannot otherwise be explained

### Treatment

Guidelines on treatment and prevention of feline dermatophytosis have recently been published in this journal by the European Advisory Board on Cat Diseases.[1]

A question that organizations commonly grapple with is: 'If we decide to treat infected cats, which ones do we focus on?' Simplistically, treatment involves resources: long-term housing in a designated treatment area, administration of a systemic antifungal drug, application of an effective topical antifungal rinse, ongoing environmental cleaning and a monitoring program. When resources for treatment are insufficient, an organization may bring about more problems and greater loss of life by attempting to treat than by making a choice not to admit or to euthanize infected animals.

Prioritization of targeted populations is common, often necessary and very reasonable. In order to treat cats, staff must be able to handle them easily. Attempting to treat feral/semi-feral cats may create welfare problems and safety risks for staff. A shelter may have endemic dermatophytosis and elect to manage the disease by focusing first on the cats they expect to be adopted most readily, with the eventual goal of having a dermatophyte-free population for adoption, while allowing some cats in segregated areas to go untreated.

The decision not to treat a population of cats is complicated and must include a plan for those cats. If the cats will remain in a sanctuary situation, the plan must include protocols which ensure that healthy cats are not exposed to this population and care staff schedules must be arranged so that there is no risk of cross-contamination. Possibly, the plan may be eventually to treat some of these cats, assuming space and funds permit. Individuals able and willing to foster or adopt infected cats must be thoroughly educated about the cat's immediate medical needs. Any decision to euthanize rather than treat an individual cat or a group of cats may be made based on population dynamics, likelihood of future placement and resources available.

Decisions on the management of shelter animals and populations are different for every organization. In every case, depopulation should only be considered when all other options are unavailable and expert opinion has been considered. It is absolutely critical to confirm the presence of an outbreak and identify truly infected cats before making life-threatening decisions.

**'If we decide to treat infected cats, which ones do we focus on?'**

## SUMMARY POINTS

- The stepwise response outlined in this article is intended to be used as a guide when there is a suspected outbreak in a shelter.
- The steps are summarized as follows:
  - STEP 1: Initial contact/interview to collect information to determine if the suspicion is valid
  - STEP 2: Staff action to contain spread: isolate suspect cats, limit movement of cats, enhance cleaning
  - STEP 3: Veterinary assessment of suspect cats to confirm true disease
  - STEP 4: Planning and discussion of the response options with the organization
  - STEP 5: Diversion of the flow of new admissions to protect them from the exposed population
  - STEP 6: Cost-effective screening of the entire population
  - STEP 7: Use of available information to group cats based on risk: truly infected/high risk, suspicious/moderate risk or non-lesional/low risk
  - STEP 8: 'Shuffling' of cats based on risk and assessment of environmental cleaning
  - STEP 9: Evaluation of available fungal culture results
  - STEP 10: 'Re-shuffling' of cats based on new information (ie, fungal culture results)
  - STEP 11: Long-term response to prevent/minimize future outbreaks
- Responses are situation-specific and some steps may be combined on the same day and/or may not be needed in a particular situation.

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## Conflict of interest

The authors declare no conflict of interest.

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