Feline respiratory disease complex (FRDC) refers to the characteristic acute presentation of a contagious respiratory or ocular disease caused by one or multiple pathogens. The complex is also referred to simply as feline upper respiratory tract infection. Although the presentation of FRDC is usually an acute illness, chronic disease sequelae are possible either from infection or an immune-mediated response to the infection.

Because FRDC is initiated by contagious pathogens, the acute manifestations are exceedingly rare in singly housed indoor cats. Rather, FRDC is a major problem in animal shelters; cats in outdoor colonies; and occasionally in cats housed in catteries, multiple cat households, boarding facilities, or cats that travel to shows. Although pathogens are crucial in initiation of FRDC, it is complicated by a number of factors related to the environment and host. For example, not only are cats housed in animal shelters exposed to contagious pathogens, but also the illness caused by these pathogens may be complicated by factors such as poor air quality or immunosuppression related to stress.

Respiratory disease complex remains a major challenge to veterinarians, shelter operators, and cat owners alike. Although morbidity greatly exceeds mortality, cats and especially young kittens may die as a result of infection. Outbreaks in animal shelters may prevent adoption of homeless cats and increase rates of euthanasia. Costs associated with treatment and prevention may impact the ability of shelters to function effectively. Although vaccines are available for several of the pathogens involved in FRDC, they do not prevent infection or pathogen transmission entirely. Although eradication of FRDC is not a realistic goal, studious efforts to minimize transmission and manage infections will result in reduced morbidity and mortality.
CLINICAL PRESENTATION

The clinical presentation of kittens and cats with FRDC is similar regardless of the pathogen(s) involved (Fig. 1). Clinical signs may be quite mild or extremely severe. Secondary bacterial infections can lead to major complications including lower respiratory infections (ie, pneumonia). Simultaneous viral infections are also possible, especially in the setting of animal shelters. The concurrent presence of two or more infections can greatly complicate the clinical disease picture.6–8 For instance, although neither feline immunodeficiency virus or feline panleukopenia are respiratory viruses, cats with either of these and simultaneous calicivirus infections would demonstrate a much more severe systemic illness than cats with a typical calicivirus infection alone.

The most common signs of FRDC include serous, mucoid, or mucopurulent nasal discharge; sneezing; conjunctivitis and ocular discharge; ulcerations of the lips, tongue, gums, or nasal planum; salivation; coughing; fever; lethargy; and inappetence. Although there are no truly pathognomonic signs of any particular underlying agent, the presence of certain clinical findings can offer a potential clue to the pathogen involved (Table 1).

### Table 1

<table>
<thead>
<tr>
<th>Clinical Clue</th>
<th>Pathogens</th>
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<tbody>
<tr>
<td>Limping</td>
<td>FCV</td>
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<tr>
<td>Oral ulceration</td>
<td>FCV</td>
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<tr>
<td>Keratitis, corneal (dendritic) ulcers</td>
<td>FHV-1</td>
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<tr>
<td>Conjunctivitis without nasal signs</td>
<td><em>C felis</em>&lt;br&gt;<em>Mycoplasma spp</em></td>
</tr>
<tr>
<td>Dermatitis, dermal ulcers</td>
<td>VS-FCV&lt;br&gt;FHV-1</td>
</tr>
<tr>
<td>Cough</td>
<td><em>B bronchiseptica</em></td>
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PATHOGENS OF FRDC

A variety of viral and bacterial pathogens have been identified in cats with FRDC, often in combinations of two or more. Simultaneous infection with multiple pathogens exacerbates the severity of illness. Unpublished data from two commercial diagnostic laboratories offering a respiratory diagnostic panel found that 45.6% (CM Leutenegger, unpublished data, IDEXX Laboratories, Inc, 2011) and 48% (David Aucoin, ANTECH, unpublished data, 2011) of cats positive for a given pathogen were positive for at least one additional pathogen. The most common viral pathogens are feline calicivirus (FCV) and feline herpesvirus-1 (FHV-1, or feline viral rhinotracheitis); the bacteria *Chlamydophila felis* and *Bordetella bronchiseptica* are also potential primary pathogens in FRDC. *Mycoplasma* species are normal commensal organisms of the upper respiratory tract, but some species may serve as pathogens. Although extremely rare, certain influenza viruses (H5N1) can cause upper respiratory signs in cats and are of concern due to the theoretical potential for zoonotic infection.9,10 It is possible that the contribution of other pathogens to FRDC has yet to be recognized.8 Secondary gram-positive and gram-negative bacterial infections may accompany either viral or bacterial FRDC.

**Feline Calicivirus**

Feline calicivirus is a single-stranded, nonenveloped RNA virus that is widespread among cat populations worldwide. Great antigenic differences exist within the single serotype.11,12 The virus is not zoonotic, nor is it an important pathogen in nonfelid species.

Both acutely infected cats and chronic carriers shed the highly contagious virus from bodily secretions and especially in respiratory, ocular, and oral secretions. Cats that recover from the acute infection often clear the virus over a period of weeks, but some cats shed for much longer, and perhaps even for life.13 The virus is quite stable in the environment and may persist for a month or longer.14 Although aerosol transmission from cat to cat certainly occurs, contact with contaminated surfaces is a more likely route of transmission.2,15

After contact with viral particles, the susceptible cat will develop a transient viremia with the primary site of viral replication in the oropharynx. Clinical disease severity depends on a number of factors including the virulence of the pathogen as well as the response of the host. Cats with a preexisting immunity may remain healthy, whereas naïve cats become ill, partially explaining why kittens are more often severely affected by FCV than adult cats. In general, a single strain of FCV tends to cause a similar disease severity and presentation in most infected cats. Oral ulcers are the classic presentation of FCV; vesicles form on the tongue margins of infected cats due to epithelial necrosis (Fig. 2).15 Sneezing and nasal discharge are less common than in FHV-1–infected cats but are still frequent findings. Less commonly, viral pneumonia and lameness occur as well. Although most manifestations of FCV are acute, it has also been associated with chronic stomatitis. Although the condition has not been reproduced by experimental infection, it is believed that an immune-mediated reaction to FCV may cause chronic lymphoplasmacytic gingivitis/stomatitis.16

Occasionally, a highly virulent viral mutation causes a more severe, systemic manifestation rather than typical upper airway disease; these infections are said to be “virulent systemic-FCV,” or VS-FCV. Routine FCV vaccination does not mitigate VS-FCV, and unlike many other infectious diseases, VS-FCV may be a more severe disease in adult cats than in kittens.17 Peripheral edema; hair loss; ulcers of the skin as well as the mucosal surfaces; and even necrosis of the ears, toes, and tail tip may
occur as a result of a profound vasculitis (Fig. 3).\textsuperscript{17–20} Mortality from VS-FCV is high, and often more than half of infected cats will die from severe vasculitis, hepatocellular necrosis, disseminated intravascular coagulation, or other disease complications.\textsuperscript{17,20} Outbreaks of VS-FCV tend to be sporadic. Although a veterinary clinic, shelter, or cattery may be affected widely, the severe disease manifestation does not seem to become endemic in a community over time. Rather, these outbreaks tend to

Fig. 2. Lingual ulcers, as seen here, are a characteristic physical examination finding consistent with feline calicivirus. However, not all cats with clinical disease due to FCV will demonstrate oral ulcers, and oral ulcers can occur in the absence of FCV infection.

Fig. 3. Virulent-systemic calicivirus results in systemic disease, with manifestations not only of nasal and ocular discharge (A), but also dermal ulceration due to vasculitis (B, D), and peripheral edema (C). (Courtesy of Kate F. Hurley, DVM, MPVM, University of California, Davis, CA.)
“burn out” over a relatively short period of time. Not all severe manifestations of FCV are due to a mutated VS-FCV; severe manifestations of routine FCV may also result in mortality, especially when coinfections exist.

**Feline Herpesvirus-1**

Feline herpesvirus 1 (FHV) is a double-stranded, enveloped DNA virus that is distributed worldwide. It is an important cause of rhinotracheitis in cats but, although antigenically similar to other herpesviruses, is neither zoonotic nor does it cause disease in nonfelid species. The virus replicates in upper respiratory and ocular epithelium as well as in neurons. Viral shedding through nasal, oral, and ocular secretions begins very soon after infection. Although the virus can persist in the environment for a few days, direct exposure to infected cats is believed to be a more important route of infection than are fomites. Unlike FCV, FHV-1 is readily destroyed by most disinfectants.

Lytic proliferation in the respiratory and ocular epithelium follows infection. The virus follows sensory nerves to reach neurons, with the trigeminal ganglia being particularly likely to harbor the virus. Although cats generally recover from acute FRDC signs within 2 to 3 weeks, most remain infected for life and can experience intermittent viral reactivation with disease recrudescence during times of stress or during immunosuppression. In the absence of recrudescence, some cats develop chronic ocular pathology, including corneal ulcers and stromal keratitis (Fig. 4). It is theorized that herpes infection, even when inactive, can predispose cats to chronic rhinosinusitis later in life as a result of damage to nasal turbinates or due to a proinflammatory state.

**Chlamydophila felis**

An obligate intracellular gram-negative bacterium, *Chlamydophila felis* does not survive for any length of time outside the host. This bacterium is primarily a cause of conjunctivitis with only mild respiratory signs. Because it is shed in ocular secretions, transmission requires close contact between infected and noninfected cats. Infected cats may initially demonstrate unilateral signs but these usually become...
bilateral. Resulting conjunctivitis can be severe, with hyperemia, ocular discharge, blepharospasm, and chemosis. Unlike FHV-1, *C felis* seldom results in corneal ulceration. It is rare to find *C felis* in healthy cats, quite unlike FCV and FHV-1, which are routinely identified in healthy cats. Although there is a risk for infection of exposed humans, it does not seem to be a common zoonotic infection.

**Mycoplasma spp**

*Mycoplasma* are gram-negative pleomophic bacteria that lack a cell wall. Compared to most bacteria, they are difficult to culture and speciate. As a result, knowledge of the importance of members of this genus as contributing pathogens in respiratory and ocular disease is limited. It is known that many species of *Mycoplasma* are normal commensal organisms in the upper respiratory tract. Nonetheless, there is mounting evidence that at least some species play a primary or secondary role in upper respiratory disease and conjunctivitis. In at least one study, *Mycoplasma* were the organism most commonly identified in cats with conjunctivitis. In several studies, *M felis* was isolated from cats with FRDC or in their housemates but not from healthy cats in noninfected households.

**Bordetella bronchiseptica**

Most commonly thought of as a cause of canine infectious respiratory disease complex, *B bronchiseptica* can infect cats as well. In fact, this gram-negative coccobacillus can infect many other species of animals but only rarely causes human infections, and then mostly in immunocompromised people. The bacterium is shed in oral and nasal secretions of infected animals, and transmission to naïve cats might occur via direct exposure to infected dogs or cats, or possibly through exposure to contaminated environments.

*Bordetella bronchiseptica* colonizes the respiratory epithelium and may remain there without causing disease, or may instigate clinical illness. Although it is likely clinical disease in infected cats is worsened by coinfection, *B bronchiseptica* alone is capable of inducing respiratory disease. Coughing may be a more common manifestation of FRDC caused by bordetellosis compared to the other common pathogens.

**Influenza Virus**

Influenza A viruses are single-stranded negative-sense RNA viruses in the family Orthomyxoviridae, and they are named numerically according to the hemagglutinin (H) and neuraminidase (N) expressed. These viruses become adapted to a particular species but are highly susceptible to genomic change and may be able to infect multiple different species or add species affinity through mutation. Naturally occurring infections with both the virulent avian influenza H5N1 and the H1N1 reassortment virus (swine flu) have been identified during the last decade. However, as of yet no well adapted feline influenza virus has become established in cat populations.

Influenza remains very rare in cats. Nevertheless, it is important for veterinarians to be aware that cats are susceptible to infection as some influenza A viruses (eg, H5N1 virulent avian influenza, H7N7) have the potential to be zoonotic infections associated with high morbidity or even high mortality in humans. Most feline infections with H5N1 are acquired when the cat eats infected birds, but cat-to-cat transmission is also possible via feco–oral or respiratory routes. Experimental inoculation of domestic cats with H5N1 can cause fever, depression, elevation of the third eye lid,
conjunctivitis, increased respiratory effort, and nasal discharge as well as icterus, ataxia, seizures, and death. 10,49,50 A few pet cats in the United States have been naturally infected with the H1N1 reassortment virus. 51,52 For at least some of these cats, close contact with the infected owner was reported. The infected cats developed respiratory signs ranging from a relatively mild, self-limiting disease to a fatal infection. In no instance has human infection been confirmed to be the result of exposure to an influenza-infected cat.

PATHOGEN PREVALENCE

The incidence and prevalence of the various pathogens that cause FRDC varies widely. In general, cats in dense housing are most likely to be infected. 1,15 Combined with the rotating populations and inherent stress of animal shelters, shelter-housed cats are most likely to develop illness and to become carriers of FRDC pathogens. 1,5,23 A large number of studies have documented the prevalence of the pathogens in a variety of settings, most often in catteries or animal shelters but also among cats with a variety of specific clinical illnesses including respiratory signs, conjunctivitis, uveitis, chronic stomatitis, nasal polyps, and others. 1,34,53–55 According to most studies, FCV and FHV-1 are overwhelmingly the most common pathogens involved in FRDC with nasal and oral manifestations. In shelter settings where FRDC has been identified, the prevalence of these pathogens is often 20% to 50% or even higher. 1,4,13,23,54,56 In contrast, B bronchiseptica is typically found in fewer than 15% of cats with FRDC. 1,4,57 Predominantly ocular manifestations are usually attributed to FHV-1, C felis, or Mycoplasma infections; no single one of these is clearly demonstrated to be most consistently implicated. 33,34,36,58,59 Of 4772 feline submissions from the United States in 2010, a large commercial laboratory offering multiplex polymerase chain reaction (PCR) panel testing for FRDC pathogens identified at least one pathogen in 66.6% of samples submitted. The positive samples included 41.8% with Mycoplasma felis, 22% positive for FCV, 25.3% positive for FHV-1, 10% positive for B bronchiseptica, and 8.1% with C felis (C.M. Leutenegger, unpublished data, IDEXX Laboratories, Inc, 2011). From 2310 feline sample from 35 states submitted to a second such large commercial laboratory, at least one FRDC pathogens was identified in 57% of samples. The positive samples included 6% with FCV, 58% with FHV-1, 14% with B bronchiseptica, and 13% with C felis (David Aucoin, ANTECH, unpublished data, 2011).

DIAGNOSIS

Any cat with an acute onset of upper respiratory signs or conjunctivitis or both and a history of recent exposure to other cats should be suspected to have infectious FRDC, and the suspicion is increased in kittens and poorly vaccinated cats. Nevertheless, not all cats with typical signs have FRDC. For example, cattery or shelter cats might develop oral ulcers as a result of topical exposure to caustic disinfectants such as quaternary ammonium compounds or phenols (eg, Lysol). For individual cats with upper respiratory signs believed to be due to FRDC, the specific causative agent need not be determined because supportive treatment is similar regardless of the pathogens involved. For individual cats with lower respiratory signs or evidence of secondary bacterial pneumonia, it is appropriate to collect airway lavage samples for bacterial culture and susceptibility testing.

Diagnostic testing aimed at detection of primary pathogens underlying FRDC is of the most use in the setting of a cattery or animal shelter experiencing an increased incidence or severity of upper respiratory infections. Other reasons for specific testing
might include evaluation of protocols for disease prevention (e.g., when changes to vaccine or disinfection protocols are being considered), to detect a disease carrier before movement from one cattery to another, or for investigation of liability or other legal issues.

Unfortunately, the diagnosis of a specific pathogen as the cause of FRDC is not simple. An educated guess can be useful when clinical signs seem to favor one pathogen over another; for example, prominent oral ulceration suggests FCV. When a guess is inadequate, PCR, bacterial cultures, viral isolation, and serologic assays can all be useful but false-negative and false-positive tests occur often. The most common pathogens can be identified in many healthy cats, so simply finding these pathogens does not prove disease causation. Conventional PCR, nested PCR, and real-time reverse-transcriptase PCR (RT-PCR) have all been used to test for pathogens of FRDC. These tests vary in sensitivity depending on a variety of factors including sampling site and method and the chosen primers; primer choice is especially problematic for pathogens with wide genetic variability such as calicivirus.54,60–64 Bacterial culture proves a viable bacteria is present in the sample, but as with PCR, it does not prove that the pathogen is the cause of illness. A negative culture does not eliminate a role for bacterial infection either; for instance, B bronchiseptica is best recovered after transport in charcoal Ames medium and growth on selective agar and might be missed if these conditions are not satisfied. Viral isolation depends on the presence of replicative virus such that in vitro inactivation due to neutralizing antibody in the sample or sample handling can cause false-negative results. Antibody detection confirms exposure or vaccination, but again, not disease causation. Prior vaccination not only causes long-lasting seropositivity, but recent use of modified live vaccines can also produce false-positive PCR results.

Differentiation between routine FCV outbreaks and those caused by VS-FCV is not possible with a single test.65 Instead, the diagnosis depends on a combination of findings. When the outbreak involves more severe disease manifestations with multiple systemic signs and when vaccinated and adult cats are affected to the same degree as are young and naïve cats, VS-FCV is likely. Although no molecular test can demonstrate that a given strain is more virulent than another, such testing will confirm that a single virus strain is involved in an outbreak caused by VS-FCV. Ideally, immunohistochemical evidence of calicivirus in affected tissues (e.g., liver) would also be used to confirm a diagnosis of VS-FCV.18

Commercially offered respiratory pathogen “profiles” have become increasingly available and can be useful in the investigation of typical FRDC outbreaks. Usually, swab specimens from the oropharynx are submitted for PCR, although other samples, including tissues obtain at necropsy, can also be tested. The saying “buyer beware” applies to laboratories conducting PCR testing; it is incumbent on the veterinarian to use only reputable laboratories with validated testing results. Both false-negative and false-positive results are possible on any one test. Identification of the causative pathogens in an outbreak setting should be based on sampling multiple involved animals (ideally 10%–30%, or a minimum of three to five cats). Cats should be sampled early in the course of disease to reduce the likelihood that complicating rather than inciting pathogens will be identified. Because of the vicissitude involved in causation and diagnosis of FRDC, it is expected that individual cats will test positive for more than one pathogen, and that some ill cats may test negative for any of these pathogens. Only by recognizing which pathogens are common to multiple involved cats can the cause of a disease outbreak be identified confidently.
TREATMENT

The most important aspect of treatment for most cats with FRDC remains supportive care, including nutritional and nursing care. Cats are often unwilling to eat due not only to systemic illness but also to nasal congestion, which interferes with the ability to smell food, and the pain of oral ulcers. Offering highly palatable, aromatic, soft foods is attempted first; warming the food sometimes helps also. Analgesia should be provided for cats with oral ulcers. Mirtazapine (1/8 to ¼ of a 15-mg tablet PO every other day to every third day) can be used as an appetite stimulant. Should these efforts fail, placement of a nasoesophageal or an esophagostomy tube becomes necessary; feeding tubes also facilitate maintenance of systemic hydration. For some cats, parenteral crystalloid fluids may be required to maintain hydration. Nursing care includes removal of nasal discharge. Humidifiers or saline nebulization may loosen thick, tenacious mucus discharge.

Antimicrobial therapy is often beneficial either to address the disease pathogen directly, or to address secondary bacterial infections. Doxycycline is a good first choice to treat infections with *C felis*, *B bronchiseptica*, and *Mycoplasma* spp and the drug achieves good airway penetration. However, if tablets stick in the esophagus, strictures can form; therefore either a liquid doxycycline should be used or the tablet should be followed with oral administration of water. Despite the fact that *C felis* causes localized ocular infection, systemic antimicrobials are more effective than topical treatments alone. Although azithromycin or fluoroquinolones are good alternatives to doxycycline for the treatment of FRDC, they are less likely to effectively clear infection with *C felis*. Cats with *C felis* are usually treated for 4 weeks, or 2 weeks past clinical disease resolution to improve the chances of eliminating the pathogen entirely, and cats with close contact to infected cats should be treated simultaneously even if they do not have obvious conjunctivitis. Longer treatment periods, up to 42 days, have been suggested for *M felis* infection. Even cats with primary viral infections may benefit from antibiotics to treat or prevent secondary bacterial infections. For this purpose, beta-lactams (eg, amoxicillin, amoxicillin-clavulanic acid) and azithromycin are reasonable choices, and duration of treatment is often only 7 to 10 days.

Antiviral therapies have also been considered for use in cats with FRDC, but of the many antiviral drugs that are used to treat humans, several are quite toxic in cats. For instance, the FCV inhibitor ribavirin and the FHV-1 inhibitor valacyclovir (the prodrug of acyclovir) are both toxic when systemically administered to cats, precluding routine use. On the other hand, oral administration of famciclovir to cats with FHV-1 infection appears to be safe and effective. L-Lysine is an oral amino acid supplement that reduces viral shedding in cats with latent FHV-1 infection. Although the treatment is safe and inexpensive, the efficacy in reducing severity or duration of the acute signs of FRDC has not been convincingly demonstrated. In an interesting trial, lysine was used as a dietary supplement in the food of cats housed in an animal shelter. Although the cats receiving the supplement had neither a reduced incidence nor severity of FHV-1 infection, the study did not directly administer the L-lysine, so intake may not have been adequate to demonstrate an effect. Feline interferon-omega is licensed for use in Europe and should theoretically be useful as an antiviral therapy, but controlled field studies are not available as of yet. Human interferon-α has also been suggested as potentially beneficial, but benefits have not been substantiated in clinical trials. Other types of care may be required for specific disease manifestations. For example, cats with ocular lesions may require mucinomimetic therapy, topic antibiotics, or
mydriatic treatment.\textsuperscript{75,82} For cats that develop pneumonia, supplemental oxygen may be required. Cats with pain related to lameness, severe dermatitis, or other complications of infection may require analgesia.

**PREVENTION**

Although there is no way to eliminate FRDC completely, there are multiple methods to reduce the likelihood and severity of infection. These include vaccination programs and efforts to reduce stress on individual cats as well as efforts to reduce pathogen exposure through population management and sanitation protocols. Some of these methods are readily applied to some cat populations but are not applicable to others. For instance, it is essentially impossible to control exposure to new cats or to disinfect and sanitize surfaces in the setting of a feral or barn cat colony.

**Vaccination**

Vaccinations have resulted in a tremendous reduction of morbidity and even mortality resulting from feline respiratory infections, but vaccinations are not perfect. Most FRDC vaccines do not provide sterilizing immunity. That is, vaccination can reduce disease severity and perhaps the risk of transmission but will not prevent infection altogether. Severe infection sometimes occurs despite vaccination, and adverse reactions to vaccination occur (albeit rarely). Decisions regarding vaccination should always be based on an understanding of the situation of the individual cat, including environment and risk for exposure as well as comorbidities and owner preferences. For example, although modified live vaccines against FCV and FHV-1 are often recommended, they may not be appropriate in immunocompromised or in pregnant cats. Some cat owners would prefer to forgo vaccination at regular intervals and instead test for antibody titers to gauge when vaccine boosters are appropriate. Titers directly demonstrate humoral immunity but imply that cell-mediated immunity, and more importantly disease protection, may exist also.\textsuperscript{83} Vaccine recommendations are available from both the American Association of Feline Practitioners (http://www.catvets.com/professionals/guidelines/publications) and the European Advisory Board on Cat Diseases (http://www.abcd-vets.org/guidelines/index.asp).

Vaccination of cats for FCV and FHV-1 is recommended unless there is a compelling reason not to vaccinate, but neither vaccine provides sterilizing immunity. For most cats, modified live vaccines (MLV) are administered in combination with feline panleukopenia vaccination. In kittens, vaccination is initiated as a series beginning at 6 to 9 weeks of age, then boostered every 3 to 4 weeks until 16 weeks of age, again at 1 year, and then again every 3 years thereafter. Intranasal MLV vaccines offer the advantage of a more rapid onset of protection with the disadvantage that some vaccinated cats display mild respiratory signs after vaccination. Even mild signs can be important in shelters where policies may exist preventing adoption of cats with any signs of respiratory disease. Regardless, MLV for these pathogens is recommended upon entry to any rescue shelter. Inactivated vaccines should be considered in cats with compromised immune responses (eg, cats with retroviral infections, cats on chronic immunosuppressive therapy). Breeding cats should be vaccinated before breeding rather than during pregnancy.

Vaccination against FCV offers special challenges.\textsuperscript{84,85} Variability in virus strains can result in vaccine resistance and therefore vaccine failures.\textsuperscript{86,87} The VS-FCV has not been mitigated by traditional MLV for FCV.\textsuperscript{17} For this reason, a new vaccine has been developed that incorporates strains known to have caused virulent systemic infection (CaliciVax, Boehringer Ingelheim). Although the new vaccine protects from the strain from which it was derived, there has not yet been proof that it protects from...
other strains that might cause virulent infection. Because the vaccine is a killed product, it requires a booster at 3 weeks and protection is delayed, thus making it unsuitable (by itself) in shelter settings. For now, special vaccines for VS-FCV should be considered conditional rather than core vaccines.

Vaccines also exist for *C. felis* and *B. bronchiseptica*, but neither is considered a core vaccine. Both MLV and killed vaccines are available for *C. felis* but vaccination has only moderate efficacy and a relatively short duration of immunity. It is not recommended for pet cats, but it may be considered in shelters or catteries where recognition of such infections remains common despite intensified efforts aimed at environmental modification. Similarly, although not routinely recommended, vaccination of cats for *B. bronchiseptica* may be appropriate in animal shelters with documented outbreaks of this common cause of canine infectious respiratory disease complex.

**Stress Reduction**

Stress results in the release of excessive cortisol and negatively impacts the ability of the immune response to counter infection. Clinical disease is often worsened in stressed cats, and quiescent FHV-1 infections can be activated through stress. Shelter-housed cats are placed under conditions of enormous stress; simple measures may help mitigate such stress. For instance, providing hiding places, visual and auditory segregation of feline and canine populations, providing for environmental enrichment through scratching materials and toys, and group housing of compatible cats can all reduce stress. However, measures such as group housing that might reduce stress for one cat might increase stress for another, less social cat. In addition, some of the same measures that reduce stress can increase the potential for pathogen transmission (eg, group housing) or make surface disinfection more challenging (eg, toys and scratching materials).

**Population Management**

Because FRDC is induced by contagious pathogens, direct or indirect exposure to previously infected cats is required for disease development. When cats with suspected FRDC are presented to the veterinary hospital, they should be taken immediately into a private examination room. Hospitalization should be avoided if at all possible, and if hospitalization is required infected cats should be isolated from all other cats. Any areas where infected cats are kept must be thoroughly disinfected before other cats are brought into the same area. Owners contemplating bringing a new cat into their household or cattery should be sure that all existing family cats are vaccinated against FCV and FHV-1. The new cat should be free of obvious respiratory signs and ideally should be kept isolated from other cats for 1 to 2 weeks after arrival.

The greater dilemmas occur in the setting of animal shelters where there is often no choice but to accept new cats, even cats already demonstrating respiratory signs. When possible, cats demonstrating signs already should be segregated from all other cats. However, routine quarantine of all cats may simply lengthen their stay in a shelter situation and increase stress, which can actually lead to more FRDC manifestations. Often shelters are overcrowded, which contributes to the incidence of FRDC both through simple exposure and because of the stress attendant when cats are kept in crowded situations. The realities of most shelters make the ideals of population management extraordinarily difficult to achieve. By reducing the number of cats in the shelter and the length of time they stay in the shelter through measures such as the use of foster care homes, the incidence of FRDC should be reduced.
Sanitation

Besides limiting contact with infected cats, strict attention to sanitation and disinfection of surfaces and potential fomites can help reduce the incidence of FRDC. Hand washing between handling cats and the use of clean coveralls or laboratory coats is helpful. Because even cats that appear quite healthy may shed pathogens, these simple measures should be practiced between handling any and all cats. Cleaning of caging to remove organic debris followed by disinfection will destroy most of the pathogens associated with FRDC. Only FCV is difficult to inactivate; like other nonenveloped virus types (eg, parvovirus), it is resistant to chlorhexidine, quaternary ammonium, and several other disinfectants.92 Either potassium peroxymonosulfate or household bleach (5% sodium hypochlorite) diluted 1:32 are good options to destroy FCV.92,93

SUMMARY

Infectious viral and bacterial respiratory diseases cause tremendous morbidity and occasional mortality in domestic cats. Although these FRDC-associated illnesses cannot be eradicated, their occurrence can be minimized and mitigated through the judicious use of appropriate diagnosis, treatment, vaccination, and husbandry.

REFERENCES


