UF Maddie's Shelter Medicine Program

Feline Respiratory Infections in Shelters

Overview

Contagious respiratory infections are the most common cause of illness in cats in shelters and the most difficult to prevent or manage. These infections represent a significant and frequent drain on shelter resources, including treatment costs, staff time, and staff morale. Holding cats for treatment and recovery adds to the number of animal care days until adoption, which in turn impacts the holding capacity for the shelter and contributes to crowding. Many shelters have accepted cats with respiratory infections as an "endemic" problem that is a "fact of life" in shelters.

This document provides a basic overview of: 1) common feline respiratory pathogens in shelters; 2) incubation times, clinical disease, duration of pathogen shedding, modes of transmission; 3) diagnosis; and 4) strategies for management and prevention in shelters.

Feline URI

Feline infectious respiratory disease (FIRD), commonly referred to as Feline Upper Respiratory Infection (URI), is caused by several viral and bacterial pathogens that are contagious among shelter cats, especially those housed in stressful high density/high turnover facilities. The most common feline respiratory pathogens include:

- Herpesvirus (FHV)
- Calicivirus (FCV)
- *Bordetella bronchiseptica* bacteria (Bordetella)
- *Chlamydia felis* bacteria (Chlamydia)
- *Mycoplasma felis* bacteria (M felis)
- *Streptococcus zooepidemicus* bacteria (Strep zoo)

While any of these pathogens can cause a primary infection, most cats frequently have mixed viral and bacterial co-infections. Recent studies in the U.S. and Europe have provided evidence that the ***viral pathogens are the more common primary cause of respiratory infections in cats in shelters.*** Viral replication damages the respiratory epithelium and mucociliary apparatus, providing opportunity for secondary infections by commensal bacteria such as *Mycoplasma* spp, *Pasteurella multocida*, *Klebsiella pneumoniae*, *E. coli, Staphyloccus spp, and Streptococcus spp.* that exacerbate the severity and duration of disease. Conversely, primary infection by bacteria such as *Bordetella, Chlamydia,* or *Mycoplasma* that destroy epithelial cells can predispose to secondary viral infections.

This is not an exhaustive list of respiratory pathogens. There are still plenty of respiratory disease outbreaks in shelters where the causative pathogen is never identified despite extensive diagnostic efforts. The emergence of H3N2 canine influenza virus in 2015 as a respiratory pathogen for shelter cats and the 2016 feline URI outbreak in New York City shelters caused by H7N2 avian influenza virus highlight the potential for discovery of new respiratory pathogens in the future.

Risk Factors for CIRD

Feline URI is strongly associated with poor housing conditions and poor population management strategies leading to crowding, long stays in the shelter, and sanitation breaks. The most important outcome of poor housing and population management is **STRESS. Stress is directly linked to feline URI.** Inappropriately-sized cages that don't allow for natural behaviors, high stocking densities in rooms, noisy environments, and long lengths of stay are the greatest causes of stress. Inappropriate housing and crowding also decreases ventilation and air quality which contributes to irritated airways, predisposing to colonization by respiratory pathogens. The risk for acquiring respiratory infections increases with every day of residence in the shelter. Studies have shown that the probability of URI in cats was 80% by the end of the first week in the shelter. URI increases length of stay in shelters where cats are held for treatment and recovery, greatly compounding stress and perpetuating the vicious cycle.

Besides stressful living conditions, additional risk factors for Feline URI include other host, pathogen, and husbandry factors.

Host factors	Pathogen factors	Husbandry factors
STRESS	Virulence	Inappropriate housing
Age (kitten vs. adult)	Incubation period	Noisy environment
Immune status	Shedding period	Crowding
Debilitation	Subclinical infection	Poor ventilation
	Persistent infection	Poor sanitation practices
	Transmission routes	Untrained staff
	Incomplete protection by vaccines	Improper vaccination strategies
	No vaccines for new pathogens	

Host Factors

In general, kittens are more susceptible to infection and disease than adult cats because of lack of protective immunity from maternally derived antibodies or from ineffective responses to vaccination. They typically enter shelters at an age when maternal immunity has waned to a level that does not protect against infection and disease, but still interferes with responses to vaccination. Unvaccinated adult cats are also at greater risk for infection and disease. Housing of kittens with adults increases the risk for respiratory infections in the kittens since some pathogens result in unapparent disease in infected adults, but the infected adults are contagious. Kittens and adults that are debilitated by poor nutritional status, parasitism, infections with other pathogens, and stress from entering the shelter environment are more at risk for acquiring respiratory infections.

Pathogen Factors

Inherent properties of pathogens also affect the risk for infection. Virulence, length of incubation period, preclinical shedding, duration of shedding, routes of transmission, and persistence in the environment significantly influence infection risk. The ability to establish subclinical infection or persistent infection increases the infectious dose of the pathogen in the environment. Feline respiratory pathogens are

spread by direct contact between cats, exposure to droplets expelled by sneezing, and contact with contaminated surfaces and staff. Available vaccines for the feline respiratory pathogens provide only partial protection in that the vaccine-induced antibodies do not prevent infection, but do reduce severity and duration of clinical disease.

Husbandry Factors

Again, stress induced by improper housing environments is the most important risk factor for Feline URI. Crowded rooms can lead to poor ventilation and breaks in sanitation practices, especially by untrained staff. Not following the best practice vaccination guidelines also contributes to spread of infections and disease. Studies have shown that ***risk for acquiring respiratory infections increases with every day of residence in the shelter, reaching 80% by the end of the first week.***

Clinical and Epidemiological Features

Approximately 80-90% of feline URI is caused by FHV and FCV.

FHV causes rhinitis, conjunctivitis, keratitis, stomatitis, and facial dermatitis resulting in sneezing, oculo/nasal discharge, corneal ulcers, oral ulcers, and hypersalivation from oral ulcers. Clinical disease can persist for 1 to 3 weeks depending on severity of symptoms. Kittens typically have more severe disease than adults, including pneumonia. Infection is life-long due to viral latency in the facial trigeminal ganglia (persistent infection). Stress reactivates virus replication in at least 50% of cats but not all cats recrudesce with clinical disease. Kittens are very susceptible to acquiring primary FHV infection from direct or indirect contact with infected adults that start shedding reactivated virus within 1 week of entering the shelter.

There are many strains of FCV and frequent mutations lead to new strains that vary in virulence and vaccine resistance. Like FHV, FCV-infected cats have sneezing, oculo/nasal discharge, oral ulcers, and hypersalivation from oral ulcers. However, FCV does not cause corneal ulcers. Kittens typically have more severe disease than adults, including pneumonia and the limping syndrome due to viral replication in joints. Clinical signs can persist for 1 to 3 weeks or longer. While the infection resolves in most cats, some cats are persistently infected and chronic shedders.

Virulent systemic FCV (VS-FCV) strains arise from FCV mutations. Unlike other feline respiratory pathogens, this highly virulent and lethal virus causes systemic infection and clinical disease due to vasculitis - edema of face and limbs; ulcerative lesions on skin and paws; ulcers on nose, lips, ears, eyes, footpads; icterus. In contrast to regular FCV, the virulent systemic virus causes more severe disease in adults than kittens, including well-vaccinated adults. Fortunately, infections by VS-FCV occur infrequently. ***A severe infection with regular FCV is often mistaken for VS-FCV, but the difference is the extensive and widespread vasculitis disease with VS-FCV.***

Bordetella and *Chlamydia* bacterial infections are not common and are an indicator of poor husbandry practices and ventilation. *Bordetella* causes sneezing and nasal discharge, but ***coughing is a unique indicator of Bordetella infection.*** *Bordetella* infection causes severe life-threatening pneumonia in kittens. *Chlamydia* causes mostly ocular signs, including conjunctivitis, chemosis, and blepharospasm.

Bordetella and *Chlamydophila* are best treated with doxycycline or minocycline for 4 weeks to eliminate infection.

Strep zoo is an emerging pathogen in cats, particularly those housed in sanctuaries and large-scale hoarding conditions where respiratory disease is rampant. One study found that *Strep zoo* was one of the most common respiratory pathogens found in cats rescued from large-scale hoarding cases. *Strep zoo* has been identified in cats with severe life-threatening URI and pneumonia - the bacteria infect the nose, lungs, and brain. Unlike *Strep zoo* infection of dogs, hemorrhage in the lungs is not a characteristic of the infection in cats. The best antibiotics for *Strep zoo* infections in cats are doxycycline, minocycline, Clavamox, and Convenia.

The ability of *Mycoplasma felis* to initiate primary respiratory infection is unclear as it is part of the normal flora in the upper respiratory tract. This bacterium is frequently identified in cats with respiratory infections initiated by other pathogens. *M. felis* is best treated with doxycycline, minocycline, or azithromycin.

Pathogen Incubation and Shedding Periods

The incubation period for all of the known feline bacterial and viral respiratory pathogens is 7 days or less. The short incubation period contributes to a rapid increase in number of sick cats within a short period of time.

Preclinical shedding occurs during the incubation period, meaning infected cats are contagious before appearance of clinical signs. Many cats also have subclinical infections but are still contagious. However, the shedding amount and duration may be shorter than for those cats with disease.

Most cats shed FHV and FCV in ocular, nasal, and oral secretions for <1 month. However, up to 50% of FCV-infected cats can shed the virus for 3 months and some have a chronic infection for life**.**

***Bordetella, Chlamydia, Mycoplasma felis, and Strep zoo* may be shed for weeks to months** if infected cats are not treated with appropriate antibiotics.

	FHV	FCV	Chlamydia	Bordetella	M felis	Strep zoo
Incubation period	≤1 wk	≤1 wk	≤1 wk	≤1 wk	≤1 wk	≤1 wk
Shedding period	<1 mo	1 to 3 mo	<2 mo w/o antibiotics	<3 mo w/o antibiotics	weeks? w/o antibiotics	weeks? w/o antibiotics
Persistent Infection	yes	yes (in some)	no	no	unknown	unknown

Pathogen Transmission

Feline respiratory pathogens are spread by three mechanisms: direct contact of sick cats with susceptible ones, environmental and staff contamination (fomites), and contact with persistently infected asymptomatic cats that are shedding FHV or FCV. ***In contrast to canine respiratory pathogens, feline***

pathogens are not transmitted by aerosols. Sneezing cats generate large droplets that only travel 4 feet or less. This small shed and spread zone makes in-cage isolation a feasible alternative to relocation of the cat to an isolation room. For in-cage isolation, the door can be covered with a towel to reduce spread of the pathogens outside of the cage.

Diagnosis

Since the feline respiratory bacterial and viral pathogens cause similar clinical signs, ***the pathogen causing the infection cannot be diagnosed based on clinical signs!*** Most of feline respiratory infections are due to FHV and FCV. Cats with severe clinical disease, including pneumonia, may be co-infected with *Strep zoo*. Consider *Chlamydia felis* infection in cats with ocular disease only, and *Bordetella* infection in cats that are coughing.

Shelters should invest in diagnostic testing when:

1. Cats have severe clinical disease, including pneumonia
2. Cats have more severe ocular signs
3. Cats are coughing
4. The duration of illness is more prolonged

Diagnostic testing to identify the respiratory pathogen(s) provides for:

1. Proper patient management, including treatment options and costs, prognosis for recovery, and average time to recovery;
2. Proper management of the at-risk population
3. Isolation time for sick infected cats (shedding period)
4. Quarantine time for asymptomatic exposed cats (incubation period)

The best diagnostic test for respiratory infections is PCR for pathogen nucleic acid on swabs. PCR is very sensitive and specific. The turnaround time for results is usually 3 to 5 business days which allows for timely patient and population management. Several diagnostic laboratories offer Feline URI PCR panels that test for multiple viral and bacterial respiratory pathogens in a single sample. Test costs range from $90 to >$120 per sample. IDEXX offers a substantial discount on their Feline URI PCR panel for shelters. IDEXX also offers the most comprehensive Feline URI PCR Panel that includes identification of any influenza A virus and *Strep zoo.* In addition, the IDEXX Feline URI PCR Panel includes a quantitative FHV PCR assay that determines the viral load in the sample. Low viral loads typically occur in latent or low-level chronic infection signifying that the virus is likely not contributing to an active respiratory infection with clinical signs. High viral loads indicate a high level of viral replication that is most likely causing the active clinical disease.

To increase diagnostic accuracy and identify a pattern, swabs should be collected from at least 5 cats with clinical signs. The more cats that are tested, the more confident you can be in the test results, especially if there is a consistent pattern of results.

Sites to swab include the caudal pharyngeal wall beyond the tongue and the conjunctiva for cats suspected to have *Chlamydia felis* infection. These sites should be rubbed with the swab tip to collect infected epithelial cells. At least 2 swabs should be collected from each cat and pooled together to maximize the probability of pathogen detection.

Necropsy of cats that die or are euthanized during respiratory disease problems is a valuable diagnostic tool. Tissues submitted for histopathology as well as diagnostic testing can help identify the pathogens and determine pathogenesis. Tissues should be fixed in large amounts of buffered formalin (9:1 ratio of formalin to tissue) for histology. Fresh unfixed tissues should be submitted for the IDEXX Feline URI PCR panel and for bacterial culture. Necropsy is especially valuable since the pathogen may not be recognized or included in PCR panels, including VS-FCV. VS-FCV can only be confirmed by necropsy..

Disease Management

Isolation of sick cats is required for control of disease spread. This reduces the infectious dose in the environment and threat of infection spillover to more susceptible cats. Sick cats in group housing need to be moved to individual housing for treatment, monitoring, and stress reduction. A physically enclosed isolation room is ideal, but in-cage isolation is acceptable if the cat can be cared for without fomite contamination of other cats. A cover over the front of the cage contains droplets generated by sneezing and reduces stress. Minimal handling, use of the spot-cleaning method with a disinfectant that kills FCV, and changing gloves between cats is paramount. Staff should care for exposed cats before sick cats and wear a long-sleeve gown that can be removed when leaving the room. Kittens should not be housed in the same room as sick or exposed adults.

The best option for sick cats is to transfer them to foster homes without other cats or adopt them to homes without other cats. The home environment is much safer and far less stressful, promoting faster recoveries.

Technically speaking, infected cats should be isolated until no longer shedding the respiratory pathogen - for FHV and FCV, this can be 1 to 3 months after recovery in many cases. However, the risk of transmission is greatly reduced once clinical signs have fully resolved. ***It is far better for the health and welfare of the cat to release them for adoption or foster once they have recovered from the illness*** than to hold them for weeks in the shelter waiting for viral shedding to stop. PCR testing of recovered cats can identify whether they are still shedding and minimize the risk that adopted or fostered cats will transmit infection to pet cats in the home.

Sanitation

FCV persists in the environment for more than 30 days. Since FCV is a common cause of feline URI, disinfectants that kill FCV should be used for cat housing. Trifectant and Accel/Rescue are the best choices since they have detergent properties and work in the face of mild contamination with organic matter. The spot cleaning method should be used for cages occupied by the same cat to reduce handling of cats. PPE (long-sleeve gown, gloves) must be worn in rooms with sick cats and gloves changed between cages. Vacated cages, bowls and litterpans, and other disinfectable items should be thoroughly cleaned with a detergent followed by disinfection with bleach, Trifectant, or Accel/Rescue. Any items that cannot be disinfected or laundered in hot water with bleach should be discarded.

Prevention

Vaccination of all cats on intake is fundamental for reducing susceptibility to respiratory disease. All cats 4 weeks of age and older should receive the modified-live FVRCP vaccine containing FHV and FCV on admission and 2 weeks later. Kittens should be re-vaccinated every 2 weeks while in the shelter until they are at least 5 months old. Vaccination does not prevent infection, but can reduce severity and duration of disease. Many FCV strains are resistant to vaccines, so even properly vaccinated cats can be susceptible to severe disease. Inclusion of killed *Chlamydia felis* in the FVRCP vaccine is not warranted since it is not effective. The modified-live *Bordetella bronchiseptica* vaccine for cats is not considered a core vaccine for shelters, but including this vaccine for all cats at intake, at least for several months, should be considered when *Bordetella* has been associated with URI cases, especially kittens.

In addition to vaccination, another strategy to reduce risk for respiratory infection is to move kittens from the shelter into foster care or adoption groups as soon as possible after intake since they are the most susceptible group for feline URI.

Finally, all efforts to reduce stress should be pursued. This is the cornerstone for preventing or minimizing feline URI in shelters. Ideally, all strategies for diverting intake of cats should be pursued, including TNR or return-to-field programs for community cats, kitten diversion programs, and providing services that promote retention of cats in their homes. The most effective way to reduce stress in cats that must be admitted to the shelter is to utilize housing that supports the behavioral and welfare needs of cats. Several case studies have shown dramatic decreases in the feline URI rates in shelters that provide proper housing for cats. Population management strategies that shorten each cat's length of stay in the shelter should be followed, including removal of stray hold times and promoting fee-waived adoptions.

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