Canine Parvovirus

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"Saving Lives and Stomping Out Disease"

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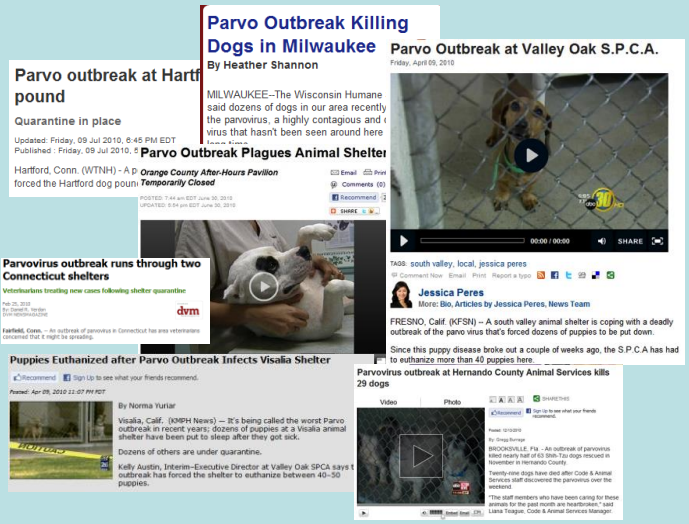


1978-1979

- CPV-2 first reported
- Word-wide spread was rapid
- Intense collaborative research efforts
- Effective vaccines were developed fairly quickly
- Spread was slowed

Carmichael LE. An annotated historical account of canine parvovirus. J Vet Med B Infect Dis Vet Public Health. 2005 Sep-Oct;52(7-8):303-11.

PARVO 101

- Un-enveloped double stranded DNA virus
  - Hard to kill
  - Persists for months-years
- Antigenically stable
  - Vaccines generally work well
  - Strain variation is small
  - CPV-2→ 2a, 2b, 2c
  - Variations in incubation, clinical manifestation
  - *Basic control and treatment remain the same so far*
- Targets rapidly dividing cells

Tools for management

- Recognition
- Vaccination
- Disinfection
- Risk assessment and quarantine
- Treatment

Transmission

- Shed in feces, vomit
- Very easily spread by fomites
- Fur, feet, arms, hands, clothing, equipment, common walkways and play areas

What's wrong with this picture?

Clinical signs

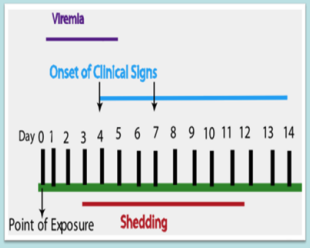
- Vomiting, diarrhea
  - Not always severe
  - Not always caused by parvo
- Myocarditis/sudden death in pups < 8 weeks old
- Subclinical or mild signs possible with age or partial protection (e.g. parvo littermates)

Who?

- Any age dog can be affected!
- Puppies 6 weeks to 6 months most susceptible
- No predictable breed predilection
- All susceptible dogs
  - Any unvaccinated dog
  - Any dog with no previous exposure

Course of disease

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

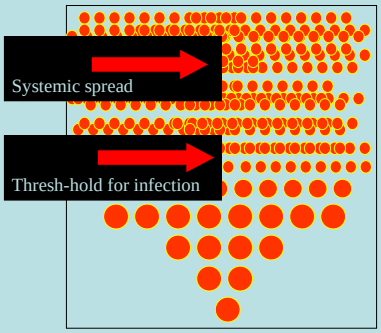


Shifting Genotypes

Research project Number	Breed	Age	Vx'd on intake	Reverse Seq. highest homology match (strain)
1	Min Pin		Yes	2C (GR09/09) (96%)
2	Pit	6m	Yes	(CPV310/TW06) (97%)
3	Chi	3m		
4	Pit	2m	arrived with Parvo	2C (GR09/09) (94%)
5	Chi	6m	Yes	2C (GR09/09) (98%)
6	Chi	8m		
7	Shep	pup	No	(CPV310/TW06) (95%)
8	Maltese	6m		2C (110/07-27) (96%)
9	Maltese	6m		
10	Pit	3.5m	Yes	2C (GR09/09) (96%)
11	Pit	6m		2C (GR09/09) (97%)
12	Pit	6m		2C (GR09/09) (96%)
13	Chi/Pit	2.5m		2C (GR09/09) (96%)
14	Pit	4m		2C (GR09/09) (95%)
15	Pit	adult	Yes	2C (GR09/09) (98%)
16				2C (GR09/09) (96%)
17				2A (3625-2) (96)

Dose effect

- Greater likelihood of infection
- Shorter time to onset
  - Less chance for vaccine to protect
- More severe disease



Vaccination and Immunity

Some good news

"Dogs vaccinated with modified live CPV developed high hemagluttination inhibition titers within four days of inoculation and antibody persisted."

- Carmichael, L. E., J. C. Joubert, et al. (1983). "A modified live canine parvovirus vaccine with novel plaque characteristics. 1. Viral attenuation and dog response." Cornell Vet 73(1): 13-29.

CPV / CDV Susceptibility

Age	CPV	CDV
7yr 0mo	+	+
1yr 4mo	+	+
6yr 7mo	+	+
0yr 11mo	+	-
1yr 7mo	+	+
5yr 1 mo	+	+
4yr 0mo	+	+
0yr 5mo	+	+
0yr 6mo	+	+
1yr 7mo	+	+
1yr 8mo	+	+
3yr 3mo	-	+
2yr 1mo	+	+
1yr 1mo	+	+
1yr 1mo	+	+
0yr 5mo	-	+

- Varies by community
- Varies by organization

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)

Challenge viruses	*Number of dogs per group*	*Years since last vaccine given (average)*	*Type of CPV-2 vaccine component*	*CPV titre at PC Day 0 (average log2)*	*CDV titre at PC Day 0 (average log2)*	*Age at challenge in years: range and (average)*	*Outcome (% protection)*
CDV-SH, CPV-2b	10	4.5	CPV-2	6.3	6.6	4–8 (6.2)	100
CDV-SH, CPV-2c	10	5.5	CPV-2	7.5	8.4	5–9 (6.8)	100
CDV-SH, CPV-2c	10	5.9	CPV-2a	7.8	8.3	7–8 (7.3)	100
CDV-SH, CPV-2c	10	4.8	CPV-2	8.2	5.1	5–9 (6.8)	100

SH, Synder Hill strain; PC, post challenge.

Schultz et al. "Age and long-term Protective Immunity in Dogs and Cats" Journal of Comparative Pathology 2010 Vol. 142, S102-S108

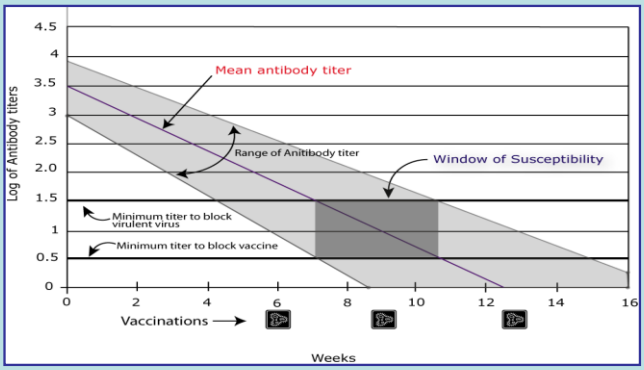
Vaccination for parvo

- Modified live
- Works in most dogs within 3-5 days without booster
- Safe in puppies ≥ 4 weeks
- Maternal antibodies may be a problem in puppies < 20 weeks
  - Or they may not be!

Shelter parvo vaccine protocol

- SC DHPP (DA2PP)
- Immediately on intake if not sooner
- Adults once at intake
  - Repeat once after 2 weeks if in doubt
- Puppies every 2 weeks while in shelter
- Last vaccine at 18-20 weeks

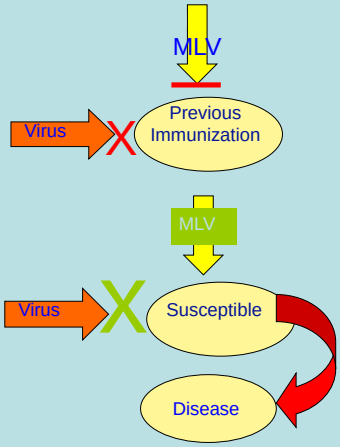
The problem



Pregnancy and Lactation

- No increased risk during lactation!
- VACCINATE!

- Risk during pregnancy?
  - Weigh the risks.
  - Vaccine virus vs. Virulent virus



Balancing protection and socialization

- 3-13 weeks is key socialization period
- Minimize time in shelter: quarantine only for super high risk puppies
- Visit with puppies in their kennel or in easily disinfected areas
- Dedicated clothing and footwear per puppy pen
- 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

Foster Care

Testing and Diagnosis

Parvo "snap test"

- False negatives
  - Variable shedding
  - Fairly uncommon in first few days of disease
  - ~ 80% sensitivity for all current strains
- False positives very uncommon with Idexx brand test
- Maybe rare weak positive 3-14 days after vaccination

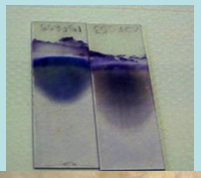
Idexx testing and 2c

- Fecal parvo ELISA SNAP test detected all current isolates including 2c
- Also detects FPV isolates from the 1960s through to current isolates
- Virus is shed sporadically and was present as early as 3 days post challenge in dogs, 5 days in cats

Evaluation of a CPV-2 Fecal Parvovirus ELISA (SNAP Fecal Parvo test) from Idexx Laboratories. Larson, Quesada, Mukater, Krygowska, and Schultz UW Madison - CRWAD

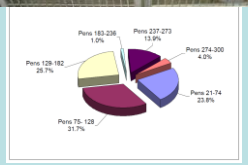
Other testing

- Blood smear
  - Panleukopenia
  - Profound neutropenia
  - Leukocytosis possible early
- Necropsy
  - Segmental enteritis
- PCR
  - Vaccine induced positive more likely
  - Only way to determine strain
- Histopathology = gold standard



Recognizing parvo

- Intake testing of sick/high risk puppies
- Daily formal rounds
  - More often during 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



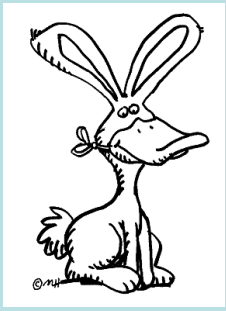
Source of disease?

ACR	Breed	Age	Arrived	DX	Parvo tested
24641	Min Pin		10/3/09	10/4/09	+
24632	Pit	6mo	9/30/09	10/1/09	+
no	Chi	3mo			+
27277	Pit	2mo	10/9/09	10/9/09	+
18313	Chi	6mo	10/3/09	10/4/09	
24097	Chi	8mo	10/4/09	10/4/09	+
27103	Shep	pup	10/11/09	10/11/09	+
24645	Maltese	6mo	10/5/09	10/5/09	+
24644	Maltese	6mo	10/5/09	10/5/09	+
30497	Pit	3.5 mo	10/5/09		
no	Pit	6mo			
no	Pit	6mo			
no	Chi/Pit	21/2 mo			
no	Pit	4mo			+
24210	Pit	adult	10/16/09	10/18/09	+

Outside the box?…

- Look further…
- Dogs over 5 months vaccinated over 7 days ago
- Normal control measures fail
- Histopathology

- Sheltermedicine@ucdavis.edu



Sanitation and Disinfection

Environmental decontamination?

*"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*

Why wait?

- No way to out wait parvo
- Kill the virus
- Repeated mechanical removal

- Foster homes
- Contaminated areas

Parvo 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 ilk
  - Wysiwash®
  - Bruclean®
- Trifectant/Virkon-S®
- Accelerated hydrogen peroxide (e.g. Accel TB®)
- Prolonged high heat (> 120 ° F for 30 min)
- +/- careful mechanical cleaning and thorough drying

- NO ☹
- Quaternary ammonium compounds
- Chlorhexidine (Nolvasan®)
- Alcohol
- Time
- Freezing

Bleach Basics

- ½ cup per gallon of 5% household bleach
- Store in light proof container
  - Undiluted stable for at least 200 days
  - Diluted stable at least 30 days??
- Apply to pre-cleaned surface
- Trifectant or Accel TB for organic matter (e.g. play yards), rough surfaces

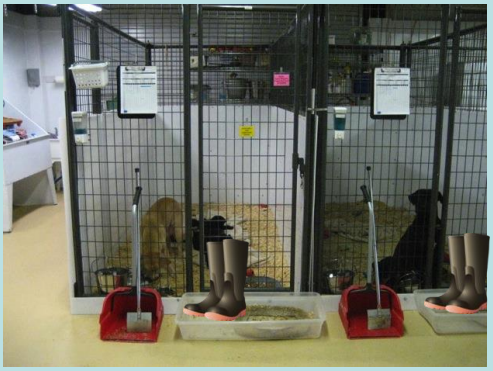
Cleaning procedures

- Minimize run entry
- If you have them, use double sided runs for one dog only
- If you must, *must* double up, two compatible dogs per run less harmful than moving dogs all over
- Move down one if you don't have double sided

Don't rely on footbaths

Stockton, K. A., P. S. Morley, et al. (2006). "Evaluation of the effects of footwear hygiene protocols on nonspecific bacterial contamination of floor surfaces in an equine hospital." J Am Vet Med Assoc 228(7): 1068-1073.

Separate Equipment



Outdoor spaces

- No puppies on grass in shelters
- Ideally foster homes set aside paved or limited areas for pups for 2 weeks out of shelter
- Trifectant/Virkon-S or Accel TB
- Irrigation and drying
- Close to puppies for 1 to 6 months if problem in homes
  - Longer if dark and moist
  - Keep puppies confined to clean areas of yard

Indoor spaces

- Launder or discard heavily contaminated items
- Careful mechanical cleaning
- Accelerated hydrogen peroxide and potassium peroxymonosulfate can be used for carpet sanitation
- Repeat depending on environment
- Limit puppy access for 1-3 months (longer if repeated problems or severe contamination)

Cleaning animals

- Coats can be heavily contaminated
- Most important for exposed, not yet sick puppies < 5 months
- Consider when moving recovered dogs out of isolation into shelter population
- Mechanical or topical parvocidal e.g. accelerated hydrogen peroxide
  - No need to bleach the puppies
- Wear protective clothing and prevent fomite transmission during bathing

Outbreak management

Management vision

- ✓ Screen on intake
- ✓ Vax on intake
- ✓ Clean, disinfected kennels
- ✓ Close, daily monitoring
- ✓ Special protection for babies
  - ✓ Double-sided housing
  - ✓ Short LOS
- ✓ Testing when needed
- ✓ **Response** when needed
- ✓ Real isolation for treatment

Post-exposure response: when is it necessary?

Population risk

- Daily disinfection of all areas, vehicles, etc.?
- Disinfectable environment?
- Cage movement/cleaning process?
- Crowding?
- Monitoring?
- Testing frequency?
- Degree of observed spread?

Individual risk

- Vaccination history
  - > 8 days pre-exposure?
- Age
  - < 5 months always greater risk
- Proximity/relation
  - Littermates at highest risk but still may not get sick

Risk Evaluation: Adults

JANUARY 2007

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
1 Intake	2 Intake	3 Intake	4 Intake	5 Intake	6 Intake	7 Intake
8 Intake 1	9 Intake 2	10 Intake 3	11 Intake 4	12 Intake 5	13 Exposure	14 7
15 8	16 Test +	17	18	19	20	21

- Adult dogs vaccinated a minimum of 5 days prior to the estimated time of **first exposure** of parvovirus are Low Risk.
- Adult dogs vaccinated a minimum of 8 days prior to the **first case breaking with clinical signs** are Low Risk.
- Shedding precedes clinical signs by up to 3 days.

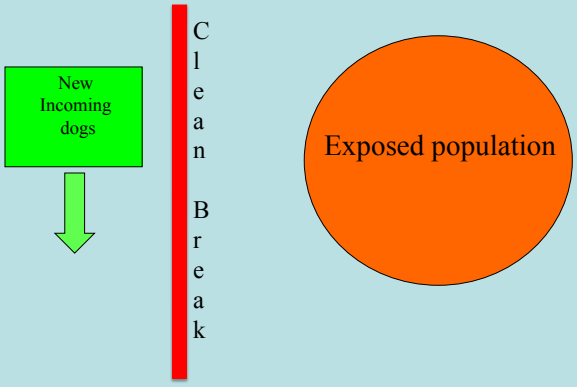
Response: General Principles

- ✓**Stop the cycle of transmission**
  - ✓Isolate or separate sick dogs
  - ✓Identify susceptible dogs
- ✓**Send low risk dogs on their way**
- ✓**Provide for sick dogs**

Step one: 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

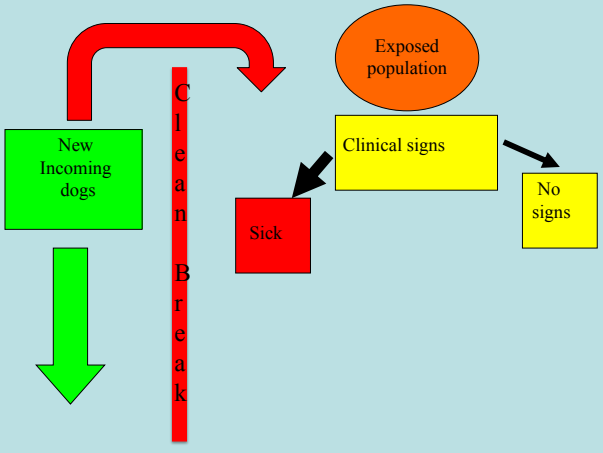
Stop the cycle



Step Two: Evaluate Clinical Signs

- Carefully evaluate each dog
- ANY suspect clinical signs = High Risk
  - Unexplained GI disease
  - Not eating
  - "ADR"
- Assessment by veterinarian to rule out clinical signs

Risk Evaluation Overview

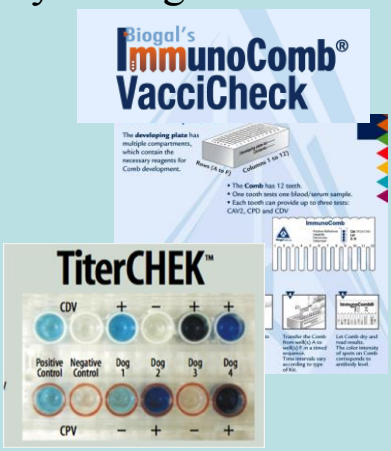


Step Three: Evaluate individual risk

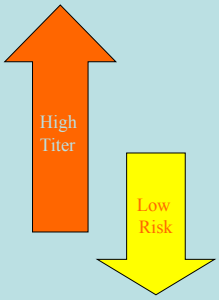
- High Risk and Low Risk groups
- Cannot evaluate dogs with clinical signs*
- Difficulties evaluating pups
- Antibodies vs. vax history
- In-house antibody testing
  - Faster
  - Positive / Negative
- Diagnostic Lab testing
  - More quantifiable
  - Longer turn around
  - Best if validated against challenge data

Antibody testing

- ~ $10 - $30 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

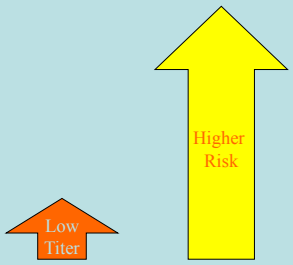


Positive Titer = Low Risk



- Send them home
- Inform potential adopters
- Move as cohorts whenever possible
- Recombine with "clean" population?

Negative or Low Titer = High Risk



- What to do?
- Remember this list?

Problems:

- Incubation period
- Ease of transmission
- Clinical signs overlap with other GI issues
- Susceptible puppies

Risk evaluation: puppies

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

Antibody Titers and Outbreak Risk Assessment

Clinical Signs	Titer Result	Age	Risk Category
Yes	Don't test	All	High
No	Negative	< 5 months	High
No	Positive	< 5 months	Low*
No	Positive	Adults	Very Low

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

TEST Interpretation

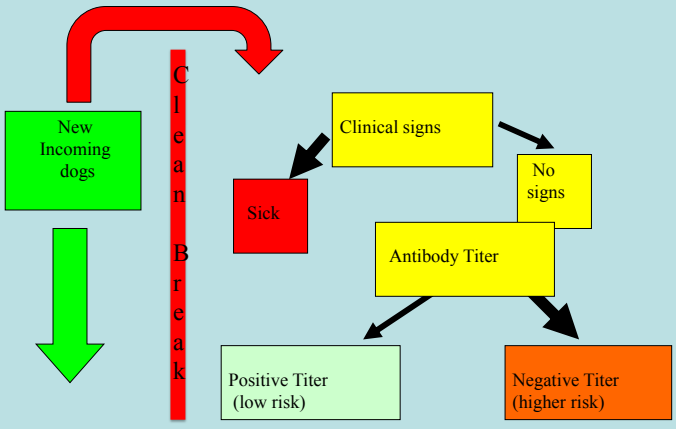
Age	CPV	CDV	Risk Category
7yr 0mo	+	+	Low
1yr 4mo	+	+	Low
6yr 7mo	+	+	Low
0yr 11mo	+	-	Low
1yr 7mo	+	+	Low
5yr 1 mo	+	+	Low
4yr 0mo	+	+	Low
0yr 5mo	+	+	Low
0yr 6mo	+	+	Low
1yr 7mo	+	+	Low
1yr 8mo	+	+	Low
3yr 3mo	-	+	High
2yr 1mo	+	+	Low
1yr 1mo	+	+	Low
1yr 1mo	+	+	Low
0yr 5mo	-	+	High
0yr 4mo	+	+	Low/Go
0yr 3mo	+	+	Low/Go

- Positive is **GOOD**
- Positive test in an adult dog with no clinical signs indicates **low risk**
- Low risk does not equal NO risk
- Negative test indicates high risk
- High risk does not equal disease
- Clinical signs means high risk

Antibody Titers and Outbreak Risk Assessment

	Dog #	CPV-2 HI Titer
1	24487	<20
2	24656	<20
3	30494	<20
4	31023	40
5	24607	80
6	24815	80
7	25006	80
8	26846	80
9	30103	80
10	24483	160
11	24814	160
12	21349	320
13	24011	320
14	24300	320
15	24510	320
16	25075	320
17	28525	320
18	28716	320
19	28761	320
20	24912-3	320
21	28721RSS	320
22	18665	640
23	24080	640
24	24200	640
25	24451	640
26	24525	640
27	24675	640
28	28722	640
29	30495	640
30	324321	640
31	19032	1280
32	19042	1280
33	21863	1280
34	23759	1280
35	23790	1280
36	24008	1280
37	24067	1280
38	24072	1280
39	24377	1280
40	24488	1280
41	24691	1280
42	24709	1280
43	24808	1280
44	25005	1280
45	30584	1280
46	18852	2560
47	18933	2560
48	21859	2560
49	24619	2560
50	24808	2560
51	24854	2560
52	24865	2560
53	24924	2560
54	28725	2560
55	30493	2560
56	24854	5120
57	26837	5120
58	24095	10240
59	24626	10240
60	26839	10240

Risk Evaluation Overview



Step Four: How high is high risk?

Population risk

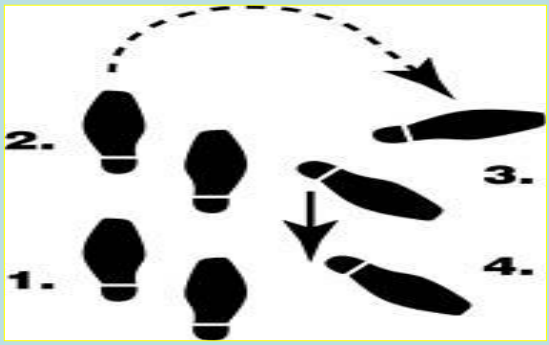
- Daily disinfection of all areas, vehicles, etc.?
- Disinfectable environment?
- Cage movement/cleaning process?
- Crowding?
- Monitoring?
- Testing frequency?
- Degree of observed spread?

Individual risk

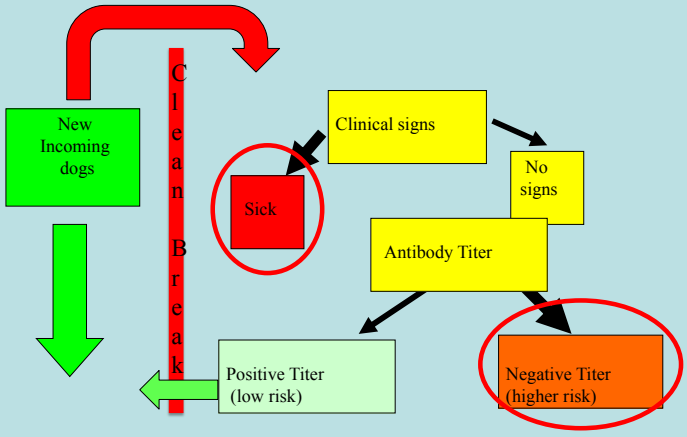
- Vaccination history
  - > 8 days pre-exposure?
- Age
  - < 5 months always greater risk
- Proximity/relation
  - Littermates at highest risk but still may not get sick

Remember these?

Step Five: Shuffle



Where to shuffle?



Quarantine?

- 14 day requirement
- Only those at risk makes it easier
- Can you really quarantine?
- What if one gets sick?
- Estimate population dynamics
- Consider impact on capacity and crowding
- Consider maintenance of health and emotional well-being

Post-exposure quarantine

- Revaccinate puppies if it's been greater than 14 days
- Consider revaccination for adults
- Repeat risk assessment and/or restart with new cases
- Bathe all puppies, adults if possible and replace into freshly disinfected runs
- Separate litters into pairs, house adults singly if possible

Quarantine and isolation requirements

- Limited personnel
- Separate supplies
  - Cleaning, feeding, exam
- Protective clothing
  - Gloves
  - Full body including *arms and legs*
  - Boots or shoe covers, *not foot baths*
  - Change between each puppy
  - Change at least before leaving building for adults

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

Transfer protocols?

- No Puppy Left Behind – SFSPCA
- Titers
- Antigen tests
- Minimize LOS
- 14 day intake quarantine only for high risk

Life or death decisions

- Risk evaluation often allows many (most) dogs to be saved.
- In some cases, when there is no safe alternative, euthanizing high risk dogs may actually save more lives in the end, by stopping the cycle of disease.
  - Less suffering
  - Rebuild trust in your community
    - Adopters
    - Rescue groups

Long-term outbreak prevention

- Part of daily planning
- Risk of introduction is constant
- Increased monitoring and screening
- Stick with what you know

Treatment

- Supportive care
  - **Hydration!!!**
  - Hygiene
- Prophylactic antibiotics
- Anti-emetics
- Transfusion
- Plasma
- IgG
- Not fasting
- Not tamiflu*

USE OF OSELTAMIVIR IN THE TREATMENT OF CANINE PARVOVIRAL ENTERITIS – Michelle Savigny

To treat or not to treat?

Consider risk to the individual and the group as a whole!!

- Likelihood of adoption
- Risk?
  - Herd Immunity?
  - Isolation?
- Resources?
- Welfare?
  - Care provided
  - Prognosis?
    - Depends on many factors
    - Improves after 3-4 days

Success rate?

- Treatment success rates can be very high
- Many vet clinics report 75%-90% success with hospitalization
- Lower success rates (50%) anecdotally with "home" care
- BUT…

CSU "at home" treatment protocol study

- 40 dogs admitted to the study
- Randomized to two groups
- Gold standard vs. "at home treatment"
- 85% survival in the 'at home" group
- 90% survival in the gold standard group
- One cross over case

http://www.cvmbs.colostate.edu/ns/pubs/einsight/2012/september/parvo-puppies-new-protocal.aspx

CSU "at home" study protocol

- Cerenia™ (maropitant)
  - once daily
  - Anti-emetic
  - central and peripheral
  - visceral pain reduction
- Convenia™
  - once (lasts two weeks)
  - Long acting antibiotic
- SQ Fluids – 3 x daily
  - Hydration

Don't under-estimate

- Need for veterinary involvement
- Need for nursing care
- Need for sanitation
- Difficulties maintaining isolation
- Need to protect general population

Hydration

- IV drip
  - Provides ideal delivery of fluid therapy
  - May be difficult to safely maintain in many shelter settings
- Sq fluids
  - Works well in most patients
  - Longer to absorb
  - May not absorb well if vascular compromise / hypoproteinemia
  - **MUCH better than trying to maintain an IV line without constant observation / supervision**
- Pedialyte - orally, 1-2 ml per hour

Antibodies from plasma?

- CSU study
- Single 12-mL IV dose of immune plasma
- 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.

Nutrition

- Nasoesophageal or nasogastric feeding tubes
- Enteric feeding study
- Effect of Early Enteric Nutrition (EEN) on intestinal permeability
  - **Earlier clinical improvement**
  - **Significant weight gain**
  - **Improved gut barrier function, which could limit bacterial or endotoxin translocation**
  - Compared to NPO group - waiting 12 hours after vomiting had ceased to feed

Antibiotic choices

- 4 quadrant protection is ideal
- Effective against all bacterial groups
- Gram (+) and (-) aerobes and anaerobes
- IV catheter can often be maintained for antibiotics even if ongoing drip is not possible.
- Flourquinolone and penicilin
- *Aminoglycoside and penicilin
  - Safer for joints
  - ***ONLY** after hydration is corrected

Anti-emetics

- Cerenia™ (Maropitant) * CSU
- Anti-emetic with both peripheral or central mechanisms
- Visceral pain reduction*
- No slowing of gastric emptying or GI transport
- Cost / benefit in puppies under 8 weeks*
  - Some association with bone marrow hypoplasia

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

Monitoring

- Pain
- General welfare
  - Attitude
  - Comfort
  - Cleanliness
- Food intake
- Hydration
- Total protein
- PCV
- CBC
- +/-Fecal float
  - Best to empiricaly de-worm

Re-introduction

- Most dogs will no longer be shedding virus 2-3 weeks post recovery
- Fecal parvo tests
- Baths

CPV Summary

- CPV is one of the most preventable infectious diseases we battle.
- Prevention is a community responsibility.
- Don't wait for an outbreak to put good practices in place.
- Help work toward a community solution.

Thanks!

We were eating pizza.