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EDITORIAL

Can there be an animal more entwined in history, myth and mystery than the domestic cat? Whilst it is true that we have lived alongside dogs for longer – perhaps for as much as the last 30,000 years –, the cat has, for better or worse, been irretrievably interlinked with humans in numerous ways for around 10,000 years. Presumably, our ancestors initially realized that cats were useful because they would protect precious food stores by hunting vermin, but the feline fantasies, legends and histories that have accumulated since then have a fascination that has carried down through the centuries. From the Chinese cat goddess Li Shou to the more general veneration shown to all cats by the ancient Egyptians; from the Norse deity Freya who had a chariot drawn by cats to the idea that cats were the preferred companion of witches in the Middle Ages; from the Eastern cultures that believed cats acted as hosts for certain holy human souls after death to the Ancients who believed cats were associated with certain emotions (Pliny linked them with lust, whilst Aesop believed they were connected to deviousness and cunning).

The beliefs of the ancient world continue to fascinate, and, in this more scientific age, separating fact from fiction can still be difficult. The myths surrounding cats in the 21st century can be as contrary as the animal itself – for example, in some countries a black cat is considered unlucky, yet in others it is regarded as a harbinger of good fortune. Separating fact from fiction when it comes to feline veterinary care is almost as problematic. Until relatively recently, the species was much neglected, with much extrapolation from canine medicine on the assumption that a cat was simply a small dog. We now know this is far from the truth; in the last few decades, our knowledge of feline disease has expanded exponentially, as this issue of *Veterinary Focus* will attest. Indeed, the reader will find that as well as reviewing various feline diseases, there are also articles on how we might understand cats better. The enigma that is *Felis catus* continues, but perhaps with slightly less mystery and myth than before.

Ewan McNeill – Editor-in-chief

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Optimizing an indoor lifestyle for cats

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Introduction

People benefit from living with pets. As companions, they provide stress relief, stability of routine, and improved health (1). Yet how to best care for our cats remains controversial, and there are cultural and regional differences in what people believe is the best way to house cats. As long ago as 1997, between 50-60% of cats were housed strictly indoors in the United States (2), whereas in the United Kingdom the majority of cats were allowed outside (3), whilst a study from Melbourne, Australia reported that 23% of cats were "mainly indoors" (4). Why are there such "cultural" differences? The decision to keep a cat indoors may be practical: living on the 21st floor of an apartment building in a busy city prevents ready access to the outside. In other situations, it is true that keeping a cat indoors reduces the risks from wandering, poisoning, automobile accidents, contagious disease or fights with other animals (5,6), and owners may also believe that it removes the risk of internal and external parasites (*e.g.,* heartworm, fleas). Other reasons to keep cats indoors include avoidance of unwanted pregnancy (assuming the pet is not spayed) and to protect wildlife.

KEY POINTS

- **Cats restricted to indoor living have a reduced risk for vehicular trauma, predation, aggressive interactions with cats and other animals, and exposure to infectious diseases.**
- **Indoor living is not without risks.**
- **Not all cats can adapt readily to an indoor lifestyle, and may be at increased risk for certain behavioral and medical problems.**
- **All environmental and social needs must be met for successful indoor living, and the well-being of each cat needs to be evaluated repeatedly over time.**
- **Predictability, familiarity, routine and having a sense of control are key factors in reducing stress.**
- **Offering outdoor access does not compensate if the cat has poor conditions indoors.**

What are the effects of indoor living on cats?

Are there any downsides to keeping cats strictly indoors? There is a reality-perception mismatch if owners think that their indoor cat's life is free from perils, as the indoor cat experiences different hazards. These include falls from balconies and windows, kitchen scalds or burns, and access to toxic cleaning products, unsuitable food (*e.g.,* onion, garlic) and plants (3) ***(Table 1).*** Studies comparing mortality of cats housed indoors with those allowed outside are not available in the North American veterinary literature (7). However, cats have not been selectively bred to be indoors 24 hours a day, and many do not adjust to living in close contact with people (4). For this adaptation to be successful, a cat must have had complete and successful socialization to people prior to eight weeks of age (4). Additionally, because fearful traits can be inherited, some cats will be unsuited to close

human contact (4). Similar concerns exist when trying to integrate cats from different sources: this requires early socialization and cats have different personalities (*e.g.,* sociable, timid and unfriendly, active and aggressive) that may be incompatible (8).

A monotonous and overly predictable environment is stressful (9). Cats may not be able to perform behaviors that express their natural *telos* – their cat-like nature. The resulting psychological and physiological stress may develop into either problem behaviors (natural behaviors that are unwelcome, *e.g.,* spraying or scratching), behavior problems (*e.g.,* obsessive grooming), or physical illness. Signs of stress and anxiety may be overt (*e.g.,* changes in appetite, grooming, increased vocalization, hiding, vigilance, aggression, spraying or compulsive behaviors ***(Figure 1)***), or subtle (*e.g.,* decreased activity, play, exploratory behavior/inquisitiveness, facial marking, affiliative interactions with people and other animals) (10).

Certain physical illnesses are more prevalent in indoor cats ***(Table 1)*** although it can be argued that indoor cats may be more closely observed, so that behavior changes are more readily noticed, or they receive more frequent veterinary care, so that diseases are identified more readily than in free-roaming cats, but this is only conjecture. One source states that "the disparity between physical and psychological stressors is an illusion. Host defense mechanisms respond in adaptive and meaningful ways to both" (11).

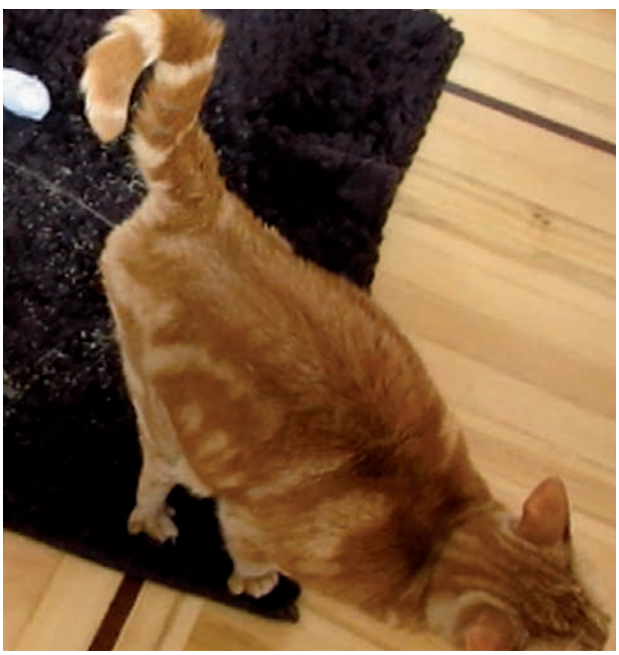
What cats need to be cats

Reducing stress for cats requires an understanding of who and what a cat is and what they need. Cats are territorial, with their territories based around essential resources, most prominently food. Both males and females mark their territories with olfactory clues: spraying urine, rubbing against objects and scratching vertical surfaces (which provides both olfactory and visual signals). Resource areas may be time-shared, so cats circumvent confrontation by avoiding contact. Fighting is a last resort and occurs when escape is impossible. Cats require privacy for hiding, safety, observation, undisturbed rest, and sleep, whilst vantage positions allow cats to avoid or evade intruders, predators and other threats. Socially, cats may live on their own or in groups. Colonies consist of related females and their offspring, with males visiting for reproductive purposes, although they may help to provide care for related young until they are mature, either sexually or socially (12).

Table 1. Comparing lifestyle risks (adapted from (3)).

Increased risks associated with living strictly indoors	Increased risks associated with outdoor access
• Lower urinary tract diseases (idiopathic cystitis and calcium oxalate urolithiasis) • Dermatologic problems (atopy/acral lick dermatitis) • Obesity • Diabetes • Odontoclastic resorptive lesions • Boredom • Household hazards (burns, poisons, falls) • Inactivity, decreased fitness • Problem behaviors (spraying, scratching) • Behavior problems (obsessive behaviors) • Hyperthyroidism	• Infectious diseases (FeLV, FIV, rabies, parasites) • Vehicular accidents • Trauma (falls) • Altercative trauma (other cats, other animals) • Getting lost • Theft • Poisoning

Figure 1. Psychological and physiological stress may result in unwelcome problem behaviors such as spraying.



The "Five Freedoms", first described in 1965 to define farm animal welfare*, have more recently been adapted for cats, as follows (3):

1. Provision of food and water: a balanced diet that meets the animal's nutritional needs at every life stage, and fresh water.
2. Provision of a suitable environment: adequate space and shelter, with sufficient light, low noise levels and no extremes of temperature. The area can be indoor-only or with outdoor access.
3. Provision of healthcare: vaccination, neutering (sterilization), parasite control, individual identification (microchip, collar), and prompt access to veterinary care.
4. Provision of opportunities to express most normal behaviors, including those directed towards conspecifics, and humans.
5. Provision of protection from conditions likely to lead to fear and distress.

While the vast majority of cats kept indoors will have adequate food and water, and illnesses addressed when noticed, many do not have the ability to express normal cat behaviors. This may result in distress, fear, undesirable behaviors, and potentially illness. Typical cat behaviors include play, investigation, observation, hunting, feeding, drinking, grooming, scratching, traveling, scent marking, eliminating, resting, and sleeping (13-15). Additionally, cats are crepuscular, *i.e.,* their peak activity times are around dusk and dawn.

Indoor life and obesity

Indoor confinement predisposes to obesity. There are numerous reasons for this, including the most obvious one, *i.e.,* ingesting more calories than they are utilizing. However, it is more complicated than this. In nature, cats do not have *ad libitum* food intake. To avoid starvation, the drive to eye, stalk, pounce and kill is permanently active, and a cat makes numerous hunting attempts for every successful kill (16). Mostly, prey are small mammals or birds, and a cat may hunt 100 times each day to meet its caloric requirements (10-20 small prey), an intellectually stimulating and physically active endeavor.

Our cats receive food with minimal effort, becoming overweight because they eat too much, and their food is often calorie-dense. One mouse (=30 kcal) meal is approximately 10 pieces of an average maintenance dry food; even eating 10 extra pieces per day can result in a 10% weight gain over a year. Owners like to see their cats eat and may interpret inquisitive, verbal or rubbing cues from a cat as a request to be fed; rewarding such actions with food reinforces the cat's behavior, and the owner feels needed and cared for. We inadvertently train cats to ask for food, and they train us to respond to their boredom or other unmet needs by feeding them.

Neutering (males and females) reduces energy requirements by between 7-33% (most studies indicate 20-25%). Additionally, feeding induces release of neurochemicals that make the cat feel good, and eating becomes a solace for negative experiences (distress, fear) or boredom. In a multi-cat household, if the cats are stressed due to incomplete socialization, they can express this by overeating, especially if they cannot achieve and maintain a comfortable spacing.

Obesity is a huge problem in cats. One study (17) determined that the risk factors associated with overweight or obesity were frequency of feeding and neutered status, regardless of whether cats were indoors or outdoors. Cats fed 2-3 times daily were more likely to be overfed than those offered *ad libitum* feeding. While contradicting the findings of other studies, this reinforces the importance of owner education regarding the amount and type of food to feed. Many diets developed for indoor cats have a higher proportion of calories derived from protein to help offset decreased exercise, and are fiber-enhanced to improve stool character, reduce fecal odor, and to help promote intestinal motility to reduce hairballs.

Optimizing the indoor environment

There are two aspects that need to be considered: the first is to decrease stressful stimuli, and the second is to improve and enrich the environment. They may overlap in some instances, *e.g.,* boredom is not a direct threat in the way that confrontation with another pet might be, but it is still a source of stress.

Stress results from unpleasant, noxious stimuli that cannot be predicted or controlled (18). These may be physical or social in nature. Early life experiences as well as genetics play a role in an individual's ability to adapt to situations. A barren environment or a chaotic one with excessive novelty are both undesirable; *e.g.,* a new member in the household, changes in routine or in the physical environment. Poor relationships with other animals and humans are stressful. Competition for resources may be real (with another animal or a teasing human) or perceived (inability to reach resources, fear of ambush). Most anxiety disorders (*e.g.,* urine spraying)

* The Brambell Report, December 1965 (HMSO London, ISBN 0 10850286 4)

are a result of social or environmental stress (12). The source of stress should be identified and removed whenever possible. Reducing disruption and creating a more predictable, harmonious schedule and environment is helpful. When the stimulus lives with the cat, (*e.g.,* another cat, a person), a gradual and prolonged reintroduction protocol, paired with positive, pleasant reinforcement, will be needed in order to reshape the cat's experience.

If a change in routine is unavoidable, proactive positive conditioning will be helpful – so, for example, to prepare for a veterinary visit, encourage the pet to regard the cat carrier in a positive manner, *e.g.,* by putting food in the carrier and emphasizing its desirability and safety.

Environmental enrichment refers to both the physical and social environment and should include temporal complexity (*i.e.,* variability) (15). The goal is to offer more behavioral diversity, increase the use of space, enhance the human-cat relationship and – ultimately – improve an individual's ability to cope with adversity, thus decreasing the expression of abnormal and undesirable behaviors (3).

Depending on resource availability, free-ranging cats occupy huge ranges, from 1.2-2450 acres (0.48-990 hectares). Clearly indoor apartments are too small for the average cat, and this situation is made worse by adding unrelated and/or unfamiliar cats (12). An indoor environment should consist of at least two rooms, but cats also need complex, stimulating, three-dimensional space; allowing a cat to climb provides distance from other cats as well as the ability to survey their environment and to predict (and evade) suspicious or threatening stimuli (3). Most cats do not get along well in a multiple cat environment if they have not been socialized together. Adult cats accustomed to outdoor access may have difficulty adjusting to indoor-only housing. However, if they have been well socialized as kittens, introduced properly (over several months) to the new cats, and there is sufficient space with appropriate number of separated resources, cats may live well together ***(Figure 2).*** Cats may also live comfortably with a dog or other companion animal assuming that they have been habituated to each other.

What can we do to optimize a cat's living area?

Recent guidelines (19) define "five pillars of a healthy feline environment", as follows:

1. A safe space: namely, somewhere that a cat can rest, relax and sleep without fear. Cats also need to be able to observe from this, or other, vantage points; hence, the space is often raised. A dip in a perch or shelf allows the cat to remain concealed and have a sense of control. Hiding is an essential coping behavior for cats: not having the ability to hide can contribute to stress and illness (12) ***(Figure 3).*** In a household with more than one cat or with a dog or a person that might invade the cat's safe space, it is essential that the cat cannot feel trapped, so a safe space must have more than one entry. There should be at least one safe space per cat in the household,

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Figure 2. If they have been well socialized as kittens, and there is sufficient space with appropriate number of separated resources, cats may live together happily.

Figure 3. Hiding is an essential coping behavior for cats, but in a multi-cat household it is essential that the cat does not feel trapped.

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separated from each other, and placement may depend on an individual's physical restrictions, *e.g.,* a cat with limited mobility needs a ramp access or a space that is low and easy to get into.

2. Multiple and separated key environmental resources: Given that territory is based on resource availability, cats must have access to all key resources without running a real or imagined risk of harm. Basic resources are food, water, toileting areas (litter trays), areas for scratching and playing, and places where they can observe, rest, and sleep. While socially gregarious, cats hunt and eat alone (20). Although cats are predators, they are also at risk of being prey if they are caught unawares, so covered litter trays in a multiple cat household may contribute to stress from a real or perceived fear of attack. Separation of resources reduces competition and the chance of ambush, with each resource located in a separate area from the others rather than in the cat's "own room" (20). Additionally, cats should have a choice for each resource: two or more feeding areas, water bowls, elimination stations, etc. Litter trays must be large – at least 1.5 times the length of the cat ***(Figure 4),*** numerous (one or more per cat) and clean. Individual cats have different preferences for type and depth of litter; in general, since soil and sand are the natural substrates for toileting, sand-like or fine clay litters are readily accepted by most cats. Litter boxes must be distributed throughout the home, just as other resources are, and away from sources of unexpected loud noises (*e.g.,* washing machine, boiler). Trays must be scooped at least daily (preferably more often) and should be emptied completely and washed weekly.

Figure 4. Litter boxes must be distributed throughout the home and should be large and clean. Individual cats have different preferences for type and depth of litter, but sand-like or fine clay substrates are readily accepted by most cats.

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Scratching surfaces must be stable. Heavy immobile posts covered in carpet or sisal, rush or rattan matting, or corrugated cardboard surfaces (on the floor or affixed to the wall) are suitable options. Drinking stations may consist of a variety of bowls, vases, and fountains or a dripping tap. Water should be fresh. In a safe, home situation, whiskers can touch the edge of the food or water bowl, but in a clinic or unsafe environment, bowls should be wide and flat ***(Figure 5).*** This is because cats' whiskers sense air movement; if a cat feels a need to be vigilant (*e.g.,* in clinic), then using a bowl that restricts the ability to sense something may cause a cat to avoid the bowl. In situations where cats have bonded as affiliates and belong to the same social group, they may share resources, but physical separation between different resources is still needed, (*e.g.,* water should not be beside food), and every cat needs at least one feeding station.

3. Occupational needs: cats need to play and hunt, and as noted above, predation makes up a significant part of their day. Cats should be able to engage in all aspects of the predatory sequence: locating, stalking, chasing, pouncing, killing, preparing, and eating their prey. In a household situation, this translates into pseudo-predatory play and feeding behaviors. If these needs aren't met, cats can become bored or frustrated and obese. Cats may play on their own or with their owner, but rarely in a group unless raised together. Ensure that there is sufficient personal space between cats when they play (> 3 meters (10 feet)), or provide different play times. Exploration of novel objects such as boxes or baskets also provides stimulation, and different cats may prefer certain toys (21). Allowing them to hunt for their food bowl or using a feeding toy are mentally stimulating activities.

Scratching is an essential need, not just for sharpening claws and to shed the nail sheaths, but also for stretching and for depositing scent on vertical objects. In addition to providing scratching surfaces, owners can undertake nail trimming with positive, treat-based reinforcement. If an owner is concerned about a cat damaging furniture, nail caps may be beneficial (although the owner should still trim the cat's nails regularly) and sticky tape may act as a deterrent if a particular surface or object is valued. Motion detectors may be used to deliver an aversive sound and

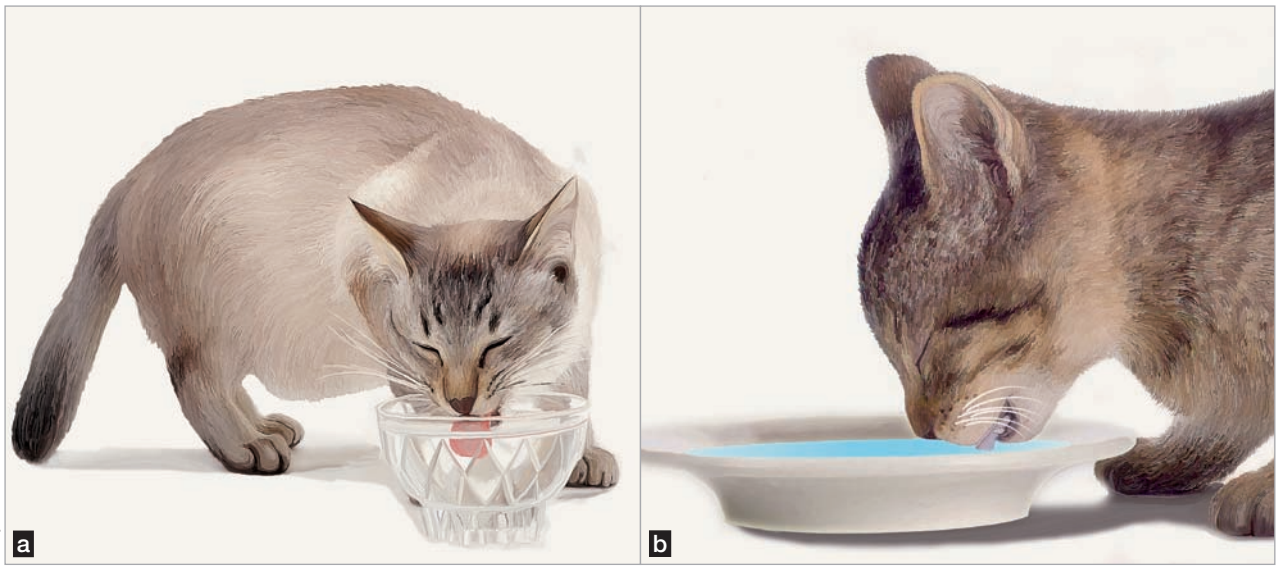

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Figure 5. In a safe, home situation, whiskers can touch the edge of the food or water bowl **(a),** but in a clinic or unsafe environment, bowls should be wide and flat **(b).**

blast of air as a deterrent if required, but they must be used carefully, and the desired behavior must be rewarded. Visual stimulation is important for cats; at least one safe resting area (window ledge, climbing platform) should have visual access of the outdoors ***(Figure 6).*** Videos of birds, mice, and squirrels provide visual as well as auditory stimulation and may be useful, especially when there is no opportunity to see or hear the outdoors. Placing a ping-pong ball in an empty bathtub for 30 minutes each day provides exercise as well as visual and auditory stimulation. Cat grass provides a textured gustatory stimulus that many cats enjoy, whilst rolling on a soft, textured mat (sprinkled with catnip) provides tactile stimulation.

4. Respect a cat's olfactory sense: Cats use their sense of smell to perceive the world to a far greater degree than humans do. They also detect and communicate through pheromones. The aromatic environment – both deliberate and unrecognized – created by humans can greatly impact cats. Air fresheners, cleaning products, perfumes, and scented cat litter may be pleasant for us but overwhelming or confusing for a cat. Smells brought in from the outside on shoes or with a visitor may be threatening for a cat. Restrict the use of fragrant products and leave footwear and shopping bags near the entrance to help reduce perceived threats. Catnip *(Nepeta cataria)*, honeysuckle wood *(Lonicera tatarica)*, valerian root *(Valeriana officinalis)* and silvervine *(Actinidia polygama)* are pleasurable olfactory stimulants ***(Figure 7).*** Use of familiarly scented clothing and bedding at home

Figure 6. Visual stimulation is important for cats; at least one resting area (*e.g.,* a climbing platform) should allow safe, visual access of the outdoors.

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Figure 7. Toys filled with catnip can be pleasurable olfactory stimulants.

© Sally Lester

Figure 8. Various cat-friendly outdoor enclosures are available.

or in the clinic may be reassuring; avoid washing all of the cat's bedding at once to provide olfactory continuity. New items (*e.g.,* furniture) brought into the home should be exposed to the cat after rubbing the furniture with a cloth that has been in contact with the cat's scent glands. These glands, which produce a variety of pheromones, are located on the cheeks, in the temporal region, around the muzzle, on the tail and dorsal tailbase, and interdigitally. When a cat marks a surface or a corner with their cheek or by scratching, they are depositing their scent and making it familiar; such marks should not be washed off. Providing sturdy scratching options (vertical or horizontal) throughout the home (but especially at the entrance) helps to provide "safety" without the need to spray urine as a means of marking/defining territory. Synthetic pheromones that replicates parts of the cheek pheromone are available in many countries and may be beneficial for a sense of security.

5. The social world: Consistency and predictability are key to positive human-cat interactions. As already mentioned, socialization between 2-8 weeks of age is critical for cats to live successfully with humans. During this period, cats should be exposed to at least four handlers and gently introduced to many, brief, positively reinforced experiences. Human attention is very important, but cats often prefer more frequent, less intense interactions than we might think. In addition, cats like to choose the time and place for the social contact. The more the owner responds to the cat's attentions, the stronger the bond will be. After initially sniffing at the person, most cats prefer to be stroked around their head and neck rather than over their whole body. When a cat chooses to move away, one should not pursue contact. Of course, cats are individuals and some prefer assertive, more forceful play; however, when becoming acquainted with any cat, feline manners prescribe head and cheek petting only. Fixed eye contact (staring) is threatening to cats. Some cats prefer being stroked or groomed, while others prefer their interactions to be oriented around play.

Cats spend over 3.5 hours of the day grooming (14), and this is clearly an important behavior. When a cat does not live with another cat to groom or be groomed by, the owner may need to step in, but as with stroking, unless a cat specifically solicits it, combing and brushing should be restricted to the head and neck areas (15,20).

The best of both worlds

Wherever possible, safe alternatives to a strictly indoor lifestyle should be sought. This can be achieved through secure yet stimulating, complex enclosures that prevent cats from escaping and other animals entering; various cat-friendly fencing options and outdoor enclosures designed for cats are available ***(Figure 8).*** Finally, learning to walk on a harness and leash suits some cats, but (not unexpectedly) they should be allowed to explore rather than be led.

Conclusion: in search of behavioral wellness

When the environmental and social needs of cats are met, and adequate space and resources are provided, many cats will adapt to indoor housing, especially if they have been exposed to this lifestyle from an early age. However, cats accustomed to having outdoor access may find it difficult to make the adjustment as adults (3,4).

Our current state of knowledge does not answer the question as to whether strict indoor living is preferable to outdoor access, and there are risks and benefits associated with both options. Each case should be assessed individually and the well-being of the cat, the owner and the environment should be reassessed as necessary.

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HOW I APPROACH...

The sneezing cat

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Introduction

Sneezing is a remarkably common presenting complaint in cats, and it is important for the practitioner both to have a good overview about the possible causes when presented with an affected cat or a clowder of cats, and to be aware of the various diagnostic and therapeutic options available.

Sneezing represents the body's efforts to clear irritants from the nose, and is generally an involuntary process. Some causes of sneezing are self-limiting, such as exposure to a dusty basement, while others may be more progressive and even life-limiting. Practically, I feel that it often appears to make sense to divide sneezing cats into categories of "easy" or "complex" when determining the types of investigations that should be pursued when presented with these cats; "easy" cases are typically represented by kittens with mild upper respiratory infections, whilst "complex" cases represent cats with chronic disease that stubbornly refuses to resolve, or cases where the etiology remains elusive despite extensive testing. This paper offers a brief overview for the clinician presented with a sneezing cat.

KEY POINTS

- **The sneezing cat is one of the most common presentations in small animal practice. The practitioner should be well acquainted as to the possible causes, as well as the various diagnostic choices and available therapeutic options, when presented with such cases.**
- **In young, healthy cats with an acute onset of sneezing, an infectious etiology is most likely and the signs will normally resolve whatever therapy is chosen.**
- **Older cats that start sneezing may warrant further diagnostics, with the choice of tests based upon assessment of the patient and the owner's wishes.**
- **Imaging, biopsy and possible rhinoscopy are the most likely investigations to result in a diagnosis, whilst PCR testing can be useful for confirmation of a chronic infectious cause.**

Key historical questions and physical exam

As with almost all diseases, signalment is very useful in the evaluation of a cat that is sneezing. Other key historical questions I ask include verification of exposure to the outdoors or to other cats, the duration of clinical signs, the animal's general appetite and activity levels, and the success of any prior therapies. It is important to identify if there has been any nasal discharge, including its characteristics, and whether it is uni- or bilateral.

From a physical examination perspective, fever can support the diagnosis of infection; viral infections in particular are commonly accompanied by a high fever. Facial asymmetry or lack of airflow through one or both nostrils may be identified and more directly support the identification of nasal obstruction. Severe dental disease or the presence of an oronasal fistula may direct therapeutics towards treatment of dental pathology. Enlarged mandibular lymph nodes may support a diagnosis of infection (*e.g.,* with *Cryptococcus)* or neoplasia. Cats that have recent significant weight loss, or appear otherwise unthrifty, are more likely to have serious underlying disease.

Potential etiologies

A multitude of potential causes of sneeze exist, and these can be largely divided into the following subcategories:

- **Foreign body/irritant.** This category includes inhaled objects such as *cuterebra* or blades of grass ***(Figure 1).*** Inhaled nasal foreign bodies as a cause of sneezing are more commonly seen in cats with outdoor access, and cases are most commonly encountered during the warmer months. Clinical signs tend to be peracute, and concurrent gagging is also common. Many cases are self-limiting and subsequently resolve, but for cases that do not resolve, further evaluation includes (at a minimum) an oral examination under sedation, and a nasal flush is often advisable (1).

- **Traumatic.** This category includes cats with facial fractures which are most commonly due to road-traffic accidents (RTA). These cats will have sneezing due to trauma to the nasal turbinates and bleeding into the nasal cavity, often associated with facial fractures. This category rarely represents a diagnostic dilemma, although cats may refuse to eat if their nose is clogged with dried blood, and sneezing fits may result in significant hemorrhage. Advanced diagnostics are not warranted for sneezing associated with trauma, but may be useful for further evaluating the extent of the cat's injuries.

- **Infection.** This is the one of the most common causes of sneezing in cats, with the most frequent agents being viral (herpesvirus, calicivirus) in origin. Bacterial infections, including *Bordetella bronchiseptica, Streptococcus canis, Mycoplasma spp.,* and *Chlamydophila felis* have also been implicated as primary causes of upper respiratory tract infections in cats, although these are relatively rare. However, any case of rhinitis may become secondarily colonized by bacteria. Note that culture from a nasal swab is rarely helpful, as results typically reflect secondary colonization. For viral infections, isolation of the causal agent is challenging, and has more recently been largely replaced by PCR (polymerase chain reaction) testing. *Cryptococcus* infection may also result in sneezing; this is often easily documented via cytology, and serology is useful for demonstration of both infection and resolution.

- **Inflammatory.** Chronic rhinitis will result in the destruction of the turbinates and accumulation of mucus and debris, which may result in sneezing. Chronic rhinitis may be initially triggered by a variety of underlying diseases, but all will result in nasal discharge and sneezing (2). Histopathological evaluation may support the diagnosis of an underlying allergic cause if certain cellular infiltrates (*e.g.,* lymphocytic-plasmacytic) are identified. Dental disease may also be considered inflammatory, or in some cases infectious.

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Figure 1. This blade of grass had been present in a cat's nose for five months and was associated with paroxysms of sneezing.

- **Neoplastic.** Nasal neoplasia may cause sneezing, with the final diagnosis requiring histopathological sampling in order to determine tissue type ***(Figure 2).***

Age and lifestyle – specific considerations

Kittens and young cats are very prone to upper respiratory infections, particularly when housed in a shelter setting or other small groups. Viral infections are easily spread from cat to cat, and even via fomites on caregivers. Other, far less common, causes of sneezing in young animals include nasopharyngeal polyps ***(Figure 3),*** nasopharyngeal stenosis, foreign body, and – rarely – persistent right aortic arch, (resulting in pooling of fluid in the esophagus and subsequent nasal reflux).

Outdoor or primarily outdoor cats are more prone to trauma and foreign bodies. Note that outdoor cats that are not members of a free-roaming colony often do not develop respiratory infection as they are quite solitary and are rarely exposed to other cats.

Middle-aged and older cats are more likely to be affected with neoplastic diseases, and this diagnosis may be suspected in an appropriately aged cat which has no prior history of nasal and airway disease. Many cats with

chronic rhinitis have a past history of an apparently favorable response to antibiotics.

Diagnostics

I am typically much more enthusiastic to advise a complete work-up in an older cat with new onset of signs. Various diagnostic options are available for investigation of the sneezing cat, and the choice of tests should be based upon the assessment of the patient and the owner's wishes (3).

- Routine laboratory testing with complete blood count/chemistry profile and urinalysis are commonly performed when evaluating sick cats. While useful for general screening purposes, it is uncommon for routine laboratory testing to be very helpful in identifying a cause for sneezing. If general anesthesia is planned, pre-anesthetic laboratory screening is useful to establish normal organ function. Testing for feline leukemia virus (FeLV) and feline immunodeficiency virus (FIV) is helpful in cats that have not otherwise been previously shown to be retroviral negative. FeLV in particular may predispose a patient to lymphoma, and any type of immunosuppression may increase the likelihood of *Cryptococcus* infection.

Figure 2. This cat had a history of sneezing for four weeks and had failed to respond to antibiotic therapy. Biopsy subsequently documented lymphoma.

- Advanced laboratory diagnostics, and in particular PCR testing, can be beneficial. PCR has evolved into an exceedingly useful method to identify underlying infectious organisms, particularly viral infections (4). PCR typically acts by identifying a specific DNA sequence, and can be used to demonstrate the presence of a given pathogen. A positive PCR result confirms that the organism was found in the sample submitted, but a negative test result does not necessarily exclude infection, whilst a positive PCR for an organism not associated with clinical disease is of uncertain significance. If investigating an outbreak of sneezing in a multi-cat population, consider the possibility of asymptomatic carriers; such cats may test positive on PCR, and the approach in this situation depends upon the agent isolated. For cats that are actively sneezing, positive PCR results for upper respiratory pathogens should be considered relevant. As noted above, aerobic cultures of nasal discharge should be avoided as a diagnostic tool; whilst such cultures almost invariably result in a positive bacterial growth, this simply reflects secondary colonization of the nasal passages, rather than the actual pathogen.

- Skull radiographs are commonly performed for evaluation of nasal disease; however, due to the small size of a cat's skull, and superimposition of various body structures, it may be hard to interpret such radiographs, especially if any soft tissue lesions are discrete. Dental radiography, where available, may also be useful to evaluate the nasal cavity.

- Advanced imaging techniques such as computed tomography (CT) or magnetic resonance imaging (MRI) are increasingly available to the general practitioner via referral to academic centers and larger specialist hospitals. The nasal cavity is amenable to both CT and MRI, and images obtained through these techniques far exceed the detail that may be seen using plain radiography ***(Figure 4).***

- Rhinoscopy can be helpful when investigating a sneezing cat, although size restrictions mean that it is perhaps less helpful than in larger dogs. The nasal cavity may be evaluated from a retroflexed view (from the caudal oropharynx) as well as from the rostral aspect of the nose (5); some hemorrhage is to be expected from the technique. If a rhinoscope is unavailable, some clinicians employ an otoscope cone to inspect the rostral region of the nose, and a spay hook and dental mirror may be successfully used to evaluate the caudal aspect of the nasal cavity.

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Figure 3. This nasopharyngeal polyp was removed from a young kitten with clinical signs that included sneezing, gagging, and stertor.

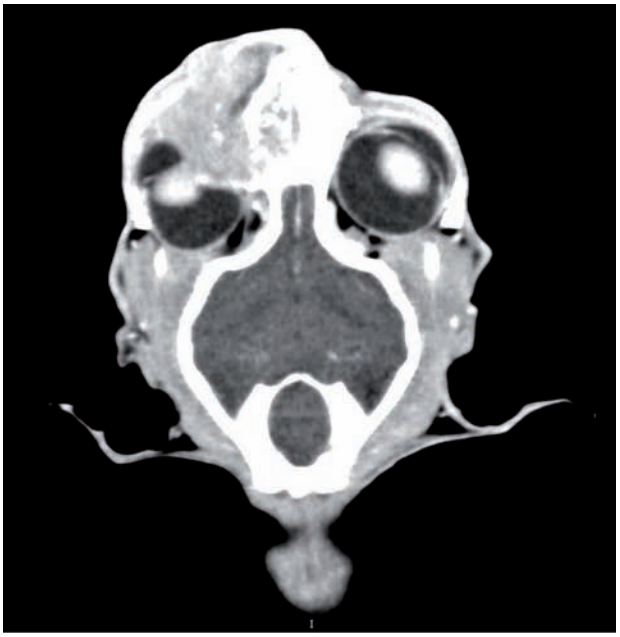

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Figure 4. A CT image of the cat shown in **Figure 2,** documenting a mass lesion.

- Histopathological evaluation of biopsy material is very useful for detection of an underlying pathology and can be advantageous when determining a treatment plan. Biopsy should always be performed under general anesthesia, and the oral pharynx should be packed with gauze to collect any fluids or tissue samples. Several options are available for biopsy sampling, including via rhinoscopy if a mass lesion is visualized, or blindly using biopsy forceps (either one designed for endoscopic work, or a larger instrument). If forceps are not available, a large gauge (14-16 G) IV catheter (minus the stylet) may be inserted into the nasal chamber; 10-20 mL of saline can then be flushed rostral-to-caudal through the catheter, collecting any biopsy samples from gauze preplaced in the pharynx. If a blind biopsy is performed, care should be taken not to enter the cribriform plate and inadvertently biopsy the brain.

- Rhinotomy may be performed in cats with chronic nasal disease to debulk a nasal mass, to obtain deep biopsies, or to explore for a nasal foreign body. Fortunately, this procedure is rarely needed, as it is an aggressive undertaking, and I rarely perform it for evaluation of sneezing. As a therapeutic tool, it is unlikely to be curative; chronic rhinitis tends to be persistent, and rhinotomy in my experience is rarely successful.

Therapy

- Antimicrobials are commonly prescribed for upper respiratory signs, but judicious use is advisable; in cats with primarily viral disease, antibiotics are not indicated. However, secondary bacterial infection is common following viral infection, and in cats that are systemically affected there may be benefit from antibiosis. Most widely available antibiotics are associated with an improvement in clinical signs, although it is likely that that improvement will occur without therapy. Azithromycin, doxycycline, amoxicillin-clavulanate, and fluoroquinolones are all reasonable choices, along with standard supportive care (6,7). Antibiotics often result in an apparent short-term improvement in the clinical signs in cats with chronic rhinitis; owners should be advised that this is due to treatment of the secondary infection, and that because the turbinates have been permanently damaged or destroyed, a “stronger” antibiotic will not result in a cure.

- Anti-viral agents such as famciclovir (62.5-125 mg per cat once or twice a day) may be used to shorten the duration of clinical signs in affected cats, but are rarely chosen clinically since improvement typically occurs quickly. A recent study using a single oral dose of famciclovir administered to cats at intake to a shelter did not show any benefit in preventing disease outbreak (8).

- Local therapy may be pursued in amenable cats using intra-nasal saline drops or hypertonic saline to help loosen mucus. Additionally, topical therapy with antibiotics (*e.g.,* ciprofloxacin drops) or anti-inflammatory agents (*e.g.,* dexamethasone drops) may be helpful. In cases where a cat will be under anesthesia for a diagnostic evaluation, a nasal flush using saline can be useful to help remove mucus and debris, and may result in short-term improvement.

- Systemic anti-inflammatory agents may be helpful. Treatment with glucocorticoids may be useful to decrease inflammation in some cats; other cats apparently have more significant improvement when treated with non-steroidal anti-inflammatory drugs (NSAIDs). However, it is advisable to confirm the manufacturer's recommendations whenever considering long-term use of NSAIDs in cats.

- Alternative therapies are also available and may be worth considering. These include humidification (*e.g.,* placing the cat in a bathroom with a hot shower running, or using a humidifier) to encourage drainage of secretions, or administering N-acetylcysteine (70-100 mg/kg PO Q12-24h) may help thin the nasal mucus. Fish oil supplements added to the diet may decrease inflammation of the nasal tissues. One small pilot study showed that immunotherapy may be useful in decreasing sneezing in older cats with chronic rhinitis (9).

- Oncological therapy may be required for cats with nasal neoplasia, and animals may respond well to therapy, at least in the short term. Radiotherapy treatment may be helpful for both carcinomas and lymphoma, and chemotherapy has also been used successfully in some cats with nasal lymphoma and can be worth consideration in such cases (10).

Further comments

• Anesthesia

General anesthesia is required for almost all diagnostic procedures involving the nose, and any commonly used anesthetic protocol is usually acceptable for a cat that is sneezing. However, the caudal oropharynx is very sensitive in this species, and any examination can result in coughing and gagging. As mentioned above, cats should be intubated if biopsy or flushing is to be performed, and remember that any gauze placed in the oral pharynx should be removed prior to recovery. Cats should always be monitored very closely during recovery.

• Prevention

Strategies to prevent sneezing in cats are dependent on the etiology. Obviously, vaccinations are widely available for protection against herpes and calicivirus; interestingly, a recent study (11) showed that intra-nasal vaccination against viral agents was also effective in decreasing signs caused by bacterial challenge. Introduction of a new cat or kitten to a household already populated with cats should be undertaken with care (12), and a suitable period of quarantine for any new arrival is certainly advisable.

In broader terms, keeping cats indoors can help prevent exposure to foreign bodies, and appropriate dental care is always advisable. I generally encourage owners not to smoke around cats. Somewhat self-evidently, neoplastic disease is difficult to prevent.

• Dietary recommendations

In most cases of sneezing, no dietary changes are required, although cats that are reluctant to eat due to an upper respiratory infection may benefit from a palatable recovery diet. In cats with nasal tumors, or other conditions that can result in more long-term anorexia, an esophageal feeding tube may be placed (see paper on page 46) and a suitable recovery diet administered. In cats with suspected allergy, it may be prudent to consider a hypoallergenic diet.

• Other thoughts

- Middle-aged and older cats almost never have nasopharyngeal polyps. Polyps are almost exclusively a disease of young cats.
- Chronic rhinitis is very frustrating, and while improvement is likely to occur, the disease is almost always chronic. Owners should be prepared for the fact that a permanent cure is unlikely.
- Some cats with upper airway disease have concurrent lower airway disease or "asthma". Cats with chronic sneezing that also cough should be evaluated for lower airway disease, and any cough should not simply be assumed to represent post-nasal drip.

Summary

Sneezing is a common presenting complaint in cats. In young, otherwise healthy cats with an acute onset, an infectious etiology is most likely and will be expected to resolve regardless of the therapy (or lack of!) that is pursued. Foreign bodies, while less common, are certainly possible, especially in cats with outdoor access where

there is a sudden onset of signs, and in particular if no fever is present. For kittens that are systemically ill, careful nursing care and antibiotics are advised. In older cats, or in cats with an acute onset of sneezing, further diagnostics are warranted, and these should be chosen based upon the assessment of the patient and the owner's wishes. If possible, a CT scan, biopsy, and rhinoscopy will be the most likely investigations to result in a diagnosis. PCR can be pursued for confirmation of a chronic infection or if treating a large group of cats. Chronic rhinitis is a long-term medical condition and is unlikely to be curable, but may be palliated with a number of therapies.

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The ascitic cat

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Introduction

Ascites is a term used to describe the accumulation of free fluid within the peritoneal cavity. Based on cell counts, total protein, specific gravity, and cellular content, the fluid may be classified as a transudate (pure or modified) or an exudate ***(Table 1).*** This classification can ultimately be helpful in identifying the etiology of ascites and directing proper treatment. Chylous or pseudochylous effusions, hemorrhagic, bilious, neoplastic effusions, and uroabdomen are specific exudates which many clinicians prefer to differentiate from true ascites (1).

KEY POINTS

- **Ascites can be classified as one of several types of fluid, most commonly pure or modified transudates or exudates. This classification helps narrow a very broad list of differentials for primary etiology.**
- **Ascitic fluid should be obtained and analyzed for the sake of classification, but this rarely provides a definitive diagnosis without additional, full diagnostic evaluation.**
- **Congestive heart failure, neoplasia, feline infectious peritonitis, and hepatic disease are among the most common causes of ascites in cats.**
- **Therapeutic abdominocentesis may be a beneficial option to relieve discomfort in many (but not all) cases of ascites. Specific treatment for the primary cause is recommended.**

Pathophysiology

Fluid can accumulate within the peritoneal cavity via several mechanisms. These include:

1) Increased hydrostatic pressure within the vasculature (as in right-sided congestive heart failure or portal hypertension)
2) Decreased colloid osmotic pressure (as in hypoproteinemia secondary to intestinal malabsorption, hepatic failure or protein-losing diseases)
3) Increased vascular permeability (as in vasculitis or inflammatory conditions)
4) Viscus, vessel or mass rupture, or coagulopathy
5) Lymphatic obstruction/rupture or lymphoproliferative disease (2)

While the character of the fluid may shed important diagnostic insight on the source of effusion, a thorough history and physical examination is essential before a fluid sample is obtained to help differentiate these possibilities.

History

An owner of a cat with ascites may describe a primary complaint of abdominal distension or clinical signs commonly associated with ascites. These include lethargy, decreased appetite, or tachypnea (this last sign results from the increased abdominal volume exerting pressure on the diaphragm). The clinician should obtain a full medical history, including any past or current conditions or operations, and all medications. A history of urethral obstruction may indicate a concern for uroabdomen. Known or suspected cardiac disease (*i.e.,* history of a murmur or arrhythmia) may portend a suspicion of right-sided congestive heart failure (CHF). The clinician should also ascertain whether or not the cat has experienced any recent trauma, which would raise suspicion of a visceral rupture or hemoabdomen. An understanding of the cat's origin, normal environment, and potential exposure to other animals may increase one's suspicion of a

Table 1. Characteristics of different abdominal effusions.

	Pure transudate	Modified transudate	Exudate	Hemorrhagic effusion	Chylous and pseudochylous effusion
Gross appearance (variable)	Not cloudy; colorless to lightly colored	Clear or cloudy; straw-colored to blood-tinged	Turbid; variable color	Heavily serosanguinous to blood red	"Milky" white or lightly pink-tinged, opaque
Nucleated cell count (cells/µL)	< 1,000	1,000-10,000	> 5,000	1,000-20,000 (dependent on peripheral count)	250-20,000
Total protein (g/dL)	< 2.5	2.5-5.0	> 3.0	3.5-7.5	2.5-6.0
Specific gravity	< 1.015	> 1.015	> 1.025	> 1.025	> 1.025
Cellular characteristics	Often few cells present; macrophages, mesothelial cells	Mesothelial cells, macrophages, RBCs, neutrophils, lymphocytes	Dependent on cause; Neutrophils (degenerate in septic effusions) and macrophages predominate. Septic effusions will also include intracellular bacteria. Bilirubin crystals may be seen in bilious effusions. Neoplastic cells (variable).	RBCs, neutrophils, mesothelial cells macrophages; platelets likely lower than peripheral blood smear; neoplastic cells (variable)	Mature lymphocytes; possible neutrophils, macrophages

primary infectious pathogen such as feline infectious peritonitis (FIP). This virus has a predilection for younger cats (< 3 years), many of whom live in crowded or stressful environments or have a history of fever that did not resolve with antibiotics (3).

Physical examination

The physical exam of an ascitic cat often (but not always) reveals abdominal distension ***(Figure 1);*** small volumes may not distend the abdominal wall. Ascites can be difficult to definitively differentiate from other causes of abdominal distension on physical exam alone, since organomegaly (including an enlarged urinary bladder), mass effects, pregnancy, and obesity can produce the same appearance. The presence of ascites may allow detection of a palpable fluid wave; this is ascertained by placing a hand flat against one side of the abdominal wall whilst the other hand gently taps the opposite flank to stimulate fluid movement (3).

Physical exam may elicit a variety of other findings that can help direct a clinician's suspicion toward the primary etiology. Particular attention should be paid to the potential presence of icterus (yellow-tinged sclera, mucous membranes, or integument), which indicate hepatopathy or coagulopathy. Subcutaneous edema may signify hypoproteinemia. Peripheral lymphadenopathy may indicate lymphoma or infectious agents. Evidence of cardiac disease can include an auscultable heart murmur, arrhythmia, or gallop sound, although it is important to remember that the lack of such findings does not exclude cardiac disease. Jugular vein distension and/or pulsation ***(Figure 2)*** suggests elevated central venous pressure secondary to right-sided CHF. Loss of auscultable air movement in some or all lung fields would suggest concurrent pleural effusion, which may occur with neoplasia, hypoproteinemia, CHF, or lymphoma. Palpable hepatomegaly can occur secondary to right-sided congestive heart failure or with primary hepatic pathology (cholangiohepatitis or infiltrative/neoplastic disease).

Diagnostic tests

Diagnostic investigation should not be limited to peritoneal fluid analysis and cytology, but this is often one of the highest yield tests for narrowing a list of differentials and so is frequently the first diagnostic performed. A sample of peritoneal fluid can be obtained via abdominocentesis. This procedure should be performed as aseptically as possible.

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Figure 1. This cat has abdominal distention secondary to ascites. A palpable fluid wave was appreciated on physical exam with the cat in a standing position.

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Figure 2. The distended left jugular vein of a cat with right-sided congestive heart failure.

Cats can be restrained in lateral, sternal, or dorsal recumbency, whichever is most likely to limit their motion and allow for atraumatic retrieval of a fluid sample. A small amount of hair should be clipped around a ventral location (often just ventral to midline for a cat in lateral recumbency). Ideally, ultrasound guidance is used to identify an anechoic fluid pocket. In the absence of ultrasound, it is advisable to restrain the cat in lateral recumbency and approach the area approximately 1 inch (2.5 cm) ventral and caudal to the umbilicus. The skin should be gently scrubbed with a chlorhexidine-based or similar cleaning agent and wiped clean with isopropyl alcohol. With or without ultrasound guidance, a 22-25 G needle, butterfly catheter, or over-the-needle (OTN) catheter is introduced directly through the abdominal wall into the peritoneal cavity, and gentle traction is applied to an attached syringe ***(Figure 3).*** A sterile sample should be preserved in both EDTA and plain tubes for laboratory analysis. Therapeutic abdominocentesis (retrieval of a large volume of ascitic fluid) is ideally not performed until the etiology is identified because, in some cases, this may be counterproductive. One exception to this is a cat with marked tachypnea or other discomfort where abdominocentesis can make the patient more comfortable and stable.

Fluid analysis and cytology

A diagnostic sample should be analyzed for total and nucleated cell counts, total protein, specific gravity, and microscopic evaluation of the cellular components ***(Figure 4).*** As outlined in ***Table 1,*** describing ascitic fluid as a pure or modified transudate, as an exudate, or one of several non-septic exudative fluids can be extremely helpful in determining the cause of the ascites.

Pure transudates occur most commonly in the setting of hypoproteinemia (secondary to hepatic failure, chronic cholangiohepatitis, lymphocytic cholangitis, renal disease) or increased hydrostatic pressure (right-sided CHF) (4). The cellular count and total protein may rival that of modified transudates because chronic ascites can inflame the mesothelial lining of the peritoneum and increase cell counts (2). This creates an “overlap” in the causes of pure and modified transudates, which is why additional diagnostics (described below) are helpful.

Modified transudates are the most frequent finding in cats with ascites, and the most common causes include congestive heart failure, neoplasia, and hepatopathy (4). With regard to hepatopathy, lymphocytic cholangiohepatitis is more likely to produce a pure transudate, whereas portal

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Figure 3. Ultrasound guidance can be useful when obtaining a fluid sample from a cat with ascites. Here, the fluid in the syringe is clearly yellow-tinged and was ultimately characterized as an exudate.

hypertension and cirrhosis are more likely to produce modified transudates, since the latter two increase hydrostatic pressure (2).

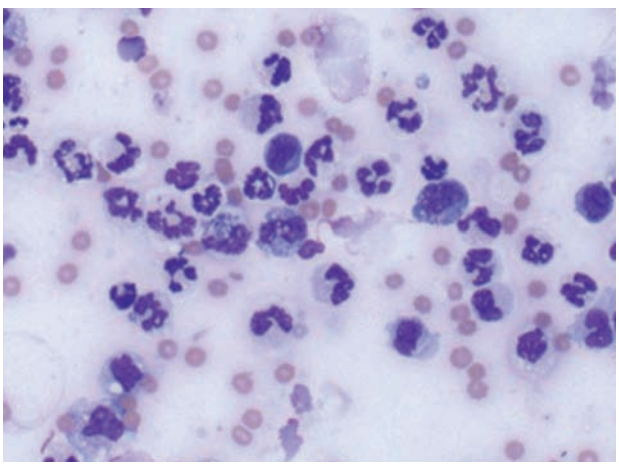
Exudative fluids can be septic or non-septic, with positive bacterial culture results being the definitive diagnostic test for a septic exudate. Such cases warrant prompt treatment, but because culture takes several days to finalize, the fluid should be evaluated cytologically in-house immediately after retrieval. Cytologically, septic exudates are characterized by degenerative neutrophils and intracellular bacteria, and there may be foreign material. These effusions may occur secondary to FIP, trauma, rupture of gastrointestinal viscera, or in conjunction with other causes of peritonitis. Non-septic exudates, by contrast, have higher cell counts than pure or modified transudates but lack the degenerate neutrophils or bacteria of a septic exudate. Causes of non-septic exudates include FIP, cholangitis, pancreatitis, biliary or urinary tract rupture, or neoplasia. Effusion secondary to biliary rupture often includes visible biliary crystals.

Many clinicians are tempted to diagnose chylous effusions if the ascitic fluid has a milky, opaque appearance, but true classification of chyle depends on comparing the triglyceride and cholesterol levels of the fluid to concurrent serum concentrations. In chylous effusions, the triglyceride concentration of the effusion is higher and the cholesterol concentration lower than serum concentrations. Chylous effusions contain mostly small, mature lymphocytes. Some clinicians also recognize pseudochylous effusions which have a similar gross appearance but higher cholesterol and lower triglyceride concentrations when compared with serum (1). Chylous effusion can be caused by lymphoma, lymphangectasia, congestive heart failure, or cirrhosis: it can also be idiopathic in nature.

Hemorrhagic effusion may occur in cats secondary to trauma, coagulopathy, rupture of a vessel or mass, or secondary to recent surgery. In comparison to dogs, cats are more likely to have mass rupture that involves the liver rather than the spleen (5). The fluid aspirated during abdominocentesis in these cases appears similar to frank blood and the packed cell volume and total solids concentration should closely match those of the peripheral blood.

Urine accumulation in the abdomen can result in a pure or modified transudate or an exudate, with cell counts increasing in cases that induce inflammation. Definitive identification of uroabdomen requires that the effusion has greater than twice the concentration of creatinine than the peripheral blood (6). If the effusate creatinine concentration is between one and two times greater than the peripheral blood, this is suggestive (but not definitive) for uroabdomen. An effusate potassium concentration that is greater than the potassium level in peripheral blood is similarly suggestive, but not definitive, for uroabdomen (6).

Figure 4. Abdominal effusion at 100X magnification. Note the high number of neutrophils. Intracellular bacteria are also present and can be better visualized at higher magnification.



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Other tests

In addition to abdominal fluid analysis and cytology, the following diagnostic tests may play an important role in the evaluation and treatment of ascitic cats.

Complete blood cell count: A blood cell count (including a reticulocyte count if applicable) should be reviewed to determine if acute blood loss or anemia linked to chronic disease is present. A neutrophilia or stress leukogram (mature neutrophilia, lymphopenia, with or without deviations in monocyte count) may raise suspicion of infectious or inflammatory disease, particularly FIP. Review of a blood smear can be additionally helpful to identify band neutrophils, toxic change, or a left shift which may indicate an acute or robust inflammatory response.

Serum biochemical profile: Serum total protein levels should be carefully evaluated. Increased total proteins (specifically, hyperglobulinemia) may indicate an infectious agent such as FIP, whereas decreased total proteins may result from hepatic failure, protein-losing enteropathy or nephropathy, or neoplasia. Hepatic disease may be further heralded by increased liver enzymes (AST, ALT, and GGT) which, if present, warrants evaluation of coagulation times, since coagulant proteins are produced within the liver and may or may not contribute to ascites. Azotemia and/or hyperkalemia may raise suspicion of renal disease or uroabdomen.

Urine testing: Urinalysis may reveal elevated protein levels which would implicate protein-losing nephropathy as a cause for hypoproteinemia. Protein within the urine should be quantified via a urine protein/creatinine ratio, provided that urine culture is negative.

Abdominal imaging: Based on the results of baseline blood testing, abdominal imaging may provide additional specific information regarding etiology. Radiographs are not particularly sensitive or specific for identifying the presence, volume, or cause of ascites (as small volumes may not be evident at all), but large volumes commonly manifest as non-specific and gross loss of serosal detail ***(Figure 5).*** Radiographs may depict hepatomegaly (which can occur with right-sided CHF or primary hepatopathy), whilst cirrhotic livers may appear small. The classically described "ground glass" appearance of abdominal viscera may indicate peritonitis. Advanced radiographic studies involving contrast may be useful for evaluating the integrity of the urinary bladder, urethra, or lymphatic vessels.

Figure 5. A lateral radiograph of a cat showing loss of serosal detail within the abdominal cavity. No pleural effusion, overt cardiomegaly or hepatomegaly can be appreciated.

More specific abdominal imaging is obtained via ultrasonography, which is more useful than radiography. Ultrasound can definitively identify fluid accumulation (which often appears as anechoic fluid or – with increasing cellularity of the fluid – partially "speckled" fluid), allow subjective estimation of the severity/volume of ascites, and aid assessment of potential etiologies. Primary hepatopathy may be reflected in abnormal liver size or echotexture, or by the presence of a hepatic mass or biliary obstruction. Hepatic venous distention is highly suggestive of elevated central venous pressures secondary to right-sided CHF. The intra-abdominal lymph nodes can be observed and measured for evidence of lymphoma or lymphatic obstruction. The integrity of the urinary tract can be assessed and, specifically, the appearance of the kidneys interrogated for changes in echotexture that might indicate glomerulopathy-inducing proteinuria.

Echocardiography: Echocardiography is pursued when the clinical picture and diagnostics suggest right-sided CHF or, less commonly, pericardial effusion as the cause for ascites. In cats, the most common diseases affecting the right side of the heart and leading to congestive heart failure include restrictive cardiomyopathy, tricuspid valve dysplasia, or arrhythmogenic right ventricular cardiomyopathy ***(Figure 6).*** Pericardial effusion causing cardiac tamponade is uncommon in cats. Hypertrophic cardiomyopathy is more likely to affect the left side of the heart, and the previously high prevalence of dilated cardiomyopathy has drastically declined since commercial cat foods were supplemented with taurine.

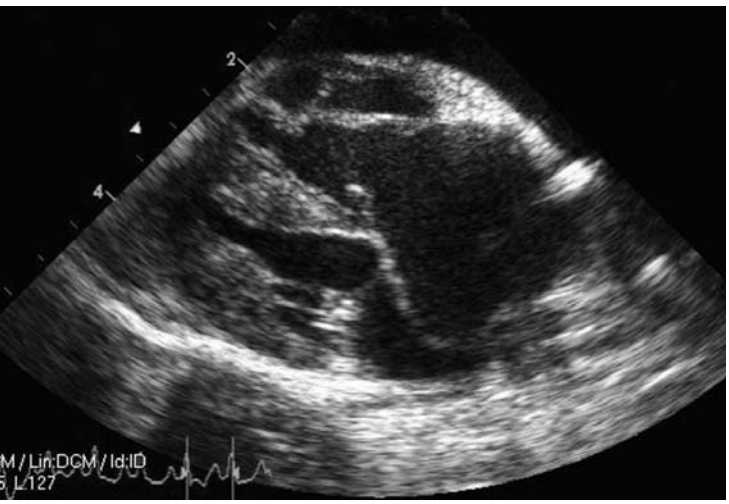

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Figure 6. A right parasternal long axis echocardiographic view showing a severely enlarged right atrium and right ventricle secondary to tricuspid valve dysplasia.

Currently, both these forms of cardiomyopathy rarely cause ascites in cats.

Additional diagnostic testing: FIP is an important differential for cats with ascites but it can present a diagnostic challenge to clinicians. Definitive diagnosis requires immunofluorescence or immunohistochemical staining of viral RNA or proteins within macrophages of diseased tissue or fluid.

A common constellation of laboratory findings that suggest a high likelihood of FIP include a leukocytosis (neutrophilia and lymphopenia), serum hyperproteinemia with relatively high globulin and low albumin concentrations, hyperbilirubinemia and hyperbilirubinuria, and sometimes a non-regenerative anemia (7,8). The peritoneal fluid obtained from cats with the "wet" or effusive form of FIP has a total protein content that is characteristically high for an exudate (greater than 3.5 g/dL), and globulins may comprise more than 50% of these proteins (9).

Serum antibody titers for the causative feline coronavirus, a common and ubiquitous pathogen among cats, are sensitive but poorly specific, since approximately only 10% of cats exposed to the virus progress to clinical FIP (10). Furthermore, a negative antibody test does not rule out FIP.

The Rivalta test has been reported to have a sensitivity of 91%, a specificity of 66%, a positive predictive value of 58%, and a negative predictive value of 93% for the diagnosis of FIP (11). This involves adding a drop of ascitic fluid to an acetic acid solution and evaluating the mixture for a white flocculent material (which occurs as a result of the high concentrations of protein and inflammatory mediators).

Where available, a conventional polymerase chain reaction (PCR) test can identify the virus in blood but does not differentiate between exposed cats and those affected with FIP. A new PCR-based test for detection of the mutated virus has been developed, and whilst preliminary results are promising, the clinical value of this test has yet to be fully elucidated (12).

Treatment

Treatment for ascites in cats is entirely dependent on the identified cause. In general, therapeutic abdominocentesis can be useful if it improves patient comfort. As for the diagnostic sampling method, cats requiring this procedure should be restrained in lateral, sternal, or dorsal recumbency, and the entry site into the abdomen aseptically prepared. A 22-25 G butterfly catheter or OTN catheter may be used to percutaneously enter the abdomen and slow, careful suction applied to an attached syringe to aspirate fluid. The author prefers an OTN catheter (possibly attached to two extension sets connected via a 3-way stopcock) for relief of a large volume of ascites. In doing so, the stylet can be removed while leaving the catheter in place, thereby avoiding a sharp needle in the abdominal cavity for a prolonged period of time.

In patients with right-sided heart failure, it is important to remember that diuretics will not quickly mobilize or evacuate ascites, so acute discomfort should be addressed first with therapeutic abdominocentesis. Diuretic therapy (furosemide 0.5-2 mg/kg PO Q12h) and ACE inhibitor therapy (enalapril or benazepril 0.25-0.5 mg/kg PO Q12-24h) should be initiated for chronic management in an attempt to prevent or reduce the rate of recurrent fluid accumulation. Ideally, serum electrolytes and renal values, as well as systemic blood pressure, should be evaluated prior to and after starting these therapies.

Lymphoma is best addressed with one of a variety of chemotherapeutic protocols, the most common among them being COP (cyclophosphamide, vincristine, prednisolone or prednisone) or CHOP (cyclophosphamide, doxorubicin, vinca alkaloid, prednisolone or prednisone) -based protocols. Recent evaluation of a 25-week modified protocol (including L-asparaginase, a vinca alkaloid, cyclophosphamide, doxorubicin, and prednisolone) provided another promising protocol to extend quality and quantity of life in cats with lymphoma (12).

Treatment for cholangitis or cholangiohepatitis depends on the underlying etiology but often includes antibiotics (amoxicillin-clavulanate 15 mg/kg PO Q12h or enrofloxacin 5 mg/kg Q24h along with metronidazole 7.5 mg/kg Q12h), hepatoprotectants (S-adenosylmethionine 20 mg/kg PO Q24h), choleretics (ursodeoxycholic acid (10-15 mg/kg Q12h), and vitamin E (10-30 IU/kg Q24h). Immunosuppressives (prednisolone 2-4 mg/kg/day) are a necessary cornerstone of treatment in chronic lymphocytic cholangitis. Supportive care (intravenous fluids, antiemetics, nutritional support) is necessary in acutely ill patients, as is specific treatment for any co-morbidities (inflammatory bowel disease, pancreatitis).

Regrettably, ascitic cats with FIP have a poor prognosis, but short-term therapy to improve quality of life commonly includes therapeutic abdominocentesis and/or thoracocentesis, immunosuppressants (dexamethasone 1 mg/kg Q24h IP or IV followed by prednisolone 2 mg/kg Q24h) and/or immunomodulating drugs (human interferon-alpha 30 U/cat PO Q24h). Supportive care is necessary in acutely ill patients (13). Initial stabilization and surgical therapy is likely necessary in patients with septic effusion, uroabdomen, or hemorrhagic effusion.

Conclusion

Cats presenting with ascites warrant thorough diagnostic evaluation to identify the primary etiology. The most common causes of ascites in cats include congestive heart failure, neoplasia, hepatopathy, and FIP, and the treatments and prognoses for these conditions vary greatly, further emphasizing the importance of proper diagnosis.

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Improving diet palatability for cats with CKD

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Introduction

Chronic kidney disease (CKD) is one of the most common pathologies in elderly cats, with more than 30% of individuals over 15 years of age affected (1). This condition is often accompanied by eating disorders, and yet maintenance of bodyweight in cats with CKD is positively correlated with their lifespan (2). The palatability of renal diets is therefore a key element in the nutritional management of this disease.

Palatability

Palatability is a complex, multifactorial phenomenon which encompasses not only the characteristics of the diet (odor, taste, texture, nutritional composition, etc.) ***(Table 1),*** but also those of the animal and its environment (perception of the food, experience, etc.). Indeed, dietary preferences vary enormously from one individual to another (3,4). Some preferences are innate and may be linked to breed, anatomy (5), or individual genetics. Others are acquired over the animal's life – for example, perinatal experiences have a major impact on future dietary choices (6) ***(Figure 1).*** Furthermore, different cats may react differently when presented with a foodstuff depending on previous experiences. These reactions can include a neophilic or neophobic response (*i.e.,* attraction to, or repulsion by, novel diets), an anti-apostatic response (preferring foods that are not novel but are rarely offered) (7), apathy, or aversion. It is therefore essential to take the animal and its individual preferences into account when optimizing the palatability of a product. This is particularly important for cats with CKD.

Table 1. Factors affecting the palatability of feline diets.

Ingredients	The nature of the chosen ingredients (proteins, fats, etc.) and how they are sourced must be optimal. Certain ingredients, known as palatants, can be added to improve the taste.
Processing	The processing parameters should be optimized to ensure attractive ingredients and textures.
Preservation	The preservation systems and packaging must be adequate to ensure product freshness.

The cat with CKD

Cats with CKD often exhibit dysorexia: 40% suffer from hyporexia, and 15% from complete anorexia (8). Importantly, cats are genetically predisposed to correlate gastrointestinal discomfort after a meal with the food ingested immediately prior to this event, and they are more likely to refuse to eat that particular food in future (9); both the taste and the odor of the product may be recognized and associated with the discomfort. The learning process is both quick and persistent, such that a single ingestion of a particular food can lead to lasting refusal. The nausea and vomiting experienced by CKD cats may therefore engender this type of reaction, so it is important to be able to offer an alternative food which both preserves the required nutritional strategy to manage CKD and offers a new sensory profile (odor, taste, texture) that differs from the previous diet, and that the animal finds appealing.

The nutritional constraints (low phosphorous levels and protein restriction) necessary for renal diets have a

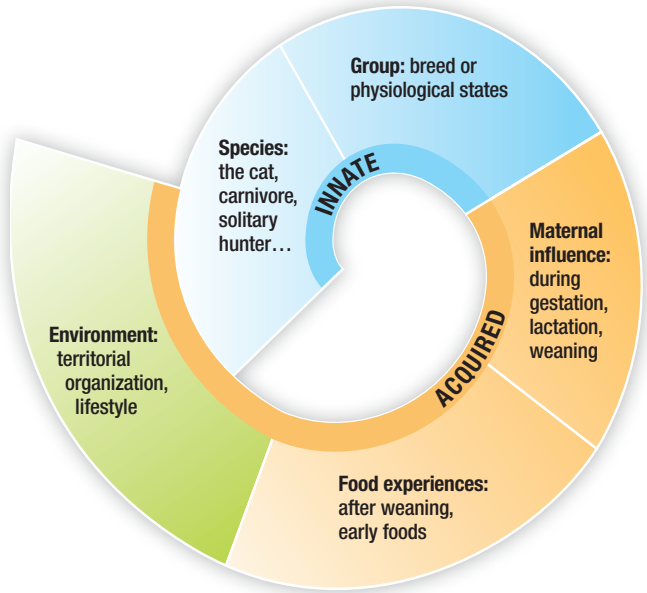

Figure 1. Factors that contribute to an individual's preferences for diet palatability.

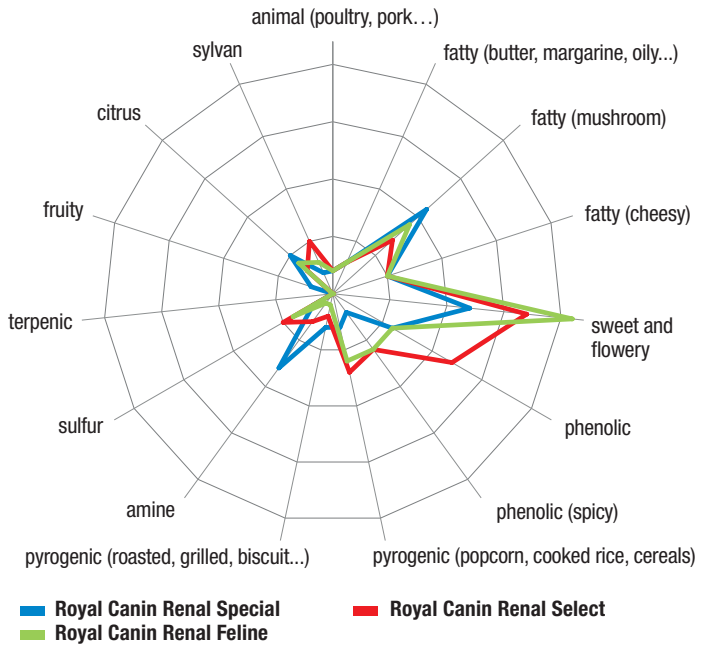

Figure 2. The various odors in different renal diets (as determined by gas chromatography-olfactometry) can be illustrated diagrammatically, demonstrating the distribution of the different classes of odors (11).

major impact on their palatability. However, these constraints are essential for good nutritional management of CKD, and dietary experts must therefore rely on their knowledge of the above parameters to make the food attractive and offer alternative solutions to the problem of aversion or reduced consumption.

With this knowledge, Royal Canin has recently developed a range of new renal diet products. These have been formulated using products that are perceived to be different by the cat, so if there is food aversion or decreased intake with one particular diet, it is possible to offer another product from the range to improve consumption. A clinical trial on 18 cats with CKD demonstrated that this organoleptic approach made it possible to offer an effective solution to appetite problems and to satisfy individual dietary preferences whilst supplying the required nutritional support (10) ***(Figure 2).***

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Feline vector-borne diseases

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KEY POINTS

- **Arthropod-transmitted pathogens are a significant cause of emerging infectious disease in cats, with pet travel, peri-urban development, outdoor lifestyle, and climate change all being contributory factors.**
- **Recent improvements in diagnostic testing have helped to improve knowledge of feline vector-borne diseases (FVBD).**
- **Chronic, concurrent, and immunomodulatory diseases may cause recrudescence of FVBD.**
- **An awareness of vector-borne disease is necessary when considering blood transfusion in cats.**
- **Some FVBD have zoonotic implications, and veterinarians must remain vigilant.**
- **Regular application of ectoparasiticides is the key to controlling FVBD.**

Introduction

By comparison with diseases transmitted to dogs by hematophagous (blood-feeding) arthropods, veterinarians appear to be relatively unaware about the global importance of feline vector-borne diseases (FVBD) (1). However, with greater understanding of FVBD, it should come as no surprise that many of the factors responsible for emerging infectious diseases in canines and humans are also relevant to our feline patients. Whenever a blood transfusion for a client's cat is required, or a feline patient presents with unexplained fever, anemia or thrombocytopenia, the clinician should always consider the possibility of a blood-borne, arthropod-transmitted infection. This brief review aims to provide veterinary practitioners with an insight to the key issues pertaining to the distribution, diagnosis, treatment, and prevention of FVBD.

FVBD: worldwide distribution, emergence and significance

Vector-borne diseases are caused by pathogens transmitted by blood-feeding arthropods, including fleas, ticks, mosquitoes, sand flies, lice, and triatomine bugs. These diseases have a worldwide distribution ***(Table 1),*** yet there are important regional variations in their prevalence due to differences in the geographical ranges and

habitat preferences of their respective arthropod vectors. Climate variations in temperature and humidity play key roles in explaining the presence of one species or another; for example, hygrophilic ticks such as *Ixodes* and *Dermacentor spp.* require humidity and do not tolerate heat and desiccation, whereas xerophilic ticks like *Rhipicephalus* live in warm areas and tolerate desiccation but not frost. The relative distributions of *Rhipicephalus sanguineus* and *Dermacentor reticulatus* in Europe clearly illustrate this point ***(Figure 1).*** Microenvironment is critical too; endophilic ticks such as *R. sanguineus* prefer enclosed environments (*e.g.,* kennels) which explains their ability to establish in people's homes, sometimes well beyond their usual geographical range (*e.g.,* when the pet returns from a holiday in those regions). This contrasts with exophilic ticks that have free-living stages present in forests, woods, fields, parks and gardens.

Global warming and changing habitats as a result of deforestation and residential expansion into sylvatic landscapes are among the many drivers for the emergence and re-emergence of vector-borne diseases, and probably exposes roaming cats to arthropods with unknown vector-potential (2,3). Land-cover areas favorable for tick habitats and climatic conditions that support the tick lifecycle are strong risk factors for feline cytauxzoonosis in the USA (4), and landscape change can influence the exposure of domestic cats to indirectly transmitted infections from wild felids such as pumas and bobcats (5). Therefore, practitioners need to be informed about the ectoparasites that occur in their region, but should be equally vigilant and "expect the unexpected" when it comes to vector-borne diseases.

Despite the geographical ranges referred to above, some vectors such as the cat flea *Ctenocephalides felis* are truly ubiquitous; this undoubtedly explains the worldwide occurrence of the two most common FVBD, namely feline hemoplasmas and *Bartonella* infections ***(Table 1).*** These common hemotropic bacteria between them illustrate many enigmatic features of arthropod-transmitted diseases. The feline hemotropic mycoplasmas ("hemoplasmas") infect red blood cells by attaching to the erythrocyte cell surface; several species of varying pathogenicity have been identified by molecular studies. *Bartonella* species are Gram-negative bacteria that also infect erythrocytes, as well as endothelial cells. Both groups of organisms are vector-transmitted (mostly by fleas), although other routes of infection are recognized such as fighting and via blood products (see below). These are also sometimes referred to as "stealth organisms"; *i.e.,* subclinical infection with these bacteria is common (making diagnosis problematic), but clinical disease is rare. That said, *Mycoplasma haemofelis* ***(Figure 2)*** in particular is a significant feline pathogen, causing pallor, lethargy, anorexia, weight loss, dehydration, and pyrexia, along with life-threatening anemia, and requires treatment with tetracycline, doxycycline or fluoroquinolones, together with compatible (typed or cross-matched) blood transfusions or other blood products in many cases.

As the cause of emerging infectious diseases, vector-borne pathogens may appear when least expected.

Figure 1. (a) *Rhipicephalus sanguineus* is primarily a tick of southern Europe, to be found primarily in the area below the red line. **(b)** Although *Dermacentor reticulatus* has been reported throughout much of Europe, it has a variable distribution, as represented by the frequency of the blue dots. The tick is found primarily in Northern Europe, above the red line.

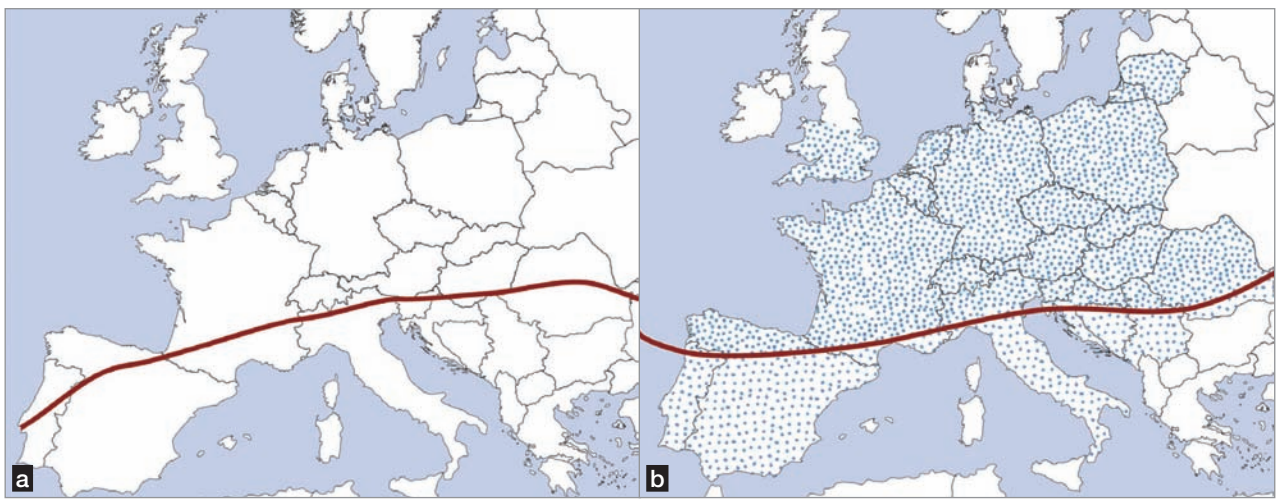

Table 1. Feline vector-borne diseases.

Distribution	Disease	Most important agents	Primary vector	Zoonotic?
Worldwide	Feline hemotropic *Mycoplasma* infection (Feline infectious anemia)	*Mycoplasma haemofelis* "*Candidatus* M. haemominutum" "*Candidatus* M. turicensis"	Fleas *(Ct. felis)*	Possibly
	Bartonellosis	*Bartonella henselae, B. clarridgeiae, B. koehlerae*	Fleas *(Ct. felis)*	Yes
Southern Africa	Babesiosis	*Babesia felis*	Ticks	No
Southern USA	Cytauxzoonosis	*Cytauxzoon felis*	Ticks	No
USA, Europe	Ehrlichiosis	*Ehrlichia canis, E. chaffeensis, E. ewingii*	Ticks	Yes
	Anaplasmosis	*Anaplasma phagocytophilum*	Ticks	Yes
	Leishmaniasis	*Leishmania infantum*	Sand flies	Yes
	Rickettsiosis	*Rickettsia rickettsii, R. conorii, R. massiliae*	Ticks	Yes
	Tularaemia	*Francisella tularensis*	Ticks	Yes
	Plague	*Yersinia pestis*	Fleas	Yes
Tropical regions	Heartworm	*Dirofilaria immitis*	Mosquitoes	Rarely

Following Hurricane Katrina, dogs and cats were relocated from New Orleans to all parts of the United States, dispersing infectious animals (and their vector-borne pathogens) into areas where normally there would be a low index of suspicion for the diseases caused by those agents (6). Increasingly, pets, including cats, are "rescued" by welfare organizations and relocated from one area to another (*e.g.,* from southern to northern Europe) potentially bringing with them infectious organisms, and there is increasing concern within the veterinary community regarding abuse of the European Pet Travel Scheme and the risk of illegal imports. Additionally, cats travel great distances to shows or (increasingly) on holiday with their owners to regions where new vectors and their pathogens occur; it is critical that clients are made aware of the risks and advised about appropriate ectoparasite control ***(Table 2).***

Since FVBD are also blood-borne infections, microscopic examination of a blood film is helpful for the diagnosis of some infections, notably protozoa infections such as babesiosis ***(Figure 3)*** and cytauxzoonosis; however, microscopy remains insensitive for detection of others such as hemoplasma or *Bartonella* infections. The good news is that the ability to detect many of the organisms responsible for FVBD is improving, largely due to the development and wide availability of highly sensitive DNA testing. Molecular epidemiological studies in cats have contributed to a greater understanding of the prevalence and distribution of FVBD as costs have decreased and high-throughput systems are developed (1), and there has been a shift from serology-based testing to increased use of PCR for detection of pathogen DNA. Importantly, this more accurately reflects the infection status of the animals being tested (assuming detection of DNA implies viable pathogen), as opposed to "previous exposure", and knowing the prevalence of bacteremia, parasitemia, or viremia provides the practitioner with important data pertaining to the real infection status of their patients.

Figure 2. Epi-erythrocytic hemoplasmas (arrowed); x1000 magnification.

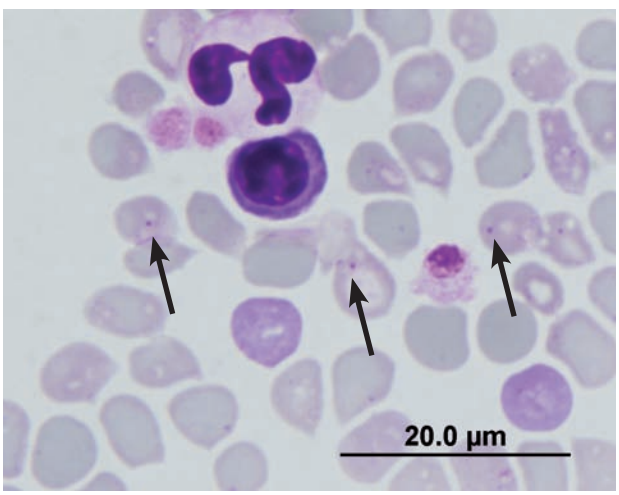

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Table 2. Products available for use in cats to prevent FVBD*.

Active ingredient(s)	Mode(s) of action	Arthropod target(s)	Formulation(s)
Imidacloprid	Blocks post-synaptic neurotransmission at insect nicotinic acetyl choline (nACh) receptors	Insects (fleas)	Spot-on with residual activity
Imidacloprid (10%) plus flumethrin (4.5%)	As above, plus flumethrin interferes with voltage-gated Na-channels in invertebrate neurons	Ticks and insects (fleas, sand flies, mosquitoes, and biting flies)	Collar (matrix for prolonged release)
Fipronil	Binds to and interferes with GABA and glutamate receptors, inhibiting chloride ion channels	Ticks, mites and insects (fleas, lice)	Spray and spot-on
Nitenpyram	Blocks post-synaptic neurotransmission at insect nACh-receptors	Fleas	Tablets
Spinetoram (modified spinosad)	Binds to and stimulates insect nACh receptors	Fleas	Spot-on
Moxidectin	Binds to glutamate-gated chloride channels and mimics GABA stimulation Often combined with imidacloprid	Fleas	Spot-on and topical solution
Selamectin	Binds to glutamate-gated chloride channels and mimics GABA stimulation	Fleas	Spot-on
Metaflumizone	Blocks Na-channels by binding to receptors	Fleas	Spot-on
Indoxacarb	Inhibits voltage-gated Na-channels in insect cells	Fleas	Spot-on
Methoprene and s-methoprene	Insect growth regulators: decreases egg hatching and larval moulting	Fleas	Spot-on
Lufenuron	Chitin synthetase inhibitor, prevents hatching	Fleas	Oral and injectable

* Availability of products and licensing details for use in cats will vary from country to country.

What are the zoonotic implications of FBVD?

Human cohabitation with cats is common worldwide, with many households having at least one cat and many additional individuals participating in so-called "semi-ownership", *i.e.,* feeding or providing care to cats that they do not consider their own. A large number of humans are thus in daily contact with cats, with growing recognition of cats as family members and sleeping companions. Paralleling this is the expanding "One Health" concept, and veterinarians are increasingly called upon for advice regarding the risks that emerging and re-emerging infectious diseases pose to humans (including those who are very young, very old, or otherwise immunosuppressed) by in-contact cats and other companion animals. Clinicians must also be mindful of occupational exposure, as in many cases the exposure to cats infected with FVBD, and in particular with their vectors, is high for veterinary personnel.

Vector-borne pathogens of importance to feline veterinarians as potential zoonoses include *Bartonella spp., Rickettsia felis, Yersinia pestis,* and *Francisella tularensis. Leishmania infantum* and *Anaplasma phagocytophilum* can also infect both humans and cats, and the role of cats as reservoirs for human disease continues to be investigated.

Bartonellosis

Bartonellosis is arguably the feline vector-borne zoonotic disease of greatest current global interest. Cats, amongst other mammalian species, can be infected by or act as a reservoir for several species of *Bartonella* bacteria. Disease in humans was once considered limited to the relatively benign cat scratch disease (CSD), which is characterized by fever and regional lymphadenopathy, but many additional manifestations of human bartonellosis in both immunosuppressed and (less frequently) immunocompetent individuals are now apparent (7). Knowledge continues to expand, and, in the past 25 years, the number of named *Bartonella* species has increased from two to greater than 24. The main species of interest in cats currently are *B. henselae, B. clarridgeiae,* and *B. koehlerae* ***(Table 1)*** with fleas implicated as important vectors (8).

Subclinical infection of cats with *B. henselae* is common worldwide, with only a small percentage of animals manifesting more serious disease. Risk factors for bacteremia in cats include young age, outdoor access, flea infestation and multi-cat environments (9). Cat-to-cat transmission primarily occurs via flea feces in contaminated claws, and the organism can survive for several days in the environment (8).

Humans typically become infected with *Bartonella spp.* species when scratched by a cat with flea feces-contaminated claws, but infection from a cat bite and indirect transmission via cat fleas are also possible (10). Immunocompetent humans typically become subclinically infected, but immunocompromised people may suffer a range of illnesses, including endocarditis, neuroretinitis, relapsing fever, aseptic meningitis, and uveitis (11,12).

Veterinarians must be able to provide advice on minimizing cat-to-human transmission of *Bartonella spp.*, most importantly for households with immunocompromised individuals. The prudent approach requires addressing cat, human and transmission factors. Recommendations include (13):

- Choosing a cat less likely to be bacteremic: *i.e.,* apparently healthy, older than one year of age, flea-free, and from a single-cat environment
- Minimizing transmission: trimming of claws, avoiding rough play, and rapid cleansing of any cat scratch or bite wounds
- Ensuring eradication of vectors: strict flea and tick control, and prevention of outdoor access

Should a young cat (*e.g.,* < 2 years) living in a household with immunocompromised people or children be found to be infected with *Bartonella spp.*, subclinical or otherwise, guidelines recommend antimicrobial treatment of the cat in order to decrease bacterial load and transmission risk (13).

Rickettsia felis infection

Rickettsia felis is a spotted fever group *Rickettsia* and the causal agent of cat flea typhus or flea-borne spotted fever (FBSF); it is also considered an emerging human pathogen. Clinical signs of FBSF in humans include macropapular rash and eschar, fever, fatigue, and headache (14). Interestingly, whilst *R. felis* DNA has been isolated from cat fleas, it appears that dogs are a more likely reservoir for the infection, and the rickettsial DNA has been identified in this species (15). Most attempts to isolate *R. felis* DNA from cat blood have failed and no clinical disease has been reported in cats, but their role in maintaining flea populations could be important in disease transmission.

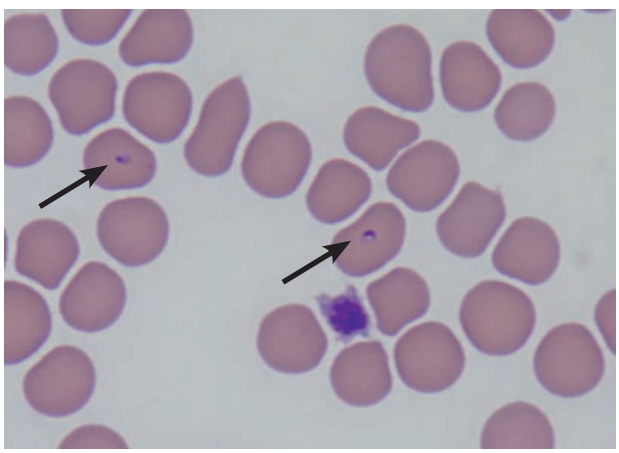
Yersinia

Yersinia pestis, a Gram-negative coccobacillus, is the agent of plague, to which cats are very susceptible. Cats in endemic areas (areas of North and South America, Africa and Asia) can contract plague via infected rodent fleas or ingestion of infected small mammals. It has been suggested that the risk of cat-associated human plague might increase as residential development continues, encroaching on the natural environment where *Y. pestis* foci exist in the western USA (2). Typical clinical signs in cats include mandibular and retropharyngeal lymphadenopathy; progression to septic shock and pneumonic forms of plague are less common (16). Humans can contract plague from cats indirectly through rodent fleas, or directly through aerosol spread, bites or scratches, and veterinary personnel have been amongst those infected.

Tularemia

Tularemia is a rare disease seen in North America and Europe caused by the Gram-negative coccobacillus *Francisella tularensis.* Major reservoirs for the organism include a large variety of small mammals, with cats becoming infected when they hunt and ingest their prey (17). Infected cats manifest clinical signs including fever, peripheral lymphadenopathy, hepatomegaly, and splenomegaly (18). Cat-to-human transmission occurs through bites (or less likely scratches), and clinical signs in humans include lymphadenopathy and transient flu-like illness, with possible progression to pneumonia (19).

Figure 3. Intracellular trophozoites of *Babesia felis* (arrowed); x1000 magnification.



FVBD and co-morbid conditions

The association between human immunosuppression and vector-borne diseases is well recognized. One of the most compelling examples is the apparent interaction between human immunodeficiency virus (HIV) and visceral leishmaniasis, which has been reported in a large number of countries worldwide. Leishmaniasis has become an important cause of death in AIDS patients, and HIV-associated immunosuppression has changed the spectrum of the disease, with an increased risk of visceral disease in retrovirus-infected individuals in comparison to the cutaneous forms typically seen in immunocompetent people (20).

A small number of studies have examined the relationship between *Bartonella* seropositivity and FIV and/or FeLV (21,22). No association has been found, but there may be an increased risk of oral cavity disease (stomatitis, gingivitis) in *Bartonella* seropositive cats. An association between feline retroviruses and *M. haemofelis* has been found in some, but not all, studies. Additionally, whilst not a cause of significant anemia in immunocompetent cats, *"Ca.* M. haemominutum*"* and *"Ca.* M. turicensis*"* have been shown to cause more marked anemia in the presence of FeLV infection and concurrent immunosuppression, respectively (23,24). No association between feline leishmaniasis and retroviruses has been reported to date, but only small numbers of infected cats have been examined.

A recent case report described a cat co-infected with *Anaplasma platys, B. henselae, B. koehlerae* and *"Ca.* M. haemominutum*"* (25). The cat was also diagnosed with multiple myeloma based on splenic plasmacytosis and a monoclonal gammopathy. It was suggested that infection with one or more of the pathogens may have mimicked or played a role in a myeloma-related disorder (MRD). Alternatively, immunosuppression related to MRD may have predisposed the cat to infection with multiple VBD.

Blood transfusions and FVBD

Veterinarians must be mindful of the potential risks of vector-borne disease associated with transfusion of blood products in cats, and need to convey these to owners. Many cats that receive blood transfusions are intrinsically immunosuppressed, or will subsequently be medically immunosuppressed, and thus may be more susceptible to clinical infection with FVBD pathogens inadvertently transmitted via infected blood.

Excellent guidelines for minimizing the risk of transmission of infectious disease via transfusion of feline blood products are available (26,27), the former including a useful "potential feline blood donor evaluation form" for practitioners. The guidelines are centered on choosing donors least likely to be infected, and screening for regionally appropriate pathogens.

With regard to FVBD, the ideal feline blood donor (26) has:

- An age of > 3 years (to minimize the risk of *Bartonella* bacteremia)
- Always lived in a single-cat household
- Good flea and tick prophylaxis
- No history of travel
- No history of VBD

In terms of screening feline blood donors for FVBD, a minimum core panel including blood PCR screening for *M. haemofelis, B. henselae,* and *A. phagocytophilum* is recommended (27). However, additional PCR screening for *A. platys,* other *Bartonella spp., Cytauxzoon felis, Ehrlichia canis, "Ca.* M. haemominutum*"* and *"Ca.* M. turicensis*"* is optimally recommended, along with confirmation of seronegativity to *A. platys* and *B. henselae.* Additional pathogens for which feline blood donors should be screened, based on local knowledge of disease or subclinical carriage, include *A. phagocytophilum, Babesia spp., C. felis, Ehrlichia spp.* and *Leishmania infantum.*

Whilst the risk of FVBD transmission via blood products can be minimized with appropriate screening, it should always be emphasized to owners that the blood transfusion procedure is not risk-free, both with regard to FVBD and other complications.

Control of FVBD

In conclusion, arthropod-transmitted pathogens are a worldwide cause of emerging infectious diseases in cats, and the implications for the health of cats themselves and also of their owners require feline veterinarians to be knowledgeable with regard to their recognition and appropriate management. FBVD need to be controlled and prevented whenever possible (28). Given the key role of the cat flea in transmission of many of the above-mentioned zoonotic diseases, as well as the risk to individual cats, the importance of strict flea control, ideally encompassing other arthropod vectors such as ticks, cannot be over-emphasized. The mainstay of prevention is the use of ectoparasiticides and compounds that interfere with the development of the egg or other life stages (Insect Growth Regulators (IGRs) and Insect Development Inhibitors (IDIs)) (29), along with chemoprophylaxis with ivermectin in heartworm-endemic areas to prevent feline dirofilariasis. Other strategies available for dogs such as

vaccination to prevent diseases including babesiosis, leishmaniasis, and Lyme disease, is either not necessary or not available in cats due to differences in their role as reservoirs. Commonly used treatments for the prevention of FVBD are listed in ***Table 2.*** Note that due to limitations in the capacity for feline hepatic glucuronidation, a number of pulicides, acaricides and ectoparasiticide groups such as organophosphates, carbamates, amitraz, and most pyrethroids (especially, permethrin) must not be applied to this species because of their toxicity.

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HOW I APPROACH...

Overgrooming in cats

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What is overgrooming?

Grooming is a normal cat behavior, involving licking and nibbling of the hair and skin, and facial rubbing with the forepaws. Its purpose is for cleaning, removal of parasites, and thermoregulation (1). However, overgrooming is a common, acquired problem of cats in which excessive licking and grooming results in hair loss. It usually presents as bilaterally symmetrical alopecia, affecting the ventral abdomen, caudal and medial aspects of the hind legs and perineum ***(Figure 1),*** although the lateral abdomen and other areas may also become alopecic (2) ***(Figure 2).***

Overgrooming is the most common cause of feline symmetrical alopecia (FSA), one of the four major cutaneous reaction patterns expressed by cats. The other reaction patterns are head and neck pruritus, lesions of the eosinophilic granuloma complex and miliary dermatitis, and all four patterns occur in response to a wide variety of underlying diseases (3) ***(Table 1).*** Although previously named "feline endocrine alopecia", it is now known that the majority of FSA cases are caused by overgrooming in response to pruritus (4).

KEY POINTS

- **Alopecia from overgrooming should be distinguished from spontaneous hair loss and requires a systematic approach to establish the underlying cause.**
- **Most cases of overgrooming are caused by pruritus, particularly due to ectoparasites and hypersensitivities.**
- **Pruritic causes should be eliminated before a diagnosis of psychogenic alopecia is made.**

Is overgrooming present?

When presented with a case of feline symmetrical alopecia, it is essential to employ a thorough and systematic approach in order firstly to establish whether it is due to overgrooming or, more rarely, spontaneous hair loss. This requires a detailed history, a thorough dermatological and general clinical examination, and some basic diagnostic tests.

This article will consider in detail the author's approach to cases of overgrooming, but the reader is referred to the standard dermatology texts for further details on the conditions causing spontaneous hair loss, which often require histopathology and appropriate laboratory tests for diagnosis.

History and signalment

A thorough history is an important first step in approaching the overgrooming cat. Unfortunately, cats are secretive animals and owners may not see them overgrooming or may not recognize the level of grooming observed as abnormal. However, a history reporting hair in the feces, vomiting of hairballs or finding hair in the house would be highly suggestive of self-inflicted hair loss.

Other areas that should be covered in the history include:

- Details of the cat's lifestyle and potential for contagion.
  - Does the owner have other pets and do they have skin problems?

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Figure 1. Overgrooming affecting the caudoventral abdomen.

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Figure 2. Overgrooming affecting the sacral region.

- Does the cat go outside? Is there direct or indirect contact with other cats, dogs, hedgehogs or rabbits?
- Does the cat visit other homes or catteries? Do other pets visit the owner's home?

- Details of ectoparasite control employed.
  - Is an effective product applied at the correct frequency to all in-contact animals?
  - Is environmental control used correctly?
- Details of past or concurrent skin problems and response to previous treatment. Does the cat appear pruritic?
- Details of the cat's systemic health.
- Are there any other behavioral signs of stress such as inappropriate urination or defecation?
- Are there any obvious potential causes of stress – a multi-cat household, changes at home (*e.g.,* new pet in the home or neighborhood, new baby)?

Information may also be obtained from the signalment. For example, hypersensitivity disorders usually develop in young adulthood, although food allergies can develop at any age. Neoplasia and systemic disease are more common in older individuals. Persian cats are predisposed

Table 1. Differential diagnosis for feline symmetrical alopecia (adapted from (2,5)).

Overgrooming (self-inflicted hair loss)	Spontaneous hair loss
Pruritus • Parasites - Fleas - Lice - *Demodex* mites *(D. gatoi)* - *Cheyletiella* mites - Otodectic mites - Notoedric/sarcoptic mites - *Neotrombicula* (harvest mites) • Dermatophytosis • Hypersensitivities - Flea bite hypersensitivity - Dietary hypersensitivity - Environmental hypersensitivity - Drug reaction • Hyperthyroidism **Psychogenic alopecia** **Pain, neurodermatitis, neuralgia (rare)**	**Endocrinopathies** • Hyperadrenocorticism • Diabetes mellitus • Hypothyroidism **Paraneoplastic alopecia** **Neoplasia** • Epitheliotropic T-cell lymphoma **Infections/ectoparasites** • Dermatophytosis • *Demodex* mites **Others** • *Trichorrhexis nodosa* • Degenerative mucinotic mural folliculitis • Telogen effluvium • Pseudopelade • Alopecia areata • Excessive physiological shedding

to dermatophytosis, and Oriental cats to psychogenic alopecia (6).

Clinical examination

A full general clinical examination should be carried out, looking for evidence of systemic disease, which may underlie spontaneous hair loss particularly.

Hair in affected areas that feels stubbly and broken off is consistent with overgrooming. Additionally, the presence of other lesions linked with pruritic, allergic or ectoparasitic disorders (such as excoriations, miliary dermatitis or eosinophilic granuloma complex lesions) would support the notion of overgrooming ***(Figure 3),*** as would the presence of visible ectoparasites such as fleas, lice or harvest mites. However, hair loss from areas that cannot be reached by the tongue, and hair that is easily epilated (*i.e.,* pulled out to reveal a patch of alopecia) would be suggestive of spontaneous hair loss.

Further evidence can be obtained by performing a trichogram, which can also prove useful to convince owners that hair loss is due to overgrooming, rather than spontaneous loss. Hairs are plucked from the area of loss using forceps and placed, aligned with each other, in liquid paraffin (mineral oil). They are then examined under a coverslip at low and high magnification. Angular and ragged distal tips to the hairs are consistent with overgrooming ***(Figure 4)*** whereas the tip of hairs in cases of spontaneous loss will be pointed. Information can also be obtained by examination of the hair bulbs.The normal cat will have 10-20% anagen (actively growing) bulbs and 80-90% telogen (resting) bulbs (***Figure 5 and 6),*** but if multiple samples show the presence of 100% telogen hairs this may suggest spontaneous hair loss and an underlying etiology such as an endocrinopathy, telogen effluvium or systemic disease.

How should overgrooming be investigated?

Once the presence of overgrooming has been confirmed, it is important to establish the cause so that appropriate treatment can be undertaken.

Investigations into ectoparasites and infections

It is essential to carry out this initial step thoroughly, particularly as flea hypersensitivity is the most common cause for feline pruritus (7).

Ectoparasites: The coat should be combed and brushed over a large sheet of white paper to look for evidence of fleas, flea feces and lice. Coat combings

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Figure 3. Alopecia from overgrooming affecting the caudoventral abdomen and caudomedial aspects of the hindlimbs. Note the concurrent presence of erythematous papules and excoriations in this cat with a hypersensitivity to environmental allergens (feline atopy).

and skin scrapings should also be examined in liquid paraffin for evidence of *Cheyletiella, Otodectes, Demodex* and, rarely, *Notoedres* or *Sarcoptes* species. Trichograms may also show eggs on the hair shafts in infestations with lice and *Cheyletiella* ***(Figure 7).***

Demodex gatoi, a *Demodex* mite with a broad blunted abdomen ***(Figure 8),*** occurs in some geographical regions and may cause overgrooming in cats. Unlike *D. cati,* it inhabits the superficial layers of the skin and so may be found on tapestrips as well as superficial skin scrapings. Due to its small size and translucency, samples should be examined with the x10 objective, with the light source reduced in intensity to avoid overlooking the parasite. However, as false negative results may occur

Figure 4. Ragged distal hair tips caused by overgrooming (x40 magnification).

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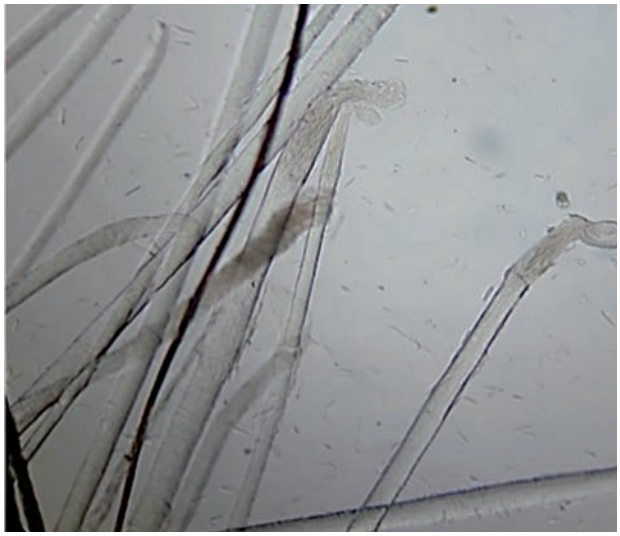

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Figure 5. Anagen hair roots are club-shaped and may be pigmented (x 40 magnification).

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Figure 6. Telogen hair roots are spear-shaped and are never pigmented (x40 magnification).

due to removal of the mites by overgrooming, it is also useful to scrape apparently unaffected areas that are out of the cat's reach. Additionally, as it is contagious, testing of asymptomatic in-contact cats may aid diagnosis. Mites may also be found on fecal examination following ingestion while grooming. If *D. gatoi* is suspected but mites cannot be found, a therapeutic trial can be undertaken, ideally using a 2% lime sulphur dip, applied weekly on three occasions to all in-contact cats. If this is unavailable, oral ivermectin (0.2-0.3 mg/kg Q24-48h) has been reported, but is unlicensed in this species and carries a risk of neurotoxicity (8-10).

Prior to embarking on these investigations, it is helpful to explain to the owner the possibility of false negative results. Therefore, even if no parasites are found, an ectoparasite treatment trial carried out for at least 12 weeks, should be undertaken to eliminate fleas and non-demodectic mites. Spot-on preparations such as selamectin or imidacloprid/moxidectin, applied to all in-contact cats and dogs, are likely to be effective, although these drugs are typically unlicensed for mites in cats.

Concurrent environmental treatment with a spray containing an adulticide and an insect growth regulator is essential, but frequently overlooked. Areas outside the house in which the animal spends time such as the car, outbuildings, and cat carriers should be included. The treatment should be repeated in 4-8 weeks, dependent on the duration of action of the adulticide used. As the pupae may take up to three months to hatch but will be unaffected by the treatment, replenishment of the adulticide

Figure 7. A louse egg on a hair shaft (x100 magnification).

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Figure 8. ***Demodex gatoi*** (x 100 magnification).

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will ensure that emergent fleas continue to be killed before biting. It is important to recognize that if the cat continues to go outside, reinfestation, particularly by fleas, may be impossible to prevent, especially if the cat has access to untreated animals or homes. However, this has to be balanced against the practicalities and potential stress of keeping the cat indoors.

If an improvement occurs, regular flea control must be maintained; systemic products are to be preferred, as overgrooming does not deplete their levels. Treatment reminders can be sent to owners by emails or text messages to optimize compliance (11).

Infections: Examination of the coat for dermatophytosis with an ultraviolet lamp should be carried out, allowing five minutes for the lamp to warm up before use. However, as false negative results are common, a sample should be submitted for culture if dermatophytosis is suspected. This is best performed by sending a sterile toothbrush that has been used to brush the affected animal to the laboratory, along with hairs plucked (using sterile forceps) from the periphery of the lesion.

Cytology of the skin surface may also be carried out, particularly if bacterial or *Malassezia* infections are suspected, using stained impression smears or acetate tapestrips. Any infections identified are likely to be secondary to an underlying cause, but should be treated appropriately.

Note that if there is no evidence of infection or demodicosis, and the pruritus is unacceptable, glucocorticoids may be given in the initial stages of the ectoparasite trial, ideally using oral prednisolone (1-2 mg/kg Q24h). The dose can be tapered to the lowest effective alternate day dose and withdrawn at the end of the trial to observe the effect of the ectoparasite treatment alone.

Drug reactions

Potential drug-induced causes should be identified from the history, and the suspected drug withdrawn if possible, alongside the above measures.

Investigations into hypersensitivities

If overgrooming persists after elimination of ectoparasitic and infectious causes, investigations can be undertaken into hypersensitivities to dietary and environmental allergens. Although a history detailing gastrointestinal problems may suggest dietary hypersensitivity, this is not always present, and the clinical presentations of the two conditions may be indistinguishable.

Dietary hypersensitivity: As *in vitro* tests to diagnose dietary allergies are of questionable accuracy (12), a strict elimination diet trial should be carried out for a minimum of 6-8 weeks. Traditionally, a home-cooked recipe using novel protein and carbohydrate has been used, but nowadays proprietary diets containing totally novel ingredients are increasingly fed, due to their convenience and balanced nutritional content. However, care must be taken that all ingredients are declared and are genuinely novel, which is not the case for many so-called “hypo-allergenic” diets, particularly over-the-counter options (13). Hydrolyzed protein diets are also available. However, concerns that individuals known to be reactive to the native protein may relapse when fed these diets have lead to the suggestion that a hydrolyzed diet based on the most novel proteins should be used if possible (14,15).

Performing an elimination diet trial in a cat can be difficult and may require some level of compromise. If the individual refuses a single diet, the author may suggest more than one appropriate diet is fed to improve variety. Additionally, as many cats ”graze” throughout the day, it may be necessary to feed the diet to all cats in a multicat household. As with ectoparasite control, it is optimal if the cat is kept indoors to prevent hunting or eating elsewhere. However, if this is impossible for reasons of stress or practicality, measures can be taken to mitigate the effects as far as possible (*e.g.,* providing neighbors who feed the cat with the appropriate diet) but the limitations of the trial must then be accepted.

If pruritus has resolved after 6-8 weeks, it is useful to continue the exclusion diet for at least a month, while maintaining strict ectoparasite control, to ensure that this improvement is sustained. However, if this occurs, the previous diet should be reintroduced and a recurrence of the overgrooming demonstrated before a diagnosis of dietary hypersensitivity is made. The cat should then be returned to the exclusion diet until the overgrooming resolves and a diet selected which can be fed long-term. This may be the exclusion diet itself, if nutritionally balanced, or a proprietary diet containing ingredients as close as possible to the exclusion diet. Alternatively, the offending allergens may be identified by the systematic reintroduction of individual ingredients, one every 7-14 days, and a diet avoiding these allergens identified.

It should be appreciated that if relapse does not occur after reintroduction of the previous diet, the pruritus may have been due to an allergen to which the cat is no longer exposed by the end of the trial. This may occur particularly

with seasonal allergens, which may not be apparent until re-exposure the following year.

As with the ectoparasiticidal trial, glucocorticoids may be required to control overgrooming in the initial stages of the diet trial, but should be withdrawn towards its end to assess the effect of the diet alone. If an improvement is not seen after the diet trial, the cat is likely to be suffering from environmental hypersensitivity.

Environmental hypersensitivity (atopy): This is the second most common cause of pruritus in the cat (7), and a sound diagnosis can only be made by working through the steps above, *i.e.,* it is a clinical diagnosis. As in the dog, intradermal allergy testing and IgE serology cannot be used simply to diagnose whether an individual suffers from environmental hypersensitivities, due to potential false positive and false negative results (16-18). Additionally, intradermal allergy testing in cats may be difficult to read, and *in vitro* testing for IgE, though easier to perform, is not as well validated as for the dog (19,20).

Once a diagnosis of environmental hypersensitivity has been made, several treatment options are available, and the choice will depend on the severity of the clinical signs, owner preference and the disposition of the patient. Allergen-specific immunotherapy can be used in this species, but is less well evidenced than for the dog (18,21). The choice of allergens for inclusion is based on intradermal allergy testing or IgE serology, albeit with the limitations discussed above. Treatment is otherwise symptomatic and based on control of pruritus and the flare factors (*e.g.,* fleas and secondary microbial infections). Allergen avoidance can also be attempted but is frequently not possible.

What are the anti-pruritic options?

Pruritus may be controlled by glucocorticoids, ciclosporin or, possibly, antihistamines. Historically, other drugs such as megestrol acetate have been used but are nowadays best avoided in the presence of safer alternatives (22).

Glucocorticoids

If glucocorticoids are used, oral administration is preferable so that the drug can be tapered to the lowest effective dose and frequency for long-term use ***(Table 2).*** Prednisolone is to be preferred to prednisone in cats as the latter is ineffectively metabolized. Depot glucocorticoids (*e.g.,* methylprednisolone acetate) may be required for cats in which oral medication is not possible, although owners should be warned about the risks of iatrogenic side effects with prolonged use.

Ciclosporin

Ciclosporin is licensed in many countries for allergic dermatitis in cats, following initial evaluation of FeLV, FIV and toxoplasmosis status. A starting dose of 7 mg/kg Q24h can be reduced after 4-6 weeks to alternate day dosing in many cases, with subsequent reduction to twice weekly dosing being possible in some individuals ***(Figure 9 and 10).***

Antihistamines

Antihistamines, possibly with concurrent oral essential fatty acid supplements, may be helpful in mild cases, though their use is poorly validated. They may also have a steroid-sparing effect when combined with prednisolone; although unlicensed in cats, reported side effects are generally infrequent and mild. Chlorpheniramine (chlorphenamine) at 2-4 mg/cat Q12h PO is usually considered the most effective (3).

Oclacitinib

Oclacitinib is unlicensed in cats, though an uncontrolled pilot study has reported its use in 12 cats with various presentations of feline environmental hypersensitivity, with a good response seen in 5 cases (23). Although it may represent an alternative treatment in the future, if used within the prescribing laws of the reader's country,

Table 2. Anti-inflammatory glucocorticoids commonly used in cats (adapted from (3,22)).

Oral glucocorticoid	Initial dose	Taper to
Prednisolone or methylprednisolone	1-2 mg/kg Q24h	0.5-1.0 mg/kg Q48h
Dexamethasone	0.1-0.2 mg/kg Q48-72h	0.05-0.1 mg/kg Q48-72h or less
Triamcinolone	0.1-0.2 mg/kg Q24h	0.05-0.1 mg/kg Q48-72h

Figure 9. Overgrooming caused by environmental hypersensitivity.

Figure 10. The same cat as in **Figure 9** after treatment with ciclosporin for 11 weeks.

further evidence is required to establish the optimal dose regime and its long-term safety profile in cats.

What else can cause overgrooming?

Other causes are rare but should not be overlooked when investigating the overgrooming patient.

Psychogenic alopecia: In rare cases, excessive self-grooming occurs in the absence of an organic cause, or may persist after an organic cause has resolved. It may be a displacement behavior triggered by a variety of environmental or social stressors. Most cases occur in cats that live indoors and with other cats (24), and Oriental breeds are predisposed. A thorough history may reveal potential stressors or other signs suggestive of a behavioral element such as inappropriate elimination (25). The lack of response to anti-inflammatory doses of glucocorticoids has also been suggested as supportive of a diagnosis of psychogenic alopecia (26), but it is important to rule out medical causes for overgrooming to avoid misdiagnosis: In one study, 16 of 21 cats referred for psychogenic alopecia were found to have an underlying medical condition (27). If psychogenic alopecia is diagnosed, it is important to try to identify the cause so that environmental and/or behavioral modification can be undertaken (25). This may involve enlisting the expertise of a veterinary behaviorist and observing the cat in the home environment. Pheromone diffusers may be helpful, but pharmacological intervention may also be required. Clomipramine has been reported as the most effective agent (0.5 mg/kg Q24h PO for 4-6 weeks; increase to 1 mg/kg Q24h if required). However, other tricyclic antidepressants, selective serotonin reuptake inhibitors, and benzodiazepines have also been used. These include fluoxetine (0.5-1 mg/kg Q24h), amitriptyline (0.5-1 mg/kg Q12-24h), and diazepam (0.2-0.4 mg/kg Q12-24h). Note these drugs are usually not licensed for use in cats, but further details can be found in the literature (26,28,29).

Feline hyperesthesia: Feline hyperesthesia may involve licking or chewing at the skin, particularly of the flank, lumbar, tail or anal regions. However, it is accompanied by other clinical signs such as rippling of the skin, muscle spasms, running, jumping, and vocalization. As with feline psychogenic alopecia, it has been associated with social or environmental stress (28).

Pain, neurodermatitis, neuralgia: Although rare, overgrooming may occur in response to pain or discomfort from an underlying organ, neuritis or neuralgia. In particular, the possibility of feline lower urinary tract disease should be considered in cats that lick the caudoventral abdomen (2).

Summary

Overgrooming in cats is a common presentation in feline practice with many potential underlying causes. A systematic approach to identifying its cause will optimize the likelihood of a successful outcome for both patient and clinician.

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Why focus on felines in your veterinary clinic?

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Introduction

Just over 50 years ago, the *Canadian Veterinary Journal* carried an article, presenting an outline of all that was known at that time about feline medicine (1). It ran to ten pages in total. Feline medicine has grown steadily in popularity since then; the first cat-only practices were established in the U.S. in the 1970's. Veterinarians can now pursue specialty certification in feline medicine and surgery in many countries, and benefit from specific continuing education opportunities, including journals and textbooks devoted to feline medicine. However, a disconnect exists between the advances in feline medicine and what is happening in day-to-day veterinary practice. Although cats have now surpassed dogs as the most popular companion animal in many countries, most veterinary clinics are designed primarily with canine patients in mind. In addition, some alarming statistics about feline veterinary care have been published recently, further highlighting the discrepancy in care for cat patients compared to dog patients. For example, in 2011, feline veterinary visits in the U.S. had decreased 4.4% from 2006, while canine visits increased by over 9% in the same period (2), and it is estimated that fewer than half of the 74 million pet cats in that country receive regular veterinary care. In 2011 in Canada, only 46% of cat owners had taken their cat to the veterinarian in the previous year, compared with 77% of dog owners (3). While these statistics are disappointing, they can be taken as an opportunity to improve feline health and to increase veterinary business.

KEY POINTS

- **Although there have been great advances in feline medicine in the last fifty years, many cat owners are less likely to seek veterinary care for their pet compared to dog owners.**
- **It is in the best interests of pet, owner, and clinician to adapt hospital policies and procedures with the feline patient in mind; an understanding of the unique nature of cats is the starting point.**
- **There are many small factors that can make a difference between a welcoming, reassuring cat-friendly clinic and a veterinary practice which is off-putting to both owners and cats.**
- **Handling cats with respect is a critical component of successful feline practice, and this can be achieved in various ways.**

The reasons for the decline in feline veterinary care are multiple and complex (4). They include issues such as:

- Difficulty getting the cat to the veterinary clinic
- Low levels of owner awareness regarding basic feline medical needs
- Owner difficulty in recognizing subtle signs of illness in cats
- The perception that cats are able to take care of themselves
- The belief that indoor cats are protected from most illnesses
- The low perceived value of cats, since many cats are acquired accidentally or for free
- Owner discomfort and stress associated with experiences at the veterinary clinic

Why have a cat-friendly clinic?

All veterinarians who treat cats can benefit from an understanding of the unique nature of cats as well as the physiologic and behavioral responses to stress experienced by this species. Cats are bonded to their home environment and seldom leave it by choice. Being forced into a strange environment makes a cat uncertain about its safety, and causes anxiety and distress. Cats prefer to avoid danger and confrontation by running away or hiding, strategies that are not easy to employ during clinic visits. It is important to make a visit to the clinic as pleasant as possible for both cat and owner, and if possible this should start when a kitten or young cat attends the clinic for the first time. This age group is less likely to experience anxiety during a veterinary consultation, which offers an opportunity to bond both client and pet to the clinic by making the visit a positive experience. This is important, as some cat owners will feel that a traumatic experience at the clinic is more detrimental to the cat than a lack of veterinary care. Implementation of approaches to create a feline-friendly practice environment and use of respectful handling techniques will improve welfare and veterinary care for cats; it will also make working with cats safer and more rewarding for the veterinary team. In addition, a focus on health care tailored to feline life stages improves early recognition and treatment of problems, thereby improving pet health and welfare, and preserving the human-animal bond.

Stress reduction

It is in the best interest of feline patients, and in the best interest of the business of veterinary medicine, for veterinarians to adapt hospital policies and procedures with the cat in mind. This starts with educating owners about cat carriers and travel to the veterinary clinic. In one study, 58% of cat owners said that just thinking about taking their pet to the veterinary clinic was stressful (compared with 38% of dog owners), and 38% said their cat hated going to the veterinary clinic (compared with 26% of dog owners) (5).

Reducing the stress associated with veterinary visits starts at home; habituation to the carrier and travel should start early in the cat's life. Each cat should travel to the veterinary clinic in a carrier; it is unsafe to allow a cat to move freely inside an automobile. Placing more than one cat in a carrier is unwise, as redirected aggression and injuries can occur in fearful situations. Solid sturdy carriers with wide openings at the front and top, or with easily removable tops, are preferred ***(Figure 1).***

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Figure 1. A cat carrier with a wide opening is ideal.

The carrier should provide the cat with an enclosed, safe feeling; carriers without solid sides can be covered with a towel or blanket to provide privacy. Feline facial pheromone can be sprayed on a towel and placed in the carrier about 15 minutes before the cat is put inside (to allow time for the alcohol in the spray to evaporate). Various other tips can help desensitize cats to carriers, such as leaving the carrier out in the home so that it is familiar, feeding the cat in or near the carrier, placing catnip or toys in the carrier, training the cat to enter the carrier on command for a reward, and acclimating the cat to the car and carrier with occasional short trips that are not to the veterinary clinic. Travel to the veterinary clinic should be on an empty stomach; this helps prevent motion sickness and makes the cat more interested in treats while at the clinic. In some cases, medications such as maropitant may be useful to prevent motion sickness.

Feline-friendly clinics

Once at the clinic, the owner should be welcomed with visible signs that emphasize the staff care about cats; *e.g.,* posters, photos of staff and clients' cats, products for cats, and cat-specific information. Veterinary staff interacting with cats and their owners should be knowledgeable about general cat care, behavior, handling, medical and surgical needs, and cat breeds. The clinic can hold special educational events or "clinics" for diabetes education, obesity prevention and treatment, "kitten kindergarten", etc. A separate cat-friendly waiting area that is not available to canine patients could be created by partitioning part of the reception area. Tables or shelves should be provided so that carriers can be placed off the floor ***(Figure 2).*** Ideally, owner and cat should be placed

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Figure 2. (a) A cat-friendly reception area in a Tokyo animal hospital, featuring tables to place carriers off the floor and blankets to cover carriers. **(b)** Commercially produced stands are also available; owners can be encouraged to place the cat carrier on the stand whilst waiting.

into an examination room as soon as possible to provide a quieter, less stressful location. Minimizing waiting times helps reduce stress for both cat and owner. In addition, some clinics have found success in reserving certain appointment times (*e.g.,* one afternoon per week or one Saturday per month) exclusively for feline patients.

The examination room should be stocked with all the supplies and equipment necessary for working with feline patients ***(Figure 3);*** it is best to avoid leaving the room to retrieve items. Ensure that all equipment (*e.g.,* stethoscope, thermometer, etc.) is cleaned between patients, not only to reduce disease transmission but also to avoid lingering odors from other patients. If possible, one examination room can be designated specifically for feline patients. Once in the examination room, the clinician should spend time taking a history and talking with the owner while allowing the cat to adjust and venture out of the carrier, on its own if possible. Cats are very sensitive to sights (*e.g.,* other cats, other pets), sounds (*e.g.,* voices, equipment, door bells), and smells (*e.g.,* perfumes, disinfectants, alcohol); attention should be paid to these details to reduce anxiety. The examination room should be a calm, quiet environment.

No rule says all cats must be examined on a stainless steel table; many cats are more comfortable remaining in the carrier (with the top removed), or being examined on a lap, on the floor, on a shelf or window ledge, in a box or basket, or even on the scale after being weighed. Exam table surfaces can be covered with non-slip washable materials such as rubber bath mats. Non-traditional exam tables are often desirable for cats such as smaller tables from home furniture stores, or custom-made tables in different shapes. When possible, allow the cat to remain on the towel or bedding that came with the carrier. A feline facial pheromone plug-in diffuser should be placed in waiting areas, examination rooms, and all areas of the clinic where cats will be housed. Security is important; ensure that any loose cat cannot escape via open doors or windows, or become trapped in an inaccessible area.

When simple procedures such as nail trims, blood pressure assessment, blood sampling, or urine collection are required, consider performing them in the exam room rather than moving the cat to another part of the clinic. It is better for staff to come to the cat than to have the cat move to another area of the clinic where it will have to acclimatize to a new environment. If the owner is uncomfortable witnessing a procedure, consider having the owner wait in the reception area until the procedure is completed.

Handling cats

Respectful feline handling is a critical component of successful feline practice (6). Owners are more likely to return for regular visits if they feel the veterinarian and clinic staff are skilled and careful when handling cats. In addition, many veterinary team members dislike working with cats if they lack the skills and equipment. They are concerned about potential injuries and zoonotic diseases, and they dislike the disruption and inefficiency that can result when a difficult feline patient must be cared for. In the worst

circumstances, performing a complete physical examination, collecting laboratory samples, or undertaking diagnostic testing such as radiographs may be difficult or impossible. Fear and stress can also affect diagnostic test results ***(Table 1).***

Gone are the days when fearful and defensive cats should routinely be handled with large gloves or "scruffed". The key to successful handling is an understanding of feline behavior. Most of the undesirable behaviors exhibited by cats in veterinary clinics are induced by fear or pain. Physical confrontation is the last resort for most cats; their efforts are first focused on avoidance and escape. The more control the cat has during the visit, the less forceful and aggressive the handling, and the more tolerant the approach, the better the outcome. Many anxious cats can successfully be examined with the use of a towel to cover the head; reducing sight of unfamiliar people and places can reduce fear. Cats should be approached calmly and talked to quietly. Avoid direct eye contact, as "staring" is considered confrontational. Minimal restraint is the best approach for cat handling; various techniques using towel wraps for restraint have been published, but always start with the least invasive procedures and progress to those more likely to be stressful later in the appointment if necessary. Reinforce the cat's positive behavior with toys or treats ***(Figure 4)*** – getting the owner's permission first – and ignore negative behavior rather than trying to correct it.

Figure 3. A cat-friendly examination room should have feline-relevant information, with all equipment for working with cats within easy reach.

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Table 1. Effects of stress and fear on results of diagnostic testing in the cat.

Stress hyperglycemia
"White coat" hypertension
Lymphocytosis and neutrophilia
Increased urine pH
Hypokalemia

Always document in the medical record which handling technique worked best for a given patient, and which approaches should be avoided. Cats that are anxious or fearful during veterinary visits may benefit from longer appointment times to avoid having to rush the consultation. If all else fails, sedation should be considered, rather than escalating forceful handling and risking an adverse outcome for all involved.

Owner considerations

Cats are not alone in experiencing anxiety during a visit to the veterinary clinic. The cat owner who accompanies the patient into the exam room often feels some apprehension that may affect their own behavior. The following advice for owners will help reduce anxiety in the exam room:

- Ask owners to avoid human behaviors that, while intended to comfort the cat, may actually increase its anxiety. Examples include clutching the cat, talking or staring in its face, and disturbing or invading its personal space. Sounds intended to soothe or quieten the animal (such as "shhhh") may mimic another cat hissing.
- Physical correction such as tapping the cat's head and delivering stern vocal corrections may startle the cat and provoke the fight-or-flight response. Cat owners and veterinary staff should remember that despite being family members, cats are not human and do not understand efforts to discipline them.
- It is often helpful to instruct the owner *not* to handle or remove the cat from its carrier until all preparations are in place and a member of the veterinary team makes the request.

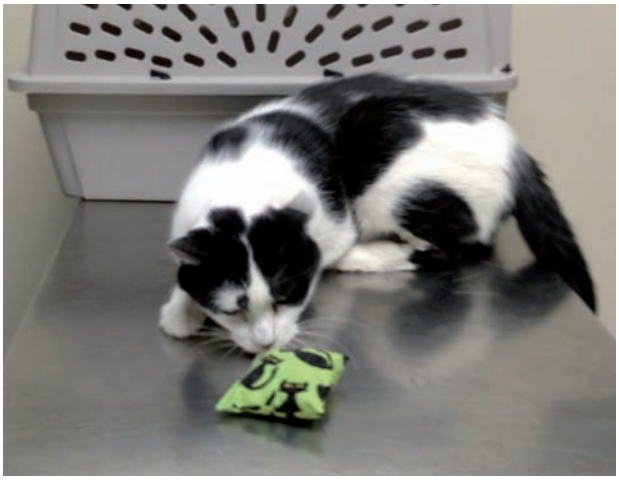

Figure 4. Enticing cats with treats or toys can help reduce stress in the examination room.

Figure 5. Making cats comfortable during procedures, *e.g.,* when giving subcutaneous fluid therapy, is an important part of respectful handling.

Once the visit has been concluded, a veterinary team member can either complete the check out and payment process in the exam room, or the cat can remain in its carrier in the exam room while the owner completes check out in the reception area.

Hospitalizing cats

There are many ways to improve the experience of hospitalization for cats, whether they are healthy and undergoing an elective procedure, or ill and undergoing diagnostic investigation and treatment ***(Figure 5)*** (7). Caging for cats in the clinic should be in a ward separate from dogs whenever possible. Additionally, cages should be placed so that cats cannot see one another. Cage materials should help decrease sounds and maintain heat, and may include bedding or blankets from home. Hiding places can be provided with a box made from material that can be cleaned or disposable materials such as cardboard. If space allows, the cat's own carrier can be placed in the cage with its door open or removed; the opening of any box or carrier should be directed away from the front of the cage for privacy. The cage should have enough room to site the food and water as far as possible from the litter box. Feline facial pheromone can be sprayed on towels or bedding 15 minutes before being placed in the cage; this helps improve appetite and normal behaviors (8).

Since cats evolved in desert environments, ambient temperatures somewhat above the typical human comfort zone are desirable, and this may be achieved with bedding for insulation and burrowing. Many hospitalized cats do not eat well due to stress; improving the cage environment, especially providing hiding places, may help increase food intake, but it is also essential to identify and treat any nausea or pain. In addition, have the owner bring familiar foods from home rather than introducing a new diet during hospitalization.

Further thoughts

Many resources are available to help veterinarians focus on felines in their practice. Programs from International Cat Care (www.icatcare.org) and the American Association of Feline Practitioners (www.catvets.com) are available in several countries to help clinics increase veterinary visits for cats and improve the level of health care that cats receive. By participating in these programs, practices have the opportunity to earn the "Cat Friendly Practice" or "Cat Friendly Clinic" designation. The programs also provide many resources for staff training, ongoing education, and support for participation in social media outlets (*e.g.,* Facebook, Twitter, and Pinterest); cat owners engage well with such websites, and having a social media presence helps practices convey their knowledge of feline medicine and their dedication to improving the veterinary experience for cat and owner.

The ultimate in feline veterinary care

The ultimate customization for feline veterinary care is the cat-only practice. Hundreds of such clinics have been established in North America, and the idea is increasing in popularity throughout Europe and Asia. There are many benefits to a species-specific clinic, such as staff that are especially interested in feline care and skilled in feline handling. Cats are smaller than most dogs, so feline clinics are often smaller than traditional veterinary

practices, which can be important in areas with high property costs. A more limited range of equipment is required as well as a smaller inventory of drugs and supplies. At the same time, cat-only clinics can often carry out more specialized care, as their budget is focused on only one species.

Another option for customized veterinary care for cats is to provide house call services. A veterinarian and nurse (or other trained team member) can provide most preventive care services in the home environment. Some simple medical care can also be provided, and blood and urine samples can often be collected if needed, and of course euthanasia services in the home environment are highly valued by owners. There are many benefits for both owner and cat in offering home visits, such as not having to leave a familiar environment and avoiding the stress of travel to the veterinary clinic. As well, some owners may have mobility or transportation issues, or may simply have little time to schedule an office visit, especially if it involves a long trip in heavy traffic. There are benefits to the veterinarian as well; home visits (if conducted properly) can be relaxed affairs with more time available for the medical history and physical examination. It also allows inspection of the home environment; this is particularly important for behavioral and house soiling problems. However, there are some potential drawbacks to the home visit, especially for sick cats; transportation to the veterinary clinic may still be required for diagnostic testing and specialized treatment.

Regardless of the type of clinic, any veterinarian that treats cats is a feline veterinarian. By following the advice of the legendary feline veterinarian Dr Barbara Stein, who always emphasized that “cats are not small dogs”, and taking advantage of the abundance of resources available, all clinicians can take steps to improve feline care and enhance the experience for the cat, the owner, and the veterinary staff.

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A QUICK GUIDE TO...

Feeding hospitalized cats

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When should a cat be fed?

- Basically, as soon as possible!
- If anorexia is or may be present for more than 3 days
- In kittens after a few hours of anorexia
- As soon as cardiovascular and hemodynamic parameters are stable; major electrolyte abnormalities such as hyperkalemia should be corrected before feeding commences
- Within 24 hours of presentation
- Within 6-12 hours following gastrointestinal surgery

What diet should be offered?

- Tasty food with a pleasant odor
- Consider starting with some "treats" to stimulate appetite
- A critical care diet with high energy and high protein content
- Food should be at room temperature

How should the cat be fed?

- Enteral if possible
- Partial parenteral if enteral nutrition does not provide adequate energy intake
- Parenteral nutrition if enteral nutrition is not possible

What is the best way to stimulate appetite?

- Use highly palatable food
- Create a cat-friendly, calm environment with soft, warm bedding and a place to hide
- Make sure the cat is not in pain; administer analgesia as appropriate
- Give anti-emetics and gastric protectants if the cat appears nauseous
- Appetite in cats is stimulated by smell; clean the cat's nose if obstructed with mucus or other material
- Offer fresh food at room temperature on a regular basis

What about appetite-stimulating drugs?

- May be used if conventional techniques do not work
- Cyproheptadine is an H1-antihistaminic drug (1-4 mg/cat every 12-24h PO)
- Mirtazapine is a 5-HT3 antagonist (3-4 mg/cat every 3 days PO)
- Benzodiazepines (*e.g.,* midazolam) may be used as a short-term option if other drugs fail. They may induce appetite at a very low dose (0.05 mg/kg IV) but may also cause sedation. However, hepatic failure has been described after giving diazepam to cats

What if the cat will not eat?

- Careful force-feeding using a syringe may be carried out if other techniques fail. It may also be beneficial to put some food on the cat's paws, as the cat may lick it off whilst trying to clean itself
- Feeding tubes should be used if enteral feeding is possible, but the energy requirements are not fulfilled by spontaneous food intake

Naso-esophageal feeding tube

- Easy to place without general anesthesia
- Can be removed whenever required
- Usable for three or more days
- Only suitable for liquid diets

Materials required:

- Feeding tube 4.5-6 FG
- Lidocaine-containing lubricant
- Suture material
- Needle holder
- Scissors

Placement technique:

- Place some lubricant on the lower nasal meatus and at the tip of the tube ***(Figure 1)***

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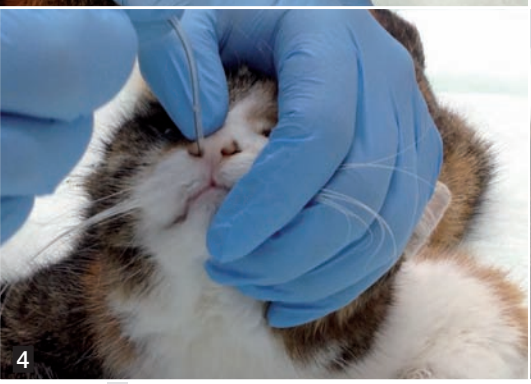
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HOW TO PLACE A NASO-ESOPHAGEAL TUBE:

1. Place lidocaine gel around the nose
2. Measure tube length from the nose to the 8th intercostal space
3. Mark the tube using a permanent marker
4. Introduce the tube into the nose in a ventromedial direction
5. Allow the cat to swallow the tube by flexing the neck
6. Suture the tube in position with a Chinese finger trap

- Measure tube length from the nose to the 8th intercostal space and mark with a permanent marker ***(Figure 2 and 3)***
- Introduce the tube into the lower nasal meatus by directing the tube tip ventro-medially ***(Figure 4)***
- Allow the cat to swallow the tube by flexing the neck slightly, and advance the tube until the mark reaches the nose ***(Figure 5)***
- Suture the tube using a Chinese finger trap; a second suture should be placed at the level of the upper jaw or on the forehead ***(Figure 6)***
- As an alternative to suturing, tissue glue may be used, but note that, when the tube is removed, some hair (and possibly skin) may be removed as well
- Check positioning with radiography

Esophagostomy feeding tube

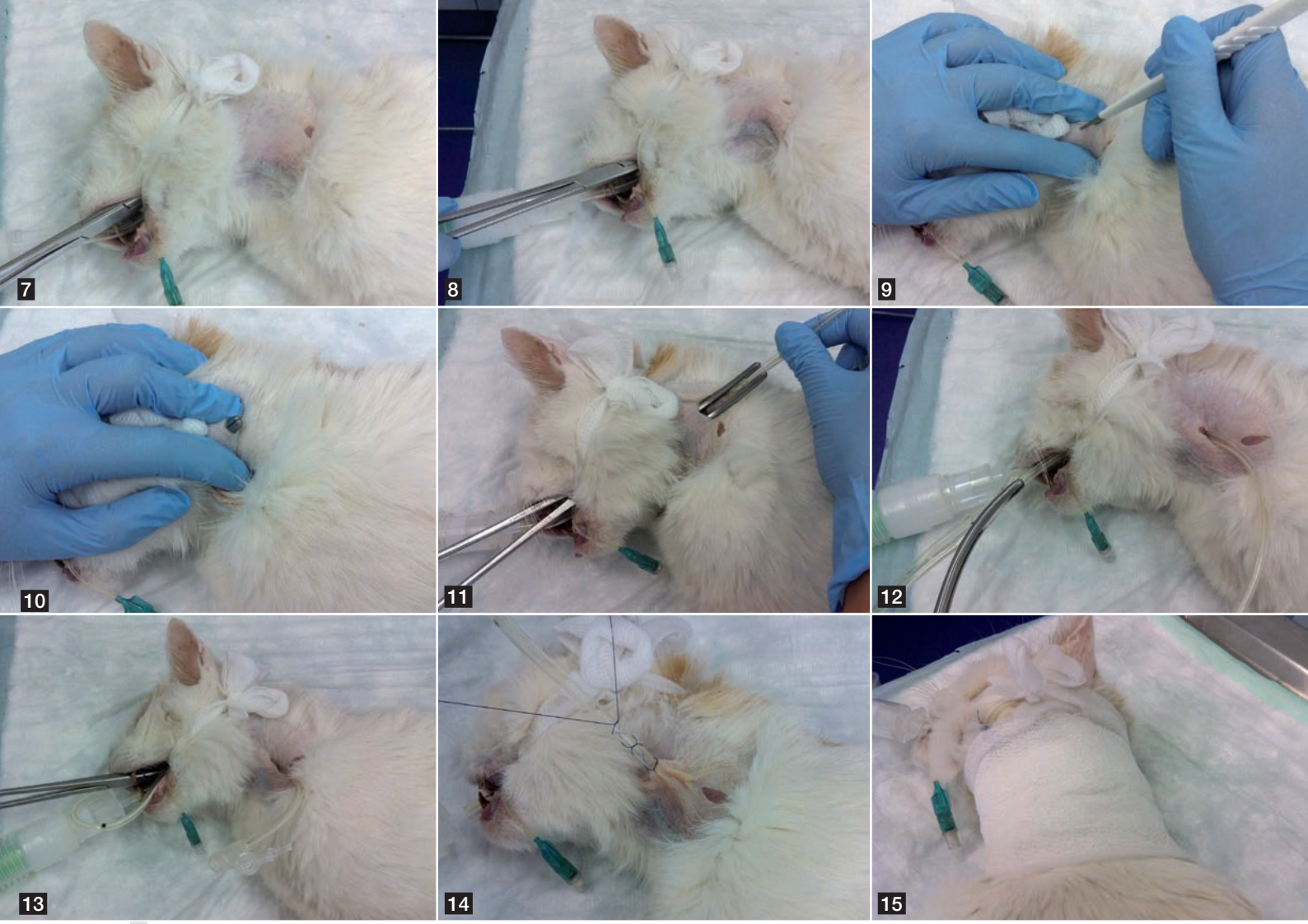
- Bypasses mouth and pharynx
- Suitable for both liquid and slurry diets
- Can be left in place for many weeks if necessary
- Can be removed whenever required
- General anesthesia needed for placement

Materials required:

- Feeding tube 9-12 FG
- Long Rochester-Péan forceps or equivalent (or a commercial esophageal tube introducer)
- Scalpel blade
- Skin disinfectant
- Suture material
- Needle holder
- Scissors
- Dressing materials

Placement technique:

- Anesthetize and intubate the cat
- Place the cat in right lateral recumbency
- Clip and disinfect the left neck
- Measure tube length from mid-neck to the 8th intercostal space and mark with a permanent marker
- Introduce the forceps into the esophagus from the mouth ***(Figure 7)***
- Direct the tip of the forceps laterally until it can be felt dorsal to the jugular vein, then push the tip of the forceps towards the skin ***(Figure 8)***
- Make a stab incision with the scalpel blade over the tip of the forceps ***(Figure 9)*** and push the forceps out through the skin incision ***(Figure 10)***
- Grasp the tube tip with the forceps ***(Figure 11)*** and withdraw the tube tip out of the mouth ***(Figure 12)***
- Redirect the tube caudally into the esophagus ***(Figure 13)***



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HOW TO PLACE AN ESOPHAGOSTOMY TUBE:

7. Introduce the forceps into the oral cavity
8. Direct the tip of the forceps laterally
9. Make a stab incision over the tip of the forceps
10. Push the forceps through the skin incision
11. Grasp the tip of the tube with the forceps
12. Pull the tube tip into the mouth
13. Redirect the tube tip back into the esophagus with the forceps, until the tube tip is caudal to the incision site; ensure the tube is not kinked and then push it further down the esophagus until the mark is level with the skin incision
14. Suture in position with a Chinese finger trap
15. Wrap the neck using dressing materials

- Advance the tube caudally until the tip of the tube is caudal to the skin incision, then maneuver the tube to ensure it is not kinked
- Advance the tube until the mark is level with the skin
- Suture the tube in place using a Chinese finger trap ***(Figure 14)***
- Apply disinfectant lube around the insertion site and wrap the neck with bandages ***(Figure 15)***
- Check positioning with radiography

Tube feeding technique

- Use food at room temperature
- Flush the tube before and after feeding with 2-3 mL of water
- Start with small boluses (1-2 mL/kg every 2-4 hours)
- Feed the cat 1/3 of its resting energy requirement* (RER) the first day, 2/3 RER the second and 3/3 RER the third day
- Increase bolus size stepwise up to 10 mL/kg (if tolerated by the cat)
- As an alternative to bolus feeding, a liquid diet can be given by constant rate infusion at a rate of 1-2 mL/kg/h. With this technique, the tube should be rinsed with water every 4-8 hours

*Daily RER can be calculated as follows: $Kg^{0.75}$ x 70 = RER (kcal)

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IN OUR NEXT ISSUE...

In our next issue of *Veterinary Focus*, we will look at different aspects of oncology:

- **Dealing with the feline cancer patient**
  Erika Krick, US
- **New therapies for cancer treatment**
  Cheryl London & Heather Gardner, US
- **Adrenal tumors in cats and dogs**
  Carolina Arenas & Mike Herrtage, UK
- **Oncology surgery**
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