

# Canine: Parvovirus (CPV)

Canine parvovirus (CPV) is a serious disease that when identified through a routine and vigilant population health monitoring program warrants an immediate implementation of the shelter's plan of action. If your shelter does not have a plan of action in place then read on and formulate one. If you do have a plan read on and make sure yours is complete and up-to-date.

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## Introduction and significance in a shelter

Canine parvovirus (CPV) first made its unwelcome appearance in the late 1970's and since then has continued to evolve, with CPV 2a, 2b and 2c gradually replacing earlier strains. As an un-enveloped, single stranded DNA virus, CPV is capable of persisting in the environment for months or even years. Unless vaccination is nearly ubiquitous in the surrounding community, periodic introduction into the shelter is inevitable. Because shedding can occur briefly in asymptomatic or pre-clinical animals, environmental contamination may go unrecognized. Disinfection, vaccination and housing practices must address this constant threat.

However, there is also some good news: although parvoviruses continue to evolve, they tend to be antigenically stable, and vaccination appears to confer reliable protection even against newer strains. In-house tests are

reasonably reliable and readily available, thus recognition of CPV does not pose the diagnostic dilemma presented by some other conditions. The incubation period is well defined and relatively short (3-4 days but can be as long as 14), making quarantine of exposed animals a realistic possibility. Antibody titers can be used to assess risk in clinically healthy dogs, allowing further refinement of quarantine decisions.

*Although parvovirus will always pose a risk for most shelters, the rate of infection can be greatly reduced by appropriate vaccination; quick recognition; appropriate segregation of diseased/exposed animals; and careful cleaning and disinfection.*

## Who can be infected?

While puppies are most likely to suffer severe disease and death, any unvaccinated dog, of any age, can become infected with CPV. Some breeds have been reported to be more susceptible to this infection (e.g. “black and tan” breeds). However, these breed tendencies likely evolve and change over time as a result of natural selection against susceptible lineages, and no one breed should be assumed to be more or less susceptible than another (nor is there any indication for a differing vaccination schedule in a particular breed). The apparent frequency of CPV infection in some breeds or mixes in shelters (e.g., anecdotally, pit bulls) more likely reflects a lower frequency of vaccination and greater exposure rather than a true genetic risk.

Some strains of CPV currently circulating in the U.S. can infect domestic cats as well as dogs. Infection with canine parvovirus can cause severe disease and death in cats, just as feline panleukopenia does. Alternately, it may cause in-apparent infection and establishment of a carrier state. Such cats would be a threat to in-contact dogs. Housing dogs and cats separately in shelters is extremely important for many reasons and especially never co-house CPV infected dogs with cats, particularly kittens or unvaccinated adults. Modified live vaccination for feline panleukopenia provides cross protection against CPV infection in cats.

## Vaccination

Vaccination is the cornerstone of parvovirus prevention in shelters and communities. In the absence of maternal antibody interference, a single modified live vaccine can confer protection within 3-5 days<sup>[1]</sup>. Research to date has found that currently available vaccines protect against all known strains of parvovirus, including parvovirus 2c<sup>[2, 3]</sup>. All dogs and

puppies > 4 weeks of age should be vaccinated at the time of shelter admission (or ideally, at least a week before), including those who are injured or mildly ill. (In shelters where parvo is extremely rare, vaccination may be started at 6 weeks instead of 4 weeks.) . Revaccinate puppies every two weeks until 18-20 weeks of age<sup>[4]</sup> as long as they remain in the shelter, and consider revaccinating adult dogs at least once 2 weeks after the first vaccine or after adoption.

For pregnant dogs, the risk of parvovirus infection must be balanced against the risk of vaccine-induced abortion. If the decision is made not to vaccinate a pregnant dog, titers should ideally be performed to evaluate susceptibility to infection (see below) and these dogs must be carefully mechanically isolated unless confirmed to have an adequate titer. Because maternal antibody can interfere with vaccination in puppies under 16 weeks, they also need to be mechanically protected from exposure by ensuring that they are housed in easily cleaned and disinfected areas; handled and cared for by people with clean hands, shoes, and clothes; and ideally, removed from the shelter to foster care, adoption or rescue as quickly as possible.

CPV enters and spread in shelters from dogs infected in the surrounding community. A cost effective and humane strategy for long term control is to ensure that community members have ready access to affordable vaccines for their pets.

## **Recognition and Diagnosis**

Diagnosis of CPV is fortunately reasonably straightforward in most cases. While not perfect, in-house fecal ELISA tests are reportedly quite specific and sensitive even for recently emerged strains. A recent study found that the Idexx SNAP test detected 80%, 78% and 77% of parvovirus 2a, 2b, and 2c respectively<sup>[5]</sup>. As with any test, false results are possible. Negative results will occur later in the course of disease when virus is bound by antibody or no longer being shed. This should not be interpreted to contradict earlier positive results. Weak false positives may also reportedly occur due to recent vaccination. However, this is likely uncommon, particularly with the Idexx brand SNAP test<sup>[6, 7]</sup>. In general, positive results should be taken seriously even in recently vaccinated dogs.

Of course, in all cases, history, signalment and clinical signs should be considered along with test results. With much at stake, confirmatory diagnostic testing should be performed, especially if the result does not fit the rest of the clinical picture. Other accessible in-shelter diagnostic tools include blood smear/CBC looking for leukopenia and, if a dog dies or is

euthanized, in-house necropsy for characteristic segmental enteritis.

Fecal samples can be submitted to a laboratory for PCR with rapid turn-around time; this method is sensitive to detect CPV infection but also more likely to detect vaccine virus in recently vaccinated dogs. PCR analysis is the only method to distinguish between the various strains of parvovirus; however, this has minimal clinical relevance as the approach to prevention and treatment is identical regardless of strain.

Histopathology and immunohistochemistry on a necropsy specimen is the gold standard for diagnosis, and should be performed in atypical outbreaks if any dog dies or is euthanized (e.g. apparent infections in well-vaccinated animals; persistent outbreak in the face of good control measures).

In general, testing should be reserved for dogs with clinical signs or recently exposed/high risk dogs. Because viral shedding can occur a few days before clinical signs appear, it can be helpful to test very high risk puppies even if they are showing no overt signs of infection, for instance unthrifty looking puppies from known high risk locations in a community. However, routine CPV testing in healthy appearing dogs or puppies is costly, ineffective for controlling parvovirus in a shelter (as animals may test negative, then begin shedding hours or days later), and likely to result in an increased rate of false positive results.

Although diagnostic tests are quite effective to confirm or rule out CPV infection, this must go hand in hand with daily or more frequent monitoring of the population. If an unthrifty animal goes undetected for hours or days, the opportunity for spread is hugely magnified. Teach all staff and volunteers to be alert for dogs with signs of illness and provide clear instructions for what to do should CPV be suspected. Train staff in correct use and interpretation of diagnostic tests and perform formal daily medical rounds during which the health of all dogs in the shelter is evaluated.

## **Risk assessment: how do you decide how much to worry about exposed animals?**

When one animal from a population is diagnosed with CPV, the question arises: what do you do about others in the environment? Are they all likely to get sick? Will widespread quarantine or depopulation be necessary? Or is it okay to simply carry on business as usual, or somewhere in between? The answers to these questions are dependent on several factors.

Not all exposed dogs will become infected. Due to varying levels of maternal antibody, it is not even uncommon for only some members of a

litter to develop disease. The risk of infection depends on the animal's individual immune and vaccination status, the overall cleanliness of the environment and the level of proximity between the exposed and infected animal. The most important factor in disease risk is vaccination: a "fully" vaccinated animal (i.e. vaccinated eight days prior to exposure – 5 days for vaccine to be fully effective and 3 days of shedding prior to clinical signs) over five months old is at very low risk of infection. However, even incompletely vaccinated animals may survive a possible exposure.

*Risk due to environmental spread is reduced if:*

- The facility is not crowded
- Dogs are housed singly or in stable pairs/groups
- Dogs are not handled or removed from their run during cleaning (e.g. double sided kennels used correctly)
- Animal housing areas are steel, sealed concrete, or other non-porous, non-scratched surface and can be effectively cleaned and disinfected
- A proven parvocidal disinfectant is used daily to disinfect all animal housing areas, including transport vehicles, exam surfaces and common rooms
- Separate tools and equipment are used for each area of the shelter
- Animals are handled with hand washing or change of gloves between individuals
- Clinical signs appeared within a few days of shelter intake (and therefore the animal was more likely exposed in the community versus in the shelter)

*Risk due to animal immune status is reduced if:*

- All animals are vaccinated immediately upon intake
- Risk is very low in animals > 4-5 months old that are either:
  - Vaccinated with an MLV SC (sub-cutaneous) vaccine at least one week prior to exposure
  - Have a documented history of vaccination at or after 18-20 weeks of age and within three years prior to exposure
- Risk is greater in puppies under 5 months old even if vaccinated (due to maternal antibody interference)
- Risk is greater in animals vaccinated less than a week before exposure
- Risk is greatest in closely exposed, unvaccinated or titer negative animals

To help with thinking about and planning for a CPV outbreak, which is nice to be able to do when not actually faced with a case of CPV, we developed the CPV Outbreak Simulator and guide. This resource allows

you to work through a real life outbreak scenario numerous times until you feel confident in your risk assessment skills. It also lets you get a sense for the shortcomings of risk analysis – every once in a while, in the simulator as in life, you will do everything right and an infected animal will slip past your radar. However, you can also clearly see how many more lives are saved through careful risk assessment than either depopulation or failure to respond at all. For more information, view the [CPV outbreak simulator](#).

## Serology to assess individual dog risk

Serology is a very useful tool to further clarify the need for quarantine of individual dogs[8, 9]. In-house serology tests can be used and have the advantage of more rapid turn-around time as compared to sending out blood samples, often within minutes.

*Note about who to test: tests should only be used on dogs without clinical signs of disease. Healthy adult dogs (> five months old) vaccinated at least eight days prior to exposure (i.e. the day that the dog with CPV had clinical signs) can be considered low risk and titer testing is not usually necessary.*

The Synbiotics Titerchek™ kit is designed to test for canine distemper virus (CDV) or canine parvovirus (CPV) antibodies in canine serum. The results are compared to positive and negative control wells and give non-quantitative positive or negative results. This kit is a well test; each time the test is run two additional wells must be used to run a positive and negative control. Because of this, the test is most economical when running several tests at once. Also since this is a well test rather than a “snap” kit, ensuring the staff running these tests is sufficiently skilled is essential. There is a video demonstrating its use on YouTube -

More recently, another in-house option has become available in the US, the VacciCheck ImmunoComb™ test by Biogal. This kit provides semi-quantitative antibody titer levels for CPV and CDV (as well as Canine Adenovirus). The kit is a “self-contained” dot ELISA titer test kit, not needing any reagent preparation. The kit looks like a flat comb; each tooth of the comb is a test for an individual dog and includes the positive and negative controls. Results can be scored by their shade relative to the positive on a scale from 1- 6. Results develop for all three 3 viruses on the same comb simultaneously. The test provides results within approximately 20 minutes. There is a video demonstrating its use on YouTube -

Adult dogs without clinical signs testing positive for protective titers are at

low risk for developing CPV infection. It is reasonable to move these dogs through the shelter as usual rather than placing them in quarantine.

Interpretation of titers in dogs < five months of age is a little less clear-cut, as positive titers may reflect either an active immune response or waning maternal antibody. Puppies testing positive are likely low risk but this is less certain than with adults and immunity may rapidly wane. These puppies are relatively safe to move to adoption or rescue, but should leave the shelter quickly if possible and it is prudent to advise adopters or rescuers of their recent exposure to CPV. Continue their vaccine schedule as usual.

Puppies, especially heavily exposed puppies or puppies from high risk environments, should be snap tested before or in conjunction with titer testing to rule out early subclinical infection which could overcome maternally derived antibodies (MDA). A positive snap test along with a positive titer, indicates subclinical infection and these dogs should be isolated. A negative snap and negative titer result would indicate that the puppy is not currently shedding but is not protected if exposed to CPV and thus should be quarantined. A negative snap and positive titer result indicates that the puppy is not currently shedding and is likely protected (for now) if exposed to CPV. These puppies should be bathed and moved out to adoption or rescue as promptly as possible.

All dogs, of any age, testing negative for protective titers at the time of exposure must be considered high risk; however, many of these dogs will not develop infection. Quarantine for 2 weeks is indicated for this group if possible.

**A caveat about risk:** Remember that low risk and high risk are only that: evaluation or risk levels, not an absolute guarantee of a particular outcome. Virtually all tests have limitations, and the tests for antibody titers are no exception. Two studies estimated the sensitivity and specificity of the Synbiotics Titercheck™ at 92- 98% and 94-98% respectively. (Litster et al, Vet J 193(2): 363-366.; Gray et al, J Am Vet Med Assoc 240(9): 1084-1087.) This means that occasionally dogs without protective titers will test positive and vice versa.

For many shelters, the combination of evaluation of exposure level, clinical condition, snap and titer test results will lead to a reasonable degree of confidence of a dog's likelihood of infection, such that the risk for an adopter or rescuer in taking on a "low risk" dog would be no greater than adopting an untested dog at any other time (when the shelter was not experiencing an outbreak).

However, if a truly no-risk scenario is desired, and it is affordable,

quarantine of all exposed dogs for 14 days would be the safest bet. In many shelters, this is simply untenable, and evaluation of risk levels is the best way to manage a potential outbreak with minimal loss of life or spread of disease. Adopters and rescuers should be counseled accordingly.

## Quarantine

Quarantine is generally for 14 days. However, if a shelter is transporting dogs from a particular shelter and finds over time that all the cases break in a shorter time period, a shorter quarantine is acceptable. This can happen when exposure tends to happen early in the dog's stay at the source shelter (prior to transport), and by the time the dogs are transported they have already had a few days to incubate illness if exposed. It can also happen when exposure is either heavy or not at all. In our experience, heavily exposed dogs will usually break within seven days of exposure.

Puppies should be bathed at the *beginning* of quarantine to prevent self-infection from virus remaining on fur as maternal antibodies wane. Ensure all dogs over four weeks of age have been vaccinated with a modified-live DHPP vaccine within the last two weeks. If under 5 months of age and it has been more than 2 weeks since last vaccinated, repeat the vaccine.

All adult dogs should be housed singly if possible and if not, should be housed as cohorts; puppies can be housed in pairs and each kennel should have their own cleaning supplies. Have limited staff assigned to the quarantine ward and provide PPE (gloves, long sleeved gowns, shoe covers or separate shoes) that must be changed between puppies/pairs of puppies and after exiting the ward for adults.

Foot baths are not acceptable to control CPV. If possible bathe adult dogs at the end of quarantine to remove lingering parvo remnants on fur, especially if exposure was heavy (bathe puppies too, if not done at the start of quarantine).

## Disinfection: how do you get rid of it?

As noted above, CPV can remain viable for months to years, especially in a dark, moist environment<sup>[10]</sup>. There is no realistic way to "out-wait" CPV in a shelter setting: it must be mechanically removed or killed by one of the few effective disinfectants. Happily a couple of new products have come on the market in recent years that give us additional choices other than our old standby, bleach.



Effective choices include 5% sodium hypochlorite (household bleach) at ½ cup per gallon (1:32 dilution). Like all disinfectants, bleach must be used and stored correctly to be effective. In the case of bleach, this means application only to pre-cleaned surfaces free of organic matter. Bleach remains stable at least 200 days when undiluted, and at least a month after dilution provided it is stored in a light proof container[11, 12]. It is rapidly inactivated by light and organic matter.

Other proven products include potassium peroxymonosulfate[13] (e.g. Trifectant®) and accelerated hydrogen peroxide[14] (e.g. Accel®), which both reportedly have greater detergent properties and better activity in the face of organic matter compared to bleach and related products.

Independent studies have repeatedly shown that quaternary ammonium disinfectants (e.g. Triple Two®, Rocal®) do not reliably kill parvovirus, in spite of repeated reformulation and label claims of efficacy[13, 15,16].

There is no benefit to a waiting period prior to re-use of a kennel after CPV decontamination; either mechanical cleaning and disinfection was effective, or it was not. Waiting a day or even a couple of weeks will not result in a significant further decrease in contamination. To be on the safe side, kennels should be completely cleaned, disinfected, and dried at least twice before re-use, however this can happen in a short period of time (e.g. 24 hours) if the area or kennel is needed urgently.

For areas such as yards and homes where disinfection is not an option, careful and repeated mechanical cleaning can be effective if applied diligently. Yards can be flushed with water and dried, and a disinfectant with reasonable efficacy in the face of organic matter (e.g. Accel®) can be sprayed on the area using a pesticide applicator or hose-end sprayer. If repeated cases occur after thorough efforts at cleaning, close the area to youngsters and unvaccinated animals for at least 6-12 months (and in general do not use grass or dirt areas for juvenile animals and animals in the shelter less than four days). In the meantime, maximize exposure to sunlight and drying of the environment.

## Treatment

Treatment of CPV infected animals should only be undertaken in a shelter if sufficient facilities exist to isolate the patient such that the rest of the population is not put at risk and staff and veterinary oversight is adequate to ensure humane and appropriate care. Other options include treatment at an off-site veterinary clinic or transfer to another shelter with sufficient facilities. Unless specifically set up for CPV treatment, foster and rescue homes are generally better used for quarantine of exposed animals rather

than treatment of ill puppies.

If facilities or staff are insufficient and off-site options are not possible, euthanasia of infected animals may ultimately save lives by preventing continued spread. Treatment is the same as that in a private practice setting, including anti-emetics, broad spectrum antibiotics to control secondary infections, fluid therapy and blood product transfusion as needed. Early enteral nutrition via syringe feeding or nasogastric tube is practical in some shelter environments and may be beneficial both in supporting the patient and decreasing the length of illness, resulting in decreased cost of care.

A recent preliminary study at Colorado State University found that intensive out-patient care at a fraction of the cost (\$200-\$300) had similar outcomes when compared to the inpatient “gold standard” of intensive care. More about this study can be found at <http://csu-cvmb.colostate.edu/pages/parvo-puppies-new-protocol.aspx>

Treatments that are either not indicated or not available in the U.S. include hyperimmune serum, interferon omega, and Tamiflu<sup>[17]</sup>. Hyperimmune serum is not widely available (and serum from a dog that has simply been immunized is not equivalent), and this treatment likely has limited benefit by the time clinical signs have been recognized. Interferon omega has been shown to decrease mortality for CPV virus but the product is not available in the U.S. at this time. The mechanism of Tamiflu is specific to influenza viruses and there is neither evidence nor indication for its use in treatment of other infections.

## **Reintroduction of recovered animals**

As noted above, viral shedding can continue for up to ~14 days following recovery from clinical signs thus isolating recovered puppies for an additional two weeks is the safest option to limit spread within the shelter. Socialization is still required for puppies during this period, making prolonged isolation a potential challenge for many shelters.

A negative CPV snap test is suggestive that significant quantities of virus are no longer being shed. In practice, snap testing recovered dogs/puppies and moving the negative animals to adoption is relatively low risk, especially if these dogs can be housed separately from puppies and recently vaccinated adults (or immediately adopted into a home meeting these same criteria). Adopters should be asked to observe a voluntary two week caution period in which puppies are not taken to dog parks, obedience class, pet stores, or other places where exposure to other puppies is a probability. Exposure to vaccinated adults is fine.

Bathe animals prior to re-introduction to a shelter in order to remove virus persisting on the coat. There is no contra-indication to performing surgery on recently recovered dogs. Continue vaccinating puppies following the normal revaccination schedule; although recovery from CPV infection will confer long term immunity, protection is still needed against the other agents included in the multivalent vaccine.

## **The bottom line**

Although it may be impossible to exclude CPV completely from an open population, having a well thought out vaccine, housing and cleaning program in place before a problem occurs can go a long way towards minimizing spread. If the worst happens and an outbreak occurs, rapid and accurate diagnosis, coupled with effective risk assessment and quarantine, will limit damage and get things quickly back to normal.

## **Balancing parvovirus risk and puppy socialization**

It is easy to see the consequences when a puppy is exposed to CPV before vaccination has a chance to protect. This motivates us to carefully protect puppies from possible exposure to this deadly virus. However, the consequences of poor socialization are less immediately apparent, but may be equally severe.

A puppy that has been isolated from other animals, people and a wide variety of experiences may grow up fearful or even aggressive. As we know in shelters, this may lead to fatal consequences if the dog is later surrendered due to these behaviors. We need to balance the risk of CPV with the very real risk of poor socialization, and do our best to provide puppies with the best of both worlds: a variety of experiences in a relatively safe and clean environment.

Research demonstrates that socialization is a critical step in the development of behaviorally healthy dogs. The primary socialization period of puppies is between 3 and 13 weeks. This period is critical for development of primary social relationships with humans and other animals. Puppies that are confined during this period are significantly more likely to develop behavioral problems (primarily fear and aggression) than puppies that are provided a socialization program.

Socialization of these puppies is thus essential and thankfully possible. Puppies can be socialized in their kennels by staff and/or volunteers wearing PPE designated for each kennel. Working with a veterinarian

and behavior staff to develop a protocol to socialize puppies is crucial when deciding to both treat and quarantine exposed puppies.

## **Client Information**

- CPV is highly infectious and causes diarrhea (sometimes bloody), vomiting, lethargy, weakness, and fever. The virus also attacks white blood cells, leaving the infected dog much more susceptible to other bacterial infections.
- Diarrhea can be mild or severe, even fatal. Diarrhea in an otherwise bright, alert, eating, drinking dog is more likely due to diet change, stress, parasites, or dietary indiscretion, than to CPV.
- The virus is very contagious and is spread by exposure to feces. Unfortunately, many dogs from shelters often have been exposed to CPV and should be observed for 14 days after adoption to be sure they are not incubating the virus.
- There is some risk that a dog incubating CPV will infect other dogs. The new dog and their feces should be kept away from puppies and unvaccinated dogs for 2 weeks. Dogs that have had at least two vaccines, with the last one at least 2 weeks prior to exposure to an infected dog are fairly protected.
- If you suspect your dog has CPV, call your veterinarian as soon as possible. The earlier the infection is diagnosed and treated with fluids, antibiotics, and nursing care, the more likely they are to do well.

## **Communicating with the general public when parvoviral infections occur in your shelter**

- The presence of cases of CPV in the shelter should be communicated to local veterinarians and to the public.
- Adopters should be informed of the exposure status of their new dog with a copy of any relevant medical records, and should sign a medical waiver form at the time of adoption.
- All adopters should be given a CPV information handout which should include a description of the disease and the associated clinical signs of an infected animal.
- As always people who have recently adopted an animal should be strongly advised to have the animal examined by a veterinarian. In the event that the adopted animal had been kept in an area where there was even a remote chance that it could have been exposed to CPV at the shelter, the adopter should be informed and it should be made clear to them that they should notify their veterinarian so that they may examine the dog, perform any necessary diagnostic tests,

and properly advise the owner on the care of their newly adopted animal.

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