Canine Parvo & Feline Panleuk: New ideas for prevention, treatment & risk assessment

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Parvo Outbreak Killing Dogs in Milwaukee

By Heather Shannon

MILWAUKEE—The Wisconsin Humane Society said dozens of dogs in our area recently have parvovirus, a highly contagious and deadly virus that hasn’t been seen around here before.

Parvo Outbreak Plagues Animal Shelter

Orange County After-Hours Pavilion Temporarily Closed

 Such an outbreak would be very unusual for the shelter, which has had parvovirus cases before, but they are not believed to be related, officials said.

Parvovirus outbreak runs through two Connecticut shelters

Veterinarians are investigating new cases following a recent outbreak at a Connecticut shelter.

Puppies Euthanized after Parvo Outbreak Infects Visalia Shelter

By Norma Yuriria

Visalia, Calif. (KMPH News) — It’s being called the worst parvo outbreak in recent years: dozens of puppies at a Visalia animal shelter have been put to sleep after they got sick.

Dozens of others are under quarantine.

By Kelly Austin, Interim-Executive Director at Valley Oak SPCA says the outbreak has forced the shelter to euthanize between 40-50 puppies.
Parvovirus 101

- Un-enveloped single stranded DNA virus
  - Difficult to kill
    - Persists for months-years
  - Highly contagious

- Antigenically stable
  - Vaccines generally work really well
  - Strain variation is small
    - CPV-2 → 2a, 2b, 2c
    - FPV - closely related to CPV-2
  - Variations in incubation, clinical manifestation
    - Basic control and treatment remain the same so far

- Targets rapidly dividing cells
  - GI
  - Bone marrow
CPV in Cats

- FPV most severe signs and *most common*
- CPV-2c seems to be the most pathologic in cats
- CPV-2a and 2b replicate efficiently in cats
  - Can induce disease similar to FPV
  - Or more commonly be non-clinical
- The true role of cats in canine parvovirus infection is *not* known
  - Probably quite limited compared to dog-to-dog spread
Important Tools

- Recognition
- Vaccination
- Disinfection
- Risk assessment
  - Titer testing
  - Quarantine
- Treatment
Who gets parvovirus?

- Any age animal can be affected
- Juveniles (4 weeks - 5 months) most susceptible
- No predictable breed predilection
- All susceptible animals
  - Any unvaccinated animal
  - Any animal without previous exposure
  - Those with co-infections
Recognizing Parvovirus

- Intake testing of sick juveniles
  - Immediate isolation if staying in the shelter
- Daily population rounds
  - More often during an outbreak
- Evaluation before cleaning
- All staff and volunteers, all the time
- Document and map test results
  - Source and shelter location
  - Time with respect to intake and vaccination
Clinical Signs of Parvovirus

- Usually develop 4-6 days after exposure
  - Can be 2-14 days

- Attacks rapidly dividing cells
  - Intestine
  - Bone marrow

- Diarrhea
  - Dogs - bloody
  - Cats - not so much

- Vomiting

- Inappetence

- Lethargy/weak

- Sudden death
  - Kittens > puppies
Cerebellar hypoplasia

- Early pregnancy
  - Abortion
  - Birth defects
  - Infertility but queen otherwise fine

- Late pregnancy to 9 days old
  - Sudden death
    OR
  - Virus destroys certain cells in cerebellum
  - Cerebellum thus cannot develop properly
  - Non-progressive ataxia
  - Alert & strong otherwise
  - Usually noticed at ~3 weeks of age with kittens ambulate

- Severity can vary within litter
  - Some may even be unaffected
Parvo “snap test”

- False negatives
  - Variable shedding
  - Fairly uncommon in first few days of disease
  - ~80% sensitivity for all current strains\(^1,^2\)
  - FPV cannot be ruled out on the basis of a negative test

- False positives
  - Maybe rare weak positive 3-7 days after modified live vaccination
  - Very uncommon with IDEXX brand test (for both CPV and FPV)
  - Confirm with other diagnostic

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Other testing

- **Blood smear**
  - Panleukopenia
    - Often very dramatic
  - Profound neutropenia
  - Leukocytosis possible early
  - Not all animals will be leukopenic

- **PCR**
  - Vaccine induced positive more likely
  - Only way to determine strain
  - Sample = fresh feces
Other testing

- **Necropsy**
  - Segmental enteritis
  - Samples
    - Obtain first
    - Small and large intestine
    - Non-fixed for bacterial culture, virus isolation and parasitology testing
    - Refrigerate for bacteria, frozen for virus

- **Histopathology**
  - Gold standard
  - Samples
    - Fixed (formalin jars)
    - 9:1 ratio formalin:tissue
Disease course

- Incubation: 2-14 days
  - Usually 4-6 days
- Shed 2-3 days before signs
- Shed usually < 2 weeks after recovery
  - Snap test/PCR to help verify full recovery
- No ‘carrier state’
Transmission

- Shed in feces, vomit
- Very easily spread by fomites
  - fur
  - feet
  - hands/arms
  - clothing
  - equipment
  - litter boxes
- Environmental contamination
  - common walkways
  - play areas
“Dogs vaccinated with modified live CPV developed high hemagglutination inhibition titers within four days of innoculation and antibody persisted.”

## Immunity from current vaccines

### Table 2

Dogs vaccinated against canine distemper virus (CDV) and canine parvovirus type 2 or 2a (CPV-2, -2a) and then challenged with CDV (intravenous) and CPV-2c or -2b (intranasal/oral)

<table>
<thead>
<tr>
<th>Challenge viruses</th>
<th>Number of dogs per group</th>
<th>Years since last vaccine given (average)</th>
<th>Type of CPV-2 vaccine component</th>
<th>CPV titre at PC Day 0 (average logs)</th>
<th>CDV titre at PC Day 0 (average logs)</th>
<th>Age at challenge in years: range (average)</th>
<th>Outcome (% protection)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CDV-SH, CPV-2b</td>
<td>10</td>
<td>4.5</td>
<td>CPV-2</td>
<td>6.3</td>
<td>6.6</td>
<td>4–8 (6.2)</td>
<td>100</td>
</tr>
<tr>
<td>CDV-SH, CPV-2c</td>
<td>10</td>
<td>5.5</td>
<td>CPV-2</td>
<td>7.5</td>
<td>8.4</td>
<td>5–9 (6.8)</td>
<td>100</td>
</tr>
<tr>
<td>CDV-SH, CPV-2c</td>
<td>10</td>
<td>5.9</td>
<td>CPV-2a</td>
<td>7.8</td>
<td>8.3</td>
<td>7–8 (7.3)</td>
<td>100</td>
</tr>
<tr>
<td>CDV-SH, CPV-2c</td>
<td>10</td>
<td>4.8</td>
<td>CPV-2</td>
<td>8.2</td>
<td>5.1</td>
<td>5–9 (6.8)</td>
<td>100</td>
</tr>
</tbody>
</table>

SH, Synder Hill strain; PC, post challenge.

More good news

“The time necessary to obtain the immunity of cats against Panleukopenia has been studied by means of a modified live vaccine. This vaccine makes it possible to obtain a very early post-vaccinal immunity: the full immunity is reached 72 hrs after the inoculation of the vaccine by the subcutaneous route.”

Vaccination for parvovirus

- Modified live
- Works in most animals within 3-5 days without re-vax
- Safe in animals > 4 weeks
- Maternal antibodies may be a problem in juveniles < 20 weeks
  - Or they may not be...
The problem

![Graph showing the relationship between vaccination and antibody titer levels.](image)

- **Mean antibody titer**
- **Range of Antibody titer**
- **Window of Susceptibility**
- **Minimum titer to block virulent virus**
- **Minimum titer to block vaccine**
Shelter vaccine protocol

- MLV DHPP (DA2PP) or FVRCP
- Immediately on intake if not sooner
- Adults once at intake
  - Repeat once after 2 weeks if in doubt
- Juveniles every 2 weeks while in shelter
- Last vaccine at 18-20 weeks
- All animals
  - If too sick to vaccinate...too sick to stay in shelter
Pregnancy and lactation

- No increased risk during lactation
  - Vaccinate

- Risk during pregnancy?
  - Frequency that MLV cause abortion or fetal malformation is unknown
  - Weigh the risks
  - Vaccine virus vs. Virulent virus
Outside the box?

- Animals over 5 months vaccinated over 7 days ago
- Normal control measures fail
- Look further...

Vaccination
Vaccine failure

- Shipping
- Storage
  - Check the temperature in the ALL fridges
- Administration
  - Reconstituted properly
  - Timing of reconstitution
  - Administered properly
  - Timing of administration
- Observe intake!
Balancing protection and socialization

- 3-13 weeks is key socialization period
- Minimize time in shelter
  - Quarantine only for super high risk puppies (more later...)
- Visit with puppies in their kennel or in easily disinfected areas
- Dedicated clothing and footwear per litter
- Counsel foster parents/adopters about safe socialization
  - Limit puppy to puppy contact for 2 weeks after adoption especially from high risk shelter
  - Vaccinated adults are ok
  - Extra caution with pet stores, dog parks, vet clinics

Behavior problems are the most common cause of relinquishment of dogs to shelters!
“The infectivity in vitro was unchanged for the first 5 months, but after mid-summer it decreased abruptly to below the detection level. The transmission of the infection to the experimental animals was successful for all samples showing infective virus by cultivation. We conclude that parvovirus can survive for at least 5-10 months (or during the winter period) under natural conditions, but complete drying out seems to lead to its inactivation. Mechanical cleaning of the premises is thus as critical as disinfection since virus can only survive the dry summer period if protected by protein or buried in moist soil on the premises.”

*Uttenthal, A., Mink enteritis parvovirus. Stability of virus kept under outdoor conditions, Apmis 1999*
Parvovirus disinfection

- Carefully clean
- Apply effective disinfectant appropriate for context
- Leave on for recommended contact time
- Dry fully
- Repeat 1-3 times
- Be aware of fomites and animals
- No need to lock down cage or area for certain time period

Biohazard
Disinfection: what works and what doesn’t?

**YES**

- Bleach and its relatives
  - Wysiwash®
  - Bruclean®
- Trifectant/Virkon-S®
- Accelerated hydrogen peroxide (e.g. Accel TB®)
- Prolonged high heat (> 120 ° F for 30 min)

**NO**

- Quaternary ammonium compounds
- Chlorhexidine (Nolvasan®)
- Alcohol
- Time
- Freezing
My favorite

- Detergent and disinfectant
- Non-toxic
- ‘RTU’ or concentrate
- Wipes
- Affordable when used correctly
Accel

- Parvocidal:
  - 4 oz/gallon with 10 min contact time
  - 8 oz/gallon with 5 min contact time
  - TB/wipes with 1 min contact time

- 90 day shelf life once diluted

- Use indicator strips
  - Initial set-up
  - Every 3-4 weeks
  - 1350 ppm = 4 oz/gallon
  - 2700 ppm = 8 oz/gallon
Cleaning procedures

- Minimize kennel entry &/or handling
- Use double sided kennels for one dog only
- If dogs must be doubled up, two compatible dogs per kennel less harmful than moving dogs all over or using only one side of kennel
- If kennel single sided
  - Move down one
  - Walk dog
Don’t rely on footbaths

Foster homes

- Foster homes are not created equal
- Depends...
- Environment - e.g. carpet vs. tile
- How much range in the foster home
  - Restrict access to certain areas
- Provide a good disinfection to the foster home
- Foster homes could still foster adults
How to keep foster homes safe (ish)

- Foster training on disease transmission
- Designated area
  - Separated from other pets
  - Easily ‘disinfectable’
  - Dedicated supplies
  - Good ventilation
  - Low traffic
- Effective sanitation
- Hand hygiene
- Protocols/policies

<table>
<thead>
<tr>
<th>Surface/Object</th>
<th>Suggested Procedure</th>
<th>Special Steps</th>
</tr>
</thead>
<tbody>
<tr>
<td>High contact surfaces</td>
<td>Daily cleaning with a detergent</td>
<td>Weekly disinfection</td>
</tr>
<tr>
<td>Visibly soiled objects/surfaces</td>
<td>Cleaning with a detergent</td>
<td>Disinfection</td>
</tr>
<tr>
<td>Litter boxes and food bowls</td>
<td>Cleaning daily</td>
<td>Disinfection weekly</td>
</tr>
<tr>
<td>All regular surfaces</td>
<td>Weekly cleaning and disinfection</td>
<td>Increase frequency to daily or more often when infectious disease is present</td>
</tr>
<tr>
<td>When new animals are introduced (between animals)</td>
<td>Thorough cleaning and disinfection between animal residents</td>
<td></td>
</tr>
<tr>
<td>Laundry</td>
<td>Remove organic material before laundering</td>
<td>Use soap and bleach Machine or sunlight to dry</td>
</tr>
</tbody>
</table>

Source: ASPCApro.org
Dose effect

- Greater likelihood of infection
- Shorter time to onset
- More severe disease
- Don’t need to be perfect...
Treatment considerations

- Prompt identification is key
  - Removal from general population
  - Timely treatment improves outcome

- Have a written protocol
  - Case definition
  - Treatment
    • Including who to treat
    • Initiating and administering
      ✓ Who, what, when, where, how
  - Containment and management
  - Intervention points & next steps
Clinical signs present, parvo diagnosis confirmed

Population Response

Individual Response

Do you have:
- Medical supplies
- Trained staff/volunteers
- Dedicated isolation facility with excellent biosecurity

Dedicated isolation facility with excellent biosecurity

Yes

Follow Parvovirus Protocol
Perform patient assessment
Isolate and Treat
Monitor Carefully

No

Are resources available to support treatment at private clinic or foster home? Is patient stable for transfer? Is a reputable rescue willing to transfer the patient immediately?

Yes

Immediate transfer

No

Humane euthanasia
Treatment

From Greene’s *Infectious Diseases of the Dog and Cat*

- Primary goal = restoration of fluid losses & electrolyte balance and preventing secondary infections
- Best antimicrobial spectrum:
  - Gram negative and anaerobic bacteria
  - Penicillin and aminoglycoside
- Anti-emetic drugs
- Feed early in dogs
- Combination B-vitamin therapy parenterally to cats

### Table 9-1

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dosage (mg/kg)</th>
<th>Route</th>
<th>Interval (hours)</th>
<th>Duration (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ANTIBIOTICS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metronidazole</td>
<td>0.2-0.4</td>
<td>PO, SC</td>
<td>6-8</td>
<td>pm</td>
</tr>
<tr>
<td>Cefazolin</td>
<td>0.1-0.2</td>
<td>IV</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>5-10</td>
<td>IM, SC, IV</td>
<td>24</td>
<td>pm</td>
</tr>
<tr>
<td>Ampicillin</td>
<td>16-20</td>
<td>IV, SC, IM</td>
<td>6-8</td>
<td>pm</td>
</tr>
<tr>
<td>Cefazolin</td>
<td>10-30</td>
<td>IV, IM, SC</td>
<td>6</td>
<td>pm</td>
</tr>
<tr>
<td>Gentamicin</td>
<td>2</td>
<td>IV, SC, IM</td>
<td>24</td>
<td>pm</td>
</tr>
<tr>
<td>Interferon-α</td>
<td>2.5 x 10^6</td>
<td>IV</td>
<td>24</td>
<td>pm</td>
</tr>
</tbody>
</table>

IM: Intramuscular; IV, intravenous; PO, by mouth, prn, as needed; SC, subcutaneous.

*Dosage per administration and specified interval. For additional information on these drugs, see the Drug Formulary in the Appendix.

*Should not be given in conjunction with other mitotic inhibitors.

*Total dose must not exceed 1 to 2 mg/kg/day; this dose may be divided as multiple bolus infusions throughout the day.

*Renal function (blood [percut] urea nitrogen, urine creatinine should be closely evaluated, and the drug should not be continued for longer than 7 to 10 days at this dose.
Treatment

From Sykes’ *Canine and Feline Infectious Diseases*

- Ideally hospitalized in isolation
- Most critical = appropriate fluid therapy and maintenance of blood glucose concentrations
- Antimicrobial drug or drug combination with activity against gram-negative and anaerobic bacteria should be administered parenterally

**TABLE 14-4**

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose (mg/kg)</th>
<th>Route</th>
<th>Interval (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ampicillin sodium</td>
<td>20</td>
<td>IV</td>
<td>6</td>
</tr>
<tr>
<td>Cefazolin sodium</td>
<td>20</td>
<td>IV</td>
<td>8</td>
</tr>
<tr>
<td>Enrofloxacin*</td>
<td>5</td>
<td>IV</td>
<td>24</td>
</tr>
<tr>
<td>Ondansetron</td>
<td>0.5 to 1</td>
<td>IV</td>
<td>12</td>
</tr>
<tr>
<td>Maropitant citrate</td>
<td>1</td>
<td>SC</td>
<td>24</td>
</tr>
<tr>
<td>Metoclopramide</td>
<td>1-2 mg/kg/d</td>
<td>IV</td>
<td>CRI</td>
</tr>
<tr>
<td>Famotidine</td>
<td>0.5</td>
<td>IV</td>
<td>12 to 24</td>
</tr>
</tbody>
</table>

CRI, Constant-rate infusion.
*Has been associated with cartilage injury in growing animals. Prolonged use (>7 days) is not recommended. See Chapter 8.
Treatment

From Miller and Hurley’s *Infectious Disease Management in Animal Shelters*

- Need to balance cost of treatment, risk to population and prognosis

- Important principles
  - Restoration of fluid loss
    - % Dehydrated x body weight (kg) = liters to replace
    - Plus ongoing losses and maintenance
  - Prevention of bacterial infection
    - Broad-spectrum antibiotics
  - Control of emesis
  - Palpation to rule out intussusception
  - All medications administered parentally for first few days
    - Intestinal lesions and V/D will decrease absorption
  - NPO cats for first 24 hours
Treat for pain

- Cerenia™
- Opioids
- NSAIDS
  - Increased risk of Cerenia™ side effects with NSAID use
  - Risk of ulceration
  - Ensure hydration prior to administration
Dewormer

- Intestinal parasites may exacerbate clinical signs
- Balance benefit of treatment with stress/vomiting
  - Panacur
  - Ponazuril
  - Consider topical treatment - e.g. Revolution
Monitoring

- Pain
- General welfare
  - Attitude
  - Comfort
  - Cleanliness
- Food intake
  - Easier with canned food
- Hydration
- Temperature

- Total protein
- PCV
- CBC
- +/-Fecal float
  - Best to empirically de-worm
Treatment option

Evaluation of an Outpatient Protocol in the Treatment of Canine Parvoviral Gastroenteritis

K. Preisner (vet student); Lauren Sullivan (ACVECC); Pedro Boscan (DVM); David Twedt (ACVIM)Department of Clinical Sciences, Colorado State University, Fort Collins CO, USA
Study Design

- Prospective randomized trial
- 40 naturally infected dogs
  - No vaccination history
  - No previous treatment
  - Parvo ELISA Snap Positive
  - Client consent
- IV fluids (with dextrose) & heat support upon enrollment
- Randomized into inpatient (n=20) or outpatient (n=20) treatment group
Treatment Protocols

Inpatient

- Continuous IV fluids
- Enteral nutrition
- maropitant (1 mg/kg IV q24 h)
- cefoxitin (22 mg/kg IV q8 h)
  - Mefoxin (Merck)

Outpatient

- SQ fluids TID (40 ml/kg)
- Enteral nutrition
- maropitant (1 mg/kg SC q24 h)
- cefovicin (8 mg/kg SQ once)
  - Convenia (Zoetis)
Parameters

- Clinical severity scoring
- Body weight
- CBC & Chem
- Frequency of vomiting
- Caloric intake
- Hydration status
- Visceral pain and nausea scoring
- Length of hospitalization
Results

- No difference between the groups for all parameters
- Survival rate
  - 18/20 inpatients (90%)
  - 16/20 outpatients -
    - 3 died, 1 moved to inpatient when condition deteriorated (85%)
  - Not significant
New Protocol Gives Parvo Puppies a Fighting Chance When Owners Can't Afford Hospitalization

Canine parvovirus is a serious and often fatal viral illness that most commonly affects puppies, though unvaccinated adult dogs can be infected as well. While treatment for parvovirus is available, it can be cost prohibitive for many families. Now, a new protocol developed at the Colorado State University Veterinary Teaching Hospital may help save “parvo puppies” and give their families a chance to give their dogs a healthy life.

“Parvovirus is one of the most common and deadliest viruses that unvaccinated dogs tend to get,” said Dr. Lauren Sullivan, an Assistant Professor in the Department of Clinical Sciences and a veterinarian with the Critical Care Unit at the Veterinary Teaching Hospital. “While a vaccine is available, puppies can be exposed to the disease before their vaccinations are complete, or if they haven’t received puppy wellness care due to their owner’s financial limitations.”

Parvovirus, which is spread through exposure to feces from infected dogs, has a wide range of symptoms including lethargy, vomiting, fever, and diarrhea. It primarily impacts the gastrointestinal tract and the circulatory system, where it suppresses the bone marrow and causes the white blood cell count to drop. Veterinary care focuses on supporting the puppy with IV fluids and antibiotics, and close monitoring, while the puppy weathered the viral storm. Without intensive veterinary intervention, parvovirus is almost always fatal due to dehydration and/or a severely compromised immune system.

Intervention, while effective, requires inpatient care ranging from $1,500 to $3,000 – a cost some owners simply can’t afford. Euthanasia often becomes the only other option for severely affected dogs.

Feed dogs early

Effect of early enteral nutrition on intestinal permeability, intestinal protein loss, and outcome in dogs with severe parvoviral enteritis

“Feeding dogs via NG tube from first day of treatment shortened their recovery time and maintained body weight compared to dogs that were NPO until vomited stopped.”

- Earlier clinical improvement
- Significant weight gain
- Improved gut barrier function, which could limit bacterial or endotoxin translocation

Antibodies from plasma?

Clinical evaluation of a single dose of immune plasma for treatment of canine parvovirus infection

- Dogs with naturally occurring CPV enteritis
- Single 12-mL IV dose of immune plasma within 18 hours of being admitted to the hospital
- Not effective in ameliorating clinical signs, reducing viremia, or hastening hematologic recovery
- Too small a dose?
- Administered too late?
- Just not needed?
  - Most animals who will survive do respond to the virus with a significant antibody response but in pups with clinical signs this happens after infection and development of clinical signs

# CPV Cost Calculator

<table>
<thead>
<tr>
<th>Treatment scenario calculator:</th>
<th>Baseline</th>
<th>Scenario 2</th>
<th>Scenario 3</th>
<th>Scenario 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment budget (optional)</td>
<td>100000</td>
<td>100000</td>
<td>100000</td>
<td>100000</td>
</tr>
<tr>
<td>Treatment cost</td>
<td>5000</td>
<td>2000</td>
<td>1000</td>
<td>100</td>
</tr>
<tr>
<td>Survival rate</td>
<td>85%</td>
<td>80%</td>
<td>75%</td>
<td>50%</td>
</tr>
<tr>
<td>Parvo rate in transfers</td>
<td>50%</td>
<td>20%</td>
<td>20%</td>
<td>20%</td>
</tr>
<tr>
<td>Euth rate if not transferred</td>
<td>80%</td>
<td>80%</td>
<td>75%</td>
<td>50%</td>
</tr>
<tr>
<td>Average cost per life saved/no transfer</td>
<td>5882</td>
<td>2500</td>
<td>1333</td>
<td>200</td>
</tr>
<tr>
<td>Average cost per life saved/transfer</td>
<td>1176</td>
<td>338</td>
<td>190</td>
<td>40</td>
</tr>
<tr>
<td>Ratio of lives saved compared to baseline</td>
<td>1</td>
<td>3</td>
<td>6</td>
<td>29</td>
</tr>
<tr>
<td># of lives saved within parvo budget</td>
<td>85</td>
<td>296</td>
<td>525</td>
<td>2500</td>
</tr>
</tbody>
</table>
Don’t under-estimate

- Need for veterinary involvement
- Need for nursing care
- Need for excellent sanitation
- Difficulties maintaining isolation
- Need to protect general population
True Isolation
Post-treatment, now what?

- Follow the protocol
- Clinical signs have resolved
  - Negative ELISA test
  - Thorough bathing, including toenails
- Move them out
- What about vaccination?
  - Return to regular vaccination schedule as soon as completely recovered from clinical signs
- Kittens may have diarrhea for weeks-months
  - Not persistent infection
  - Due to extensive intestinal epithelial damage/fibrosis
Transferring juveniles

Making it not so scary...
Puppy Intake Program (Pre Oct 2012)

- All puppies quarantined for 14 days before moving on through spay/neuter and adoption
- Puppy housing in old building. Harder to clean, not all runs have dedicated drains.
- Puppy foster program and puppy socialization volunteer protocols not yet ironed out
- All parvo positive puppies treated
- $3500 average cost/puppy......likely about 95% survival
Puppy Intake Program (Oct 2012)

- No Puppy Left Behind – actively source from high risk shelters
- Each puppy gets bathed & titer tested (VacciCheck) within 24 hours of intake, initial housing is in ‘2412’
- Parvo titer negative puppies are moved to ‘2418’ for a 10-day quarantine (previously was a 14-day quarantine)
- Parvo titer positive puppies are moved to ‘2416’ for a 2-day quarantine and can then immediately move to spay/neuter and adoption
- Increased recruitment and training of puppy foster volunteers and in-shelter puppy socialization volunteers for 2418
Biogal Canine Vaccichek

Dark color change denotes PAT
Running the Canine VacciCheck Test

Dr. Ronald Schultz
Professor and Chair
Department of Pathobiological Sciences
School of Veterinary Medicine
University of Wisconsin - Madison

Manufacturer:
Biogal Galed Labs
www.biogal.co.il

Demonstration given by Bliss Thiel

Running Canine VacciCheck Test

http://www.youtube.com/watch?v=wQ4o6gFzqiw
- Total dogs = 917
- Test results show an almost even 50/50 split between positive & negative results
38 confirmed parvo cases among titered puppies
- 36 had initial negative parvo titers
- 2 had initial positive parvo titers
  - Tiffany (parvo titer score 3) and Stephanie (parvo titer score 5) from Merced, broke with parvo 6 days after intake
  - Came in with a group of 8 puppies total. Two other puppies in group, Bobby and Peter (negative parvo titer scores), broke with parvo 3 weeks after intake

By intake source: Merced (42%), Stockton (47%) and San Francisco ACC (11%)

Parvo cases now have new ‘parvo bag’ treatment
- $1500/case with same survival (95%)
What That Really Means

- 428 puppies potentially to adoption floor in 4 days
- Major cost savings as well as socialization benefits
- Can better predict where parvovirus will emerge
- Volunteer resources more targeted
- Don’t get careless with puppies who have positive titers…
- Could use the data to target transfers by source, time of year, likelihood of parvo cases etc.
- Puppy enrichment continues to be priority
- We can save more lives!
No Puppy Left Behind

- Goal - transfer in MORE puppies!
- All healthy litters are transferred
- Titer testing balances:
  - quarantine length to catch virtually all cases of CPV in high risk puppies
  - moving low risk puppies through rapidly
No Puppy Left Behind

If titer positive:

- Bathe upon intake if transferred from a very high risk environment (shelter where frequent CPV is seen) or known recent exposure
- Schedule surgery after 48 hours and move to adoption
- Continue with their vaccination schedule and use current protocol for handling
If titer negative - determine desired quarantine length:

- 7 day quarantine
  - will pick up a large percentage of puppies that will break with CPV

- 10 day quarantine
  - will pick up the vast majority
  - decreased risk of puppies breaking post adoption

- 14 day quarantine = least risk
  - will pick up almost all puppies that are going to break
  - The quarantine can be completed in reliable, trusted foster homes
  - If foster homes are not available, quarantine puppies in the double sided run designated for puppies
Testing all juveniles?

- High predictive value when used on animals with clinical signs
- Can be helpful to screen very high-risk
  - Example - littermates/kennelmates of affected animals
- Frequency of **FALSE POSITIVES** increases when testing animals without clinical signs that are not high-risk
- Resource-intensive strategy
- Not recommended
Required two week holding?

- Leaves the animal in the high risk environment
- Better to get them out ASAP
Outbreak Management/Risk Assessment
Management vision

- Screen on intake
- Vaccinate on intake
- Clean, disinfected kennels
- Capacity for care
- Close, daily monitoring
- Special protection for juveniles
  - Double-sided housing
  - Short LOS
- Testing when needed
- Response when needed
- Real isolation for treatment
Response: General Principles

- Stop the cycle of transmission
  - Isolate or separate sick animal
  - Identify and quarantine susceptible animals

- Send low risk animal on their way

- Provide for sick animals
  - Treat if appropriate
    - Adoptability
    - Isolation
    - Risk to rest of population
    - Resources
Evaluate Clinical Signs

- Carefully evaluate each animal
- ANY suspect clinical signs = high risk
  - Unexplained GI disease
  - Not eating
  - Lethargic/weak
  - “ADR”
- Assessment by veterinarian to rule out clinical signs
Evaluate individual risk

- Determine high risk and low risk groups
- Antibodies vs. vaccine history
- In-house antibody testing
  - Faster
  - Positive / Negative
  - Cannot use on animals with clinical signs
- Diagnostic Lab testing
  - More quantifiable
  - Longer turn around
  - Best if validated against challenge data
Risk evaluation: juveniles

- Parvo snap test for very high risk (littermates, closely exposed, widespread outbreak)
- Titer test
- Minimize movement, full body protection *per animal* when testing
  - Tyvek painting suits (hardware store)
  - Gloves
  - Shoe covers
Antibody testing

- ~$10 - $20 per test
  - Cheaper than quarantine
- Positive is good
  - Low risk is not no risk
  - High risk does not mean doomed
- Vaccicheck
  - Semi-quantitative results in about 20 min.
  - 12 tests / comb
Positive Titer = Low Risk

- Send them home
- Inform potential adopters
- Move as cohorts whenever possible
- Recombine with “clean” population?
Negative or Low Titer = High Risk

What to do?

Problems:
- Incubation period
- Ease of transmission
- Clinical signs overlap with other GI issues
- Susceptible puppies
Antibody Titers and Risk Assessment

<table>
<thead>
<tr>
<th>Clinical Signs</th>
<th>Titer Result</th>
<th>Age</th>
<th>Risk Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Don’t test</td>
<td>All</td>
<td>High</td>
</tr>
<tr>
<td>No</td>
<td>Negative</td>
<td>All</td>
<td>High</td>
</tr>
<tr>
<td>No</td>
<td>Positive</td>
<td>&lt; 5 months</td>
<td>Low*</td>
</tr>
<tr>
<td>No</td>
<td>Positive</td>
<td>Adults</td>
<td>Very Low</td>
</tr>
</tbody>
</table>

*Pups with in-house positive titers can only be considered low risk for short periods of time because MDAs are constantly declining.*
Parvo outbreak simulator

Parvo outbreak simulator

UC Davis Koret Shelter Medicine Parvo Simulator

<table>
<thead>
<tr>
<th>APRIL 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>12</td>
</tr>
<tr>
<td>19</td>
</tr>
<tr>
<td>26</td>
</tr>
</tbody>
</table>

Low risk exposure
Parvo outbreak simulator

Greetings and welcome to the world's first online parvo outbreak simulator (to the best of our knowledge). Each time you come to the page, the simulator will generate a new group of dogs representing a fairly typical population at an open intake shelter in the United States. As in real life, finances, space for quarantine and number of spaces available at your friendly local rescue groups are limited. But don’t worry - the simulator will always make sure there are enough spaces and sufficient funds for testing and treatment as long as you play the game correctly, and you earn back $50 in fees for every dog that gets to go up for adoption. To learn more about the simulator, risk assessment and outbreak management, review the Parvo Outbreak Simulator Guide at The Koret Shelter Medicine Program site.

When you arrive at work today (Wednesday, Apr 22), a shelter technician rushes up to you and tells you a dog in the adoption ward was diagnosed with parvo this morning. The dog had been in the shelter for 9 days, leading you to conclude that it most likely got infected during its shelter stay and that dogs in both the stray holding area and the adoption ward could have been exposed. Below is the census of dogs currently in these two wards. Fortunately, the staff at this shelter are very good about vaccinating immediately on intake, so it’s safe to assume the “date arrived” is the same as the date of vaccination. Based on the information about each dog below, choose a testing strategy and outcome for each dog. The goal of the game is to stay within budget, avoid euthanasia, and not place for adoption or send to rescue any dogs with parvo. Once you’ve selected a testing plan and action for each dog, click “show correct actions” to see what the simulator thinks of your choices. Unlike real life, you can hit refresh and try this as many times as you like.

<table>
<thead>
<tr>
<th>Patient</th>
<th>Date Arrived</th>
<th>Signalement</th>
<th>Clinical Signs</th>
<th>SNAP Test</th>
<th>Antibody Titer</th>
<th>Action</th>
<th>Correct Action</th>
<th>Animal Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case 1</td>
<td>4/20</td>
<td>Adult</td>
<td>GI Signs</td>
<td>Run Test $15</td>
<td>Run Test $15</td>
<td>SELECT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case 2</td>
<td>4/3</td>
<td>Adult</td>
<td>GI Signs</td>
<td>Run Test $15</td>
<td>Run Test $15</td>
<td>SELECT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case 3</td>
<td>4/16</td>
<td>Adult</td>
<td>Healthy</td>
<td>Run Test $15</td>
<td>Run Test $15</td>
<td>SELECT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case 4</td>
<td>4/4</td>
<td>Adult</td>
<td>Healthy</td>
<td>Run Test $15</td>
<td>Run Test $15</td>
<td>SELECT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case 5</td>
<td>4/8</td>
<td>Puppy</td>
<td>Healthy</td>
<td>Run Test $15</td>
<td>Run Test $15</td>
<td>SELECT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case 6</td>
<td>4/16</td>
<td>Adult</td>
<td>Healthy</td>
<td>Run Test $15</td>
<td>Run Test $15</td>
<td>SELECT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case 7</td>
<td>4/7</td>
<td>Adult</td>
<td>Healthy</td>
<td>Run Test $15</td>
<td>Run Test $15</td>
<td>SELECT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case 8</td>
<td>4/3</td>
<td>Adult</td>
<td>Healthy</td>
<td>Run Test $15</td>
<td>Run Test $15</td>
<td>SELECT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case 9</td>
<td>4/13</td>
<td>Adult</td>
<td>Healthy</td>
<td>Run Test $15</td>
<td>Run Test $15</td>
<td>SELECT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case 10</td>
<td>4/8</td>
<td>Adult</td>
<td>Healthy</td>
<td>Run Test $15</td>
<td>Run Test $15</td>
<td>SELECT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case 11</td>
<td>4/20</td>
<td>Adult</td>
<td>GI Signs</td>
<td>Run Test $15</td>
<td>Run Test $15</td>
<td>SELECT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case 12</td>
<td>4/22</td>
<td>Adult</td>
<td>Healthy</td>
<td>Run Test $15</td>
<td>Run Test $15</td>
<td>SELECT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case 13</td>
<td>4/7</td>
<td>Puppy</td>
<td>GI Signs</td>
<td>Run Test $15</td>
<td>Run Test $15</td>
<td>SELECT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case 14</td>
<td>4/19</td>
<td>Adult</td>
<td>Healthy</td>
<td>Run Test $15</td>
<td>Run Test $15</td>
<td>SELECT</td>
<td></td>
<td></td>
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</table>
Parvo outbreak simulator

Adoption or send to rescue any dogs with parvo. Once you've selected a testing plan and action for each dog, click "show correct actions" to see what you can do. You can hit refresh and try this as many times as you like.

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<tr>
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<td>4/20</td>
<td>Adult</td>
<td>GI Signs</td>
<td>Negative</td>
<td>Run Test $15</td>
<td>Quarantine</td>
<td>Quarantine (SNAP)</td>
<td></td>
</tr>
<tr>
<td>Case 2</td>
<td>4/3</td>
<td>Adult</td>
<td>GI Signs</td>
<td>Negative</td>
<td>Run Test $15</td>
<td>Quarantine</td>
<td>Quarantine (SNAP)</td>
<td></td>
</tr>
<tr>
<td>Case 3</td>
<td>4/16</td>
<td>Adult</td>
<td>Healthy</td>
<td>Positive</td>
<td>Run Test $15</td>
<td>Adopt</td>
<td>Adopt (Titer)</td>
<td></td>
</tr>
<tr>
<td>Case 4</td>
<td>4/4</td>
<td>Adult</td>
<td>Healthy</td>
<td>Positive</td>
<td>Run Test $15</td>
<td>Adopt</td>
<td>Adopt (Titer)</td>
<td></td>
</tr>
<tr>
<td>Case 5</td>
<td>4/8</td>
<td>Puppy</td>
<td>Healthy</td>
<td>Negative</td>
<td>Run Test $15</td>
<td>Quarantine</td>
<td>Quarantine (SNAP &amp; Titer)</td>
<td></td>
</tr>
<tr>
<td>Case 6</td>
<td>4/16</td>
<td>Adult</td>
<td>Healthy</td>
<td>Positive</td>
<td>Run Test $15</td>
<td>Adopt</td>
<td>Adopt (Titer)</td>
<td></td>
</tr>
<tr>
<td>Case 7</td>
<td>4/7</td>
<td>Adult</td>
<td>Healthy</td>
<td>Positive</td>
<td>Run Test $15</td>
<td>Adopt</td>
<td>Adopt (Titer)</td>
<td></td>
</tr>
<tr>
<td>Case 8</td>
<td>4/3</td>
<td>Adult</td>
<td>Healthy</td>
<td>Positive</td>
<td>Run Test $15</td>
<td>Adopt</td>
<td>Adopt (Titer)</td>
<td></td>
</tr>
<tr>
<td>Case 9</td>
<td>4/13</td>
<td>Adult</td>
<td>Healthy</td>
<td>Positive</td>
<td>Run Test $15</td>
<td>Adopt</td>
<td>Adopt (Titer)</td>
<td></td>
</tr>
<tr>
<td>Case 10</td>
<td>4/8</td>
<td>Adult</td>
<td>Healthy</td>
<td>Positive</td>
<td>Run Test $15</td>
<td>Adopt</td>
<td>Adopt (Titer)</td>
<td></td>
</tr>
<tr>
<td>Case 11</td>
<td>4/20</td>
<td>Adult</td>
<td>GI Signs</td>
<td>Positive</td>
<td>Run Test $15</td>
<td>Treat</td>
<td>Treat (SNAP)</td>
<td>Parvo Positive</td>
</tr>
<tr>
<td>Case 12</td>
<td>4/22</td>
<td>Adult</td>
<td>Healthy</td>
<td>Negative</td>
<td>Run Test $15</td>
<td>Quarantine</td>
<td>Quarantine (Titer)</td>
<td></td>
</tr>
<tr>
<td>Case 13</td>
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<td>Puppy</td>
<td>GI Signs</td>
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<td>Adult</td>
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<td>Negative</td>
<td>Run Test $15</td>
<td>Quarantine</td>
<td>Quarantine (Titer)</td>
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<tr>
<td>Case 15</td>
<td>4/20</td>
<td>Puppy</td>
<td>Healthy</td>
<td>Negative</td>
<td>Run Test $15</td>
<td>Quarantine</td>
<td>Quarantine (SNAP &amp; Titer)</td>
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<tr>
<td>Case 16</td>
<td>4/3</td>
<td>Adult</td>
<td>GI Signs</td>
<td>Negative</td>
<td>Run Test $15</td>
<td>Quarantine</td>
<td>Quarantine (SNAP)</td>
<td></td>
</tr>
<tr>
<td>Case 17</td>
<td>4/10</td>
<td>Adult</td>
<td>GI Signs</td>
<td>Negative</td>
<td>Run Test $15</td>
<td>Quarantine</td>
<td>Quarantine (SNAP)</td>
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<tr>
<td>Case 18</td>
<td>4/4</td>
<td>Adult</td>
<td>Healthy</td>
<td>Negative</td>
<td>Run Test $15</td>
<td>Adopt</td>
<td>Adopt (Titer)</td>
<td></td>
</tr>
<tr>
<td>Case 19</td>
<td>4/17</td>
<td>Puppy</td>
<td>Healthy</td>
<td>Negative</td>
<td>Run Test $15</td>
<td>Quarantine</td>
<td>Quarantine (SNAP &amp; Titer)</td>
<td></td>
</tr>
<tr>
<td>Case 20</td>
<td>4/14</td>
<td>Adult</td>
<td>Healthy</td>
<td>Negative</td>
<td>Run Test $15</td>
<td>Adopt</td>
<td>Quarantine (Titer)</td>
<td></td>
</tr>
</tbody>
</table>

Please review the 'Correct Actions' and 'Animal Status' and bask in your glory as a Shelter Veterinarian.
**Risk Assessment of Exposed Animals**

**Clinical Signs?**
- **No**
  - Perform CPV Ab Titer
  - Negative → Low risk ≠ no risk!
  - Positive → Isolate and Treat
- **Yes**
  - Perform CPV ELISA
  - Negative → Isolate and Treat, Further diagnostics
  - Positive → Positive

**Positive**
- = 6 months (Adult)
  - Low risk: Adopt or transfer
- < 6 months (Puppy)
  - Moderate risk: Transfer or foster off-site, or Adopt w/ full disclosure

**LITTERMATES ??**
- Negative → Very High Risk: BATHE Quarantine for 14 days
- Positive → Low risk: Adopt or transfer

**High risk: Quarantine for 14 days**
Quarantine

- Consider impact on capacity and crowding
- General rule is 14 days - lowest risk
- Helpful to divide up litter into smaller groups
  - 2 ideal
  - Helps to limit exposure
  - Separate PPE & equipment for each housing unit
- If one animal breaks, quarantine has to restart for all exposed
- Need to use a disinfectant effective against un-enveloped viruses
- Frequent challenge is not having enough space
  - May need to happen outside the facility
    - Foster home
    - Veterinary clinic
- A blanket quarantine for all animals entering a facility is *not* recommended
Separate Equipment
Can you safely send them somewhere else?

- Prioritize healthy high risk dogs
- **What is safe?**
  - Well vaccinated adult dogs
  - Resilient humans
  - No puppies in the house
  - No uninformed adopters
Management summary

- Not exposed $\rightarrow$ segregate and adopt/transfer
- Clinically ill $\rightarrow$ test, strict isolation, treatment
- Potentially exposed, positive PAT $\rightarrow$ bathe, segregate, and adopt
- Potentially exposed, negative PAT $\rightarrow$ bathe, quarantine and monitor, revaccinate, prevent new exposure, bathe at the end of quarantine
- Clinically recovered $\rightarrow$ quarantine until shedding stops, bathe, adopt out
Finally set up a “clean break”

- New, incoming dogs must be separated from exposed dogs
- Clean and disinfect the area first
- Evaluate expected intake
- Plan co-mingling
- Clean and care for new arrivals first
- Separate staff if possible
Stop the cycle

New Incoming dogs

Exposed population
Parvovirus Summary

- Parvovirus is one of the most preventable infectious diseases we battle
- Prevention is a community responsibility
- Do not wait for an outbreak to put good practices in place
- Help work toward a community solution
Thank you!

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