MDL Biosecurity Manual

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BIOSECURITY

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What is Biosecurity?

The MDL program would greatly benefit from the biosecurity measures seen in Shelter Medicine. Biosecurity is the active control of disease through prevention as well as the implementations of failsafe barriers and protocols to halt spread of disease. These barriers can be physical or procedural preventatives such as daily sanitation. These procedures include all the ways staff and volunteers utilize the MDL facilities and how the animals are managed. Prevention is included with these procedures as well as prophylaxis such as vaccination protocols, thorough history of animals on intake, and even dewormings.

Why is Biosecurity Important in Shelter Medicine?

With the constant intake of multiple animals from various populations comes the risk of introduction and spread of disease. Some of these animals were surrendered at previous shelters with little health information, vaccination history, or previous exposure to other diseases. More importantly unknown introduced disease can be spread to staff, their personal animals, other animals on school grounds, or could possibly be adopted out.

Populations like these are more difficult since some animals come and leave, while others have extended stay. Therefore, typical all-in all-out population measures do not work in animal shelters. It is also difficult to group by age due to space restrictions. It is often seen where younger animals are housed with adults which increases chances of spreading to those with incomplete immunity. Lastly, in a shelter environment there are several opportunities for direct and indirect transmission. Frequently used items including bedding, toys, mats, and staff can all act as fomites for indirect transmission.

Is Biosecurity Practical?

Control of disease in the shelter setting is of course vital. There is a question for practicality and if tight biosecurity protocols negatively affect the population in the shelter. A strict no contact quarantine period for incoming animals for example does limit spread of disease but may come at the cost of poor behavioral development, decreased overall psychological health of the animals, and slow the process of homing these animals. Of course, strict and rigorous quarantine may be necessary during serious infectious disease outbreaks. Therefore, there should be multiple quarantine protocols to fit varied situations. The protocol put in place should always be the most appropriate for the health of the shelter population as a whole.

Intake Policy

Parameters set for populations on intake will vary from shelter to shelter. Stray animals and those with no history are an unknown factor and are more likely to introduce new pathogens into the shelter. Shelters within the USA have shown a large percentage of animals they bring in are immunologically naïve and therefore are more likely to contract and spread preventable disease. These facilities are often labeled as open-intake facilities that take in all animals regardless of ability to be adopted. This has a major impact on the general health of the shelter and may change biosecurity protocols to be stricter.

The MDL program is meant to provide healthy animals to help teach incoming students and have quick turnover and home these animals. Intake policy should be less inclusive and more selective than an open-intake facility, lowering risk for infectious disease and increasing ability to turn out animals that are sociable and emotionally healthy.

https://www.horshamvethospital.com.au/canine-parvovirus9aafc7c9

What is Adequate Isolation?

With any biosecurity plan there needs to be an area in which sick or ill animals can be isolated. These factors determine what is an adequate isolation area:

- Limited and designated faculty are allowed into quarantine or isolation areas
- Separate full clothing coverage (jumpsuits), shoe covers, boots, and gloves should be available
- Feeding, cleaning, and treatment supplies specific to that area
- If possible, separate ventilation that is differentiated by at least a full wall and door

Incoming Shelter Animals Procedure

Pre-Transport Examination and Requirements

The facility that is housing the animals prior to transport should have a preventative health program in place for their dogs. They should have their core vaccines already prior to transport to the MDL program or if needed they can receive them on intake. Ideally, they should have their vaccines administered 3 to 5 days prior to transport. This allows certain vaccines to provide adequate immunity before travel. All animals that are being transported should be treated for any external or internal parasites prior to transport.

Outside of any examination required by federal or state law, all of the animals destined for transport should receive a medical exam within 24 hours of transport. This exam can be done by a veterinarian or animal care professional. The animal care professional is someone under the indirect or direct supervision of a veterinarian who has been considered adequate to perform the examination and perform treatments. All abnormal findings should be given to the destination facility (MDL).

The status of every animal's health and behavior must be accurately documented and given prior to transport. Health certificates, rabies certificates, and all records should be given with every animal transported. Every animal should have some sort of identification like a tag or collar. Microchipping or a tattoo is also recommended. All animals being transported should be in good health to prevent spread of disease and improve welfare of the destination program.

Dogs older than 6 months of age should be tested for heartworm disease before being transported. These canines should also be started on macrocyclic lactones (avermectins, milbemycins) before transport. If a heartworm positive animal needs to be moved, they should be treated with a topical macrocyclic lactone or moxidectin along with a topical insecticide. They should also be started on oral doxycycline. If previously treated with a heartworm adulticide, it is recommended to wait 30 days after treatment to move the animal.

Vaccinations

In order to adequately protect the animals that come through the MDL program, all animals should have vaccine history or have vaccines administered on arrival. It is recommended animals have a prior history of vaccine for full immunity does take time after vaccine is administered.

The core vaccines that every canine should have prior to or administered at a shelter are:

- Distemper
- Adenovirus-2 (CAV-2/hepatitis)
- Parvovirus
- Parainfluenza
- Bordetella bronchiseptica

Distemper, adenovirus, parvovirus, and parainfluenza are all available through a modified live vaccine that is given subcutaneously. Puppies should have their first vaccine at around 4 to 6 weeks of age and then every 2 to 4 weeks until they are 18 to 20 weeks old. Adults who are not up to date on the vaccine should receive this vaccine on arrival. A booster is not typically needed for adults, but it would be beneficial at 2 to 4 weeks, especially for those who are immune deficient or in poor health.

Bordetella has a vaccine that comes with or without canine adenovirus and parainfluenza. It has been shown in a shelter setting a Bordetella vaccine is highly beneficial for canines since exposure to disease is high. Intranasal is recommended for its fast onset for protective immunity which is 3 to 5

days. It is also approved for use in puppies as young as 2 to 3 weeks of age and may work even though they still have maternal antibodies. All puppies and adults should either have a history of Bordetella vaccine or be vaccinated on arrival. It would be ideal if those who are not vaccinated get the vaccine 3 days prior to moving to the MDL service to ensure immunity before arriving.

Rabies is another vaccine that is important, although not considered a shelter core vaccine since there is very little risk of spread in a shelter setting. It is however a public health issue and animals that are anticipated to have an extended stay or get adopted out should receive a rabies vaccine if they have no history of one. This is more difficult to administer since most areas require direct veterinary supervision for rabies vaccine administration.

Canine influenza is another vaccine that is not considered core for shelter animals. There is an available killed vaccine for the H3N8 strain that reduces shedding time and clinical signs. It is not shown to be effective against the H3N2 strain of influenza. It is a vaccine that requires a booster and needs time to create effective immunity, so it is not as useful for a shelter setting. It may be effective for areas where the disease is endemic or for animals moving to areas where the disease is prevalent.

Vaccines that are typically not seen as beneficial in a shelter setting are canine coronavirus, giardia, leptospirosis, and Lyme disease. These vaccines are either not effective, or the diseases represented are of low risk of transmission in a shelter.

All animals taken in should be considered unvaccinated unless a medical history says otherwise. Special exceptions can be made for those with medical conditions, are pregnant, or are less than 4 weeks of age. If there is vaccine history, animals should be vaccinated on arrival or ideally sooner. Delaying even by a day or two significantly decreases the efficacy of protection provided by the vaccine.

Transport

https://i.pinimg.com/originals/cc/48/eb/cc48ebfdbc15b50fe8e74f929e47c15d.jpg

Transporter Requirements

All transporters should have animal training in health, safety and welfare to be able to notice issues with animals during transport and react. All transports should have a sufficient number of personnel to be able to handle the animals. Number of personnel and staffing can be determined by the distance being traveled, number of animals, what species of animal is being transported, and the weather during the time of transport.

There should be as little loading and unloading as possible during transport. This lessens stress and exposure to outside elements. Time of transport should be made as little as possible. There is an increased risk of animal health directly associated with the amount of time being transported.

Animals should never be left unattended in a vehicle for more than an hour. All animals should be observed as often as possible during transport and not less than every 4 hours. During times of observation animals should be tended to (fed, water, spot cleaning).

Animal enclosures should receive spot cleaning and changed bedding whenever they have been soiled.

If removing the animal is necessary, make sure to take precaution when taking it out of the enclosure. All enclosures and vehicles should be cleaned and disinfected appropriately between populations of animals. Proper sanitation can be found in the sanitation section of this document. Pheromones and calming music may be utilized to reduce stress during transport.

Vehicle Requirements

All vehicles being used for transport should be used properly under all federal and state regulations. The Animal Welfare Act and Regulations should be followed by all individuals involved in relocating animals.

A thermometer should be placed where the animals are held that can be readily seen. Temperatures should never drop below 45°F for more than four hours straight. For some animals, especially those with short hair coats, it is recommended to increase that limitation to 60°F. Temperatures should also never go over 85°F for more than 4 hours consecutively. Humidity should be within 30% to 70% at all times. Special modifications to these limitations may be made if transporting brachycephalic breeds.

Animals should have access to fresh air when needed and no animal should be kept unconfined within the vehicle.

Enclosure Requirements

All enclosures should give enough space for an animal to be comfortable and have good air quality. They should be large enough to allow the canine to sit upright, stand, turn around, and lie down in a normal position. If there is more than one animal per confinement, then both animals should have enough space to lie down. Animals that are not regularly with another animal should not be transported in the same enclosure.

Enclosures should never be stacked on top of one another. This increases stress, can compromise free flow of air, occludes proper observation by the transporter, allows waste material to fall on to animals below, and increases time for a potential emergency removal.

Enclosures should have absorbent material as bedding. Avoid things like thick blankets during the summer. All crates should be secured to prevent movement within the vehicle and have sturdy doors to prevent animal escape. All crates within the vehicle should be positioned to protect from weather and environmental extremes.

Actions upon Arrival

The destination facility should have personnel ready to receive all documented histories and physical examinations. All animals should be evaluated at arrival with another basic physical exam.

Adequate space and housing should be prepared for the animals. All animals should have a documented area of origin that will be disclosed to any adopters. Arriving animals should be quarantined for an amount of time determined by health status, legal requirements, source of the animals, or infectious disease potential.

https://www.amazon.com/Brady-126052-Chemical-Hazard-Quarantine/dp/B001MAHCWO

Quarantine Procedure

Animals should be quarantined in their own specific areas by population on intake. Every population should have specific staff and supplies dedicated to that area.

Typically with incoming healthy animals, shelters quarantine them at intake for up to 2 weeks. Newer studies suggest that extended times of quarantine are not actually effective for keeping animals healthy or preventing disease. It is now advised that healthy animals only be quarantined for a period of 7 to 10 days after intake. These reduced periods help to stop animals from experiencing any possible deterioration of physical, mental, or behavioral health from quarantine. They should be carefully examined and given proper preventative care while in quarantine. Quarantine times can be variable according to what infectious diseases these animals have been exposed to. Things such as a potential for an exposure to rabies or distemper would obviously alter and extend those quarantine times.

Medical rounds should be performed at least once every 24 hours. This does not have to be done by a veterinarian. A well-trained staff member or other veterinary professional can do it. Things that should be evaluated are urination, defecation, water and food intake, attitude/behavior, ambulation, and any obvious clinical signs associated with disease.

Another possible additive measure to quarantine is keeping animals in small groups or pods. When proper biosecurity is performed, widespread disease or problem can be avoided. This allows animals to develop socially and behaviorally while reducing the number of quarantined individuals during an outbreak since pods of animals are not exposed to other groups within the facility.

https://www.reddit.com/r/aww/comments/5rmbnj/happy_puppy/

Sanitation and Cleaning

Sanitation is a very important aspect to shelter medicine and is vital for a program that takes in multiple populations of animals like the MDL program. What follows will answer what should be cleaned and when and how to do it properly.

A Sanitation Plan

The last thing any facility wants is to have an animal in their care to acquire an illness or spread that disease outside the facility's walls. This is why a proper sanitation plan should be made to prevent spread from animal to animal, fomite to animal, or caretakers to animals.

Every object and area involving the animals needs to be taken into account with a comprehensive list. For all these things there needs to be something that removes organic matter, another product to disinfect and destroy potential pathogens, and finally adequate drying of the object or surface. These products must be practical, safe, and cost effective.

Surfaces and Objects to be Cleaned

The main focus for most facilities and sanitation are the cat cages and dog kennels where incoming animals are kept. What is often overlooked are the ways of how foot traffic from both animals and people spread pathogens and germs through the shelter. Disease can be spread by many surfaces and objects such as hands, carriers, clothing, transport vehicles, toys, exam tables, or even doorknobs. There are many things that require cleaning that tend to actually be the source of transmission instead of what the animals are housed in. A kennel will only have the germs of the animal that is housed in it, while things such as exam rooms or staff clothing will be exposed to multiple animals. Surfaces that require extra care and need to be fully disinfected include those that have high population contact, those that will have contact with young animals or those not protected by vaccination, and surfaces that have had contact with an ill or questionably ill animal. The following is a list of common items that should be regularly cleaned as provided by the shelter medicine program at UC Davis.

- Office areas
    - Those that contain animals at times
    - Those that do not but still need to be periodically disinfected
- Main lobbies and hallways
- Animal housing areas, including central walkways, walls, doorknobs, gates, etc.
- Medical/surgical areas, including instruments and equipment
- Other indoor animal areas, such as grooming, treatment rooms, intake rooms, visiting rooms, training areas, etc.
- Exercise yards or other outside animal areas
- Vehicles Carriers and transport cages
- Hiding boxes
- Furniture In animal housing areas (e.g. in grouped areas or canine real life rooms)
- In the shelter generally
- Hands
- Shoes
- Employee and volunteer clothing
- Bedding
- Dishes
- Litter pans
- Toys
- Tools, such as poop scoopers and mops
- Storage areas (especially food storage)
- Entire building, especially door knobs, phones, keyboards, and other frequently handled items

Order of Cleaning

With any good cleaning system there are always potential pathogens and germs that can be passed through the shelter. To decrease the risk of disease outbreak, cleaning should be done in the following order with younger animals being cleaned first before adults.

1. Young healthy animals not in quarantine
2. Adult healthy animals not in quarantine
3. Young animals in quarantine
4. Adult animals in quarantine
5. Sick young animals
6. Sick adults

When to Clean

Moving animals and completely disinfecting can cause stress on that animal which can result in further spread of disease. In these cases, daily cleaning may not be necessary and could be proven detrimental.

When an animal is remaining in its run or kennel, spot cleaning is preferable to complete cleaning and disinfection. This not only reduces a possible stressor but frees up time for staff to perform other duties. Complete cleaning and disinfection should primarily only occur between animals residing in that kennel. This also applies to transport vehicles which should be completely cleaned and disinfected between populations of animals.

Cleaning Products

There is no single product that is good for every situation. Aspects of cleaning products to consider are disinfection spectrum, how well it works with organic matter, cost, safety, speed of action, and how it is applied.

One important aspect is whether the disinfecting agent covers non-enveloped viruses. This is an important consideration in shelter medicine with canines since these include viruses such as parvoviruses and canine adenovirus.

Quaternary ammonium-based products (KennelSol, Clorox), although labeled for non-enveloped viruses are shown not to be effective as seen in a study done by Cornell in 1980. This has been repeatedly shown in more recent research as well. Although not an adequate disinfectant, quats are acceptable cleaners and do well with organic material depending on concentration being used.

One of the best disinfectants that is practical and affordable is diluted bleach (sodium hypochlorite solution) and is effective against non-enveloped viruses. One half cup of household bleach diluted in a gallon of water is acceptable to disinfect surfaces. These solutions are also stable for 30 days when stored in dark areas at room temperature.

Bleach however does have some pitfalls, like inability to disinfect with the presence of organic material. It also has no cleaning properties like you would find in detergents. More recent disinfectants have shown effectiveness against non-enveloped viruses, but have better cleaning ability, work well with organic material, and have a more rapid onset. These include accelerated hydrogen peroxide (Rescue) and potassium peroxymonosulfate (Virkon or Trifectant). Rescue is stable for 90 days making it a more practical cleaning product.

The conclusion to which is best is that no cleaner fits every situation. For regular cleaning where parvovirus is not a problem, quaternary ammonium is effective. In shelters with turf and potential parvo outbreaks Rescue is more effective and practical. For rare cases such as ringworm outbreak there are few practices that are effective. One method is diluted bleach at separate cleanings 24 hours apart. Another common practice is use of detergents

to remove organic material followed by Rescue. All of these examples show that it is good to have many disinfectants and detergents available for a multitude of situations.

https://www.theguardian.com/environment/2018/feb/15/cleaning-products-urban-pollution-scientists

Effective use of Cleaning Products

Always make sure to use correct concentration as labeled on the product. Correct application, contact time, dilution and method are all important when using cleaning products.

Contact time is often overlooked and simplified to always being 10 minutes of contact time for best effect. Many disinfectant products such as Rescue and Trifectant only require 1 minute under ideal conditions. Of course certain factors can affect the time such as low temperatures and presence of organic material. It is often recommended that if there is organic contamination or low temperatures that contact time should be increased to an hour or more to be safe. It is also ideal to disinfect right after a surface is used. This instant cleaning stops organic material from previous use, having time to dry and making it harder to disinfect.

Always check expiration dates and dates when the solution was made for effectiveness. Every container should be dated and labeled when the solution was made, as well as include information on what disinfectant is used and concentration.

One of the most important steps often overlooked is drying the area after cleaning. Many germs and pathogens prefer a moist environment and if they avoid a disinfectant can thrive in a damp area of a run for days. There have been instances of fatal pathogens being cultured in areas that had previously been cleaned and disinfected. Drying is especially important in areas where floors are uneven and allows for pooling of moisture to occur.

https://www.houstonmethodist.org/blog/articles/2020/mar/hand-washing-why-it-matters/

Sanitizing Hands

One of the most important surfaces to keep clean between populations of animals and individual animals are caretaker or staff hands. The environment can be clean but if a handler's hands are dirty, it promotes major spread of disease. Hands touch animals all over, end up in humans mouths or near their faces, promoting any potential zoonotic diseases or spread to animals outside of the facility.

There are three main methods to hand sanitation and those are use of gloves, washing hands, and hand sanitizers. The most proven effective choice is the use of gloves. Gloves however can be time consuming to take on and off and are not cost effective. They are however recommended with changes between

each animal when dealing with resistant pathogens, zoonotic disease, or if there is an unknown disease spreading within the facility. If performing something that requires little dexterity, plastic food handling gloves can be used and do not cost much. Always wash hands between glove changes especially when handling a seriously diseased animal due to possible small cracks in gloves or spread to hands when removing them.

Washing hands in between handling has always been widely accepted as the next best choice. There has been more recent research that shows this may only be true in certain situations. It has been shown that hand washing can get rid of even the most resistant of pathogens especially when organic material is present. It is the hand cleaning of choice when visibly soiled with feces or blood, or a durable pathogen is present like ringworm or parvovirus. The biggest issue with hand washing is compliance and doing it properly. The CDC's guidelines for handwashing have been to wet hands with warm running water, lather with soap and scrub for at least 20 seconds and then rinse. Hands should always be dried completely after washing with two single-use paper towels. As was talked about in environmental sanitation, damp areas and moisture allow for certain pathogens to survive, even on hands.

The last choice when sanitizing hands is the use of hand sanitizers. Even though shown to be less effective with a smaller spectrum of effect, if used consistently with better compliance may be proven more effective. There have been studies showing that after handling animals, bacterial growth was decreased on those that used hand sanitizers over hand washing.

The hand sanitizer that is used should have over 60% ethanol and should contain a skin protectant or moisturizer to protect the user's hands. The sanitizers require rubbing for at least 10 seconds and are allowed to air dry. No hand sanitizer is effective against the most durable of pathogens (parvo and ringworm) so make sure to use either gloves or hand wash in those instances.

Newer hand washing techniques are the use of hydrogen peroxide (Rescue) wipes when hand washing is not available and durable pathogens are dealt with. Rescue has been shown to be effective in these cases and can be used without gloves. This makes it a viable option in these cases.

Cleaning Feet

https://primed.com/medical-products/medical-shoe-covers/

Feet sanitation is a very important aspect in veterinary medicine and shelter medicine especially. Animals often sit on the floor of exam rooms and staff walk in and out of kennels to walk animals as well as clean the kennels. Pathogens and germs can be tracked on the bottom of their shoes especially if organic material is present.

Fortunately the chances of this are low if the kennels are disinfected correctly. Typically whatever is tracked in is destroyed by the disinfectant used in a prior cleaning. Changing footwear when entering or leaving the kennel area lowers the chances even more. Cleaning feet or changing footwear is primarily only important when entering or exiting isolation areas where animals with durable pathogens

reside, or when entering an area where vulnerable or immune deficient animals live (neonates).

Foot baths, dedicated boots or shoe covers are the ways to prevent spread of disease. Foot baths are convenient but do not actually work very well. There is insufficient contact time with foot baths to actually kill any pathogens being tracked into areas. They are also typically not deep enough to cover all of the areas of potential pathogens on a person's shoe or boot. Overall foot baths are not very effective, can cause harm to the animals if tracking in a toxic dose of disinfectant, and are difficult to maintain.

Boots specifically used for isolation areas or shoe covers are the best when dealing with serious disease. If foot baths need to be used, they should use a disinfectant that works in the face of organic matter, have an adequate depth, should always have a brush to remove as much material as possible, and should be changed at least once a day or if contaminated.

Clean Clothing

It is typically unreasonable to have staff change clothes between every animal. It has been shown however that some pathogens are concentrated in the hairs of an animal (ringworm for example) and can be spread by the loose hairs left on clothing. The major prevention of spread from clothing is to use dedicated smocks, scrubs, or surgical gowns when interacting with animals with serious disease. Make sure these materials are only used once until being washed. Most laundry detergents will be adequate to kill even the most durable of pathogens as long as the washer is not overloaded, and excess debris is removed before washing. Additional adequate drying and desiccation will further the destruction of any pathogens.

https://www.momscleanairforce.org/5-ways-to-protect-families-from-toxic-chemicals/

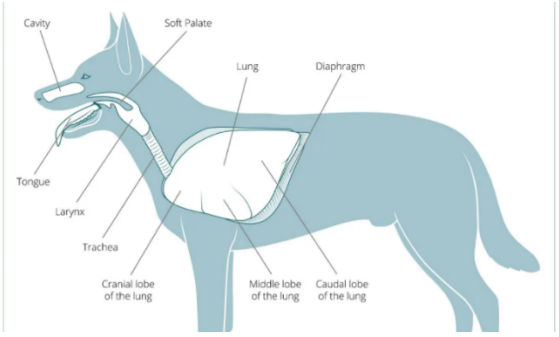
Chemical Toxicity

Disinfectants used at too high of a concentration can cause toxic effects in some animals. Toxicity should be suspected when seeing multiple episodes in a population of fevers, respiratory signs, pneumonia, and oral ulceration. In these cases make sure to bathe the animal and rinse all of the disinfectant from the kennel or run. If ingested, call poison control immediately, since offering an emetic could cause additional harm especially with caustic disinfectants. If ulceration is seen, adequate pain management with broad spectrum antibiotics tends to resolve the issue.

Disease Recognition and Response

Quick and accurate response to a potential outbreak is always important in any shelter setting. Identifying infectious disease and moving an animal to isolation are important steps to preventing spread of disease. The following breaks down common infectious diseases seen in a shelter setting by what system in the animal's body it typically affects. Knowing clinical signs, what tests can be done to confirm disease, and what actions to take after diagnosis are necessary when you are dealing with a facility taking in multiple populations of animals.

Respiratory



https://avopix.com/premium-vector/306525950-shutterstock-respiratory-system-of-the-dog-vector

Canine Infectious Respiratory Disease Complex

General Information

Also known as "kennel cough", canine infectious respiratory disease complex (CIRDC) is a common respiratory infectious disease in a shelter facility or any multiple dog setting. It is difficult to control and diagnose since multiple pathogens are involved in this disease. Often exactly knowing the pathogen that caused the outbreak is not achievable, so prevention is the best practice.

CIRDC or kennel cough typically includes certain clinical signs like nasal discharge, eye discharge, sneezing, and possible lower respiratory signs. Many different agents, both viral and bacterial, can work together to cause this disease.

Pathogens listed by the OSU veterinary program that may be involved are:

- Parainfluenza
- Adenovirus-2
- Respiratory coronavirus
- Herpesvirus-1
- Pneumovirus
- Bordetella bronchiseptica
- Mycoplasma spp.
- Streptococcus zooepidemicus

Canine distemper and influenza may also play a part, but typically are more systemic in nature causing additional clinical signs. There may be other bacterial pathogens that contribute as well but are unknown or play minor parts.

The most important factors are environmental and host immunity. This is why this disease has been known as kennel cough where these factors play a primary role. Increased stress and crowding seen in shelters contribute to lowered immunity and increased contact allowing for outbreaks of this disease.

Potential Zoonosis and Cross Species Infection

Although this disease is primarily for canines, there are some involved agents that can be transmitted to other species, including humans. Bordetella bronchiseptica is a bacterial agent that can be spread to people, especially those that are immune suppressed or compromised and those with other respiratory issues. This as well as influenza has

also been seen to infect some cats. This is why it is always good to separate species with housing in a shelter as well as washing hands between handling of animals.

Incubation and Infection

Most of the pathogens involved with CIRDC have an incubation period of 2 to 3 days, but if including distemper can have an incubation period of up to 6 weeks. One of the most complicated aspects is the shedding period of these pathogens that happens preclinical. These pathogens can be spread from animal to animal without seeing any signs, which is why quarantine is warranted for incoming animals. Signs and shedding of these pathogens last around 5-10 days. Some of these pathogens require longer isolation periods with longer shedding times such as Bordetella (14 days), distemper (3 to 4 months), and Mycoplasma (1-4 weeks).

The clinical signs of the majority of these pathogens resolve with supportive care. They are usually mild and self-limiting. Of course these can be exacerbated in neonates and immunocompromised animals.

Diagnostics

Many of these pathogens cause similar upper respiratory signs, so diagnosis cannot be made on that alone. Most of the time exact diagnosis is not needed since many of these cases resolve on their own. Some agents can be ruled in or out based on more severe signs or history. Distemper uniquely can show neurologic signs or can be ruled out with vaccination history. Influenza will affect larger populations of animals at a faster rate regardless of vaccination status.

It is when cases are not self-limiting that diagnostics may be required for proper treatment. If they have upper respiratory signs a nasal swab should be sufficient. Lower respiratory signs may require a tracheal wash sample.

Depending on the agent that is causing disease there are multiple diagnostics that can be performed. Culture and sensitivity can be used for resistant bacterial infections, including Streptococcus zooepidemicus. Serology is effective for influenza in areas that are non-endemic for it. Serology is not as useful when vaccines can interfere with accurate detection. PCR or polymerase chain reaction is always a good option for viral isolation. Some labs have quantitative results that can be helpful as well. Histopathology can also be helpful when agents affect tissues and cells directly and can be visualized. Lastly necropsy can always be utilized if the disease involved causes death within the population.

Prevention - Environmental

The biggest way to prevent the spread of CIRDC is similar to prevention of other diseases. This is through support of the animal's immune system and proper sanitation. The best ways to help an animal fight off disease is by vaccinating, reducing stress, and stopping potential irritation of the upper airway. Reduction of environmental components would be again good sanitation, less crowding, and proper ventilation and air quality.

Proper dog housing is incredibly important for prevention. Increased density of the animal population increases contact rates, stress, and risk of disease introduction. Housing unrelated animals, not isolating clinical animals, and increased time in the shelter are all proponents of a serious disease outbreak.

Prevention – Vaccination

CIRDC is not completely preventable by vaccination. The total amount of pathogens, both primary and secondary, within the complex do not have vaccines available. With some pathogens disease can be completely prevented, while others have vaccines that greatly reduce the chance of contracting disease or reduce clinical signs.

The recommended vaccine protocol for distemper, adenovirus-2, and parvovirus is a modified live virus subcutaneous for all dogs over 4 weeks of

age upon admission or more ideally at least 3-5 days before joining the facility. Puppies should of course be vaccinated every 2 weeks until reaching an age of 18 weeks due to maternal antibodies. Of course population selection of animals that have a history of vaccination is ideal as well.

All animals over 2 weeks old should also receive a mucosal modified live virus for Bordetella and parainfluenza. This should be done upon admission or more ideally 3 days before joining the facility. Puppies less than 6 weeks of age should be vaccinated again after 6 weeks for adequate protection. These vaccines are available by either nasal or oral administration. This mucosal vaccine has rapid protection both locally and systemically and in some studies showed exceptional protection within 3 days. The subcutaneous administration takes 2 to 3 weeks after the booster to provide adequate protection. The rapid protection from the mucosal vaccination is paramount in a shelter setting. The mucosal vaccine is also preferred for puppies since it is primarily not affected by maternal antibodies.

Canine influenza (H3N8) has two available subcutaneous vaccines. They do not provide complete protection against the disease but do lessen duration of shedding and reduce clinical signs. Proper administration will be expanded upon in the canine influenza section.

Environmental Decontamination

The agents involved in canine infectious respiratory disease complex typically only last in the environment from a couple hours (like canine distemper) to 3 or 4 weeks (like Bordetella). They are fortunately denatured and deactivated by mostly all routine disinfectants. Adenovirus-2 however is a non-enveloped virus and is only affected by limited disinfectants. Bleach products (5% sodium hypochlorite, sodium dichloroisocyanurate), accelerated hydrogen peroxide, and potassium peroxymonosulfate are all proven effective against non-enveloped viruses.

It should be emphasized that there needs to be adequate drying after cleaning to prevent moisture and pooling that can harbor pathogens.

It is important to realize that improper methods can serve to spread disease instead of prevent it. Ideally kennels should be separated by a transfer door so at any time the animal can be moved and the contaminated side cleaned if needed. If the facility has an adequate dog walking program, the kennel does not need to be cleaned until after the animal's stay. Spot cleaning until then is sufficient. Cleaning should ideally not be done with a mop and bucket for those materials can act as fomites. If an animal needs to be moved for cleaning, they should not be kept in a communal holding area or tied near the kennel while being cleaned.

Isolation

Mildly affected dogs play a major role in the spread of this disease. Mild clinical signs do not represent a mild pathogen. There should be an immediate removal of all clinical animals, and this is critical for ending the outbreak of disease. Caretakers and staff should all be able to scan for things such as sneeze spots on kennel walls as well as clinical signs.

If possible, animals should be taken to a separate isolation area with ideally separate air flow since many CIRDC pathogens have airborne transmission. If this is not possible, it has been shown that moving clinical animals at least 25 feet from healthy animals with adequate fomite control is an effective isolation technique. This can be done simply by having a few empty kennels between the sick and healthy animals with a physical barrier showing where sick animals are being held.

Treating Sick Animals

There is no one drug that can treat every pathogen represented with CIRDC. Most animals with mild disease do not require any treatment and get better on their own. For those with more difficult or challenging disease, antibiotics may be warranted.

Bordetella has been shown to be affected by empiric treatment with antibiotics such as doxycycline and potentiated sulfonamides. Cephalexin is not a good choice for Bordetella for it is usually resistant to this antibiotic. Secondary pathogens to viral outbreaks are typically treated with broad spectrum antibiotics. These include cephalexin, fluoroquinolones, or Clavamox. If needed, for resistant pathogens a culture and sensitivity should be performed to select an appropriate antibiotic. Antitussives are not recommended since this can reduce bacterial clearance and can contribute to infection of secondary pathogens.

Supportive care is appropriate as well, giving adequate hydration and nutrition and reducing triggers for barking to inhibit irritation of the upper airways. When walked, leashes connected to collars should be avoided as well to prevent tracheal irritation.

Canine Influenza

General Information

This is a highly contagious disease of the respiratory system for canines. Canine influenza should always be a concern wherever dogs are cohabiting. It is a relatively new concern in shelter medicine for the first recognized outbreak that occurred in 2004 with a population of racing greyhounds. After this first incident there have been multiple appearances of this virus across the United States.

Previous outbreaks have been primarily due to the H3N8 strain which is believed to originally be equine in origin. In 2015, there was a new strain (H3N2) that is avian in origin that was first detected in the U.S. in Chicago. It has now been seen periodically all across North America, and even though it is rare, most dogs are likely susceptible to it. Most recently there has been an outbreak in 2019 in multiple North Carolina shelters.

Canine influenza is an enveloped virus that can affect dogs of all breeds and ages. Compromised animals may have more severe clinical signs, but overall mortality rates are low. There has been an instance in Korea where cats had become infected by the H3N2 strain during a canine outbreak, but no other outbreaks in felines have been seen. At this time there have been no cases of humans contracting this disease.

Clinical Signs

When a population of canines is newly introduced to canine influenza there is a large percentage of the population that will become infected. Up to 20% of this infected population will have no clinical signs at all. This is why any dog that was exposed, having clinical signs or not, should be considered an infectious risk.

Typical clinical signs are similar to kennel cough and could include:

- Mild fever
- Poor response to antibiotics
- Soft productive cough
- Dry honking cough
- Nasal discharge
- Hyporexia

A small portion of these dogs can progress to more severe signs such as:

- Severe fever
- Pneumonia
- Death

Severity is usually determined by the health and immunity of the individual dog.

Incubation Time and Recovery

H3N8 typically has an incubation time of 2-5 days after exposure and maximum shedding during the 2-4 days after exposure. This is important because it shows that canines shed the virus the most before showing clinical signs. Shedding ends usually

around 7 days after being infected. This short shedding window makes diagnosing the outbreak very difficult. The shedding window along with no carrier state means that dogs infected after 1 week do not have high potential to spread disease.

H3N2 has a long shedding period. Viable virus has been shown to be shed from infected animals up to 20-24 days after initial infection. Some cases have shown intermittent shedding during this period, testing negative in between positive tests. Shelters have made the mistake of introducing clinically healthy animals back into the population before 21 days and having newly diseased animals appear afterwards.

Suspicion Factors

It is very difficult to differentiate canine influenza from all the other pathogens involved with canine respiratory disease. With increased incidence in the United States, it is recommended we start surveillance testing or suspecting the disease when there are certain factors of disease observed. Some of these are:

- Large percentage of animals becoming affected, especially in a non-endemic area
- All ages of animal affected
- Dogs of all vaccination status are affected
- Severe signs such as pneumonia or high fever
- Poor or no response to antibiotics

Diagnostics

For the H3N8 strain there are PRC tests, serology, and in-house ELISA tests to detect it. Serology is not very useful for test results and can take up to 3 weeks which is not helpful during an active outbreak.

H3N2 has recent diagnostics available through PCR. This is available through IDEXX, Cornell, or the Wisconsin Veterinary Diagnostic Lab. There is also a specific serology test for H3N2 that can be done solely at the Cornell lab.

Transmission Prevention

When disease is first seen it is important to know which animals had been exposed several days beforehand to the infected animal. This is because of the peak shedding period that occurs 3 days prior to clinical signs showing.

The virus is spread through respiratory discharge and can be transmitted through aerosol, direct contact, fomites, and droplets. It has been seen before that handlers have carried the virus home on their clothing and have infected their own animals. It is important that caretakers have a change of clothes when dealing with canine influenza.

It is preferred to have separate ventilation and air supply for those animals being isolated with canine influenza. Not every shelter has access to this, but many shelters have controlled disease with attention to fomites. Unlike other respiratory pathogens it has been shown to spread by aerosol even when separated by 20 feet. It is recommended ill patients be kept at least 50 feet from healthy animals if separate ventilation is not available.

Canine influenza typically lives in the environment for only around 12 to 24 hours and rarely survives any longer. Since it is an enveloped virus, it is susceptible to most disinfectants. These include Rescue, isopropyl alcohol, Trifectant, bleach, and quaternary ammonium compounds (ex. Chlorox).

Vaccines

There is a vaccine for canine influenza, but is only shown to help with immunity to the H3N8 strain and not the newer H3N2 strain. This vaccine reduces clinical signs and viral shedding times, but does not provide complete immunity.

This vaccine is used in puppies over 6 weeks old and requires a booster 2 to 4 weeks after the first subcutaneous injection. This means there is a 4 to 6 week time frame until there is adequate immunity

from the vaccine. This limits its usefulness in most shelter settings.

Treatment

There is no direct treatment for canine influenza. For severe cases it is important to control any secondary bacterial pathogens for which broad spectrum antibiotics are used. These include fluoroquinolones, doxycycline or Clavamox. Respiratory panels can be helpful to identify secondary pathogens as well as culture and sensitivity testing. Thoracic radiographs may be indicated for severely infected animals.

Supportive care just like CIRDC is indicated. There should be adequate nutrition and hydration as well as reduced triggers for barking. Cough suppressants are not recommended here and should be avoided.

Managing an Outbreak

The primary goal with an outbreak is to stop the transmitting of disease between infected, exposed, and new healthy dogs. This is easier to manage with H3N8 since it has a short shedding period, unlike H3N2. Breaking these connections with transmission can be hard since shedding happens in the preclinical period of disease. It is still achievable with careful monitoring and isolation of dogs with exposure and isolation of those that are sick.

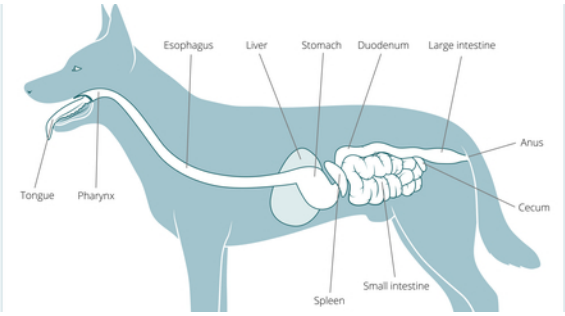
Since most dogs are susceptible since they have never been exposed or vaccinated prior, when you have one animal with canine influenza you can consider all of the animals in the shelter currently exposed. Dogs with no clinical signs of illness should be quarantined for 7 days before being moved back into the healthy population. Those with clinical signs should be isolated for 7 days following the first day of showing clinical signs. This is for the H3N8 strain only. Those infected and have clinical signs associated with H3N2 should be isolated for at least 21 days.

Shelters should discontinue the intake of animals during the period of the outbreak. For H3N8 this should continue for at least 14 days, 7 days for quarantine and 7 days for isolation. For H3N2 this must be done for 28 days, 7 days for quarantine and 21 days for isolation. Both of these periods can be extended if newly infected animals become clinical.

If intake cannot be discontinued, the shelter should take the following precautions. There needs to be a separate intake area for new healthy animals. Separate staff from the infected population should be working with these new animals only. All animals in the clean area should be closely monitored twice a day for any signs of canine influenza. Sick animals and exposed animals should be isolated but separately. Exposed animals can be released to new adopters as long as they comply with the quarantine in their own household. The quarantine times are the same as they would be in the facility and there should be a required agreement made between the facility and the adopter. Of course, let the adopter know the potential for disease to develop and the risk to other dogs.

If the disease is endemic in the community, it may not be practical to shut down for multiple weeks every time a new case is identified. Recognition of clinical signs and isolation is a constant. All adopters should agree to the quarantine period of their new animal and should have strict fomite control at home if exposed to other animals. The adopter's regular veterinarian should be advised of the risk the animal has of being infected with influenza. Animals that have been infected and have gone through the appropriate quarantine protocol are not likely to become infected again or shed it to another animal. Immunity to canine influenza for previously infected animals usually lasts for at least a year.

Gastrointestinal



https://www.petcoach.co/article/anatomy-function-of-the-esophagus-stomach-intestines-in-dog/

Parvovirus

General Information

Canine Parvovirus is an incredibly serious disease that when detected in a shelter setting needs an immediate plan of action. It is a non-enveloped DNA virus and can survive in the environment for months to years. It will appear rarely in a shelter even with good vaccination programs within the community. There is some shedding that occurs in pre-clinical canines and contamination can go without being recognized. A shelter needs a good vaccination program, proper disinfection, and appropriate housing practices to prevent parvovirus outbreaks.

One important aspect of parvovirus that although there are multiple strains and they continue to evolve, it tends to be stable antigenically and therefore vaccination continues to provide adequate protection against it. Testing in house is still reliable making diagnostics easy. There is also a short incubation period making quarantine possible for exposed animals (anywhere from 3 to 14 days). All of these characteristics make this very serious disease manageable and containable within a shelter facility.

Who's Susceptible and Cross Species Infection

Puppies are typically the most susceptible and can suffer from serious disease or even death. Any dog that is unvaccinated and of any age can become infected. Some people stipulate that the black and tan breeds of dogs are more susceptible, but with evolving breed lineages one breed should not be assumed to be any more susceptible than another. Any increased prevalence seen in certain facilities or breeds is more likely attributed to inadequate vaccination frequency.

Some parvovirus strains have been able to cross the species barrier and infect cats. Like panleukopenia, it causes serious disease and even death in felines. More importantly, some strains can establish a carrier state in cats and can infect dogs in comes into contact with. Fortunately, the feline panleukopenia vaccine provides adequate protection against canine parvovirus as well.

Vaccination

Having animals vaccinated is the most important aspect of prophylaxis and protection within the shelter community. It protects against all strains of canine parvovirus and in the absence of maternal antibodies can provide protection in 3 to 5 days. All canines over 4 weeks of age should be vaccinated on intake or more ideally a week before transport. If parvovirus is rare in the community, vaccination can be started as late as 6 weeks. Puppies should be revaccinated every 2 to 4 weeks until 18 to 20 weeks of age. If an adult canine has no history of vaccine, a booster in 2 weeks after initial vaccination should be considered. It is important to know canine parvovirus spreads to a facility due to infection of dogs within the community. Protection against parvovirus starts in the community and it is important that they have affordable access to vaccines for their pets.

Clinical Signs and Diagnosis

The most typical clinical signs that are seen with canines with parvovirus are:

- Lethargy
- Anorexia or hyporexia
- Bloating
- Abdominal pain
- Vomiting
- Severe bloody diarrhea

Many times, persistent infection can lead to rapid dehydration, intestinal damage, immune deficiency and resulting sepsis. Suspicion should be raised if these signs are seen in susceptible animals such as puppies or those that are unvaccinated.

Diagnosis is usually achievable from in house ELISA tests. These are highly specific and sensitive even with new emerging strains. As with any test, false negatives are possible and are more likely near the end of disease where virus is not being shed. There have been reports of possible weak false positives from vaccination, but this is fairly uncommon with the Idexx SNAP test. Essentially, if disease is suspected and the animal is not vaccinated, a positive should always be taken seriously. Other in-house diagnostics that are indicative for infection of parvovirus is a leukopenia on CBC or characteristic segmental enteritis on necropsy.

There is always the option for a laboratory PCR which has good turnaround time. It also can distinguish between strains of parvovirus, but this has little clinical significance. Immunohistochemistry and histopathology are always the gold standard on necropsy during a random outbreak that is unsuspected.

Testing should be done on all suspected animals with clinical signs and those suspected of exposure. Since viral shedding occurs primarily in pre-clinical animals it is important to test those that are at high risk for exposure. Testing should not be done on a screening basis since it is not cost effective and is likely to increase numbers of false positives. Diagnostics are important but daily monitoring is just as essential in recognizing an outbreak. An animal that is not doing well and goes unrecognized and significantly increase the chance for spread throughout the facility. Make sure all staff are trained to recognize the clinical signs and be able to perform and interpret in house testing.

Quarantine

A typical quarantine for potentially infected animals is 14 days. If a shelter finds that in most cases they are seeing a break of disease in a shorter time span this quarantine can be shortened appropriately. This is typical of animals that are exposed prior to being transported to a new facility and have gone through multiple days of incubation before arriving. It can also occur in animals with large amounts of exposure to the virus in which the disease may break in as little as 7 days.

All canines over four weeks old should be vaccinated or have history of being vaccinated with a modified live DHPP vaccine within the last 2 weeks. Adults should all be housed individually if possible. If not, they can be kenneled in pairs and each kennel have their own cleaning and treatment supplies. There should only be certain staff assigned to these quarantined areas with sufficient PPE equipment (gowns, gloves, shoe covers, or dedicated boots). All PPE should be changed in between individuals or paired cohorts. Foot baths are not effective in stopping spread of parvovirus. Animals should be bathed at the end of quarantine to remove any potential parvovirus on fur.

Disinfection and Sanitation

Canine parvovirus can sustain in the environment for months to years, especially in areas that lack natural lighting and are moist.

Bleach has always been a highly reliable disinfectant that inactivates parvovirus. This includes products that contain calcium hypochlorite and sodium dichloroisocyanurate. The downside of these products is that they are not effective in the presence of organic matter and does not penetrate porous materials. They are effective on sealed

materials and stainless steel. Surfaces made of plastic, wood, carpet, or other porous materials should be cleaned with another product.

Accel, Rescue, Trifectant, and Virkon all have much more effective detergent properties and work better when faced with organic material. These products can effectively be used on contaminated carpets or furniture. Quaternary ammonium products as discussed previously are not effective with non-enveloped viruses and would not be useful when disinfecting surfaces contaminated by parvovirus.

There is no shown benefit to a large waiting period before reusing a kennel after disinfection. Waiting even a couple weeks does not decrease any potential contamination. The safest method of disinfection is to clean, disinfect, and dry at least twice within a day if the kennel needs to be turned over as soon as possible.

Areas that cannot be completely disinfected such as an outside yard or homes, repeated cleaning can be effective if done diligently. Outside play areas can be flushed with water and sprayed down with effective disinfectants. Accel and Rescue would be most effective since it works best in the face of organic matter being present. If new cases keep appearing the area should be closed off to puppies and unvaccinated animals for 6 to 12 months. During this period expose the area to sunlight and keep as dry as possible.

Treatment

Animals with canine parvovirus should only be treated within the facility if they have the adequate space and capability to truly isolate the animal. This should ensure that the rest of the animals in the facility are not at risk and there is adequate staff and veterinary care to provide appropriate care. Another option is transfer to a veterinary clinic or shelter that does have the ability to treat the animal.

If neither option is possible with ability to transfer to another facility euthanasia is a possibility to prevent disease spread. If treatment is possible, anti-emetics, fluids, broad spectrum antibiotics, and possible blood products should be administered. Enteral nutrition as early as possible is often recommended to limit the course of disease and decrease the overall cost of care. Cost of outpatient care is often much less when compared to inpatient care.

Reintroducing Animals

Animals can continue to shed virus up to 14 days after clinical signs have resolved, therefore the 2 week isolation period is recommended before putting back in the healthy population. The biggest setback is for puppies who can suffer from poor socialization and have increased chances of growing up with increased fearfulness and possible aggression. This is why even when in isolation, volunteers should continue to socialize the animal with proper PPE.

It is recommended the animal have a negative SNAP test to ensure they are no longer shedding the virus. Those that test negative can returned to the adoption floor especially if they are housed with those that are vaccinated and adults. If the animal is adopted out, it is recommended the new owner practice a 2 week cautionary period and not take their canine to places where they are in contact with other canines.

Animals should be bathed before being reintroduced. There is no reason the recovered animal should be exempt from surgery and should continue their vaccination schedule.

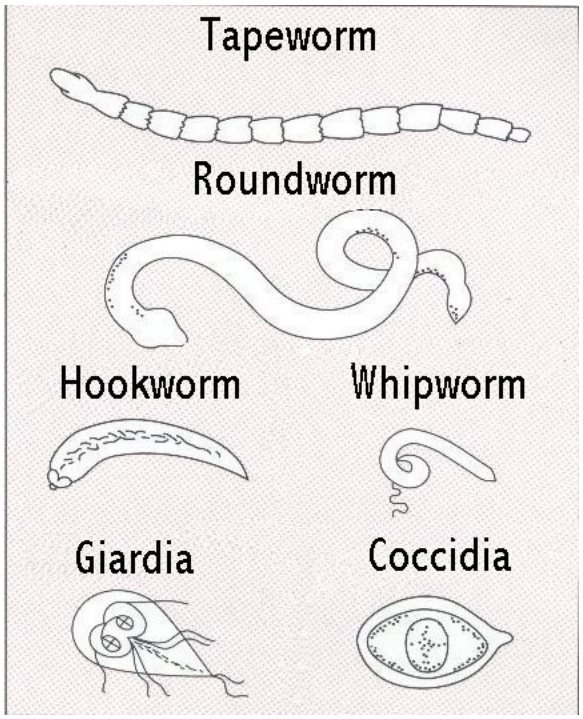
GI Parasites

General Information

Intestinal parasites are responsible for mild to severe health problems in shelter animals. Some of these parasites can be zoonotic and be spread to staff. These parasites include a number of

parasites and protozoans. The most common seen in shelter medicine include:

- Tapeworms
- Roundworms
- Whipworms
- Hookworms
- Giardia
- Coccidia
- Cryptosporidium
- Tritrichomonas foetus
- Toxoplasma



https://www.marlborovets.com/intestinal-parasites-in-pets-a-veterinary-plan-for-pet-care/

Diarrhea is most commonly seen with GI parasites, but may also cause anemia, coughing, or even death. Some animals may be infected with a heavy load of parasites but have no clinical signs. This is important for these animals that show no sign of disease can spread disease through environmental contamination.

Shelter staff with constant exposure to the animals and fecal material are at a decent risk for infection. Contamination by eggs and oocysts are a prolific problem that is difficult to resolve since they can be resistant to cleaning and disinfection. When dealing with dense populations of animals with new animals arriving this can be a major issue.

Diagnostics

Protocols differ from shelter to shelter depending on which parasites are more prevalent in their region. Diagnostics can help narrow down the more general treatment protocols for animals that are not responsive to initial treatment or have more severe disease. False negatives are definitely a possibility given intermittent shedding of the organism, a long pre-patent period, or other aspects of the parasite's life cycle.

Gastrointestinal parasites can often be found in the healthy animal as well. If it is identified, it does not mean the parasite is the cause of a clinical sign or that the animal needs treatment. Diagnostics must be backed up by the animal's history, signalment, clinical signs, and known risks within the population.

The most common diagnostic test is the fecal float. This can be done in a standing technique or with centrifugation. Both are effective, but centrifugation is much more sensitive for detection, especially with Giardia cysts and whipworm eggs.

Direct fecal smears can be done by simply placing fresh feces on a microscope slide with a drop of saline. This is more sensitive for Giardia trophozoites and Tritrichomonas.

There is a Giardia SNAP ELISA test available for Giardia detection. This test is very sensitive for Giardia and should not be used as a screening test or to test dogs post recovery.

Other available laboratory tests not regularly seen are PCR, Immunofluorescent antibody tests (Giardia and Cryptospordium), and acid fast staining (also primarily for Giardia and Cryptosporidium).

Basic Shelter Parasite Control Protocol

All animals that are being brought into the shelter should be treated for particular parasites to protect the population and staff working at the facility. Prophylactic treatment of basic parasites should be done at intake. This should be done with a dewormer that treats hookworms and roundworms, and a flea and tick preventative. The simplest products for this are pyrantel pamoate (Nemex or Strongid) and a topical for flea and tick such as imidacloprid and fipronil (Advantage and Frontline). Any puppies that are received should be consecutively dewormed every 2 weeks until 16 weeks of age with pyrantel. Adult animals are recommended a second deworming 2 to 3 weeks after intake as well. Of course, if the animal has previous treatment and has a history of a monthly preventative, this prophylactic treatment is not needed. If other parasites such as whipworms, tapeworms, coccidia, Giardia or ear mites are common in the population this protocol can be altered to fit it.

Who Should be Treated

It is recommended by the Companion Animal Parasite Council that these animals should be given a year-round preventative with a heartworm anthelminthic that also treats basic GI parasites. This means it is important to make the prophylactic treatment as widely available as possible for all shelter animals.

Roundworms and hookworms are commonly found in puppies, so it is important to prophylactically deworm those that are under the age of 3 or 4 months. Of course, adults showing clinical signs that can be directly contributed to GI parasites should be treated as well.

Environmental Contamination and Disinfection

Many eggs and cysts of these parasites remain viable in the environment for a long time and are resistant to disinfection. Roundworms, coccidia, and whipworms in particular are not easily rid of from the environment. This is why prophylactic treatment is very important for control of parasite infection. Other parasites such as Giardia are easily rid of from the environment and can be deactivated by most disinfectants with sufficient drying.

Dermatology

Ringworm

General Information

Ringworm in a shelter setting can lead to outbreaks that are unmanageable and can be costly financially. It can also spread to staff and potential adopters. This is why adequate prevention and management of this disease is needed in a shelter facility.

Dermatophytosis or ringworm is an infection caused by a fungus that affects the skin, hair, and sometimes the nails of an animal. The three most common fungal organisms that cause this disease are Microsporum canis, Microsporum gypseum, and Trichophyton mentagrophytes.

All of these species can affect dogs, cats, and even humans or other mammals. Young and geriatric animals are usually more susceptible. Cats are overall a greater risk than dogs. Animals that are immune deficient are also at increased risk. Lastly, those with history of skin conditions or loss of skin integrity are more likely to contract ringworm.

Transmission and Incubation Time

Microsporum canis is transmitted by contact with another infected animal or environmental contamination. This is why it is the most detrimental in a shelter setting. Trichophyton mentagrophytes is usually contracted from rodents and their nests. Microsporum gypseum is usually found in the soil but can also be spread from animal to animal or the contaminated environment.

Ringworm is extremely durable in the environment and can persist for months to years. It can be spread through grooming tools, toys, bedding, and by staff clothing or hands. Ringworm can also be seen on the hair of animals even when the animal is not clinical itself.

Clinical Signs and Diagnosis

As the name ringworm would suggest, typical lesions are circular in appearance with loss of hair and some scaling. These are typically seen on the ears, face, feet, or tail. There can also be a variety of different appearances with larger areas of hair loss, exudate, and may or may not have crusts. Ringworm can also cause infection in the nail or nailbed. Animals with ringworm may or may not pruritic.

For diagnostics there are ways to confirm the presence of dermatophytosis, but no great way to confirm its absence other than fungal culture and microscopic examination. To pursue a definitive diagnosis, it is important to consider the history of the animal, clinical signs, and a Wood's lamp examination before diagnostics such as a fungal culture.

A Wood's light examination is done with an ultraviolet light which causes fluorescence in some strains of Microsporum canis. This can be a very cost effective screening tool when considering an outbreak of ringworm. It is typically stated that 50% of strains fluoresce but can actually range anywhere between 30% and 80%. A bright green fluorescence is very indicative of dermatophytosis and warrants a fungal culture. A negative Wood's lamp examination does not rule out potential infection and suspected lesions should likely still be cultured. It should be noted that tetracycline drugs and their topical products can fluoresce under a Wood's lamp.

A trichogram or direct microscopic examination of the animal hairs should also be done to potentially diagnose ringworm. Like the Wood's lamp examination if negative it does not rule out a possible infection. Hairs can be suspended in mineral oil and examined under a microscope. There has been suggestion to suspend the hairs in 10% KOH solution prior to examination but has not been shown to increase the ability to diagnose ringworm.

Affected hairs usually are frayed, appear swollen, and have an irregular outline. The regular structure of the hair is typically lost. Small chains of rounded cells and hyphae can sometimes be visualized. Being able to diagnose by a trichogram takes practice and should be done by a veterinary professional with plenty of experience.

https://humanepro.org/magazine/articles/ask-expert-ringworm-screening-and-diagnosis

Fungal culture is the most reliable way to diagnose ringworm. This can be done in house which provides the advantage of quick turnaround times. Plated cultures are the easiest and can be plated with a toothbrush used on a suspected animal's hair or with plucked hair from a single lesion. Plates usually have a side that changes to a red color in response to most dermatophytes and a rapid growth medium on the other side to help with microscopic identification. It usually takes around 10 days for Microsporum canis to grow on the

medium but should be held for 21 days if another pathogenic species is present. Microscopic confirmation should always be done to rule out any non-pathogenic fungi. Ringworm usually grows at the same time the medium turns red and has white, fluffy colonies.

Microscopic examination is done with a tape prep. This involves putting lactophenol blue stain on a slide, then placing the sticky side of a piece of tape on the colony and placing that tape on the stained slide. Most kits come with guides to correctly identify potential ringworm.

Treatment

Many times, a healthy animal will recover on its own in 3 months. In a shelter setting there must be a quicker resolution. Topical treatments are usually the first line of treatment and most effective. Lime sulfur solutions are very useful for they sterilize the coat and stop any further growth of ringworm. Another approach is through medicated shampoos that contain miconazole in combination with chlorohexidine.

Systemic therapy is an important additive especially when trying to expedite resolution for the animal. The major issue with systemic treatment is the high cost and detrimental side effects. The best choice is usually itraconazole since it is effective and is relatively safe. It is recommended it is not compounded since it usually lowers efficacy.

Treatment can officially be a success after 3 weekly fungal cultures are negative. This can be reduced to 2 tests if lime sulfur and itraconazole are used on 2 times a week basis. Fungal cultures can take 2 weeks to show an absolute negative result which means this process could take up to 3 to 4 months when treating an animal. Housing and socialization become a heavy issue when dealing with this disease and questions if treating in a shelter setting is practical.

Decontamination

The biggest step to decontamination is identifying an infected animal, removing it, and treating it along with environmental cleaning. Disinfection is important but is primarily an adjunct to the mechanical removal of the contaminant.

Surfaces should be cleaned 3 times with an effective detergent. Disinfection can be done with multiple products such as Accel, Rescue, diluted bleach, or even Formula 409. Many disinfectants are effective after all organic matter has been removed. Heat in excess of 110°F is also effective which can be attained in most dishwashers and clothes dryers.

After cleaning and disinfecting surfaces, you can confirm successful destruction of the pathogen by doing a fungal culture. This can be done using a Swiffer pad cut into sections that has been wiped on a potentially contaminated surface. The wipe is then pressed on the culture plate. Cleaning, disinfecting, and culture can be done repeatedly until a negative is achieved.

FROM THE AUTHOR

Kyle Borodunovich and Lil Kim

Working to create a biosecurity manual for the MDL program at Virginia-Maryland College of Veterinary Medicine has been an incredibly rewarding and educational experience during my public corporate clerkship. The amount of procedure and protocol associated with shelter medicine biosecurity is astonishing and requires a different view on veterinary medicine than I am used to. With the introduction of multiple populations of shelter animals into the teaching program I found it was essential for the development of such a manual to allow staff to always be prepared for any potential outbreaks. It has been an honor to partake in something that may continue to be used or built upon by future students. I hope this manual is found to be useful for it makes me feel like I am giving back to the institution that has already given me so much. This experience is one that I will never forget and has supplemented me with knowledge that will make me a better veterinarian. Special thanks to my co-author and research fur buddy "Lil Kim" who always kept me focused on the task at hand, and as a past shelter animal, an inspiration for this project.