Virginia Animal Diagnostics

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Minimum inhibitory concentrations (MIC) interpretation:

Antimicrobial susceptibility testing allows veterinarians to confirm susceptibility to empiric therapies already in use or to detect resistance in bacterial isolates that requires a change in antimicrobial treatment. While antimicrobial susceptibility testing is very useful, interpreting the results can be challenging, and performing susceptibility testing on non-pathogenic organisms is misleading. While we often think of susceptibility testing as a "gold standard" diagnostic, not all bacterial pathogens require susceptibility testing because some bacteria are predictably susceptible to recommended therapies.

Susceptibility testing is most often performed by either Kirby-Bauer disk diffusion or by broth microdilution to determine the minimum inhibitory concentrations (MIC) of a panel of drugs. The information obtained from disk diffusion testing is adequate for most cases. However, determination of MIC values allows you more flexibility in determining dosing regimens, and sometimes there is more data available on veterinary drugs for MIC testing compared to disk diffusion testing.

Below is an example of a case, along with interpretation of a MIC report.

Culture Results:

Bovine Lung: 3+ *Mannheimia haemolytica*

Antimicrobial Susceptibility Report:

Drug	*M. haemolytica* MIC (µg/mL)	Interpretation
Ampicillin	≤0.25	NI
Ceftiofur	0.5	S
Danofloxacin	0.25	S
Enrofloxacin	0.25	S
Gamithromycin	>8	R
Penicillin	≤0.12	S
Spectinomycin	>64	R
Tetracycline	4	I
Tildipirosin	>16	R
Tulathromycin	>64	R

Interpretation:

It is important not to overinterpret the MIC values on a susceptibility profile. Each antimicrobial, bacterial organism, and animal species has its own particular susceptible breakpoint value; this value is the maximum MIC that predicts successful antibiotic therapy. Breakpoint values are established by the Clinical Laboratory Standards Institute, a nonprofit entity that sets these values for human and veterinary patients. Over time, new breakpoint are developed for veterinary species, but there is still limited availability of species-specific breakpoint in some animals. Breakpoint are not included on your susceptibility report, but they have been used to make the S/I/R interpretation that you receive. A veterinary microbiologist can help you determine what breakpoint were used for susceptibility testing for your patients, if needed, but this information is rarely useful to clinicians and therefore is not routinely reported.

It is not appropriate to directly compare MIC values and select the drug that has the lowest MIC value. For example, if you were choosing between ceftiofur and enrofloxacin, you might be inclined to select enrofloxacin since the MIC value is lower. However, the ceftiofur MIC for this case is 0.5, and the susceptible breakpoint is 2 mg/mL. For enrofloxacin, the MIC value is 0.25, and the susceptible breakpoint is £0.25 mg/mL. Therefore, the isolate is only one dilution away from being considered non-susceptible to enrofloxacin. The ceftiofur isolate is 2 dilutions away from the breakpoint, so the organism is actually "more" susceptible to ceftiofur despite the higher MIC value. Because of the careful analysis of pharmacokinetic and pharmacodynamic data that goes into setting breakpoint, as long as an organism is interpreted as susceptible, you have a good chance of therapeutic success, no matter what the MIC value is. Thus, comparison of MIC values for routine cases can be misleading; if a drug is listed as susceptible, other factors such as cost of treatment, drug class, side effects, and patient co-morbidities should be used to choose between antimicrobials rather than overinterpret MIC values.

"NI" or "NN" is sometimes present on a susceptibility report — this indicates that no interpretation is available. In the case of ampicillin, there is no interpretation available because the clinical breakpoint is S 0.03 mg/mL. However, the commercial MIC plate used for susceptibility testing only included dilutions down to 0.25 mg/mL. Therefore, we cannot differentiate susceptible from resistant isolates based on the testing that was performed.

When a drug, such as tetracycline, is interpreted as "I" or intermediate, this means that the bacteria is inhibited by concentrations of the antimicrobial that are physiologically attainable, but that the therapeutic effect is uncertain. You may have therapeutic success in an otherwise healthy animal or if the infection is in a site where that drug tends to concentrate. Increasing the dose and/or frequency of the antimicrobial may increase your chances of clinical success if an "Intermediate" drug is already being used for empiric therapy.

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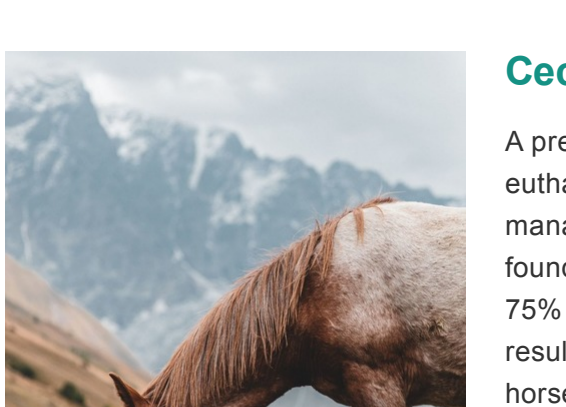
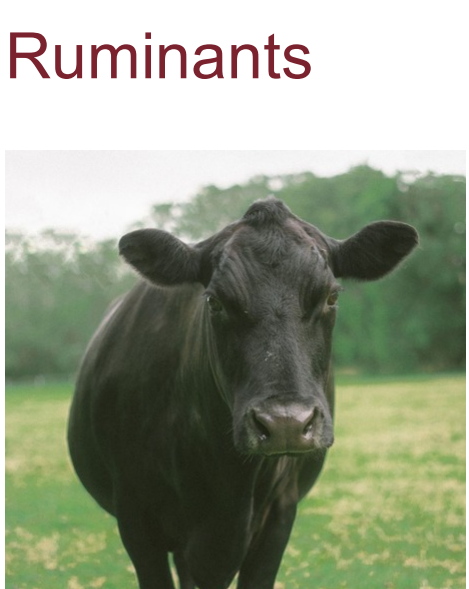
Equine



Strangulating lipoma and disseminated melanoma

A 33-year-old gray Arab gelding presented to the VMCVM Veterinary Teaching Hospital for colic that was refractory to pain management was ultimately euthanized and submitted for necropsy. Numerous black nodular masses were widely disseminated throughout the peri-anal region, spleen, liver, lung, kidneys, adrenal glands, skeletal muscle, lymph nodes, and bone marrow, and these were diagnosed as melanomas microscopically. A strangulating mesenteric lipoma was discovered and was determined to be the primary cause of colic. A pituitary adenoma of the pars intermedia was also diagnosed; in horses, insulin resistance and higher frequency of mesenteric lipomas have been correlated with pituitary lesions. Although not directly related to the cause of colic in this case, the neoplastic burden was severe and ultimately would have contributed to significant morbidity.

Thomas Cecere, DVM, PhD, DACVP
Virginia Tech



Cecocolic intussusception

A pregnant 7-year-old Rocky Mountain horse mare was euthanized following lack of response to medical management of colic. A cecocolic intussusception was found during postmortem examination with approximately 75% of the cecum inverted within the right ventral colon resulting in cecal infarction. Cecal intussusception in horses is often associated with cyathostomiasis. Although no definitive evidence of severe endoparasitism was identified in this case, the mare reportedly was dewormed with Moxidectin several days prior to the onset of colic which could have contributed to the development of intussusception.

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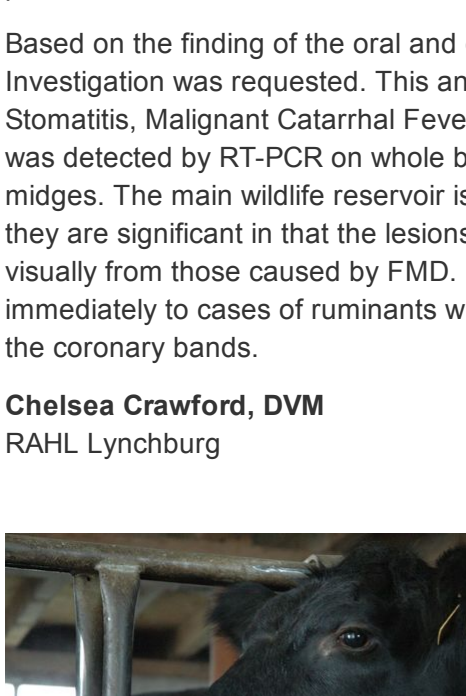
Ruminants

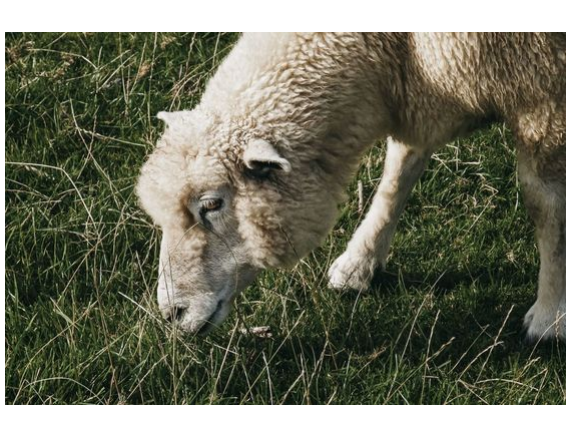


Foreign Animal disease investigation

A 1.5-year-old Angus heifer, up-to-date on routine vaccinations, failed to come up to the feed bunk one morning. When the herd manager went out to gather her up from the pasture, there was mucus coming from her nose, she appeared very weak, and she moved as if she were blind. She walked into a pond located in the pasture and drowned. On external examination, all four feet were swollen from the fetlock area distally, and there were ulcerations near the coronary bands. There were severe erosions around the nares and on the hard palate and tongue. The more-chronic areas were covered with diphtheritic membranes. Internally, there was severe, dark yellow interlobular pulmonary edema and caseous material filling the larger cranioventral airways. There was severe, multifocal to coalescing chronic proliferation of the rumen mucosa centered on the rumen pillars, with some areas up to 10 cm in diameter and covered with thick, yellow fibrinous material. The kidneys had petechiae.

Based on the finding of the oral and coronary band lesions, a Foreign Animal Disease Investigation was requested. This animal tested negative for Foot and Mouth Disease, Vesicular Stomatitis, Malignant Catarrhal Fever, and Bluetongue. Epizootic Hemorrhagic Disease (EHD) was detected by RT-PCR on whole blood. EHD is caused by an orbivirus and transmitted by biting midges. The main wildlife reservoir is white-tailed deer, and while outbreaks in cattle are rare, they are significant in that the lesions caused by this virus cannot be definitively distinguished visually from those caused by FMD. USDA-APHIS or the state veterinarian should be alerted immediately to cases of ruminants with vesicular or erosive lesions in the oral cavity and/or near the coronary bands.

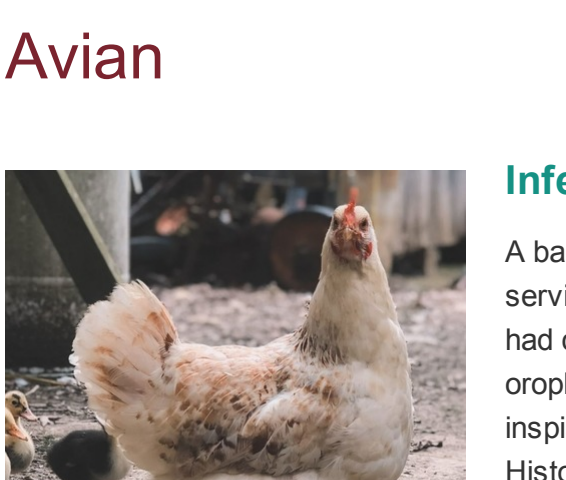
Chelsea Crawford, DVM
RAHL Lynchburg



Theileria orientalis

Theileriosis was the cause of death in a twelve-year-old Angus cow submitted to the VDACS Wytheville Regional Lab. The slow-moving cow reportedly collapsed and died while being moved to a new pasture. Necropsy revealed diffuse icterus, and the pale/tan liver exhibited a diffuse, enhanced lobular pattern. Histopathology confirmed diffuse, centrilobular hepatic necrosis/degeneration with dissociation of hepatic cords, hemorrhage, and multifocal thrombosis of the centrilobular vein. PCR testing of spleen, performed at VMCVM, was positive for *Theileria orientalis*. Testing for *Anaplasma* spp. was negative. *Theileria orientalis* is a blood borne parasite transmitted in the saliva of certain Ixodid ticks, most notably *Haemaphysalis longicornis* ("longhorned tick").

Christopher Halsey, DVM
RAHL Wytheville



Neoplasia in an ewe

An adult Merino ewe was presented to necropsy following spontaneous death. Necropsy revealed several firm, tan masses up to 4 cm scattered along the lesser curvature of the abomasal serosa, the base of the pericardium, and at the hilus of the lungs. A few larvae of *Oestrus ovis* were present in the nasal cavity. The masses were made of sheets of round cells with round nuclei and prominent eosinophilic granules. This is consistent with a neoplasm of the granular leukocytes usually associated with gastrointestinal mucosae.

Phillip Sponenberg, DVM, PhD
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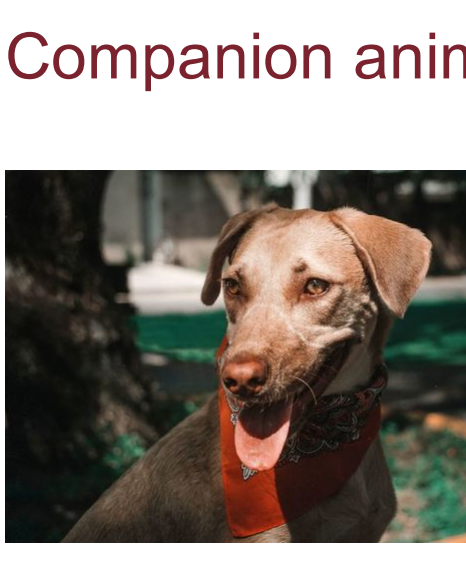
Avian



Infectious laryngotracheitis

A backyard chicken was referred to the necropsy service with a history of difficult breathing. The chicken had caseous white plaques on the mucosae of the oropharynx, larynx, and crop. It was obese, and several inspissated egg yolk were present in the abdomen. Histologic examination revealed ulcerative laryngitis, pharyngitis, and tracheitis with distinctive syncytial cells that had eosinophilic intranuclear inclusion bodies. This is a case of infectious laryngotracheitis due to gallid herpesvirus-1 infection. The bird was also an internal layer.

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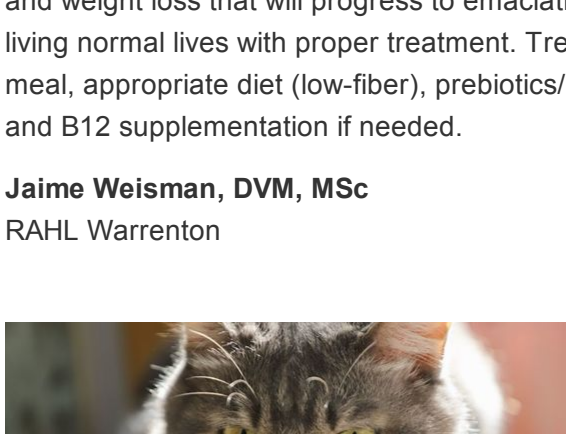
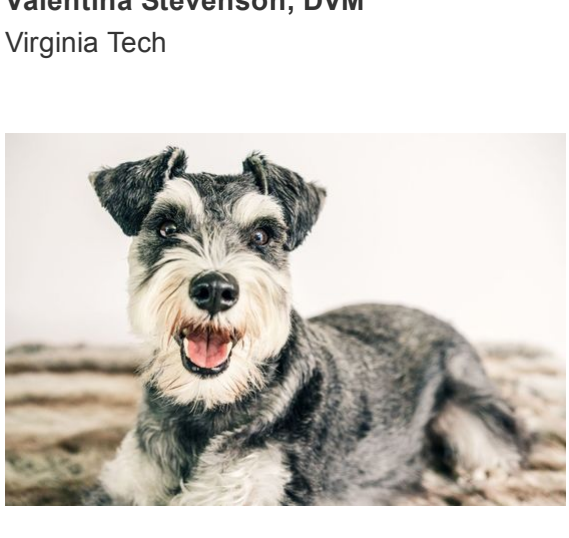
Companion animals



Exocrine pancreatic insufficiency in a dog

An 8-year-old female dog was submitted for necropsy due to severe emaciation (1/9 BCS). Grossly, the pancreas was atrophied and indistinct. On microscopic evaluation, there was severe, diffuse atrophy of the exocrine pancreatic tissue, which is consistent with exocrine pancreatic insufficiency (EPI). EPI occurs when the body is unable to produce sufficient pancreatic enzymes needed to properly digest food, resulting in poor nutrient absorption and, essentially, starvation. EPI can be congenital, inherited, or acquired. It is most commonly seen in German Shepherd dogs, where it is considered inherited. Other breeds that appear to be predisposed include Chow Chows, Cavalier King Charles spaniels, and rough-coated collies. In the congenital and inherited form, clinical signs often present in dogs younger than 2 years. Acquired EPI is most often associated with chronic pancreatitis and is generally observed in middle-aged to older dogs. Affected dogs often exhibit a ravenous appetite, have pale to yellow, fatty/greasy, foul-smelling diarrhea, occasional vomiting, and weight loss that will progress to emaciation if untreated. EPI is manageable with most dogs living normal lives with proper treatment. Treatment consists of pancreatic enzymes with each meal, appropriate diet (low-fiber), prebiotics/probiotics to prevent intestinal bacterial overgrowth, and B12 supplementation if needed.

Jaime Weisman, DVM, MSc
RAHL Warrenton



Feline progressive dendritic cell histiocytosis in a cat

A mass located on the rear leg of a 13-year-old female spayed American short-hair cat was received. The mass extended from the dermo-epidermal junction to the deep and lateral margins of the specimen and was densely cellular, monomorphic, poorly demarcated, solid, infiltrative, expansile, and unencapsulated. The neoplastic cells were arranged in swirls and sheets intercepting collagenous fibers. The cells were mostly spindle-shaped, with abundant vacuolar eosinophilic cytoplasm, characteristic bean-shaped nuclei, and single prominent nucleoli. The mitotic count was 2 per 2.37 mm2. This neoplasm respected the overlying epidermis and was consistent with the non-epitheliotropic variant of feline progressive dendritic cell histiocytosis. This is a slowly progressive cutaneous neoplasm that can disseminate to lymph nodes and various organs. We recommended complete excision and monitoring for recurrence.

Valentina Stevenson, DVM
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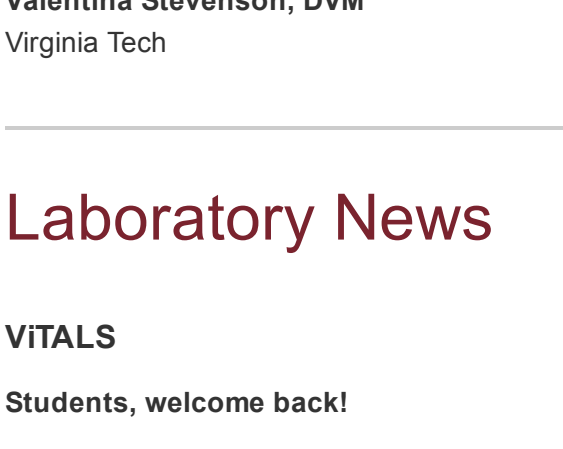

Granulomatous panophthalmitis due to uncontrolled diabetes mellitus

Both eyes of a 7-year-old female Schnauzer with a history of uncontrolled diabetes, an ocular mass of unknown origin, ocular erythema, corneal pigmentation, and uveitis were submitted for histopathology. The most important findings from both eyes were: lens rupture, stromal thickening by fibrous tissue, and stromal infiltration by large number of epithelioid macrophages and giant cells with occasional cholesterol droplets. Additionally, there was focal tearing of Descemet's membrane, and extensive necrosis and hemorrhage within the anterior and posterior chambers accompanied by large numbers of large foamy macrophages filling the vitreous chamber. These findings are consistent with granulomatous panophthalmitis. The cause of the inflammation was attributed to the lens-induced uveitis, likely secondary to hyperglycemia associated with the uncontrolled diabetes mellitus.

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Laboratory News

ViTALS

Students, welcome back!

In July, ViTALS welcomed students on clinical rotations back to the necropsy floor on a small scale. In August, with the start of the semester, our students returned to necropsy full-time. After a relatively isolated and challenging spring and summer, we were happy to have them back.

We are excited to once again offer our services at full capacity. We are using a hybrid education approach, with a combination of hands-on training and virtual rounds to keep our students safe. Our staff, students, and faculty are physically distancing whenever possible, and masks are required in our labs and buildings at all times.

New ViTALS website

We are proud of our newly launched website at **vitals.vetmed.vt.edu**! Thank you to Alexander Fox and the college's Advancement team for all of their work in making the site a reality.

VDACS

New hires

The Virginia Department of Agriculture and Consumer Services (VDACS) Office of Laboratory Services is thrilled to announce that **Dr. Sheryl Coutermarsh-Ott** has joined the VDACS lab system as a pathologist. She will provide part of the histopathology services for the VDACS lab system on a statewide basis. Dr. Coutermarsh-Ott was previously with the Virginia-Maryland College of Veterinary Medicine, and her employment with VDACS will bolster the already strong working relationship between VDACS and Virginia Tech. Dr. Coutermarsh-Ott started her work with VDACS on September 25.

Necropsies in RAHL Lynchburg

Due to the recent departure of the veterinary diagnostician from the VDACS Lynchburg lab, the necropsy service there is temporarily suspended. Necropsy cases that would have gone to Lynchburg can go to one of the other VDACS labs (in Harrisonburg, Warrenton, or Wytheville) or to the Virginia Tech necropsy service (please call first).

Laboratory Locations

RAHLS

Regional Animal Health Laboratory System

Harrisonburg
261 Mt. Clinton Pike
Harrisonburg, VA 22802
540-209-9130
RAHLHarrisonburg@vdacs.virginia.gov

Warrenton
272 Academy Hill Rd.
Warrenton, VA 20186
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Virginia Department of Agriculture and Consumer Services

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Virginia-Maryland College of Veterinary Medicine

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