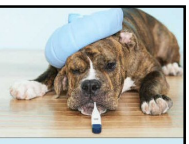
Canine Influenza Virus

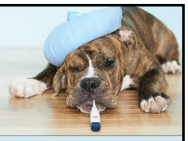
Wendy Blount, DVM

Kennel Cough



- A low level of upper respiratory infection is common at any shelter or kennel
- **"Upper Respiratory"**
  - nasal sinuses, trachea, large airways
- **"Lower Respiratory"**
  - lungs (bronchopneumonia, pneumonia)
- 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

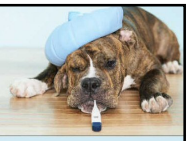
Bacteria

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

Viruses

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

Kennel Cough



Things that can look like kennel cough

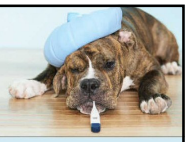
Allergic Bronchitis

Congestive Heart Failure

- Listen for a heart murmur
- Can resemble pneumonia
  - Coughing up pink foamy fluid
  - Breathing hard
  - Blue gums
  - Chest x-rays and other tests can tell the difference

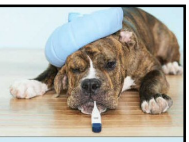
Heartworm Disease

Canine Flu



- Influenza A virus (orthomyxovirus)
- Related to (Hemagluttinin 16 Neuraminidase 9)
  - **Human flu** – H3N2
  - **Equine flu** – **H3N8**
  - **Swine flu** – H1N1
  - **Avian flu** – H5N1
  - **Canine flu** – **H3N8**
- First isolated from racing greyhound that died from pneumonia at tracks in Florida in 2003-2004
- Canine flu has since marched its way across the US
  - Not uncommon in shelters, rare in veterinary practice

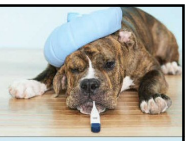
Canine Flu



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

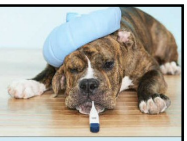


Epidemiology

- 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

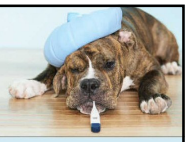
Common Shelter Fomites

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

Fomites You Might Not Think Of

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

Transmission

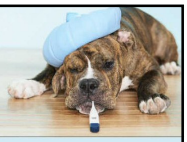


Incubation Period

- 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

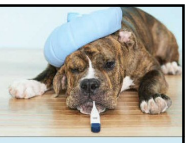


Virus Shedding Period

- 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

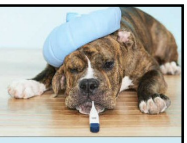


Virus Shedding Period

- 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**)

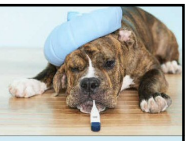
Transmission



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.

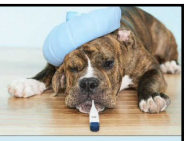
Clinical Signs



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

Clinical Signs

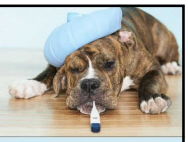


Animals fall into 3 categories

- **Asymptomatic infection** – 10-20%
- **Mild Infection** - 60-85%
- **Severe Infection** – 5-20%

- Most dogs look like garden variety kennel cough
- A few get severely ill

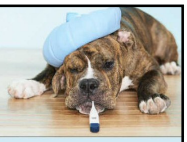
Clinical Signs



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
- Little response to antibiotics
- Mild fever or lethargy
- Purulent nasal discharge
  - **Purulent** – having the quality of pus
  - Due to secondary bacterial infection

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 reported only in the greyhound
  - **Peracute** – less than 24 hours from first symptoms
  - **Hemorrhagic** – coughing up blood (**hemoptysis**)

Other Causes of Pneumonia

Allergies
- **COPD**
  - Chronic obstructive Pulmonary Disease

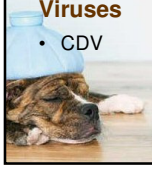
Bacteria
- many

Viruses
- CDV

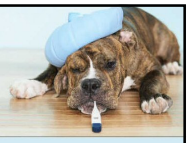
Protazoons
- Toxoplasma
- Neospora

Fungus
- Histoplasma
- Blastomyces
- Cryptococcus

Parasites
- Lung flukes
- Migrating hooks/rounds
- Heartworms

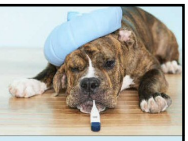


Diagnosis



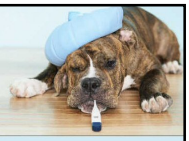
- CIV can't be distinguished from other respiratory pathogens based on clinical signs
- Coinfections may occur, confusing matters
  - **Coinfection** – infection with more than one organism simultaneously
- Diagnostic tests
  - Bacterial culture of trans-tracheal wash
  - Virus isolation (culture) from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

Diagnosis



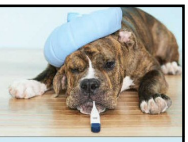
Nasal and Throat Swabs
- Must be taken in first week of infection to be positive
- As soon as symptoms begin is best
  - Peak shedding 2-4 days post-infection
- Submit samples from multiple animals for
  - Antigen detection
  - Virus isolation
  - **PCR**
    - Polymerase chain reaction
    - Detects 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

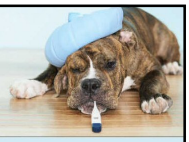
Diagnosis



Antigen Detection (immunoassay kits) – Swabs

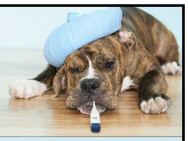
- **Directigen Flu-A**
  - By BD – Becton-Dickinson
  - http://www.bd.com/ds/productCenter/256020.asp
- **QuickVue Influenza Test**
  - By Quidel
  - http://www.quidel.com/products/product_detail.php?prod=56&group=1&cat=1

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

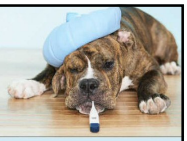
Diagnosis



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

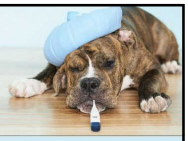
Diagnosis



Virus isolation

- 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

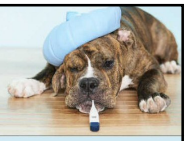
Diagnosis



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

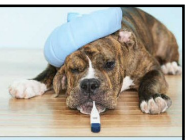
Diagnosis



CIV Labs

- Cornell University (PCR, titers, virus isolation)
  - New York State Animal Health Diagnostic Center
  - http://diaglab.vet.cornell.edu/issues/civ.asp
- Colorado State University (H1, PCR, ELISA)
  - CSU Veterinary Diagnostic Laboratory
  - http://www.dlab.colostate.edu
- UC-Davis (PCR)
  - Lucy Whittier Molecular & Core Diagnostic Center
  - http://www.vetmed.ucdavis.edu/vme/tagmanservice

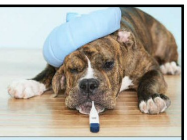
Diagnosis



Ancillary Diagnostics

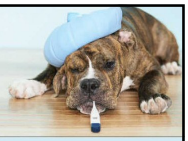
- CBC
  - Complete blood count
  - High white may indicate pneumonia or infection
  - Low white count might indicate overwhelming infection, or concurrent parvovirus
- Profile & urinalysis
  - tests liver, kidney, blood sugar, proteins, minerals, etc.
- Chest x-rays – to detect pneumonia
- Necropsy – ask the lab to look for CIV

Outbreak Control



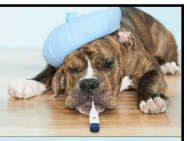
- Entire shelter must be **quarantined/isolated**, unless there are truly separate kennels which are not cross-contaminated
  - **Quarantine** – separate exposed from unexposed animals to see if the former become sick
  - **Isolation** – separating infected animals with symptoms, to limit infection of 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 is sufficient for quarantine/isolation if there are no breaches

Outbreak Control



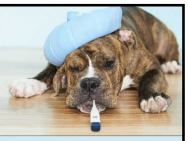
- **Deep cleaning and disinfection**
  - CIV is killed by most disinfectants, including **quats,** peroxygens and bleach
    - **Quats** - Quaternary ammonium compounds
  - CIV can live for 24-48 hours on nonporous surfaces
  - 8-12 hours on porous surfaces
  - Only minutes on hands

Outbreak Control



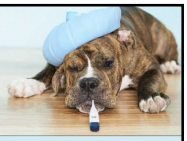
- **Deep cleaning and disinfection**
  - Review cleaning and disinfection protocols to make sure we are doing things as we know we should
    - Clean with detergent to remove organic debris
    - Then disinfect – soak for 10 minutes
    - Rinse and dry before returning the animal
    - Remove and disinfect/discard 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



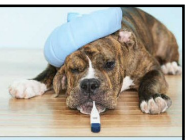
- **Increase air exchanges**
  - **Air exchange** – number of times per hour air in a room is moved out and replaced
  - 10-12 acceptable
  - Increase to 15 during an outbreak
  - Set fans by open windows - fresh air in
  - Close vents to stop air-sharing with rest of the shelter

Outbreak Control



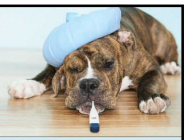
- Wear **PPE**
  - Personal Protective Equipment
  - Isolation gowns – less than $2 each
  - Gloves and booties
  - Staff assigned to either quarantine/isolation or naïve population for the day
  - Change out of your street clothes when you clock in, and into you street clothes when you clock out (scrubs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

Outbreak Control



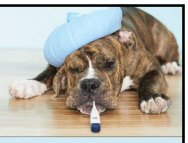
- **Inform the public - 30 day period**
  - Give each adoptive family written information on CIV
    - What to look for
    - What to do in case symptoms occur
    - Advise of risk to other dogs in the adoptive home
    - Remind that CIV is a community problem, came form the community, and the shelter 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



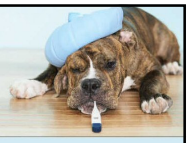
- **Inform the public – 30 day period**
  - Consider releasing adopted dogs only after the 14 day quarantine
    - They may still have symptoms, but are no longer shedding
    - Single dog homes are the best situation
    - Or vaccinate dogs in the adoptive home
    - Provide a complete medical record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

Outbreak Control



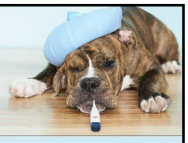
- **Inform the surrounding shelter community**
  - Issue a "CIV Advisory" to inform neighboring
    - shelters
    - Veterinary clinics
    - rescue groups
    - foster homes
    - boarding kennels
    - Groomers
    - trainers
  - Inform the general public – newspaper, PSA radio
  - Be a considerate member of the animal welfare community

Outbreak Control



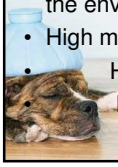
- **Review intake Quarantine Procedure**
  - Intake quarantine of at least 2 weeks is required to keep respiratory outbreaks down to a dull roar
  - If your intake quarantine is shorter, you will have frequent problems with kennel cough
  - If you can't do a 2 week intake quarantine, consider "cohort 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

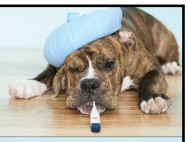
- Highly contagious
- Prolonged shedding
- Resistant to disinfection
- Prolonged survival in the environment
- High morbidity
- High mortality
- Many at risk
- Zoonotic
- Resource intensive to treat (severe form)
- Unable to effectively isolate/quarantine
- Unable to disinfect

Arguments Against

- Ubiquitous in the environment

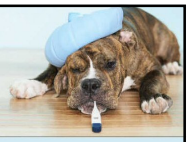
****CIV**

Treatment



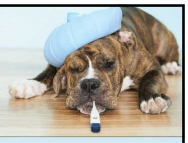
- **Antibiotics** for secondary infection indicated by:
  - Fever
  - Productive cough
  - purulent nasal discharge
  - pneumonia
  - Tetracyclines for mild form
    - doxycycline 5-10 mg/kg PO BID x 2-3 weeks
    - **PO** – per os – by mouth
    - **BID** – latin "bis in die" – two times daily
  - Plus IV antibiotics for severe form

Treatment



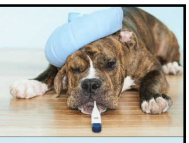
- **IN Bordetella vaccine booster for all**
  - **IN** - intranasal
  - Will decrease severity of secondary bacterial infection with Bordetella
- **Antitussives**
  - Cough suppressants
  - Contraindicated in dogs with productive cough
  - **Contraindicated** – "against indicated" – cause more harm than good

Treatment



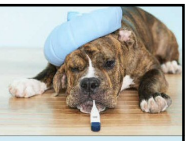
- **IV fluids** for severe form
  - Prevents/treats dehydration
  - Loosens and thins respiratory secretions so that they can be coughed up and eliminated
- **Coupage**
  - Clapping hands on the chest to loosen secretions and promote coughing

Treatment



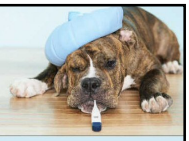
- **Oxygen therapy**
  - For severe pneumonia
  - cage or nasal cannula
- **Nebulization**
  - Treatment with steam to loosen secretions
  - Some put antibiotics in the nebulizer or other drugs to thin the respiratory secretions

Treatment



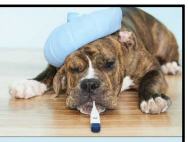
- **Tamiflu**
  - Generic - oseltamivir
  - For best results in people, it must be given with 48 hours of being infected with flu
  - Have no idea whether it helps dogs with flu
  - But it does make more sense to use it for canine flu than for parvovirus
    - N in flu virus = neuraminidase
    - Neuraminidase 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

Treatment



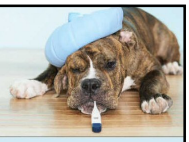
- **Euthanasia**
  - Some shelters may need to euthanize dogs with severe form of CIV
    - **It can be resource intensive to treat**
  - But remember that euthanasia will not change the outcome of the outbreak, unless all were euthanized within 2-4 days of exposure
  - Depopulation might be considered 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

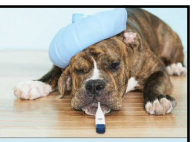
Immunity



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

- May be useful to lessen severity of outbreaks
  - only if dogs are in the shelter for longer than 3-4 weeks
- 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
- Vaccine is only conditionally licensed at this time
- Shelter workers should consider vaccinating their pets