Canine Influenza Virus

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)
    - Seizures, twitching, paralysis
    - 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 (Hemaglutinin 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

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

#### 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**

#### Protazoons
- Toxoplasma
- Neospora

#### Fungus
- Histoplasma
- Blastomyces
- Cryptococcus

#### Parasites
- Lung flukes
- Migrating hooks/rounds
- Heartworms

### 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

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#### Other Causes of Pneumonia

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### Diagnosis

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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
  - Specificity low – likelihood that negatives will be detected
- PCR is even more sensitive after the peak shedding period
- There is a problem with false positives with PCR

- Many false negatives
- Sensitivity good – likelihood that positives will be detected
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- 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)

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

• 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

• 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

• 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

• 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 to 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

**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

- 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

**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