

Diagnosis and Management of Canine Distemper Outbreaks

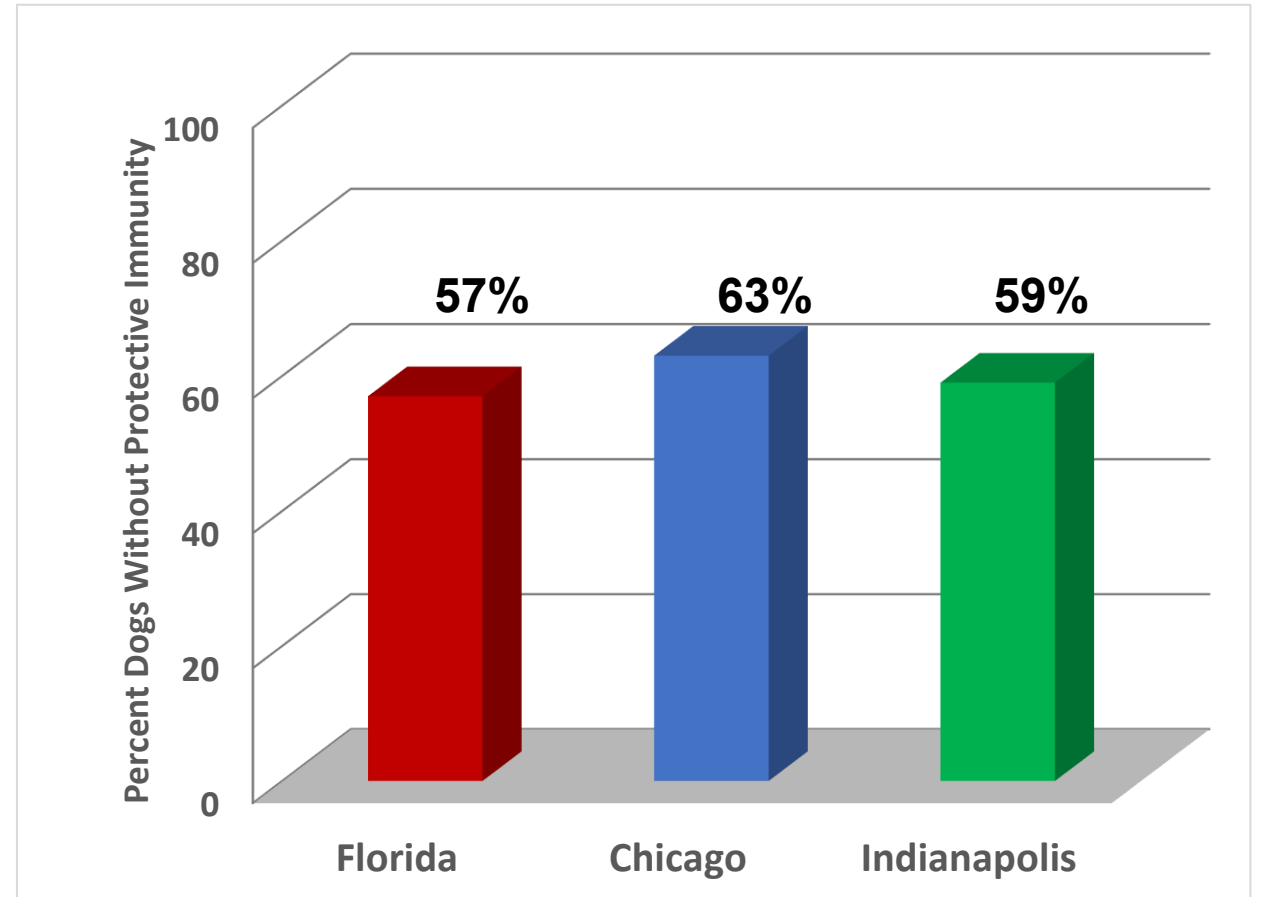
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Why are Shelters so Vulnerable to Distemper Outbreaks?

CDV Immunity at Intake

- What is the CDV immunity status of dogs entering shelters?
 - Blood samples from 1336 dogs on entry into shelters in Florida
 - Blood samples from 102 dogs on entry into a Chicago shelter and an Indianapolis shelter
 - CDV antibody titers measured to determine number of dogs with protective antibody titers (PAT)

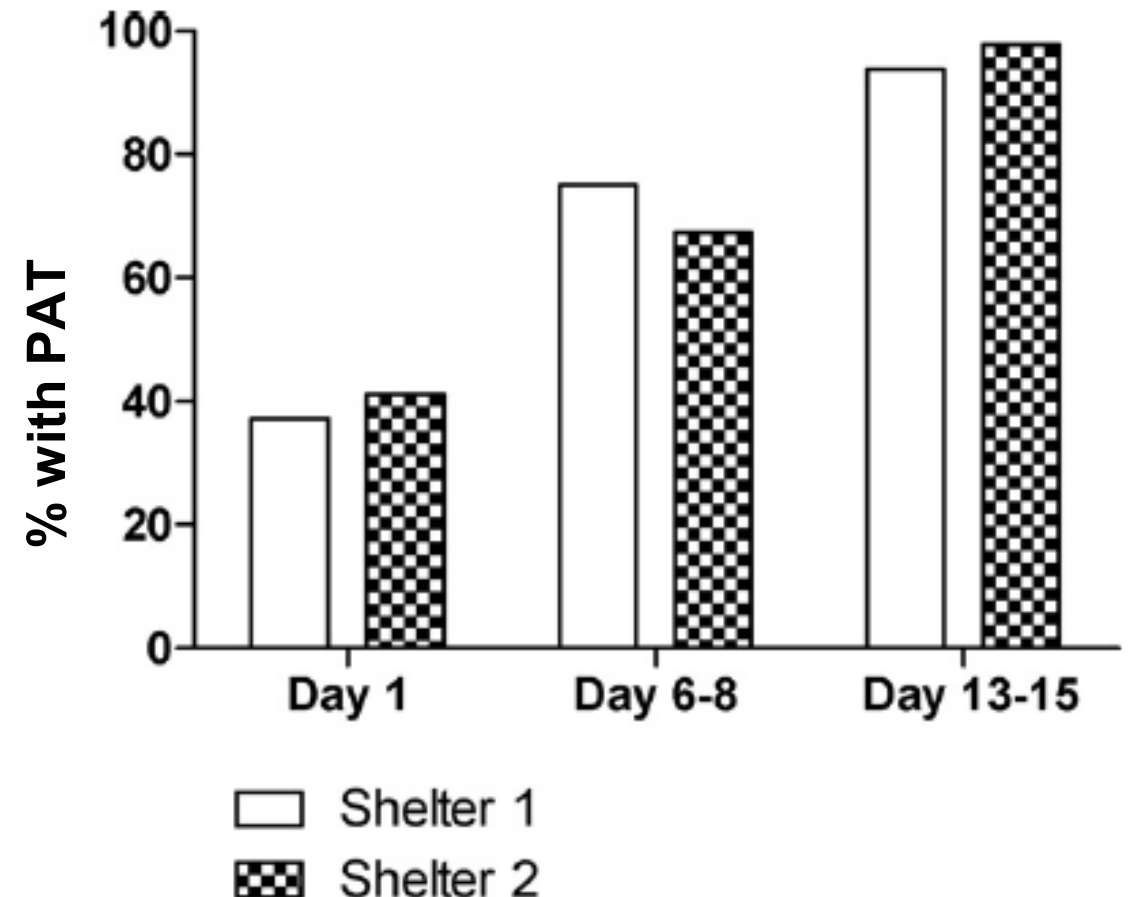


Lechner. *JAVMA* 2010; 236:1317-1321

Litster. *Vet Micro* 2012; 157:86-90

CDV Antibody Response to MLV DAPP Vaccination

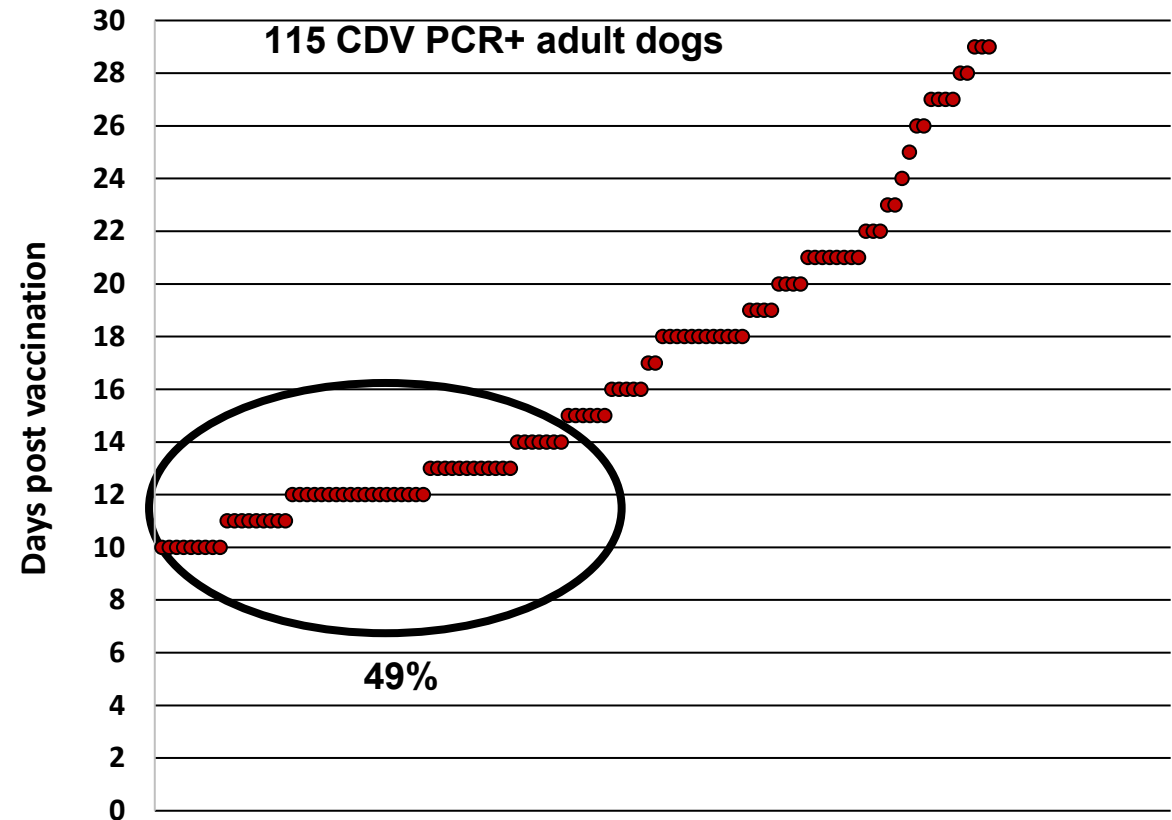
- How long does it take dogs to develop CDV PAT after vaccination?
 - 102 dogs in 2 shelters
 - 4 mo to 2 years old
 - 37 to 41% had CDV PAT on admission
 - Vaccinated with Duramune or Vanguard MLV DAPP at intake
 - CDV antibody titers measured prior to and after vaccination



Litster. *Vet Micro* 2012; 157:86-90

MLV DAPP Vaccination

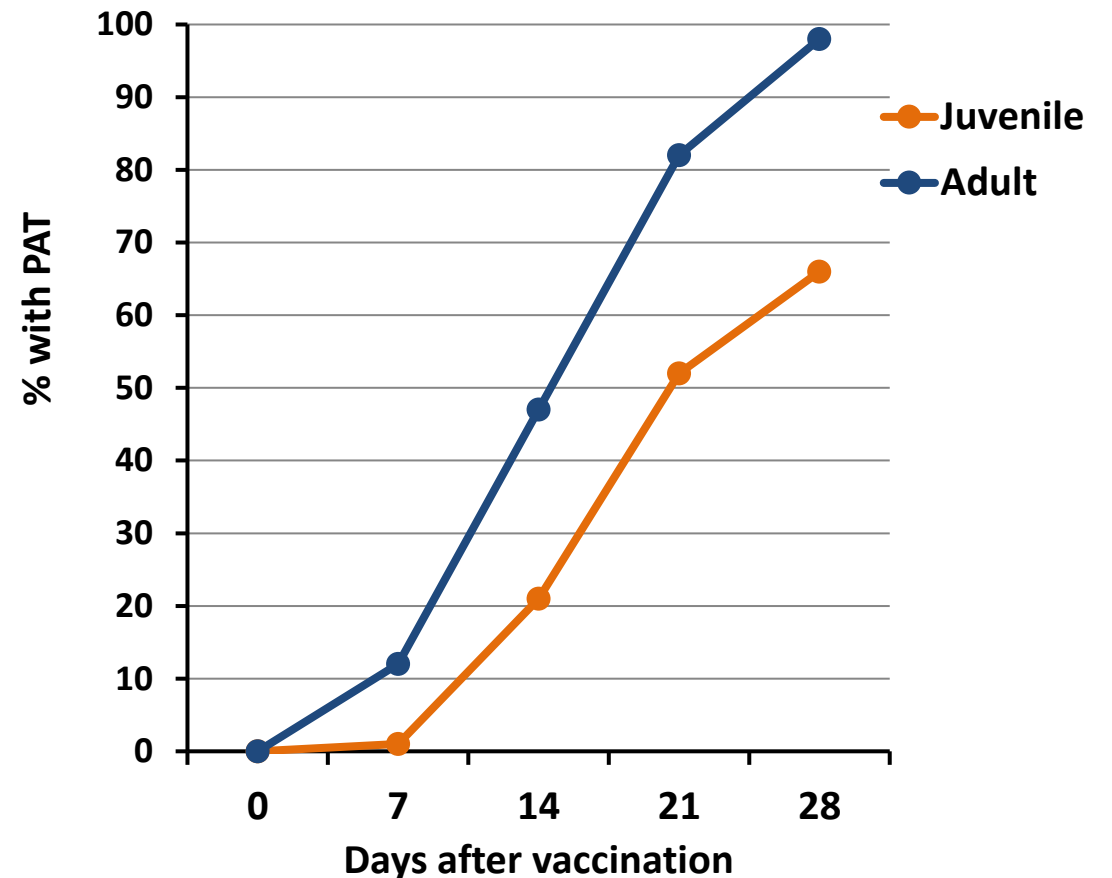
- 4 shelters in 3 states with CDV outbreaks
- MLV DAPP vaccination at intake
- CDV PCR post vaccination
- Unknown CDV antibody titers



Dog ID	Clinical Disease (days after intake vax)	Clinical Signs	Idexx CDV PCR (viral count)
1555903	11	cough, mucoid nasal discharge	20,468,000
1556350	11	cough, mucoid nasal discharge	53,837,000
1562644	12	cough, mucoid nasal discharge	5,624,000
1562233	12	cough, mucoid nasal discharge	30,000
1554972	13	clear nasal discharge	4,967,000
1554651	14	cough, thick nasal discharge	43,160,000
1555046	15	cough	6,000
1555496	16	thick mucoid nasal discharge	30,000
1559834	16	mild mucoid nasal discharge	35,000
1562763	16	cough, clear nasal discharge	652,000
1555088	17	pneumonia	980,000
1559572	17	cough, serous nasal discharge	207,000
1566505	18	clear nasal discharge	1,423,000
1554255	18	purulent nasal discharge	24,000
1553829	18	cough, purulent nasal discharge	51,000

Antibody Response to Recombitek rCDV Vaccination

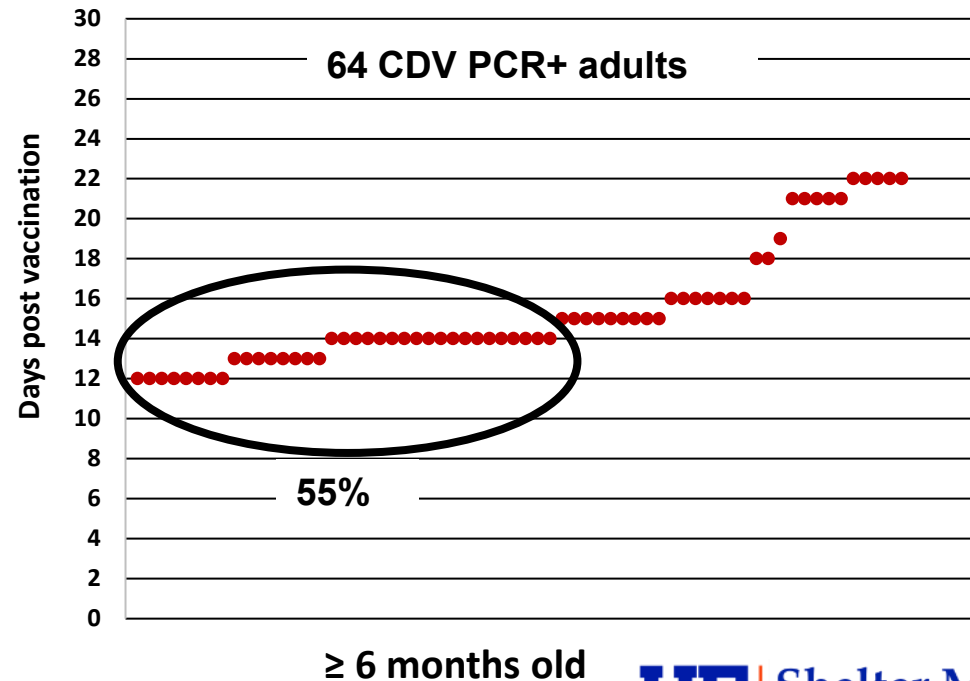
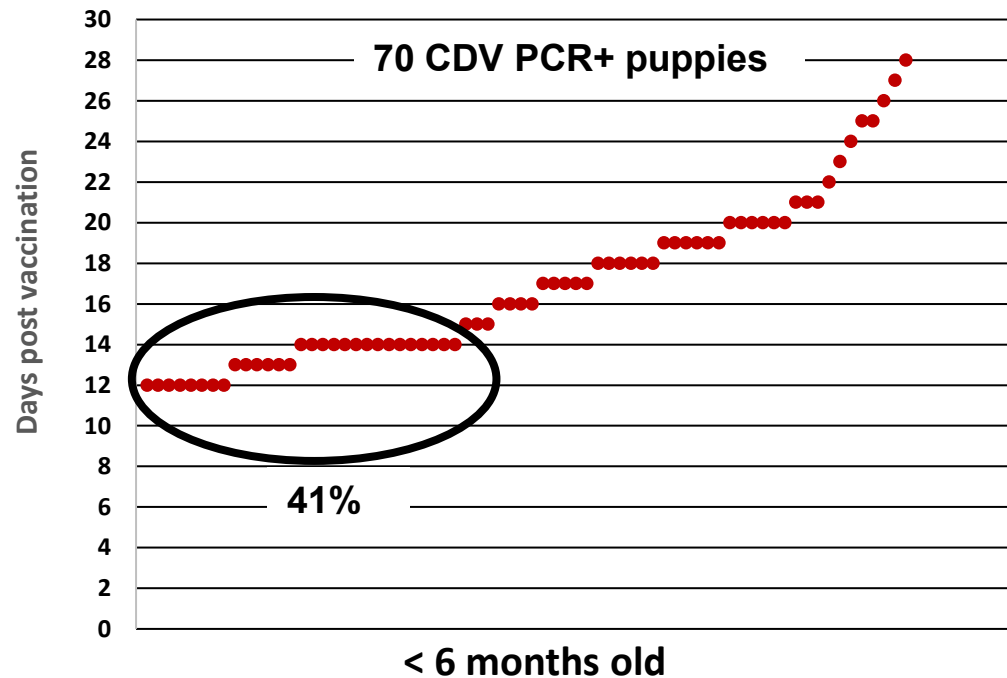
- How long does it take naïve dogs to develop CDV PAT after vaccination?
 - 204 dogs with no CDV antibody at intake
 - 86 juveniles <6 mo old
 - 118 adults ≥6 mo old
 - Vaccinated with Recombitek rCDV vat intake
 - CDV antibody titers measured weekly for 4 weeks



Fabian. ACVIM Forum. June 2013

Recombitek Vaccination

- 3 Florida shelters with CDV outbreaks
- Recombitek vaccination at intake
- CDV PCR post vaccination



Why are Shelters so Vulnerable to CDV?

- Large numbers of dogs enter shelters without protective immunity to CDV
- Slow response to CDV vaccination in naïve dogs creates a pool of susceptible dogs in first 2 weeks
- Once introduced into the shelter, CDV is efficiently spread to susceptible dogs with inadequate vaccine responses

Lifesaving Strategies for Managing CDV Outbreaks

Disease Outbreak Management Goals

- Maximize life-saving
- Minimize disruption of shelter operations
- Achieve the quickest resolution possible
- Be financially responsible

Unexposed

Adopt

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Exposed

Clinical Signs

Isolation

Not Infectious

No Clinical Signs

Sick

Quarantine

Risk Assessment

Release

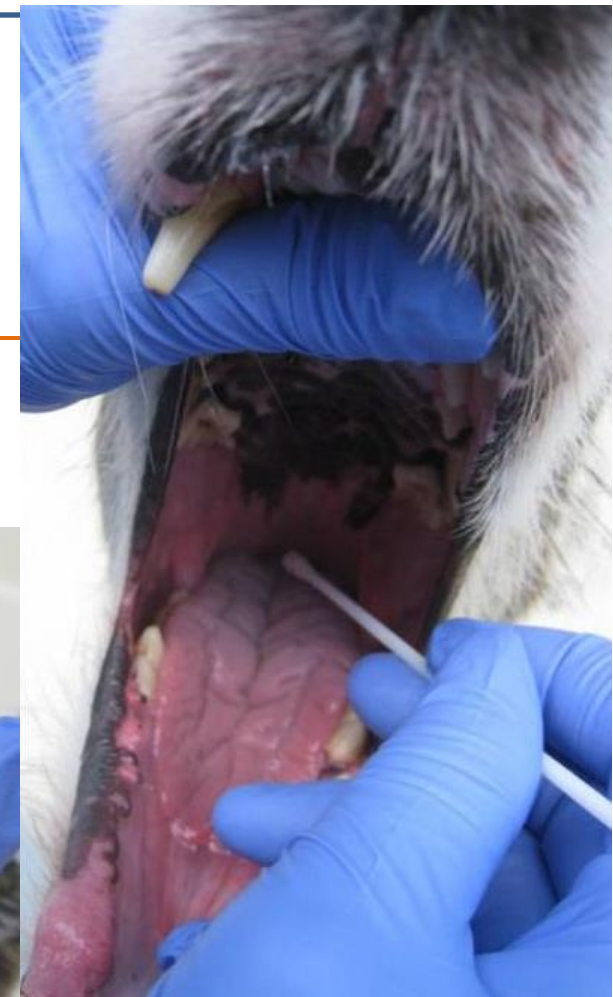
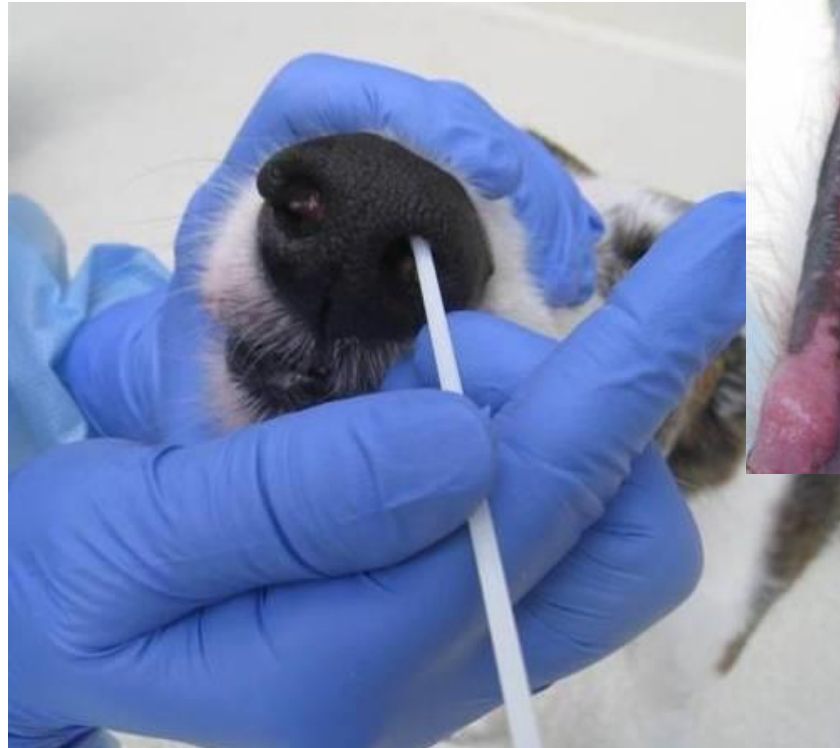
Diagnosis

The Many Faces of Distemper

- CDV causes a systemic infection
 - Respiratory tract
 - Ocular tract
 - GI tract
 - Urinary tract
 - Bones
 - Skin
 - CNS
 - Transplacental
- Infection of multiple systems confounds recognition and causes frequent misdiagnosis
- **Cannot diagnose by clinical signs alone**

Diagnostic Test

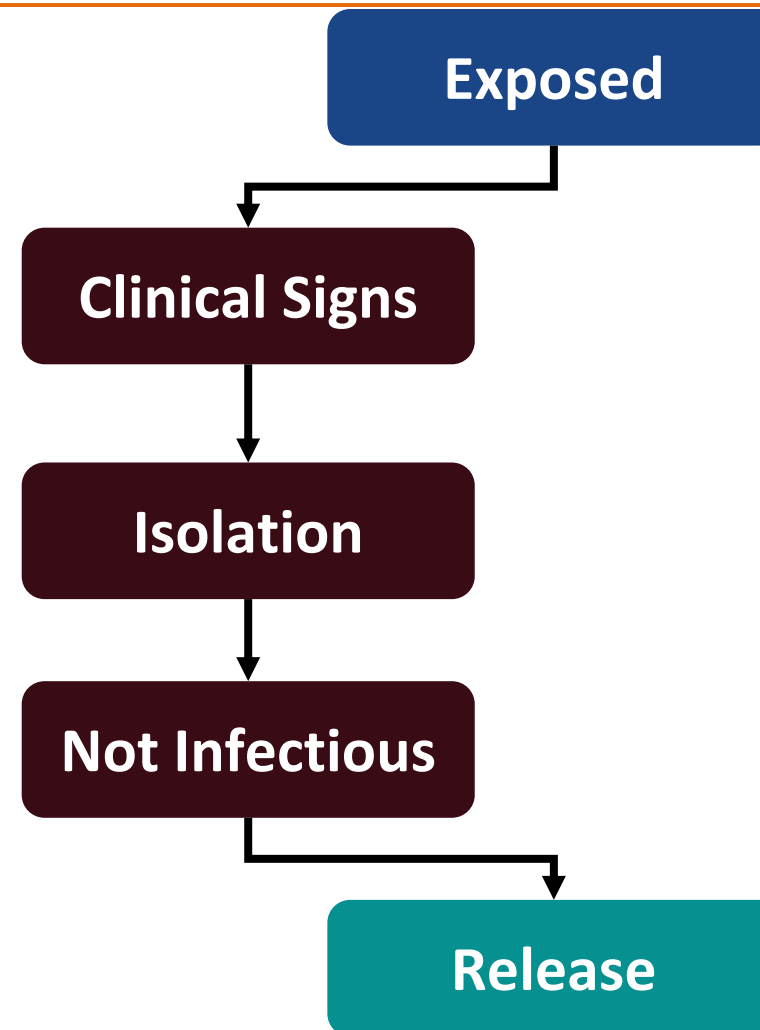
- Best antemortem test is PCR on swabs from the upper respiratory tract
 - PCR detects DNA from live and dead virus
 - Very sensitive and specific
 - Rapid turnaround time for results (1-3 days) – timely patient and population management



Diagnostic Labs for CDV PCR

Lab	Test Code	PCR Type	Readout	Cost	Cost/100 dogs
IDEXX	3265	Quantitative	Viral count	\$90	\$900
Cornell	DIS	Semi-quantitative	Ct	\$41	\$410
Purdue	CDV PCR	Semi-quantitative	Ct	\$39	\$390
Wisconsin	30653	Semi-quantitative	Ct	\$60-\$90	\$600-900

Isolation



Isolation of Sick Dogs

- Single most important step to stop virus transmission
- Perform CDV PCR for confirmation
- Requires a physically enclosed room in the shelter
- Can transfer to medical foster homes without other dogs or with well-vaccinated adult dogs
- Can transfer to offsite locations (warehouse)



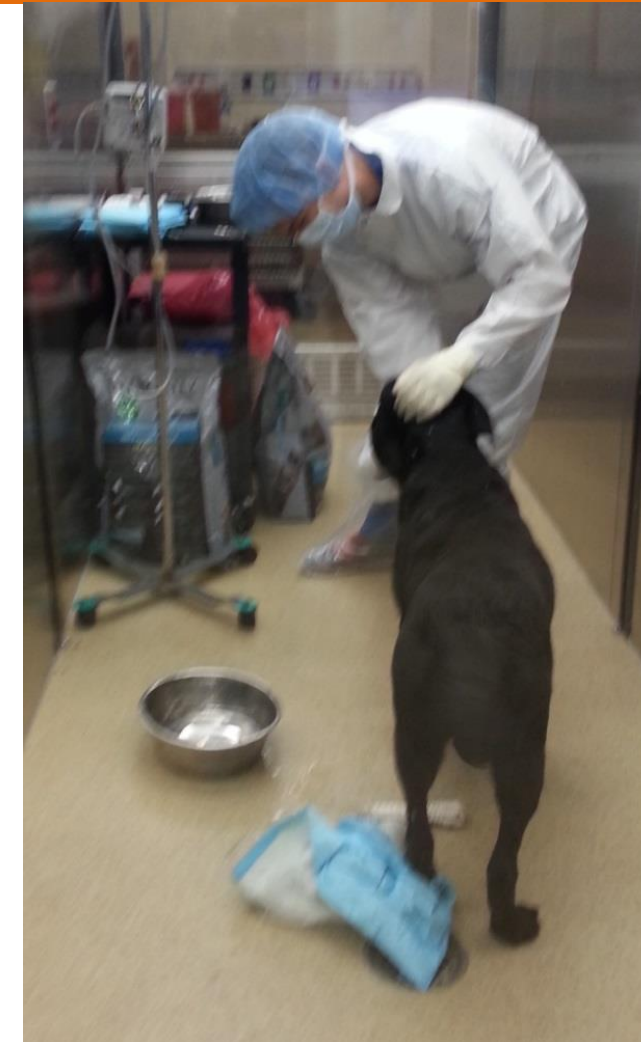
Isolation Biosecurity

- Ineffective PPE



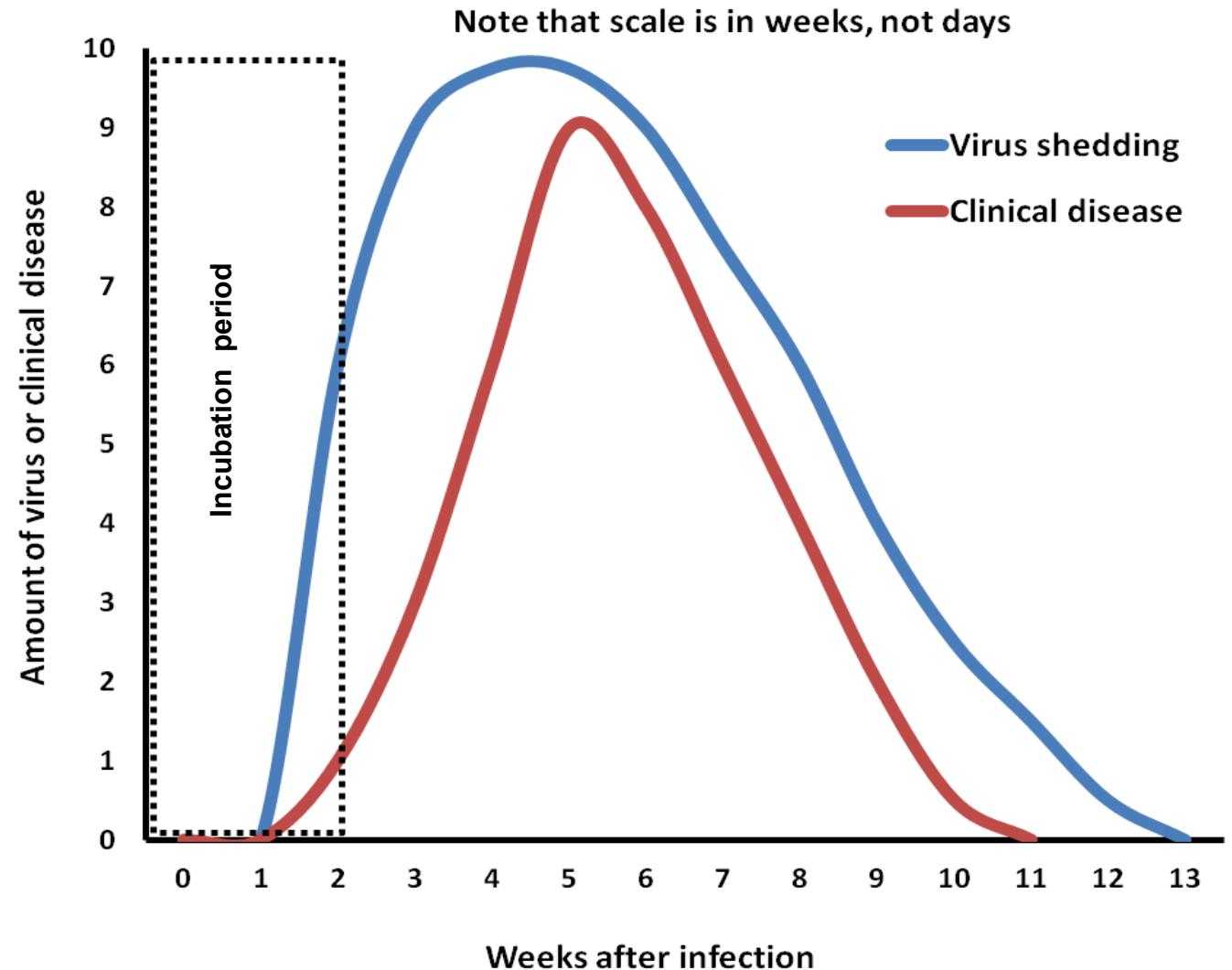
Isolation Biosecurity

- Effective PPE



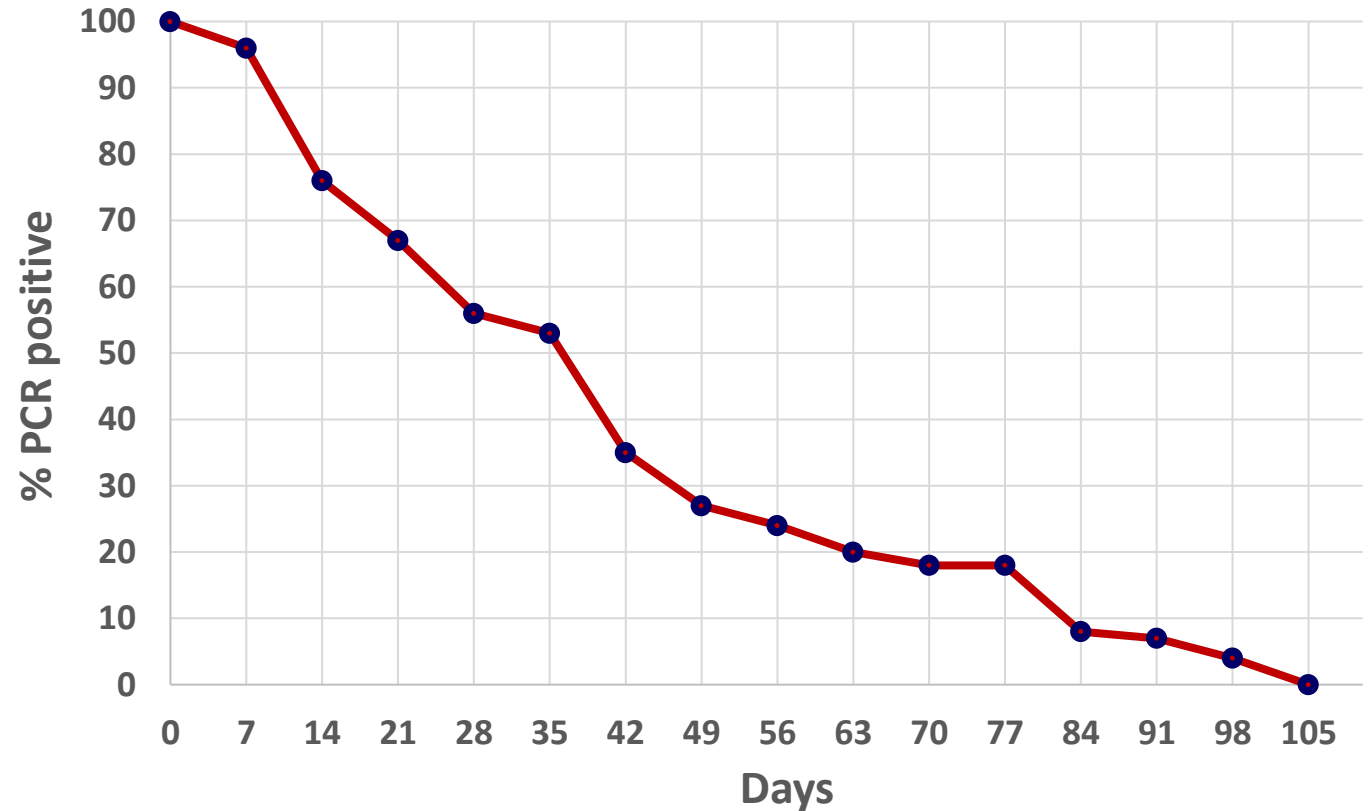
Isolation Duration

- Duration = virus shedding period
- Requires strict biosecurity for 1 to 3 months on average
- Euthanasia may be the only feasible option for municipal shelters due to long-term strain on housing and staffing capacity



CDV Shedding

- Serial CDV PCR testing of 100 infected dogs
- 50% remained PCR+ for 5 weeks
- 100% remained PCR+ after clinical recovery



Release from Isolation

- Safe release based on serial PCR testing until there are 2 consecutive negative results
- Testing interval is dictated by the viral count or Ct value: the higher the viral amount, the longer the interval between testing
- Some dogs have intermittent shedding near the end where the PCR results alternate between positive (low viral count/high Ct) and negative before reaching 2 consecutive negative results

		PCR #2		PCR #3		PCR #4		PCR #5		PCR #6	
Dog ID	Initial PCR	Time	Result	Time	Result	Time	Result	Time	Result	Time	Result
Guiness	28,000	5 wks	Neg	7 wks	Neg						
Winter	118,000	5 wks	77,000	8 wks	Neg	12 wks	33,000	14 wks	Neg	16 wks	Neg
Ginger	372,000	6 wks	241,000	10 wks	49,000	12 wks	Neg	14 wks	Neg		
Cuddlebug	1,556,000	4 wks	76,000	6 wks	Neg	8 wks	30,000	11 wks	Neg	13 wks	Neg
Lucy	1,633,000	4 wks	16,000	6 wks	109,000	9 wks	24,000	11 wks	Neg	13 wks	Neg
Blizzard	4,765,000	6 wks	17,000	8 wks	8,000	10 wks	Neg	12 wks	Neg		
Snowy	6,369,000	6 wks	41,000	8 wks	Neg	10 wks	Neg				
Troy	17,222,000	6 wks	Neg	8 wks	8,000	10 wks	Neg	13 wks	Neg		
Sissy	50,244,000	7 wks	Neg	8 wks	47,000	10 wks	42,000	15 wks	Neg	16 wks	Neg
Beau	85,523,000	7 wks	297,000	12 wks	Neg	14 wks	Neg				

Alternative Release from Isolation

PLOS ONE 1/20/23

RESEARCH ARTICLE

Prolonged persistence of canine distemper virus RNA, and virus isolation in naturally infected shelter dogs

Carolyn Allen^{1☯*}, Alexandre Ellis^{1‡}, Ruibin Liang², Ailam Lim^{2‡}, Sandra Newbury^{1☯*}

- Performed virus isolation on archived samples from 6 dogs with CDV PCR+ results > 60 d
- Infectious CDV only isolated for 2 weeks after the peak PCR value
- Release of clinically recovered dogs 2 weeks after PCR values start decreasing

Quarantine



Quarantine Exposed Asymptomatic Dogs

- No clinical disease – why?
 - Infected but in incubation period
 - Subclinical infection
 - Not infected due to immunity
 - Not infected
- All exposed dogs should be considered an infectious risk pending assessment
- House together in a separate room from isolation and unexposed dogs
- Can quarantine in a foster home with well-vaccinated adult dogs
- Duration = max CDV incubation period = 2 weeks
- Restart quarantine clock with each new clinical case
- PPE required

Quarantine Challenges

- Strain on housing capacity
- Strain on capacity for care
 - Staff is spread thin by care for segregated populations while adhering to strict biosecurity measures
- Concerns for deterioration of the behavioral health and welfare for dogs held in shelter quarantine for long periods of time

Release from Quarantine

- Release asymptomatic dogs at the end of quarantine?
 - What about dogs with subclinical infection?
 - How about dogs exposed late in quarantine and in the preclinical incubation period?
- Perform CDV PCR at the end of quarantine?
 - Identifies safe dogs for release
 - Does not shorten the quarantine time

Subclinical Infections in Exposed Dogs

- 25% to 50% of exposed dogs
- Silent source of virus spread
- Will not be identified if release from quarantine without PCR test

Dog ID	Clinical Signs	CDV PCR Ct
Chew Barka	No	29
Sally O'Malley	No	30
Duke	No	32
Harold	No	32
Molly	No	31
Ella	No	35
Sade	No	35
Bingo	No	26
Reese	No	34
Strawberry	No	31

Risk Assessment for Quarantined Dogs

- Provides an alternative to waiting out the quarantine clock
- Paired CDV PCR and antibody titer testing of each exposed dog
 - Determines infection and immunity status to identify who is safe to release, who needs to go to isolation, and who needs to stay in quarantine
 - *Identifies dogs with subclinical infections*
 - *Identifies dogs with immunity*
 - *Reduces number of dogs in quarantine*
 - *Relieves strain on housing capacity and capacity for care*
 - *Shortens the quarantine time*
 - *Provides quicker resolution of the outbreak*

Paired PCR/Titer Testing

- Collect swabs for CDV PCR and serum for CDV antibody titer
 - Submit swabs to a reference lab
 - Submit serum to a reference lab or use a point-of-care test (Vaccicheck)

Lab	Test	Test Code	Readout	Cost	Total/dog	Total/100 dogs
Cornell	CDV PCR	DIS	Ct	\$41	\$60	\$600
	CDV SN	CDVSN	Endpoint titer	\$19		
Purdue	CDV PCR	CDV PCR	Ct	\$39	\$61	\$610
	CDV IFA	CDV IFA titration	Endpoint titer	\$22		

CDV Antibody Titers

- Serum neutralization or IFA tests
 - **Antibody titer** = last serum dilution that prevents CDV infection in cell cultures
 - **Titers ≥ 64** considered protective against infection (PAT)

Purdue Animal Disease Diagnostic Lab Report

<u>Animal ID</u>	<u>Age</u>	<u>Tube#</u>	<u>Method</u>	<u>Titer</u>	<u>Interpretation</u>
35236 CHARLIE	1.5 Years	1	IFA assay (titration)	1:320	positive
41448 PRINCESS	1 Years	2	IFA assay (titration)	1:1280	positive
44876 BONGO	1 Years	3	IFA assay (titration)	1:80	positive
38159 MIDNIGHT	11 Months	4	IFA assay (titration)	1:20	negative
44573 HYRDA	1 Years	5	IFA assay (titration)	1:80	positive
44532 WICK	9 Months	6	IFA assay (titration)	1:1280	positive

CDV Antibody Titers

- Canine Vaccicheck
 - CDV spot must be darker than the positive control
 - Color intensity should be S4 to S6 to consider protective against infection

+ control →

CDV →

PAT
interpretation →

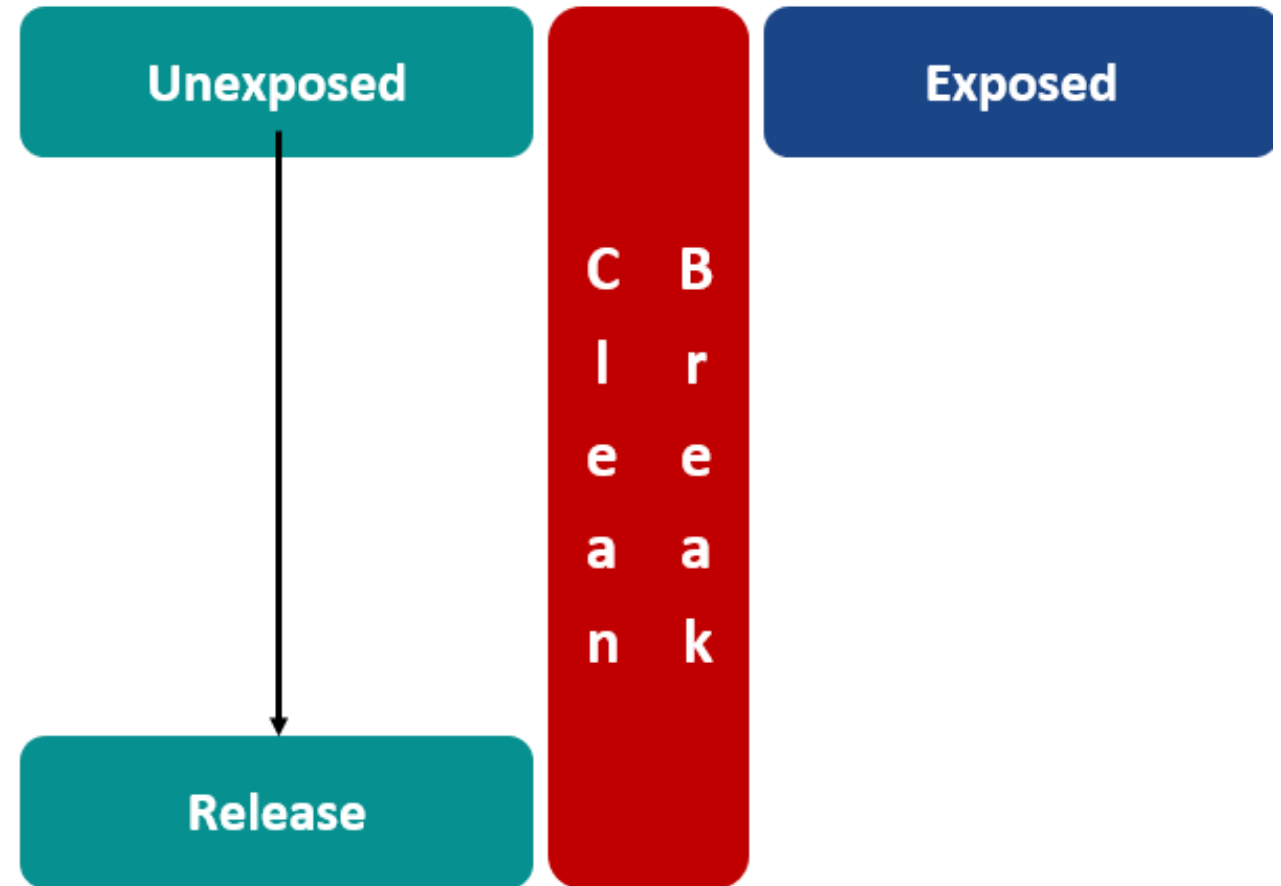


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Paired PCR/Titer Results

CDV PCR	CDV PAT	Interpretation	Outcome
Neg	Neg	Uninfected/unprotected	Quarantine/revaccinate
Neg	Pos	Uninfected/protected	Release
Pos	Neg	Infected/no immune response	Isolation
Pos	Pos	Infected/immune response	Isolation

Clean Break



Clean Break

- Private shelters: stop admissions pending outbreak resolution
- Municipal shelters
 - Essential admissions only (ill/injured strays, bite Qs, dangerous dogs)
 - Divert intake to another facility, rescues, or foster homes

KENNEL CLOSURE

In order to protect the general public and the animals in our care, the Hill Country SPCA has temporarily closed our Dog Kennels, we will not be allowing the public into our kennels for at least 2-3 weeks.

The HCSPCA transferred in a group of dogs from another shelter, one of which tested positive for Distemper. Despite following best vaccination protocols, there is a time between vaccination and onset of immunity that may have left some of the dogs already in our care susceptible.

CDV Management Outcomes

Humane Society of North Texas

- Private nonprofit
- July to Dec 2021
- Closed for intake and adoption
- 328 dogs infected or exposed
- 80 infected dogs
- 54 infected dogs recovered
- 302 dogs (92%) were saved

BARC Houston

- Municipal
- July to Nov 2021
- Closed adoptions
- Restricted intake to “must admits”
- 222 dogs infected or exposed
- 32 infected dogs (euthanized)
- 190 dogs (86%) were saved

CDV Management Outcomes

Greenwood Humane Society SC

- Private nonprofit w/ municipal contract
- Nov 2021 to Jan 2022
- Closed adoptions
- Restricted intake to “must admits”
- 152 dogs infected or exposed
- 26 infected dogs (euthanized)
- 126 dogs (83%) were saved

Wright Way Rescue in Chicago

- Private nonprofit/transfer in
- Dec 2020 to April 2021
- Closed adoptions
- Different location for intake
- 102 dogs infected or exposed
- 61 infected dogs
- 50 infected dogs recovered
- 91 dogs (89%) were saved

CDV Management Outcomes

CincyCARE OH

- Private nonprofit w/ municipal contract
- May 2024 to Aug 2024
- Closed adoptions
- Restricted intake to “must admits” housed in different building
- 305 dogs infected or exposed
- 85 infected dogs
- 63 infected dogs recovered (74%)
- 283 dogs saved (93%)

My Lessons Learned

- Municipal shelters are at greatest risk for CDV outbreaks
- CDV diagnosis must be confirmed by PCR testing
- The long CDV incubation and shedding period have the greatest impact on outbreak management options
- Use the basic outbreak management strategy (isolation, quarantine, clean break)
- Release dogs from isolation based on CDV PCR status over time
- Perform paired CDV PCR and antibody titer testing for exposed dogs
- Be prepared for a 2- to 3-month intervention with substantial financial investment