

## Management of Disease Outbreaks in Animal Shelters

### Overview

Management and control of contagious infectious diseases in dogs and cats continues to be one of the biggest challenges facing shelters. Every shelter is at inherent risk for introduction of infectious agents into their facility with intake of animals from the community, many of which have acquired infections prior to entry. In addition, infected animals may be in the clinically silent incubation period at intake, and thus not recognized as an infectious risk. If the shelter population contains large numbers of susceptible animals, particularly puppies and kittens, then a disease outbreak will ensue from exposure to the infected animal. Even shelters with strict adherence to vaccine guidelines are threatened by outbreaks due to housing of immature animals that have ineffective responses to vaccination or the introduction of newly emerging diseases to which most of the population has no immunity and there is no vaccine. ***While the risk for introduction of disease cannot be eradicated, there are sound and systematic strategies for minimizing the transmission of contagious infections within the shelter.***

Of course it is always preferable to follow practices that minimize the risk for disease outbreaks rather than having to institute a reactive approach to managing one. Preventive strategies include population management practices that limit the number of animals to within the capacity for care and reduce length of stay, vaccination, sanitation, and stress reduction. Risk factors for disease outbreaks include crowding, which increases animal contact and stress and decreases care capacity; random co-mingling; suboptimal vaccination policies, especially for puppies and kittens; housing of juveniles with adults; and failure to promptly remove sick animals from the general population. ***Of all the risk factors, crowding is the most important and common since it directly impacts all other facets of animal care and exponentially increases the stress level for both the animals and the staff.***

Disease outbreaks not only impact the life-saving capacity of shelters, but also destroy the shelter's reputation with adoption partners, local veterinarians, and the entire community, especially when such outbreaks are publicized by local and national media sources. This contributes to paralyzed adoptions, low staff morale, and perpetuation of the vicious cycle of crowding. In addition to the tangible losses associated with the financial costs of a disease outbreak, there are the intangible but far more costly losses of life and community support.

Draconian responses to disease outbreaks such as depopulation have become increasingly unacceptable - most outbreaks can be managed with far less drastic outcomes that increase the number of lives saved. The success of life-saving alternative strategies for disease outbreak management is totally dependent on staff adherence to the steps involved. Staff that disregard or "make exceptions" to the decisions required for each step will undermine success by assuring continual transmission of disease, prolonged resolution, increased financial burden, public scrutiny, and ultimately the loss of more lives than was necessary.

## Common causes of disease outbreaks in shelters

***Parvovirus and respiratory infections are the most common causes of disease outbreaks in dogs and cats in shelters.*** These infections represent a significant and frequent drain on shelter resources, including treatment costs, staff time, and staff morale. Holding animals 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 potential for crowding. Many shelters do not have adequate isolation areas to house animals with contagious infections, so they are frequently kept in the general population, assuring the transmission and perpetuation of the pathogen so that it becomes an accepted “endemic” problem. These situations not only impact animal health and welfare, but also attract unfavorable scrutiny by the media and community.

**Parvoviruses:** The parvoviruses include canine parvovirus (CPV) and feline parvovirus (FPV), also known as panleukopenia virus. The primary route of exposure to parvoviruses is nasal or oral contamination with virus in feces, vomit, on the fur, in the environment, and on staff. The incubation period from time of exposure to onset of clinical disease ranges from 2 to 14 days, but typically is 5 to 7 days for dogs and 7 to 10 days for cats. Parvovirus shedding in feces starts within 3-4 days of exposure, so that healthy-appearing dogs and cats in the incubation period are already contagious **prior** to onset of clinical signs. Virus shedding usually ceases at the time of clinical recovery. Animals with subclinical infection or transient symptoms also shed infectious virus in feces, albeit in lower amounts for less time. FPV is the most common cause of sudden death in cats in shelters.

**Respiratory pathogens:** The known viral and bacterial pathogens that cause kennel cough or canine infectious respiratory disease (CIRD) and feline upper respiratory infections (URI) are shown below. Any one of these pathogens can cause a primary infection, but dogs and cats are often co-infected with more than one pathogen.

### Dogs

Adenovirus type 2 (CAV2)  
Parainfluenza virus (CPiV)  
Distemper virus (CDV)  
Influenza H3N8 virus (H3N8 CIV)  
Influenza H3N2 virus (H3N2 CIV)  
Respiratory coronavirus (CRCoV)  
Pneumovirus (CnPnV)  
Herpesvirus (CHV)  
*Bordetella bronchiseptica*  
*Mycoplasma cynos*  
*Streptococcus zooepidemicus* (Strep zoo)

### Cats

Herpesvirus type 1 (FHV)  
Calicivirus (FCV)  
*Chlamydomphila felis*  
*Bordetella bronchiseptica*  
*Mycoplasma felis*  
*Streptococcus zooepidemicus* (Strep zoo)

The incubation period for the feline and canine respiratory pathogens is <1 week except for CDV. The incubation period for CDV is typically about 2 weeks. All the viral and bacterial pathogens are shed during the incubation period, meaning infected animals are contagious **before** they have clinical signs.

Most of the canine viruses are shed in respiratory secretions for ≤10 days, contributing to feasibility of isolating infected dogs for 2 weeks before sending to adoption groups or new owners. Exceptions are H3N2 CIV which can be shed for up to 3-4 weeks, and CDV which is shed for weeks to months. FHV and

FCV are shed for a month (FHV) or longer (FCV), making isolation until virus shedding stops very challenging and costly. *Bordetella* and *Chlamydomphila* bacteria can establish chronic infections for 2-3 months if not treated with appropriate antibiotics. It is unknown if *Strep zoo* and *Mycoplasma* can establish chronic infections and if so, for how long. Appropriate antibiotic therapy abolishes this possibility.

Dogs and cats can have subclinical infections with active shedding, increasing the number of exposed animals since they cannot be readily identified and isolated. However, sick dogs and cats shed greater amounts that significantly increase the infectious dose in the environment.

Both CHV and FHV establish life-long latent infections, and virus replication and shedding can be re-activated by stressful episodes such as entering a shelter. FCV can also persist for life in some cats and these cats shed virus in an intermittent fashion that is unrelated to a stress trigger.

Pathogen	Incubation period	Preclinical shedding	Shedding period	Subclinical infection	Persistent infection
<b>CPiV</b>	<1 week	yes	<2 weeks	yes	no
<b>CAV2</b>	<1 week	yes	<2 weeks	yes	no
<b>CDV</b>	2 weeks	yes	wks to mo	yes	no
<b>CRCoV</b>	<1 week	yes	<2 weeks	yes	no
<b>H3N8 CIV</b>	<1 week	yes	<2 weeks	yes	no
<b>H3N2 CIV</b>	<1 week	yes	3- 4 weeks	yes	no
<b>CnPnV</b>	<1 week	yes	<2 weeks	yes	no
<b>CHV</b>	<1 week	yes	<2 weeks	yes	yes
<b>FHV</b>	<1 week	yes	1-3 weeks	yes	yes
<b>FCV</b>	<1 week	yes	1-3 mo	yes	yes
<b>Bordetella</b>	<1 week	yes	up to 3 mo	yes	no
<b>Chlamydomphila</b>	<1 week	yes	up to 2 mo	yes	no
<b>Strep zoo</b>	<1 week	yes	weeks?	yes	?
<b>Mycoplasma</b>	<1 week	yes	weeks?	yes	?

All of the respiratory pathogens are highly contagious in a high density/high turnover shelter, especially if there are susceptible kittens and puppies mixed in with adults that have subclinical infection with active shedding. The pathogens are transmitted by contact with ocular and oronasal secretions from infected animals, either directly or via fomites, including staff. In addition, the canine viruses (but NOT feline viruses) are effectively spread over distances of 5 to 20 feet in droplets and aerosols generated by sneezing and coughing – this significantly increases the difficulty in stopping rapid transmission throughout the kennel. The feline respiratory viruses are shed in droplets generated by sneezing that spread up to 4 feet. Since CDV infects multiple organ systems (respiratory, gastrointestinal, urinary, ocular, central nervous system), this virus is shed not only in respiratory secretions and aerosols, but also in feces and urine.

## Life-saving strategies for managing disease outbreaks

Successful life-saving strategies for managing disease outbreaks include the following basic steps. Please note that while these are listed as steps, the responses are actually occurring simultaneously. ***The overarching goal of the management strategy is to create an effective break between the infected/exposed population and the unexposed population without resorting to mass depopulation via euthanasia.*** This strategy is effective in minimizing in-shelter transmission of infection.

1. Diagnosis of the disease
2. Isolation of sick animals
3. Quarantine of exposed asymptomatic animals
4. Assessment of infection risk in exposed animals
5. Protection of unexposed animals (clean break)
6. Biosecurity and environmental decontamination
7. Documentation
8. Communication

### Diagnosis

***Timely diagnosis substantially impacts how many dogs and cats remain healthy and adoptable. No diagnosis or late diagnosis increases the number of sick and exposed animals due to improper management and ultimately the number of animals euthanized.***

Identification of the pathogen(s) dictates not only the proper treatments for the disease, but also provides a prognosis for survival, average time to recovery, how long the animal is contagious based on duration of pathogen shedding, how the pathogen is transmitted, what disinfectants are required for inactivation, and finally, what is the best preventive strategy to reduce the chance for recurrence. ***Even shelters with tight budgets should invest in diagnostic testing since this is the key to management and prevention strategies.*** It is far more costly to base these core strategies on guesswork and trial by error, both in terms of the financial burden as well as the suffering of the animals and the shelter's reputation.

Diagnostic testing should be conducted on sick animals and exposed animals. Diagnostic test accuracy is dependent upon the timing of sample collection with the periods when the suspected pathogens are shed in highest amount. For parvoviruses and respiratory pathogens, the largest amounts of shedding occur during the preclinical incubation period (exposed animals) and the acute phase of illness (sick for <4 days). At least 5-10 cases of the combined sick and exposed population should be tested in order to identify a pattern and improve the accuracy and reliability of the results. Not all diagnostic tests are created equal with regard to accuracy. Shelter personnel should consult with infectious disease experts when deciding on what diagnostic tests are most appropriate and reliable and provide the quickest turnaround time for results. In general, diagnostic tests that actually detect the pathogen in some body secretion or excretion are more desirable than those that detect antibodies to the pathogen since this approach is easily confounded by prior vaccinations or exposures. For parvoviruses, the point-of-care CPV/FPV antigen kits for testing fecal samples are most reliable if conducted during the acute virus shedding period. For respiratory infections, PCR testing of swabs from the upper respiratory tract for pathogen nucleic acid is the best diagnostic approach. The most valuable diagnostic test frequently overlooked by shelters is necropsy - animals that die or are euthanized due to illness yield the most clues for solving the diagnostic puzzle.

## Isolation of sick animals

**Prompt removal of sick animals from the general population is the single most important step in controlling a communicable disease outbreak.** This significantly decreases opportunities for transmission to other animals and reduces the infectious dose in the environment. Leaving sick animals in the general population guarantees the spread of infection to others and perpetuation of the outbreak. A common and dangerous belief is that mildly ill animals are not as contagious as those that are sicker - this is a myth because the severity of the illness is more dependent on the individual animal's response to the pathogen. Transmission of severe and even fatal infections by mildly ill animals occurs quite commonly with pathogens such as CPV, FPV, CDV, CIV, and FCV.

Sick animals should be isolated in a manner that contains spread of the pathogen, including those with airborne transmission (respiratory pathogens). **Ideally, the animals should be housed in a physically separated and enclosed room for full containment of the pathogens.** This is particularly important for the parvoviruses and canine respiratory viruses. Cats infected with FHV and FCV can be isolated in-cage if they can be cared for without fomite contamination of other cats. A cover over the front of the cage contains droplet fomites and reduces stress for these cats.

If the shelter cannot provide adequate isolation or do not have enough staff and medical resources to provide proper care, then the sick animals should not be kept in the shelter for treatment. In some cases, the sick animals can be transferred off-site to veterinary clinics, foster homes, or adoption groups with greater resources. However, foster homes and adoption groups are not the best candidates for highly contagious diseases that pose a threat to other pets, diseases requiring extensive treatment modalities other than oral medications, diseases requiring continual or frequent veterinary assessment, and pathogens that are difficult to remove from the environment. Unfortunately, euthanasia may be the only humane option if on-site or off-site facilities providing adequate isolation and treatment are not available. **Infected animals should be isolated for the duration of pathogen shedding.** For CPV, FPV, and canine respiratory viruses (except H3N2 CIV and CDV), shedding stops within 2 weeks of illness onset. FHV is typically 3 weeks. FCV and CDV shedding can continue for weeks to months, even after clinical recovery. Shedding of the bacterial pathogens is quickly stopped by proper antibiotic therapy. Confirmation of shedding cessation can be determined by testing for the pathogen in the same manner as for the initial diagnosis. This may allow for faster release from isolation for many animals.

## Quarantine of exposed animals

The benefit of isolating sick animals on disease containment is undermined if exposed animals remain in the general population. Exposed animals may not yet be ill because they are in the preclinical incubation period, they have a subclinical infection, or they are truly immune to infection. **All exposed animals should be considered an infectious risk regardless of vaccine status and quarantined to protect other animals from exposure.** Ideally, all of the exposed animals should be consolidated to one ward that is physically separated from other wards used for unexposed animals and new admissions. **The quarantine time is equal to the pathogen's maximum incubation period. For the respiratory pathogens (except CDV), this is 1 week. For parvoviruses, this is 2 weeks. For CDV, the quarantine time is at least 2 weeks.** Quarantined animals should be monitored twice daily for clinical signs. Sick animals should be promptly removed to isolation and the quarantine clock re-started for the remaining animals. Effective quarantine of exposed animals can save lives and increase staff morale.

## Assessment of risk for infection

Quarantined animals can be assessed for their risk of infection. This provides a humane and cost-effective strategy for quickly moving animals out of quarantine, thereby relieving the strain created by utilizing housing for quarantine. The risk assessment is based on 2 approaches: 1) testing for protective immunity to the pathogen, and 2) testing for the pathogen itself. Although no risk assessment is 100% accurate, these approaches when used and interpreted appropriately can predict in most cases which animals are safe to release and which animals are at risk.

For CPV and CDV, the assessment can be based on whether the exposed dog has protective antibody titers. CPV/CDV antibody titer testing kits are available for in-shelter use and provide rapid results. Animals that are **free of clinical signs and have protective antibody titers** based on serological testing are considered **low risk** for infection and can be moved into the adoption ward or to foster or adoption groups. Animals that are **free of clinical disease but do not have protective antibody titers** are at **high risk** for infection and should be held in quarantine at the shelter or transferred to foster homes that do not have other pets or have well-vaccinated pets for completion of the quarantine period. The off-site quarantine homes should be provided verbal and written disclosure that the animal is potentially contagious and should be kept separate from other pets, should be housed in an area amenable to effective sanitation, and could break with clinical disease. The best approach is to combine the antibody titer testing with pathogen testing described below.

Quarantined animals can also be assessed using a diagnostic test that detects the pathogen, such as PCR for respiratory pathogen nucleic acids or in-clinic tests for parvovirus antigens. Animals that are **free of clinical signs and test negative for the pathogen** are **low risk** and most likely safe to move into adoption or transfer to an adoption group. Animals that **test positive for the pathogen are an infectious risk** to others and should be moved to isolation.

## Protection of unexposed animals and new admissions

**The cornerstone for prevention of further spread of infection is creation of a clean break. This is defined as protection of unexposed animals and new arrivals from exposed or infected animals** by housing them in a physically contained clean room. Ideally, no new animals should be admitted until the outbreak is resolved. This is feasible for private, nonprofit shelters with controlled admissions. This is not feasible for municipal shelters with animal control contracts that must take in sick and injured animals, dangerous animals, and animals from cruelty investigations. However, these shelters can temporarily discontinue admission of owned pets, transfers from other shelters, and healthy free-roaming animals that are not a public health threat. The pet owners and finders of stray animals can be diverted to other groups or shelters, or asked to keep the animals until the outbreak is resolved. During this time, these animals can be vaccinated to establish immunity while awaiting surrender to the shelter. There are other ingenious solutions for diverting new admissions from shelters during disease outbreaks: 1) affected shelters have partnered with other shelters that agree to receive intakes pending resolution of an outbreak; 2) other shelters have arranged for temporary off-site housing such as empty commercial warehouses for new admissions; 3) still other shelters have utilized housing resources provided by local or national emergency/disaster response groups. These groups have mobile tractor trailers containing temporary housing units and even provide staffing to assist with care of the animals.

In conjunction with intake diversion, population management strategies should focus on moving the clean

animals out of the shelter as quickly as possible to keep the shelter from getting crowded. Litters of puppies and kittens should be placed for adoption or transferred to rescue groups and foster homes immediately at intake to reduce the number of vulnerable animals on-site.

Vaccination of all incoming animals immediately at intake or before becomes more critical in the face of an outbreak, especially since some of the pathogens that commonly cause more deadly outbreaks are “vaccine preventable” [CPV, FPV, CDV].

### **Biosecurity and environmental decontamination**

Biosecurity and effective sanitation should be practiced at all times, but is paramount during a disease outbreak. Signage should be placed on entrances to the isolation room, quarantine room, and clean rooms indicating what animals are in the room, no movement of animals in or out, and what staff can enter. Visibility is enhanced by color-coding the rooms: red = isolation, yellow = quarantine and green = clean. All animal care supplies can be similarly color-coded and dedicated to each area with no movement of supplies between rooms.

Ideally, dedicated staff should be assigned to each room and can wear color-coded badges to match their room assignment to ensure accountability. If there is not enough staff for assignment to specific rooms, then staff should care for animals in the clean rooms first, followed by quarantine, then isolation last. When caring for animals in quarantine and isolation, staff must wear PPE consisting of full-length gowns or scrubs that completely cover arms and legs, hair cover for long hair, rubber boots, and gloves. Street shoes with shoe covers are incompletely covered and become contaminated. Staff should never enter quarantine or isolation without PPE, and the PPE should never be worn outside the room.

Effective sanitation reduces the infectious doses of pathogens in the environment. Disinfectants that kill the parvoviruses and feline calicivirus must be used in all housing areas - household bleach, Wysiwash, Trifectant, or Accel/Rescue are the only 4 reliable disinfectants. Contact times for these disinfectants should be adhered to. Spot-cleaning should be used for cats to foster little to no handling of cats and gloves changed between cages. These disinfectants should also be used for dishes, litterpans, animal transport or animal control vehicles, transport cages, animal handling equipment (leashes, muzzles, catchpoles, catnabbers) and hallways.

### **Documentation**

There are several parameters of the disease outbreak that should be documented to aid in diagnosis, determination of whether the infection was contracted outside of the shelter or acquired in the shelter, containment strategy planning, assessment of the effectiveness of the strategy, and identification of the weakness in the system that enabled the outbreak. These parameters include onset date of illness for each animal, clinical signs observed, duration of illness, number of sick animals, number of exposed animals, kennel location of sick and exposed animals, cases confirmed by diagnostic testing, suspect cases not confirmed by diagnostic testing, age of sick and exposed cases, vaccination status of sick and exposed cases, and where did the first sick animals come from and where were they initially housed.

A trace-back of all animals exposed to infected animals based on the full incubation period for each pathogen should be conducted to identify what exposed animals were released to adopters and pet placement partner agencies during this time. The adopters and transfer agencies should be notified and

provided a written statement explaining what to do if infection is suspected or diagnosed, including who to contact at the shelter and whether the shelter is accepting animals back or assuming financial responsibility for veterinary treatment.

Protocols for intake processing, vaccination, sanitation, and daily monitoring of animal health should be evaluated and updated to include best practices. Responsible staff should be trained, supervised, and held accountable for the practices. To mitigate risk for recurrent outbreaks, a disease surveillance and monitoring protocol must be implemented for prompt identification and isolation of sick animals followed by examination and diagnostic testing to determine cause.

Tracking the origin of affected animals can be helpful in determining if the disease consistently originates from certain locations in the community so that extra precautions can be followed for admission of animals from these locations. Educational outreach and vaccination clinics can be targeted to these locations to increase community awareness and population immunity. Preventing the disease at the source is more effective than responding to recurrent outbreaks.

## **Communication**

Proactive communication about disease spread within the shelter and the control strategy provides an opportunity to disseminate accurate information to shelter staff as well as community stakeholders such as adopters, rescue groups, and veterinarians. Proactive communication averts spread of rumors and false information, improves the shelter's image, and enlists public support and trust.

A written statement describing the disease, what animals are at risk, and the transmission modes should be provided to all shelter staff, including managers, directors, and public information officers. A written protocol detailing the management strategy should also be provided to each staff member, regardless of whether they are directly tasked with implementing the protocol or not.

A press release containing pertinent facts about the disease, the number of affected and exposed animals in the shelter, number of deaths, diagnostic testing, strategy for control and elimination, and what expertise has been enlisted should be released to media sources, community veterinarians, and pet placement partners. Community support for the shelter can usually be maintained if the shelter is transparent about the problem and provides information on the pursuit of diagnostic testing, plans for containment of the disease, numbers of affected animals, what agencies are providing expertise and help, etc.

Consulting with infectious disease experts is another important component of communication, especially when dealing with an outbreak that cannot be diagnosed with routine testing, outbreaks with high morbidity/mortality, and outbreaks with unusual clinical signs. Reaching out for help should be done before deciding on drastic measures such as depopulation. Asking for help early in the course of outbreak favors a more positive and successful outcome and saves lives.