

Canine Influenza Virus

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Kennel Cough

- A low level of upper respiratory infection is common at any shelter or kennel
 - Vaccine not available for all pathogens (KC, PI, CAV2, flu)
 - Vaccines do not prevent infection, they just mitigate severity of disease
- Any shelter manager manages “kennel cough” syndrome in a few dogs at any point in time
- A large outbreak or repeated outbreaks can have long term effects on a shelter and impact the entire community



Kennel Cough

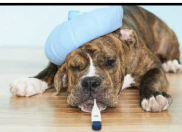
The many causes of kennel cough

Bacteria

- *Bordetella bronchiseptica*
- *Mycoplasma spp.*
 - Arthritis
 - Many other infections

Viruses

- Canine parainfluenza (CPI)
- Canine distemper virus (CDV)
 - Seizures, twitching, paralysis
 - hard pad
- Canine herpesvirus (CHV)
 - Abortions and fading puppies
- Canine adenovirus 2 (CAV2)
 - hepatitis
- Canine respiratory coronavirus
- Canine influenza (CIV)



Kennel Cough

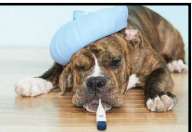
Things that can look like kennel cough

Allergic Bronchitis

Congestive Heart Failure

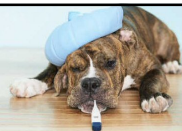
- Listen for a heart murmur
- Can resemble pneumonia on exam
 - **Coughing up pink foamy fluid**
 - Breathing hard
 - Blue gums
 - Chest x-rays & other tests (proBNP) can tell the difference

Heartworm Disease



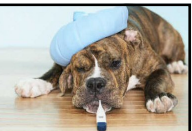
Canine Flu

- Influenza A virus (orthomyxovirus)
- Related to (Hemagglutinin 16 Neuraminidase 9)
 - **Human flu** – H3N2 - has infected dogs in Korea
 - **Equine flu** – H3N8
 - **Swine flu** – H1N1
 - **Avian flu** – H5N1
 - **Canine flu** – H3N8
- First isolated from racing greyhounds that died from pneumonia at tracks in Florida in 2003-2004
 - Dogs were fed horse meat
 - Testing old serum samples showed virus was around at least back to 1999

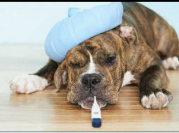


Canine Flu

- Major outbreak in New York in all dog breeds, early 2005
- Outbreaks at dog tracks in 10 states, including Texas
- Endemic areas:
 - **New York-New Jersey**
 - Florida
 - Northern Colorado-Southern Wyoming
- Confirmed cases in 39 states and Washington, DC
- Outbreaks in tracks, kennels, shelters, veterinary hospitals, pet stores



Canine Flu



- Two years ago, one vet in San Antonio received many Antech PCR positives and reported an outbreak
 - Outbreak never actually occurred
- 1 case (mild) confirmed in Katy, TX earlier this year
- Now new positives in TX at [Cornell Univ Lab](#) since 2010
- Some boarding kennels in the Houston areas are requiring the vaccine for boarding
 - Vaccine manufacturers marketing directly to boarding kennels and shelters
- I recommend it for dogs who attend competitions or shows
- Have looked for CIV 3 times at our shelter and not found it

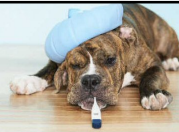
Canine Flu



Who can get it?

- Because the virus is new, most dogs are susceptible
 - Few have been vaccinated
 - Few have been exposed and infected
- Horses can be infected, but show mild symptoms
- No evidence that cats can be infected
 - Cats housed with infected dogs have been tested
- No evidence that people can be infected

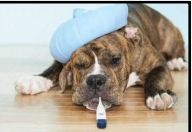
Canine Flu



Epidemiology

- Study of risk factors and patterns of disease
- **Contagiousness**
 - likelihood that exposure will result in infection
 - CIV is highly contagious – nearly 100%
- **Morbidity**
 - likelihood that infection will cause disease
 - CIV has high morbidity – 80-90%
- **Mortality**
 - likelihood that illness will result in death
 - CIV has low mortality – 5-8% (lower with prompt treatment)
 - Most recover within 30 days, often within 7-10 days

Transmission



Modes of Transmission

- **Aerosols and Droplets**
 - Tiny droplets produced when an animal coughs or sneezes
 - droplets travel up to 4 feet through the air
 - Human flu aerosols can travel up to 50 feet
 - Aerosols cause many to get sick quickly in shelters
- **Direct Contact** with respiratory secretions
- **Fomites**
 - Objects contaminated by respiratory secretions
 - **HANDS ARE THE PREDOMINANT FOMITE IN SHELTERS**
 - Shelter workers have taken CIV home to infect pets

Common Shelter Fomites

- Staff hands
- Visitor hands
- Bowls
- Litter boxes
- Toys
- Bedding
- Clothing
- Animal Hair

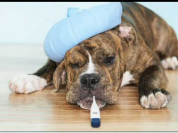


Fomites You Might Not Think Of

- Door knobs
- Keyboards
- Telephones
- Cell phones
- Light switches
- Leashes
- Cage cards



Transmission



Incubation Period

- The time between exposure and apparent symptoms
- 2-4 days for CIV
- Much shorter than other causes of kennel cough
 - 1-14 days for other causes
 - [Respiratory Pathogen Chart](#)

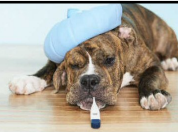
Transmission



Virus Shedding Period

- Time after infection that the dog is shedding infectious organisms in respiratory secretions
- Begins at 2 days post infection
- Continues for 7-10 days
- Peak shedding is 2-4 days post-infection
 - This overlaps with the incubation period
 - Dogs can shed virus prior to showing clinical signs
 - 10-20% of dogs will be infected and shed, but never become ill

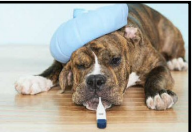
Transmission



Virus Shedding Period

- Comparison to other respiratory Pathogens
- **CHV** – 2-3 weeks (**asymptomatic carriers**)
- **CDV** – up to 90 days
- **Parainfluenza** – 6-8 days
- **Bordetella bronchiseptica** – 90 days or more (**asymptomatic carriers**)
- **CAV2** – 10 days
- **Mycoplasma spp.** – 90 days or more (**asymptomatic carriers**)

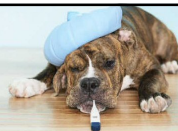
Transmission



Carrier State

- Long term shedding after recovery
- **No carrier state with CIV**
- There are carrier states for other respiratory pathogens
 - *Bordetella bronchiseptica*
 - *Mycoplasma spp.*
 - CHV
 - Dogs who have recovered from the respiratory phase of CDV can shed virus for up to 90 days
 - They seem clinically normal, but later develop neurologic signs which reveal their CDV infection.

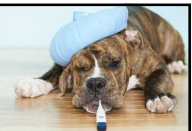
Clinical Signs



Symptoms – Clinical Signs

- Distinguishing CIV from other causes of **URI/LRI** can be difficult
- Most dogs in the shelter are infected within 2 weeks
 - This may be less apparent with a second round
 - Dogs of all ages are affected
- Sudden increase in the prevalence of kennel cough
 - **Prevalence** – percentage of animals in a given population who have a disease at a point in time
- Suddenly increase in severity of kennel cough
- Prolonged to complete lack of response to antibiotic therapy (cough for up to 3-4 weeks)

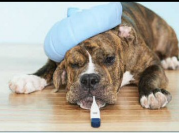
Clinical Signs



Animals fall into 3 categories

- **Asymptomatic infection** – 10-20%
- **Mild Infection** - 60-85%
- **Severe Infection** – 5-20%
- Most dogs look like garden variety kennel cough that lasts a little longer than usual
- A few get severely ill

Clinical Signs



Mild Infection

- Productive cough for several weeks
 - Gag or swallow at the end, like dog has something caught in their throat
 - Sometimes cough up foamy fluid or mucus
 - **Mild fever**
- Little response to antibiotics
- Mild fever or lethargy
- Purulent or bloody nasal discharge
 - **Purulent** – having the quality of pus
 - Due to secondary bacterial infection and vasculitis

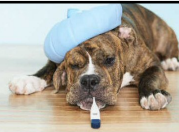
Clinical Signs



Severe Infection

- High fever – 105-106°F
- **Tachypnea**
 - Rapid breathing
 - > 40 breaths per minute while resting
- Pneumonia - Need chest x-rays to confirm
- Prolonged recovery
- Fatality rate is 5-8%
 - Peracute hemorrhagic fatal pneumonia
 - **Peracute** – less than 24 hours from first symptoms
 - **Hemorrhagic** – coughing up blood (**hemoptysis**)

Clinical Signs



Red Flags for CIV (canine influenza virus)

- Sudden increase in acute respiratory infection
 - Every day, many more start coughing
 - Most are infected within 2 weeks
- Sick dogs that cough, not well dogs that cough
- This happens despite herd being vaccinated with kennel cough vaccine
- No response to antibiotics
- Cough for 3-4 weeks
- Some become severely ill and may die within 24-48 hours

Other Causes of Pneumonia

Allergies

- **COPD**
 - Chronic obstructive Pulmonary Disease

Bacteria

- many

Viruses

- CDV

Protazoans

- Toxoplasma
- Neospora

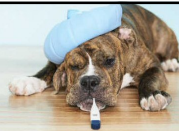
Fungus

- Histoplasma
- Blastomyces
- Cryptococcus

Parasites

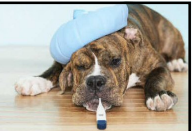
- Lung flukes
- Migrating hooks/rounds
- Heartworms

Diagnosis



- CIV can't be distinguished from other respiratory pathogens based on clinical signs
- Coinfections may occur, confusing matters
 - **Coinfection** – infection with more than one organism simultaneously
- Diagnostic tests
 - Bacterial culture of trans-tracheal wash
 - Virus isolation (culture) from nasal and throat swabs
 - Blood titers
 - PCR from nasal and throat swabs

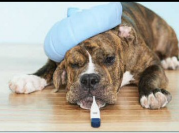
Diagnosis



Nasal and Throat Swabs

- Must be taken in first week of infection to be positive
- As soon as symptoms begin is best
 - Peak shedding 2-4 days post-infection
- Submit samples from multiple animals for
 - Antigen detection
 - Virus isolation
 - **PCR**
 - Polymerase chain reaction
 - Detects presence of viral DNA
- Contact the lab in advance for handling instructions

Diagnosis



Antigen Detection (immunoassay kits) - Swabs

- Manufactured to detect human flu
- Also detect canine flu
- Easy to run in the shelter for instant results
- A positive result is most likely correct
- Negative doesn't mean as much, because peak shedding may have already passed
 - Many **false negatives**
 - **Sensitivity good** – likelihood that positives will be detected
 - PCR is even more sensitive after the peak shedding period
 - There is a problem with false positives with PCR
 - **Specificity low** – likelihood that negatives will be detected

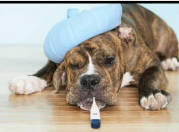
Diagnosis



Antigen Detection (immunoassay kits) – Swabs

- **Directigen Flu-A**
 - By BD – Becton-Dickinson
 - <http://www.bd.com/ds/productCenter/256020.asp>
- **QuickVue Influenza Test**
 - By Quidel
 - http://www.quidel.com/products/product_detail.php?prod=56&group=1&cat=1
- Fisher Supply & Cornell CVM Animal Diagnostic Ctr
- Box of 20 - \$10-25 a test

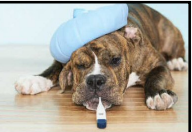
Diagnosis



Swab Collection Technique

- Wear exam gloves to prevent contamination of the sample with your own DNA
- New gloves for each dog
- Touch the swab tip only to the area sampled
 - Avoid contamination with your own DNA and DNA in the environment

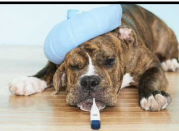
Diagnosis



Transtracheal Wash

- Performed by a veterinarian
- Dog is lightly sedated, so they can still cough
- Catheter passed into the trachea (wind pipe)
- Fluid rinse collected in a sterile manner (**aseptically**)
- Submitted for
 - **Cytology** – look at the cells present and possible bacteria
 - Bacterial culture – check for coinfections, and to test for antibiotic sensitivity
 - Ask for culture and sensitivity, not just culture
 - CIV PCR

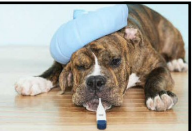
Diagnosis



Virus isolation – GOLD STANDARD

- Takes a long time – a week or more
- Probably won't help animals that are sick at the time
- But can help identify the cause of a severe outbreak
- Remember to contact your lab in advance for instructions on sample handling and shipping
 - Use polyester rather than cotton tipped swabs
 - Placed in sterile dry tubes or tubes with transport medium
 - Shipped on ice to arrive the within 2 days
- Can help decide whether you need to vaccinate for CIV
- Many false negatives

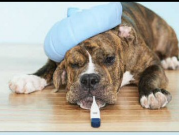
Diagnosis



Blood titers

- **Most reliable test for identifying CIV infection in a particular dog**
- Antibodies detected as soon as 7-10 days after infection
- Take 2 blood samples
 - 7-10 days after first signs
 - Then 2 weeks after the above sample
- Collect in a red top tube and let clot
- Spin down, harvest serum and put in freezer
- Send all samples to the lab at the same time (LABEL THEM!!)
- Four-fold increase in titer is diagnostic for CIV

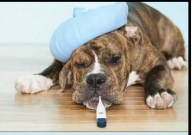
Diagnosis



CIV Labs

- [Cornell University](#) (PCR, titers, virus isolation)
 - New York State Animal Health Diagnostic Center
- [Colorado State University](#) (PCR, ELISA)
 - CSU Veterinary Diagnostic Laboratory
- [UC-Davis](#) (PCR)
 - Lucy Whittier Molecular & Core Diagnostic Center
- [U of Florida VMC Clinical Diagnostic Laboratory](#) (titers)

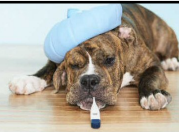
Diagnosis



Ancillary Diagnostics

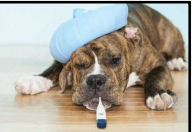
- CBC - nonspecific
 - Complete blood count
 - High white may indicate pneumonia or infection
 - Low white count might indicate overwhelming infection, or concurrent parvovirus
- Profile & urinalysis
- Chest x-rays – to detect pneumonia
- Necropsy – ask the lab to look for CIV

Outbreak Control



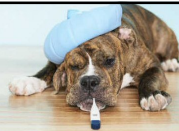
- Entire shelter must be **quarantined/isolated**, unless there are truly separate kennels which are not cross-contaminated
 - **Quarantine** – separate exposed from unexposed animals to see if the former become sick
 - **Isolation** – separating infected animals with symptoms, to limit infection of others
 - Ideally, these should be 2 separate groups
 - But because CIV spreads so quickly, most dogs have already been exposed before quarantine is possible
 - 14 days after the last dog gets sick is sufficient for quarantine/isolation if there are no breaches

Outbreak Control



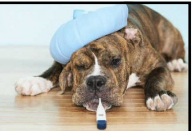
- **Deep cleaning and disinfection**
 - CIV is killed by most disinfectants, including **quats**, peroxygens, accelerated peroxides and bleach
 - **Quats** - Quaternary ammonium compounds
 - **Peroxygens** – Trifectant
 - **Accelerated peroxides** – Accel, Butler
 - CIV can live for 24-48 hours on nonporous surfaces
 - 8-12 hours on porous surfaces
 - Only minutes on hands

Outbreak Control



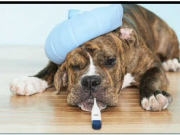
- **Deep cleaning and disinfection**
 - Review cleaning and disinfection protocols to make sure we are doing things as we know we should
 - Clean with detergent to remove organic debris
 - Then disinfect – soak for 10 minutes
 - Only 1 minute required for accelerated peroxides
 - Rinse and dry before returning the animal
 - Remove and disinfect/discard all possible fomites
 - If you can't soak every cage/run every day, then rotate and do each at least once or more weekly

Outbreak Control



- **Increase air exchanges**
 - **Air exchange** – number of times per hour air in a room is moved out and replaced
 - 10-12 acceptable
 - Increase to 15 during an outbreak
 - Set fans by open windows - fresh air in
 - Close vents to stop air-sharing with rest of the shelter

Outbreak Control



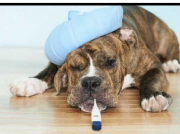
- **Wear PPE**
 - Personal Protective Equipment
 - Isolation gowns – less than \$2 each
 - Gloves and booties
 - Staff assigned to either quarantine, isolation or naïve population for the day
 - Change out of your street clothes when you clock in, and into your street clothes when you clock out (scrubs work well)
 - Wash or sanitize hands, use peroxygen foot bath/mat

Outbreak Control



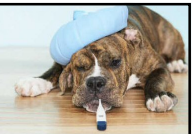
- **Inform the public - 30 day period**
 - Give each adoptive family written information on CIV
 - What to look for
 - What to do in case symptoms occur
 - Advise of risk to other dogs in the adoptive home
 - Remind that CIV is a community problem, came from the community, and the shelter makes every effort to eradicate the pathogens that come in the door every day
 - Also that CIV is not prevented by kennel cough vaccine

Outbreak Control



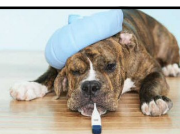
- **Inform the public – 30 day period**
 - Consider releasing adopted dogs only after the 14 day quarantine
 - They may still have symptoms, but are no longer shedding
 - Single dog homes are the best situation
 - Or vaccinate dogs in the adoptive home
 - Provide a complete medical record for transfer to the new veterinarian
 - Exam findings, test results, treatments, progress notes

Outbreak Control



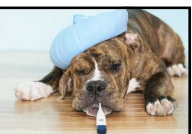
- **Inform the surrounding shelter community**
 - Issue a “CIV Advisory” to inform neighboring
 - Shelters, rescue groups, foster homes
 - Veterinary clinics, local and state VMAs, ASV
 - State Vet – health department
 - boarding kennels, dog parks
 - Groomers
 - trainers
 - Inform the general public – newspaper, PSA radio
 - Vaccine Reps can help with this
 - Be a considerate member of the animal welfare community

Outbreak Control



- **Review intake Quarantine Procedure**
 - Intake quarantine of at least 2 weeks is required to keep respiratory outbreaks down to a dull roar
 - If your intake quarantine is shorter, you will have frequent problems with kennel cough
 - If you can't do a 2 week intake quarantine, consider “cohort admissions”
 - Add dogs to one room or area, until it is full
 - Add no more until the room is empty
 - Scrub from top to bottom before the new groups comes in
 - Multiple small rooms make this easier

Outbreak Control

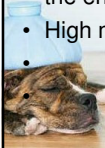


- **When to consider depopulation****
 - Short incubation and shedding makes CIV more manageable than CDV, *Bordetella* and *Mycoplasma*.
 - Quarantine/isolation need only be for 14 days
 - High contagiousness makes it harder to manage
 - exposure of just one naïve dog puts the entire naïve population at risk
 - ****When new intakes can not be separated from the rest of the isolated/quarantined population (separate air)**
 - **Consider reducing population density for 30 days as an alternative to complete depopulation**

Depopulation

Arguments For

- Highly contagious
- Prolonged shedding
- Resistant to disinfection
- Prolonged survival in the environment
- High morbidity



High mortality
Many at risk

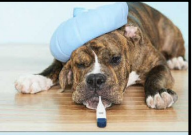
- Zoonotic
- Resource intensive to treat (severe form)
- Unable to effectively isolate/quarantine
- Unable to disinfect

Arguments Against

- Ubiquitous in the environment

****CIV**

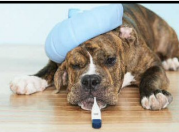
Treatment



• Antibiotics for secondary infection indicated by:

- Productive cough
- purulent nasal discharge
- pneumonia
- Tetracyclines or azithromycin for mild form
 - doxycycline 5-10 mg/kg PO BID x 2-3 weeks
 - **PO** – per os – by mouth
 - **BID** – latin “bis in die” – two times daily
- Plus IV antibiotics for severe form (cephalosporins)
 - Some are trying Convenia

Treatment



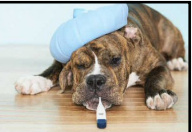
• IN Bordetella vaccine booster for all

- **IN** - intranasal
- Will decrease severity of secondary bacterial infection with Bordetella

• Antitussives

- Cough suppressants
- Contraindicated in dogs with productive cough
- **Contraindicated** – “against indicated” – cause more harm than good

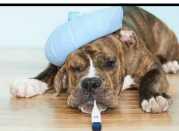
Treatment



• IV fluids for severe form

- Prevents/treats dehydration
- Loosens and thins respiratory secretions so that they can be coughed up and eliminated
- **Coupage**
 - Clapping hands on the chest to loosen secretions and promote coughing

Treatment



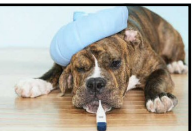
• Oxygen therapy

- For severe pneumonia
- cage or nasal cannula

• Nebulization

- Treatment with steam to loosen secretions
- Some put antibiotics in the nebulizer or other drugs to thin the respiratory secretions

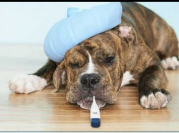
Treatment



• Tamiflu (oseltamivir)

- For best results in people, it must be given with 48 hours of being infected with flu
- Have no idea whether it helps dogs with flu
- But it does make more sense to use it for canine flu than for parvovirus
 - N in flu virus = neuraminidase
 - Neuraminidase is an enzyme that breaks down mucus on the surface of the respiratory and GI tracts so the virus can attach
 - Flu viruses have it, but parvovirus does not
- There are no studies to tell us the dose or frequency to use, or whether it helps to treat CIV
- **Some discourage its use for fear of causing resistant flu in people**

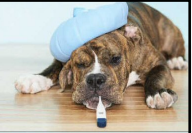
Treatment



• Euthanasia

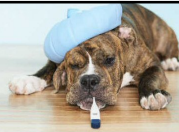
- Some shelters may need to euthanize dogs with severe form of CIV
 - It can be resource intensive to treat
- But remember that euthanasia will not change the outcome of the outbreak, unless all were euthanized within 2-4 days of exposure
- Depopulation might be considered of quarantine/isolation of all dogs for 14 days is not possible in your facility

Immunity



- Antibodies persist for at least 5-6 years after infection
- But we don't know if these antibodies protect from disease
 - Studies have not yet been done
- In people, flu viruses mutate often, so that new flu vaccines must be produced each year to keep up with the changes in the virus

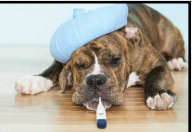
Immunity



Vaccine

- Not useful once an outbreak has begun
 - Does not prevent infection
 - lessens severity of symptoms
 - Lessens but does not prevent shedding
 - Killed vaccine requires at least 2 doses, 2 weeks apart to take effect
 - Immunity is best 1-2 weeks after the second dose (a month after the first vaccine)
 - Outbreak is over by the time the vaccine takes effect

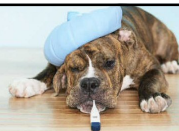
Immunity



Vaccine

- Useful to lessen severity of outbreaks in endemic areas
- Will help minimize community impact of an outbreak in shelters with short turnover time
 - **Turnover time** – average number of days between admission and leaving the shelter
 - Those adopted out infected with CIV will be less likely to have clinical signs, and if they do, they will be less severe
- Shelter workers should consider vaccinating their pets
- Two manufacturers – Pfizer and Merck

Immunity



Vaccine

- Two vaccines, 2-4 weeks apart
- Then one vaccine yearly
- If the second booster is not given and it has been more than 6 weeks since the first was given, then you need to start the vaccine series over
- Payment up front for both increases the chance that they will get the second
- Killed vaccine can be given as young as 6 weeks of age