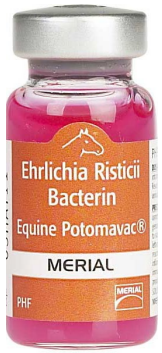
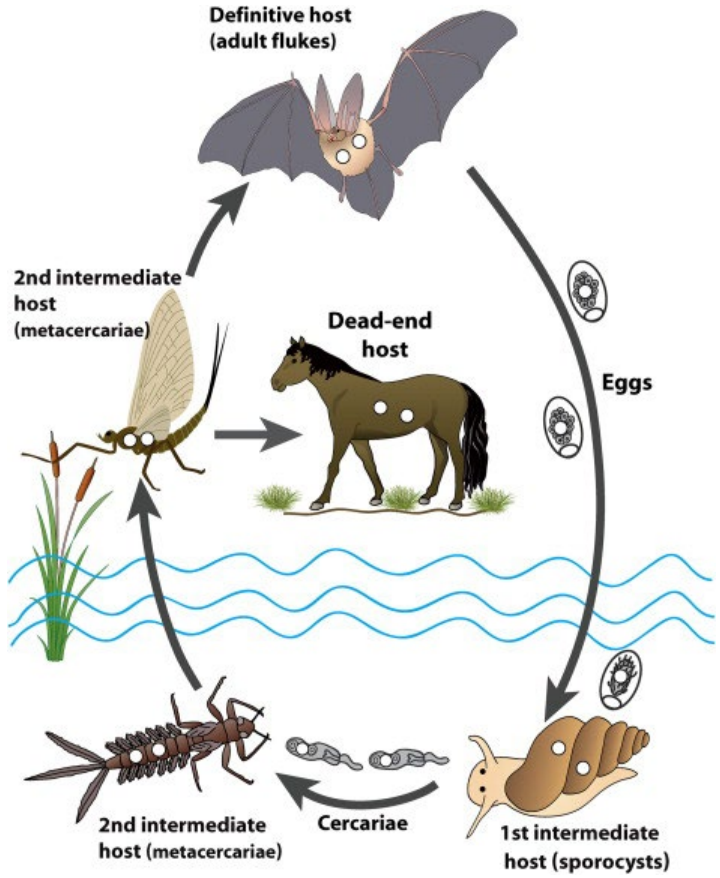
An Update On Equine Infectious Diseases



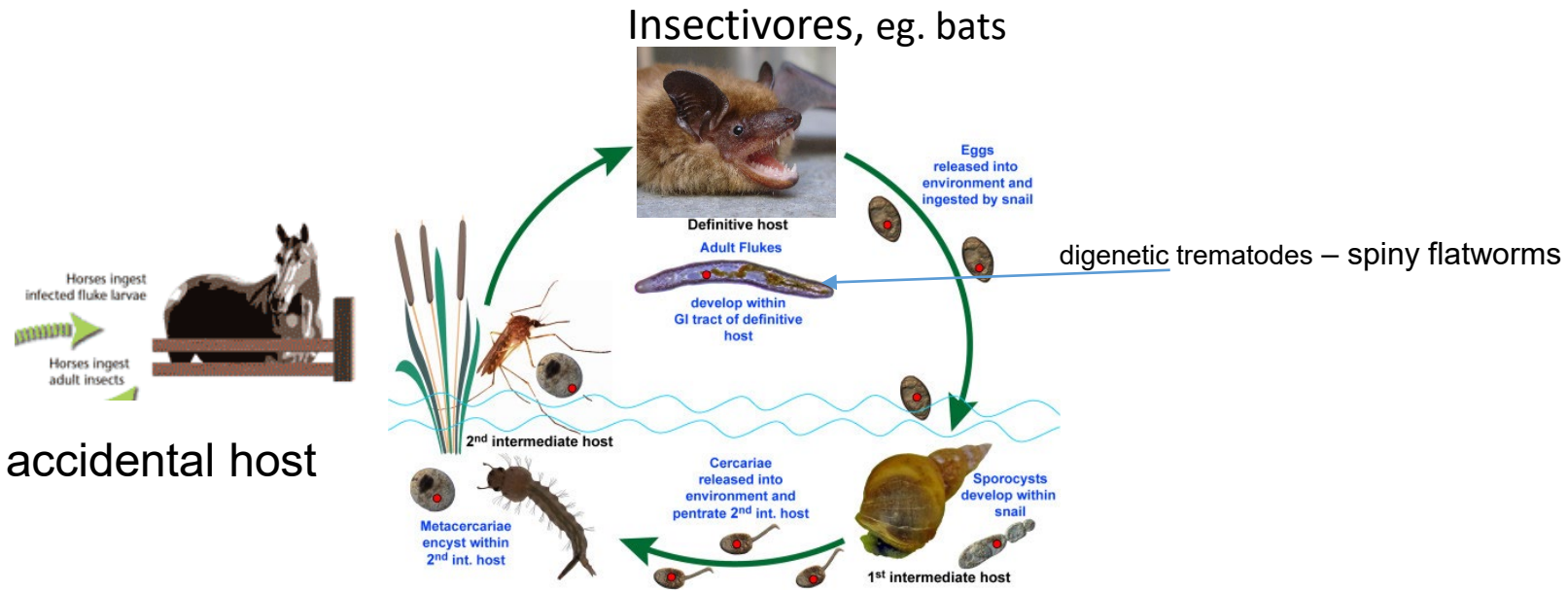
GI diseases

Potomac Horse Fever- Neorickettsia



https://ars.els-cdn.com/content/image/

Potomac Horse Fever- *Neorickettsia risticii*



- Trematodes, *Acanthatrium orgenense*, infected with *N. risticii, a gram negative intracellular bacteria,* release oocysts into water
- Oocyst ingested by snails and oocyst develop into cercariae
- *During hot weather cercariae released into water and penetrate aquatic insects*
- *Cercariae mature into acid resistant metacercariae within the insects*
- Horses ingest vectors(dead or alive) with *N. risticii infected* metacercariae
  - *Pasture, water, feed, or water buckets*

Neorickettsia risticii -Pathogenesis

- Horse infected via ingestion of *N. risticii* infected insects and/or fluke larvae
- Incubation period for clinical disease may be approx. 2 weeks!
- Biphasic fever may occur-
  - Initial fever may be associated with finding *N. risticii* in the blood 1-2 week after exposure (with seroconversion)
- Increased bacteremia and movement of *N.risticii* to colon (trophism) resulting in clinical signs in some horses
  - depression, anorexia, fever, dehydration, diarrhea, and laminitis (all feet)
  - diarrhea in <20% of cases
- No stress factors required
- Mostly adult horses
  - Yearlings occasionally
- Infectious but unlikely to be contagious
- Rarely reported to cause abortion

Isolation and Molecular Analysis of a Novel *Neorickettsia* Species That Causes Potomac Horse Fever

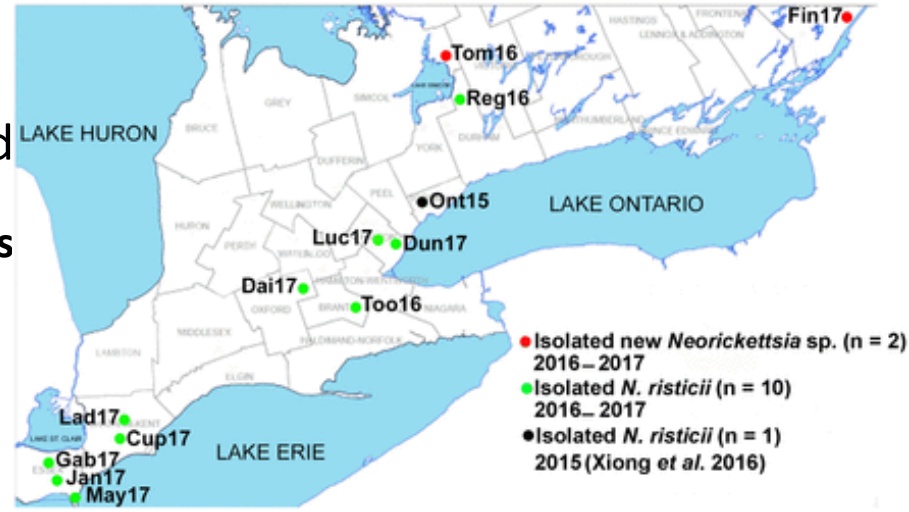
mBio. 2020 from the laboratory of Dr. Yasuko Rikihisa OSU

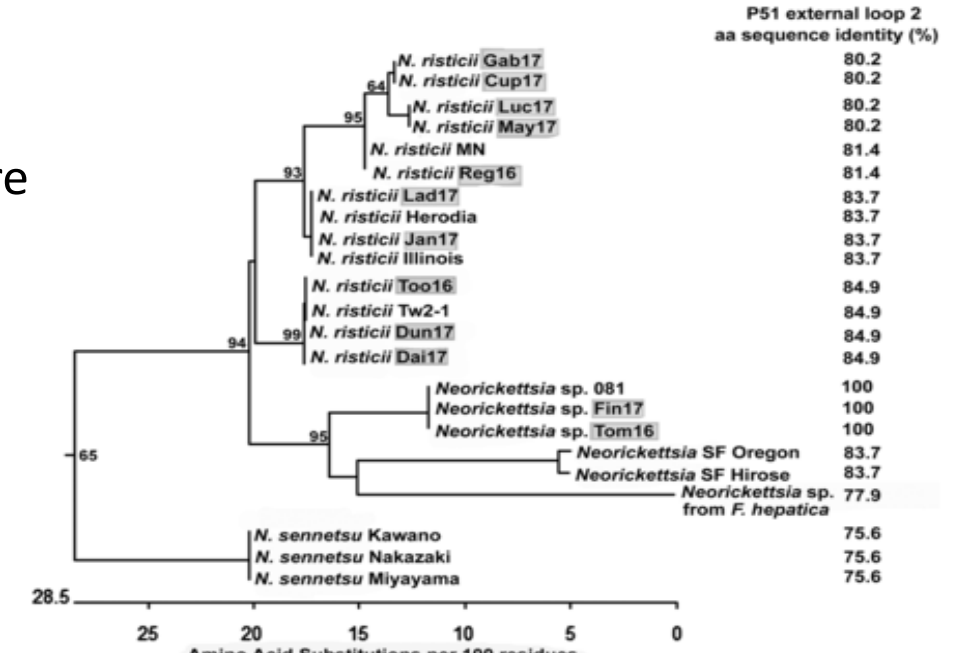
- Report on the isolation of a new *Neorickettsia* species found in the blood of 2 horses at two locations in eastern Ontario, Canada
  - in addition to 10 variable strains of ***N. risticii* from *N. risticii* PCR-negative horses** with clinical signs of PHF were genotyped.

- Experimental inoculation of two naive ponies with the new *Neorickettsia* species produced severe and subclinical PHF, respectively, and the bacteria were reisolated from both of them, fulfilling Koch's postulates.

- Serological (IFA) assay titers against the new *Neorickettsia* species were higher than those against *N. risticii*. Supposedly X-reactive?

- We propose to classify this new bacterium as ***Neorickettsia findlayensis* sp. nov.**





All 12 horses

Horse ID[a]	Sex[b]	Age	Stabled at night	Sick (days)[c]	PHF vaccinated	Depression	Anorexia	Fever	Diarrhea[d]	Mucous membranes[e]	Laminitis[f]	PCR[h] Blood	PCR[h] Feces	Treatment outcome[g]
Fin17	MC	3	No	1	Yes	Yes	Yes	No	Profuse projectile	Pink	No	−	−	Full recovery
Tom16	MC	8	No	2	No	No	Yes	Yes	Moderate	Dark pink	No	−	−	Full recovery
May17	F	6	No	2	No	Yes	Yes	No	Severe profuse projectile	Purple toxic line	No	−	+	Died day 2
Luc17	F	7	Yes	1	No	Yes	Yes	No	Impaction to profuse	Pink initially	No	−	−	Full recovery
Cup17	F	26	Yes	3	No	Yes	Yes	Yes	No	Toxic line	No	+	+	Full recovery
Lad17	F	5	No	<24 h	No	Yes	No	Yes	Yes	Pink	No	+	+	Full recovery
Dun17	M	4	Yes	7	No	Yes	Yes	No	Profuse projectile	Purple toxic line	Yes	+	+	Euthanized day 8
Jan17	F	12	Yes	2	No	Yes	Yes	Yes	No	Pale pink toxic line	No	NS[i]	−	Full recovery
Gab17	MC	9	Yes	1	No	Yes	Yes	Yes	No	Pale pink	No	+	+	Full recovery
Dai17	F	10	Yes, 45 days	2	Yes	Yes	Yes	No	Watery	Dark pink toxic line	No	+	+	Full recovery
Too16	MC	7	Yes	3	No	Yes	Yes	Yes	Mild on admit	Toxic line	Yes	+	+	Full recovery
Reg16	F	22	Yes	3	No	Yes	Yes	No	Yes, watery	Brick red	No	+	+	Full recovery

What does this mean for clinical practice and how to best diagnose *N. risticii* and *N. findlayensis*

Diagnosis- PHF

- Season of year!
- Geographic location!
- Clinical signs- higher incidence of laminitis and many times w/o diarrhea
- Serology- IFA >1:800* at time of clinical disease and horse is not recently vaccinated
  - If *Neorickettsia findlayensis* is the causative organism the initial IFA could be <1:800 but should increase with a second sample 5-7 days later
  - Paired serology recommended as IFA titers vary between labs and vaccination staatus!
- PCR-early in disease
  - EDTA blood and fecal samples
    - Primers used in some labs may not detect *Neorickettsia findlayensis !* Therefore, pair serology may be important in confirming the diagnosis.
    - Blood <u>can</u> remain positive for 2 or more days after beginning Oxytet; this does not mean antibiotic resistance!
  - Colon tissue (0.5 g mucosal scraping) on deceased horse

*Se. and Sp. of this in unknown and may vary from lab to lab. The higher the titer above 1:800 the Sp. should increase

Treatment for PHF

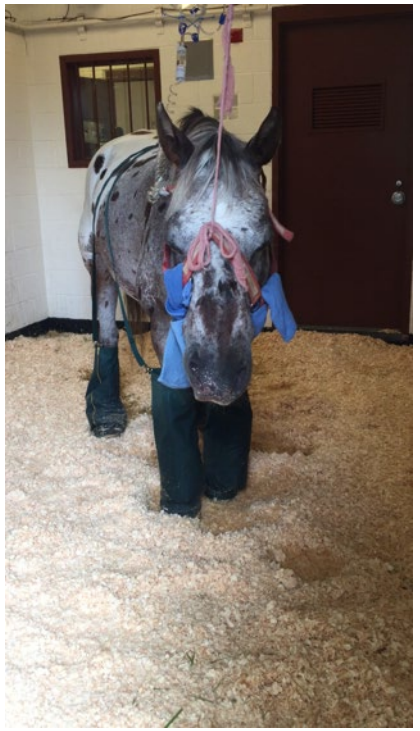
-Tetracycline

-Supportive

NSAIDs- as needed (next slides)

Cryotherapy!

Prognosis - very good with early treatment and without laminitis



When NSAIDS are Used in Infectious Diarrhea

- Pros:
  - Horses feel better, systemic inflammation decreases and the horses may eat better but no evidence they decrease incidence of laminitis
  - They alleviate lameness due from laminitis.
- Cons:
  - NSAIDS change the microbiota (dysbiosis)
  - May be cytotoxic to intestinal wall, especially RDC
  - May delay repair of intestinal barrier and increase permeability
  - Increase incidence of gastric ulcers and renal disease

van Galen G, Saegerman C, Hyldahl Laursen S, Jacobsen S, Andersson Munk M, Sjöström H, Holm Lindmark S, Verwilghen D. Colonic Health in Hospitalized Horses Treated with Non-Steroidal Anti-Inflammatory Drugs - A Preliminary Study. J Equine Vet Sci. 2021 Jun;101:103451

When NSAIDS are Needed in horses with Infectious Diarrhea

- Use a COX2 selective drug if possible
- For All NSAIDS, use as low a dose as possible
- Maintain hydration and plasma protein concentration (not easy)
- Use Omeprazole
- Use misoprostol*
- Try to re-establish microbiota
  - Transfaunation
  - Intestinal support

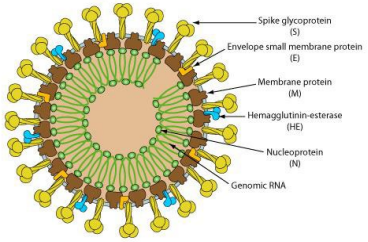
Whitfield-Cargile CM, Coleman MC, Cohen ND, Chamoun-Emanuelli AM, DeSolis CN, Tetrault T, Sowinski R, Bradbery A, Much M. Effects of phenylbutazone alone or in combination with a nutritional therapeutic on gastric ulcers, intestinal permeability, and fecal microbiota in horses. J Vet Intern Med. 2021

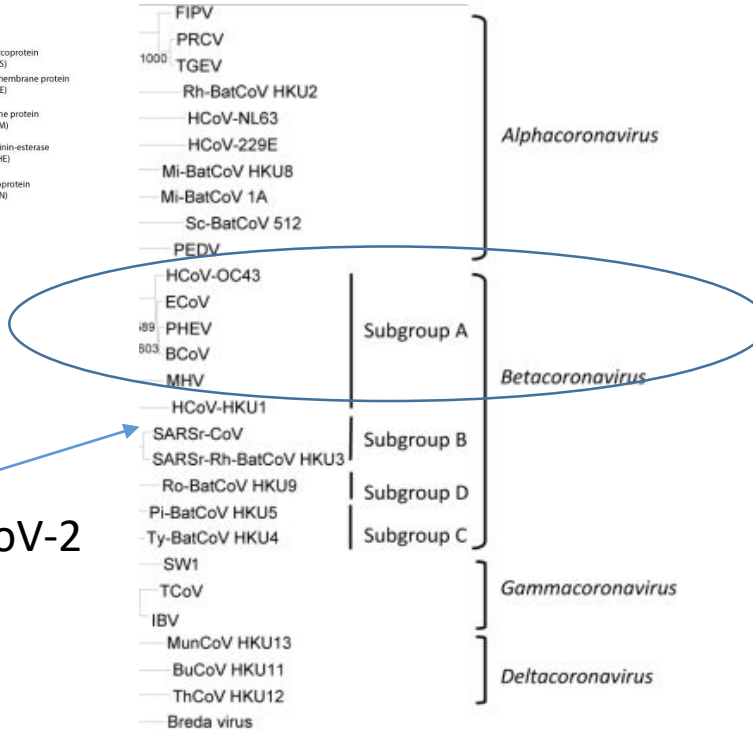
Control-PHF

- Protect feeds etc. when moths, mayflies or caddisflies swarming- turn out the lights!
- Prevent grazing of previously wet pasture areas during drought
- Do not let horses stand or drink from ponds during peak season
- Vaccination – marginal efficacy
    - At least 16 genetically distinct strains have been found
- Poor immunogenicity- McKenzie HC, Funk RA, Trager L, Werre SR, Crisman M. Equine Vet J. 2019
    - Only 1/3 to 1/2 of vaccinated horses seroconvert
    - 1/4 of seroconverting horses will have IFA 800-1600 for 3 months or > following vaccination

Equine Coronavirus (ECoV)- *A Beta coronavirus*

- In <u>Adult Horses</u> with enteric disease ECoV appears as a mono-infection -numerous reports from 3 continents
- Isolation of an equine coronavirus from adult horses with pyrogenic and enteric disease *Oue Y et al* ***2011*** *Vet Microbiol.*
- In <u>Foals</u> ECoV is believed to be a co-infecting agent for diarrhea *Slovis N et al. Eq. Vet. J 2014*





Covid 19/SARS-CoV-2

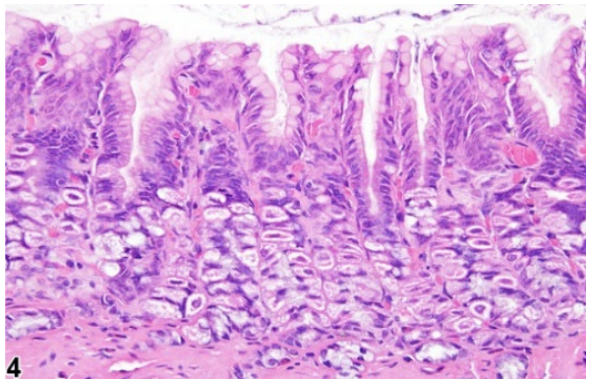
***Equine Coronavirus*: An Emerging Enteric Virus of Adult Horses**
Pusterla N et al. *Vet Microbiol.2013*

Biology of Infection

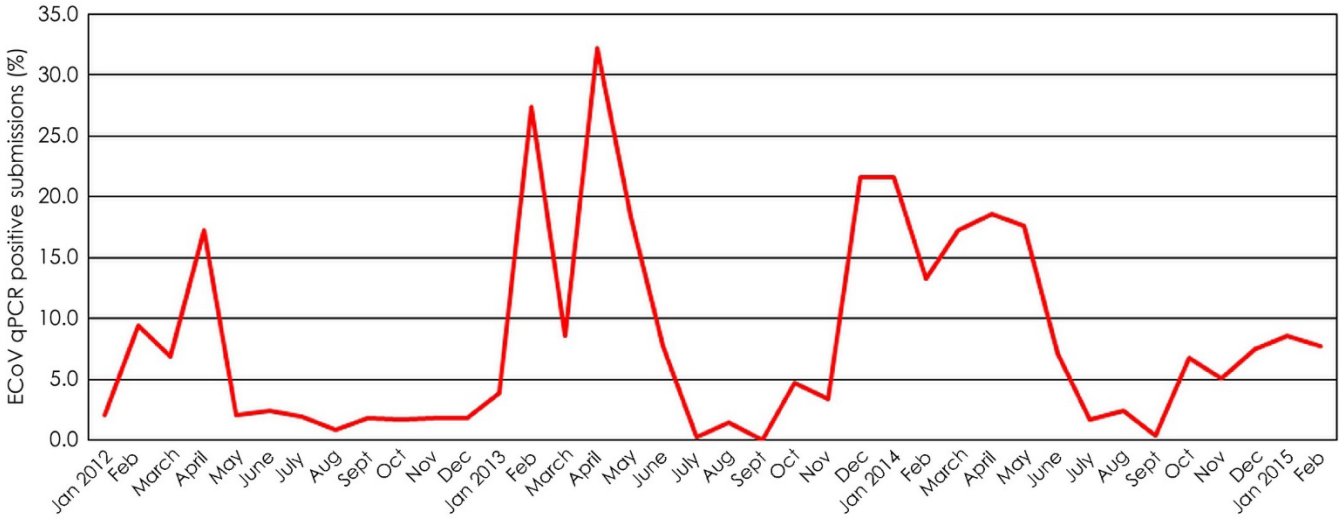
- Fecal-oral transmission
- Incubation period - 2-4 Days (Giannitti F, 2015, Nemoto M. 2014)
- Fecal shedding- generally 14 days but may be longer
  - Nasal shedding in some infected horses Nemoto M. 2014,Pusterla Vet Rec 2015
- Clinical disease in recently infected horses- c 20-67%
  - C.L. Fielding et al J Vet Intern Med 2015; Goodrich E. et al. 2017; Berryhill EH, Magdesian KG, Aleman M, Pusterla N Vet J. 2019

- Pathology is mostly an Enteritis!!

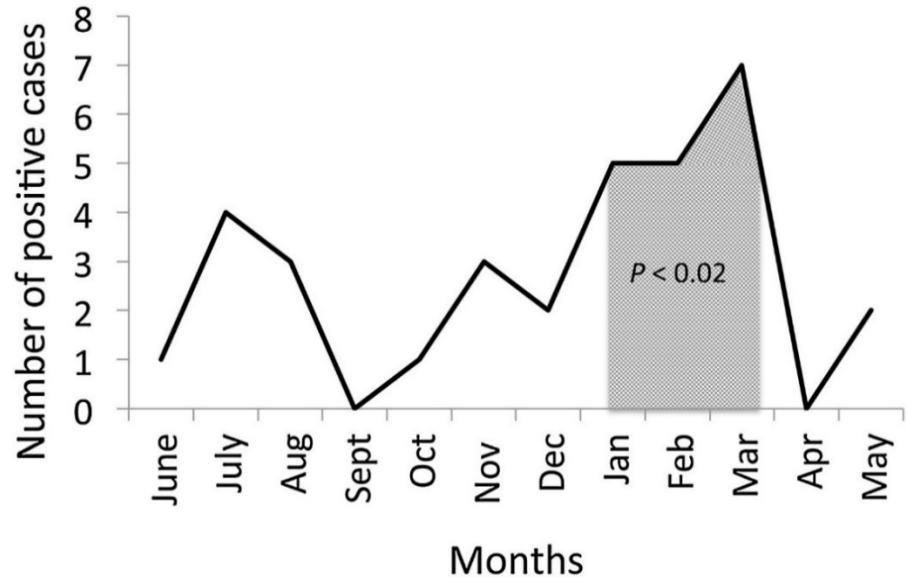
F. Giannitti et al. Vet Pathol



Equine Enteric Coronavirus PCR Results by Season



Equine Veterinary Education Volume 28, Issue 4



β-coronavirus, is known to survive > 5 days outside the host at a temperature of 22–25 °C and relative humidity of 40–50%. Higher temperatures and/or humidity levels resulted in a rapid loss of viability.

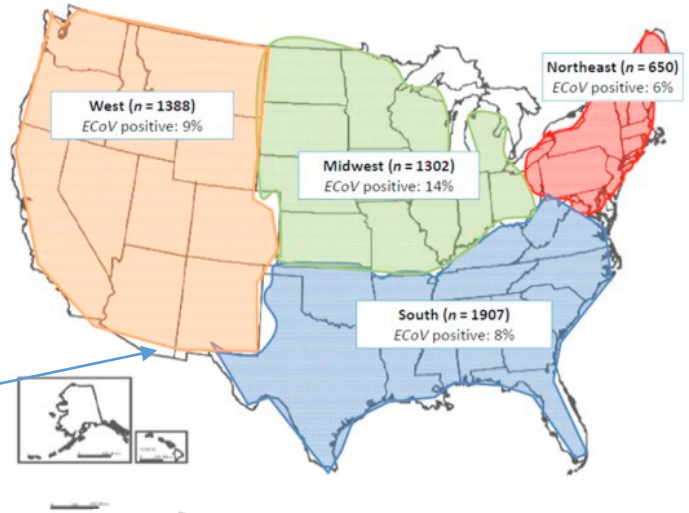
Berryhill EH, et al. Vet J. 2019 - 33 cases

Exposure and Risk Factors for Adult Horse ECoV-

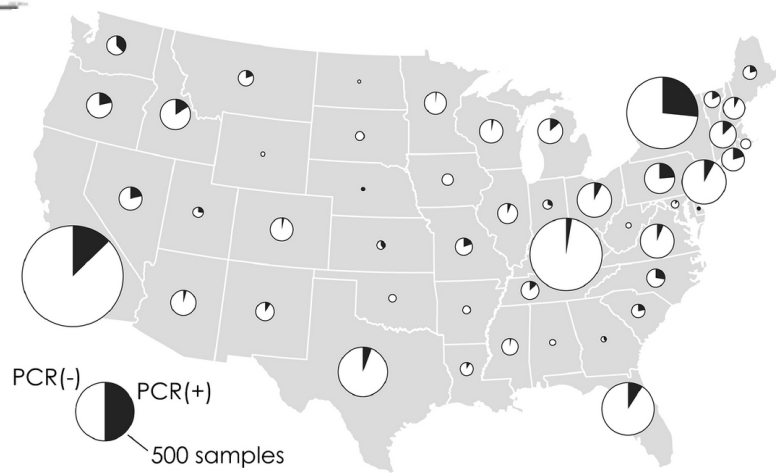
- *Seroprevalence and selective risk factors for ECoV exposure in 5247 healthy adult horses in the USA, using a recently established and validated ELISA -*

  Kooijman Lj et al. Vet J. 2017

  - 504/5247 horses **(9.6%)** horses tested seropositive
  - Risk Factors:
    - Age- >20 yrs.
    - Breed (Draft horses-17.6%)
    - Use of horses (ranch/farm-12%)
    - HIGHEST IN HEALTHY BREEDING ANIMALS
      - *lack of documented outbreaks of ECoV at large breeding farms*!



Antibody testing



PCR testing

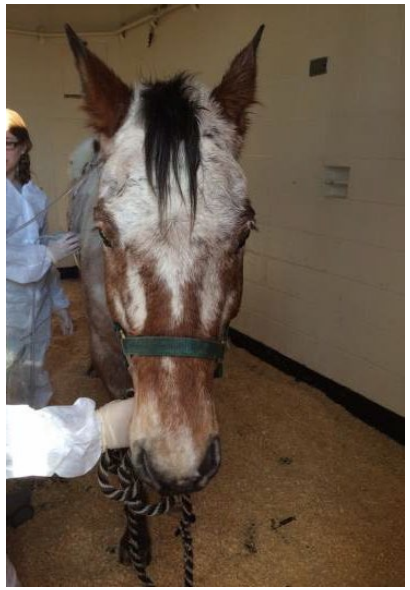
PCR positive-
Circle size -# of test
Black wedge # positive

Equine Veterinary EducationN. Pusterla, R. Vin, C. Leutenegger, L. D. Mittel and T. J. Divers 2016

Clinical Findings in Reported Outbreaks

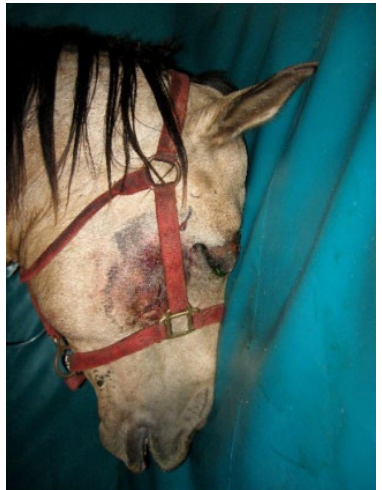
Clinical Signs of ECoV	Percentage of Affected Horses Showing These Signs
Anorexia	97%
Lethargy	88%
Fever (range, 101.5-106°F median, 103.8°F)	83%
Soft, watery feces	23%
Colic	19%
Encephalopathy (circling, head-pressing, seizures)	3%

From the Horse Magazine 2020
Which summarized available scientific publications

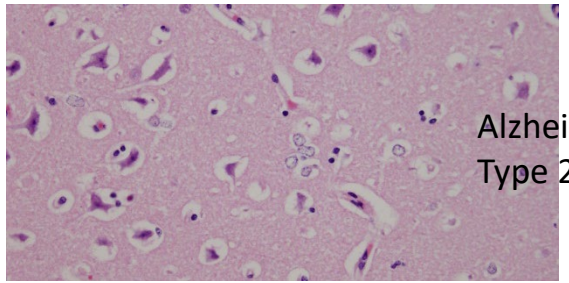


A few horses have severe diarrhea

No Laminitis?? Why?



Ammonia encephalopathy



Alzheimer's
Type 2 astrocytes

Novel findings from a beta coronavirus outbreak on an American Miniature Horse breeding farm in upstate New York

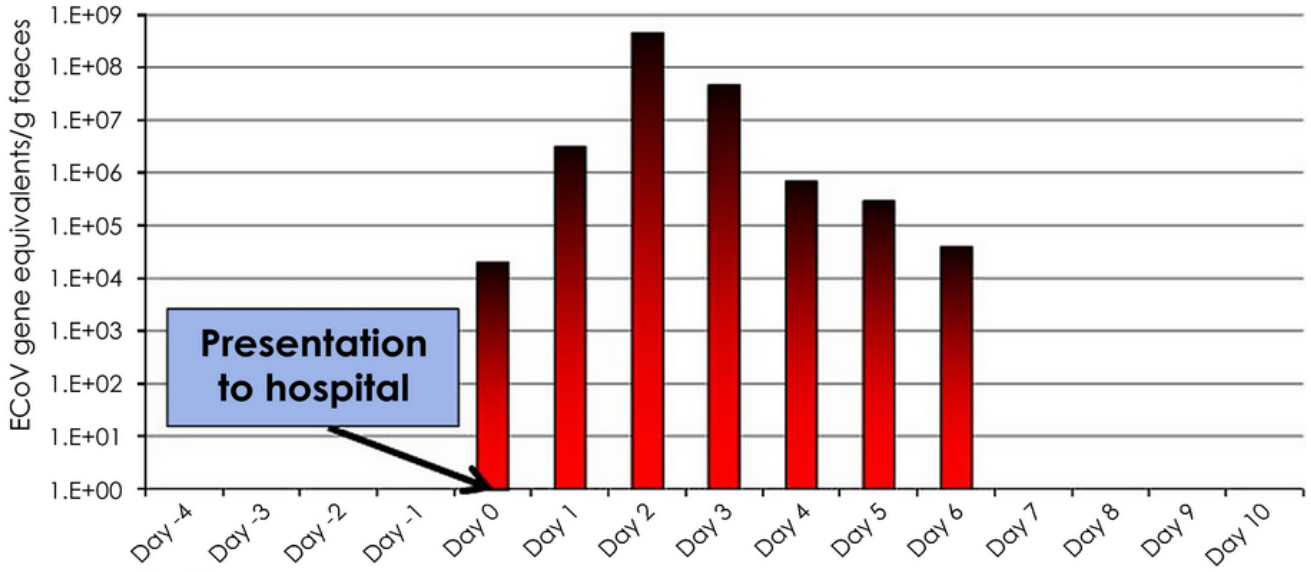
Goodrich E. et al. Equine Veterinary Education, May 2018,

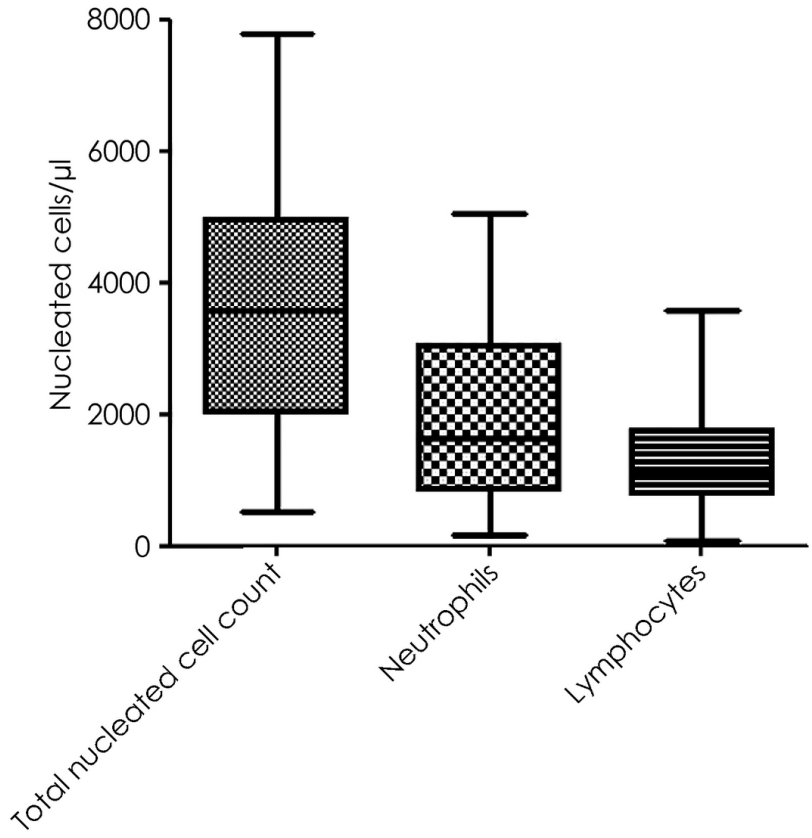
And 1 miniature donkey

	Number of animals (n = 30)	Percentage of total
With any clinical signs	5	17
Anorexia	5	17
Fever	5	17
Colic	2	7
Soft formed faeces/diarrhoea	1	3
No clinical signs detected	25	83
Fatality	0	0
Faecal PCR-positive sick	5	17
Faecal PCR-negative sick	0	0
Faecal PCR-positive normal	20	67
Faecal PCR-negative normal	5	17

	Number of animals (n = 6)	Percentage of total
Blood PCR-positive sick	3	50
Blood PCR-negative sick	0	0
Blood PCR-positive normal	1	17
Blood PCR-negative normal	2	33

Common Finding in Sick Horses with Equine Coronavirus Disease





Possible infection

Depression/anorexia

Fever (> 38.6°C)

Soft formed faeces

Hospitalisation

CBC: leukopenia (0.9 x 10^9/l), neutropenia (0.6 x 10^9/l), lymphopenia (0.2 x 10^9/l)

Occasional thrombocytopenia.

Equine Veterinary Education
Volume 28, Issue 4, pages 216-223, 25 OCT 2015 DOI: 10.1111/eve.12453
http://onlinelibrary.wiley.com/doi/10.1111/eve.12453/full#eve12453-fig-0003

Diagnosis- Equine Coronavirus

- History, Clinical Signs and Blood Laboratory findings
  - Ultrasound examination and serum chemistries may be unremarkable

- PCR of Feces
  - Experimental horses became Fecal PCR + 24 hrs. after initial fever- E. Schaefer JVIM 2018
  - PCR blood- +/-

- Difficult to Culture

Treatments for Equine Coronavirus Cases

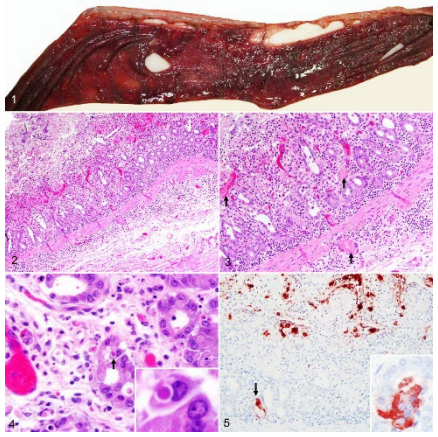
- Intravenous fluids if needed
- NSAIDS- only for colic
- Omeprazole
- Probiotics
- Misoprostol- 2ug/kg P.O.

- Early treatment of <u>CNS signs</u> with
  - Lactulose, Neomycin
  - Mannitol or hypertonic saline
  - Transfaunation
  - Potassium added to I.V. Fluids
    - No dextrose
  - Keep head elevated

Prognosis Equine Coronavirus Enteritis

- Generally Excellent except for occasional case of
  - Hyperammonemia

  - Necrotizing enteritis



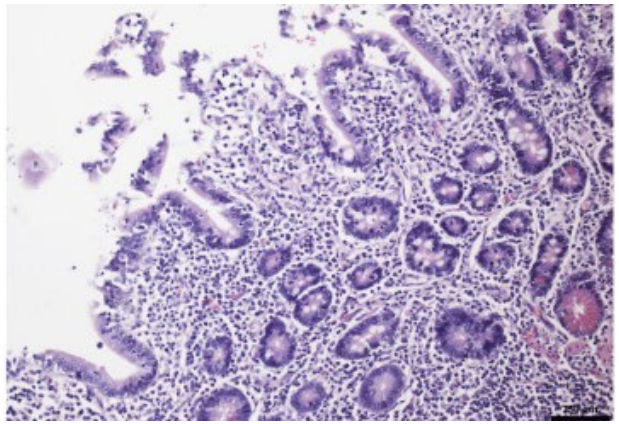
Giannitti F et al. Vet Path 2015

Equine Coronavirus- Biosecurity

- Early detection of the disease by fecal PCR and quarantine along with other biosecurity measures.
- Virus sheddings (feces)-
  - 14 days or less in most horses (Fielding CL 2014, Nemoto M 2014)
  - 18, 22 and 25 in 3 horses (Goodrich et al 2017)
  - 35 days Miszczak F, Tesson V, Kin N, et al. First detection of equine coronavirus (ECoV) in Europe. Vet Microbiol. 2014
- Horses have a serologic response to bovine coronavirus vaccination but it's value in clinical practice is unknown. NEMOTO J Vet Med Sci 2017
- Coronavirus is susceptible to common disinfectants (Betadine 1 min; 1:100 bleach for equipment)

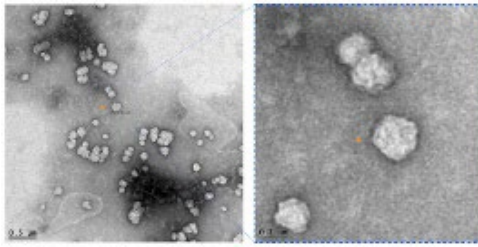
Rotavirus in Foals

- Historically foal infections have been group A rotavirus
- Incubation period 1-2 days
- Age at clinical signs: few days to 4 months
- Causes malabsorption (feces often have a yellow color & characteristic smell)- decrease enzyme activity
- Causes hypersecretion
- Inhibits Na+-D-Glucose symporter preventing water reabsorption even in the absence of histological damage to the villi



Virus Res. 2018

Rotavirus- Diagnosis and Treatments



- Diagnosis- Clinical Signs, Farm history, Fecal PCR*, ELISA or EM* Uprety 2021
- Treatments-
  - Maintain hydration
  - Nutritional support and Nursing Care as needed
    - +/- single dose Flunixin
  - Ulcer Prophylaxis- foals with diarrhea often have ph < 4 ; Wise et al. 2020
  - Supportive Care - Lactaid ® , Pepto-Bismol, Yogurt
  - Biosponge
  - Antibiotics if septic
- Complications
  - Ulcers, Bloat, Rapid Weight Loss, Sepsis

Identification of a Ruminant Origin Group B Rotavirus Associated with Diarrhea Outbreaks in Foals

Uprety T, Sreenivasan CC, Hause BM, Li G, Odemuyiwa SO, Locke S, Morgan J, Zeng L, Gilsenan WF, Slovis N, Metcalfe L, Carter CN, Timoney P, Horohov D, Wang D, Erol E, Adam E, Li F. Viruses 2021

- In February 2021, there was an increase in the frequency of severe watery to hemorrhagic diarrhea cases in neonatal foals 9often < 4 d old) in Central Kentucky. Diagnostic investigation of fecal samples failed to detect evidence of diarrhea-causing pathogens including ERVA.
- Diagnostic investigation of fecal samples failed to detect evidence of diarrhea-causing pathogens including ERVA.
- A novel equine rotavirus group B (ERVB) in fecal specimens from the affected foals (96% identity with ruminant group B rotaviruses)

Photo- U Kentucky- .Equine Disease Quarterly

• commercially available vaccine is for RV type A only has 1 (G3) of the 2 predominant strains (G3 and G14 genotypes)- Recent studies indicate G14 most common in Ky foals Carossino M Virus Res. 2018

Prevention Rotavirus-

- Disinfect – phenols best
  - Bleach not effective
- “Spread out”- proper biosecurity
- Vaccinate late pregnant mares on large and/or endemic farms – vaccine only has 1 (G3) of the 2 predominant strains (G3 and G14 genotypes)- Recent studies indicate G14 most common in Ky foals Carossino M Virus Res. 2018
  - Hyperimmune plasma
- Virus is shed for up to 10 days
- Virus can live in the environment for several days

NetF-positive *Clostridium perfringens* type A in neonatal foal necrotising enteritis in Kentucky

Veterinary Record 2016 Mehdizadeh Gohari et al.

Recently, a novel, pore-forming toxin NetF has been strongly associated with foal necrotizing enteritis

Foal identification	**Year**	**Age**	**Disease**
UK MF 05/00	2001	1 day	Acute necrotising colitis
ST9020	2004	7 days	Enteritis
245084	2006	14 days	Enteritis
82649	2011	7 days	Enteritis
2575	2011	3 days	Acute necrotising colitis
420568	2008	3 days	Enteritis

Clostridium perfringens CP netF Toxin Gene RealPCR™ IDEXX

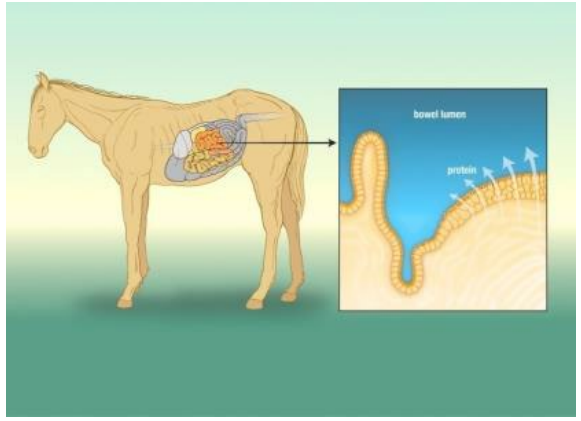
NetF-producing *Clostridium perfringens* and its associated diseases in dogs and foals

Mehdizadeh Gohari I, Unterer S, Whitehead AE, Prescott JF. J Vet Diagn Invest. 2020 Mar;32(2):230-238.

- Foals are often very young and disease may be epidemic
- Colic, toxemia and bloody diarrhea may occur
- Often referred to as necrotizing enterocolitis
- Related to the beta toxin of *C. perfringens* type C
- An autogenous vaccine is available and is apparently effective for mare immunization in Kentucky for the prevention of type A *C. perfringens* enterocolitis in their foal

In vitro antimicrobial activity against equine *Lawsonia intracellularis*.

Pereira CER, Resende TP, Gebhart CJ Equine Vet J.2019



Strain	Foal/96				E40504			
	Intracellular activity		Extracellular activity		Intracellular activity			Extracellular activity
Passage	26	27	26	27	15	17	15	17
Ampicillin	4	4	16	8	4	8	128	>128
Cefazolin	>128	>128	>128	>128	64	>128	64	>128
Ceftiofur	128	>128	>128	>128	128	>128	32	>128
Cephalothin	32	64	>128	>128	128	>128	128	>128
Chloramphenicol	0.25	0.5	2	8	0.5	≤0.125	4	1
Clarithromycin	≤0.125	≤0.125	≤0.125	≤0.125	≤0.125	≤0.125	≤0.125	≤0.125
Doxycycline	≤0.125	≤0.125	2	4	0.25	≤0.125	≤0.125	0.5
~~Enrofloxacin~~	≤0.125	0.25	0.5	0.5	≤0.125	≤0.125	1	0.25
Erythromycin	≤0.125	0.25	0.5	0.5	≤0.125	≤0.125	4	16
Metronidazole	2	1	16	32	32	32	128	>128
Minocycline	≤0.125	0.25	1	2	≤0.125	≤0.125	8	32
Penicillin	2	2	2	2	2	2	128	32
Rifampicin	≤0.125	≤0.125	≤0.125	≤0.125	≤0.125	≤0.125	≤0.125	≤0.125
Sulfamethazine + Trimethoprim (4:1)	0.5	2	64	>128	>128	128	>128	64

MAIN LIMITATIONS:

Only two equine isolates of *L. intracellularis* were available for this study due to the difficulty in isolating this obligate intracellular species from intestinal samples.

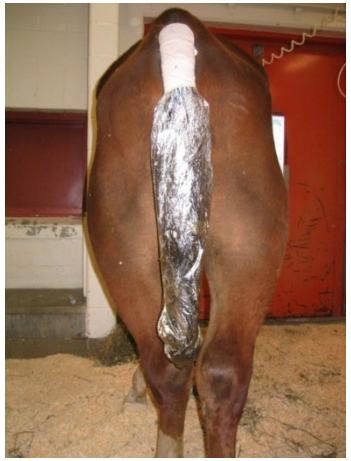
CONCLUSIONS:

This is the first report of antimicrobial susceptibility patterns for equine *L. intracellularis* strains.

Outbreak of acute larval cyathostominosis – A "perfect storm" of inflammation and dysbiosis

Nicola Walse et al EVJ 2020

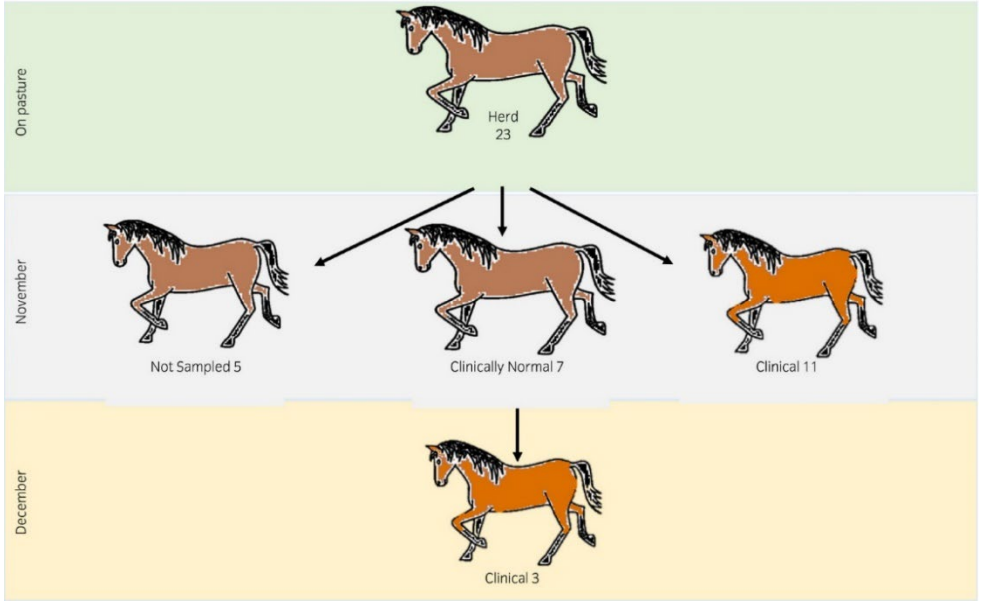
- an outbreak of acute larval cyathostominosis during November and December 2018 in a herd of horses on an equine rescue facility.
- Horses were suspected of having clinical cyathostominosis if they presented with the following clinical signs that were shown to be associated with acute larval cyathostominosis, acute weight loss, diarrhoea/soft faeces, pyrexia, dullness and colic.



- A commercialised cyathostomin-specific enzyme linked immunosorbent assay (ELISA). This test detects IgG (T) antibodies specific to a combination of larval cyathostomin antigens from three common cyathostomin species. Serum scores are reported together with statistically derived probabilities (using logistic regression models) that a horse is infected with a cyathostomin burden greater than a given threshold.

Outbreak of acute larval cyathostominosis

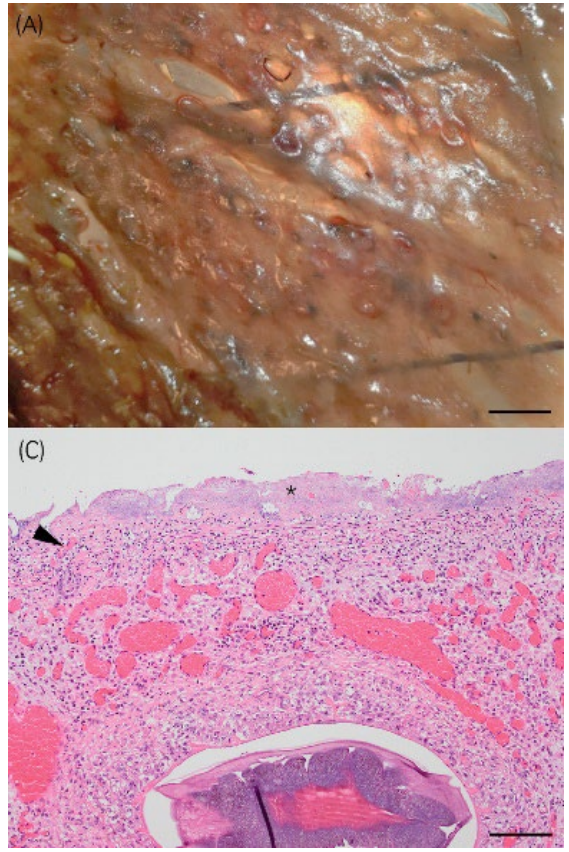
- Common clinical signs included loose faecal consistency, weight loss and pyrexia.
- the seven most severely affected horses had been treated with an ivermectin or a combination of ivermectin/praziquantel product three weeks prior to first observation of clinical signs.



- Clinically affected horses had higher neutrophil counts (P = .01) and lower albumin (P = .002) and total serum protein (P = .02) concentrations than clinically normal horses. Total serum protein concentrations, however, remained within the reference range. The more severely affected cases presented with neutrophilia with a left shift and monocytosis.
- Only one clinically affected horse had a faecal egg count of over 200epg at presentation

Outbreak of acute larval cyathostominosis

- Fecal Microbiota analysis -decreased alpha-diversity of the faecal microbiota and greater Streptococcaceae, and Prevotelleceae was found in clinically affected horses compared to their clinically normal cohorts. An increase in obligate fibrolytic bacteria was seen in the clinically normal group compared to the clinical group.
- Treatments- prednisolone 1 mg/kg PO for 2 days and moxidectin PO
- 12 of 14 survived.



Comparison of the larvicidal efficacies of moxidectin or a five-day regimen of fenbendazole in horses harboring cyathostomin populations resistant to the adulticidal dosage of fenbendazole.

Reinemeyer CR Vet Parasitol.2015

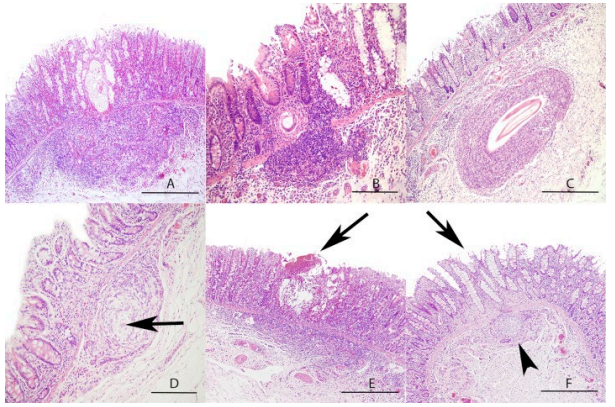
- The five-day regimen of FBZ achieved 44.6% fecal egg count reduction, had 56.4% activity against luminal adults and larvae, and was 38.6% and 71.2% effective against encysted early third stage (EL3) and late third stage/ fourth stage (LL3/L4) cyathostomin larvae, respectively.

- In contrast, MOX provided 99.9% FECR, removed 99.8% of luminal stages, and exhibited 63.6% and 85.2% efficacy against EL3 and LL3/L4 mucosal cyathostomins, respectively.

Local and systemic inflammatory and immunologic reactions to cyathostomin larvicidal therapy in horses M.K. Nielsen

- This study revealed a subtle inflammatory reaction to moxidectin, which is unlikely to cause clinical issues.

Cecum Mox.

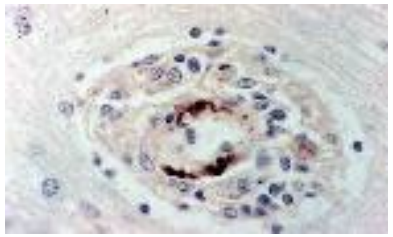


Vent. Colon Fen

Vent. colon control

Editorial: **Current Research in Equid Herpesvirus Type-1 (EHV-1)** Tracy Stokol and Gisela Soboll Hussey Front Vet Sci.2020

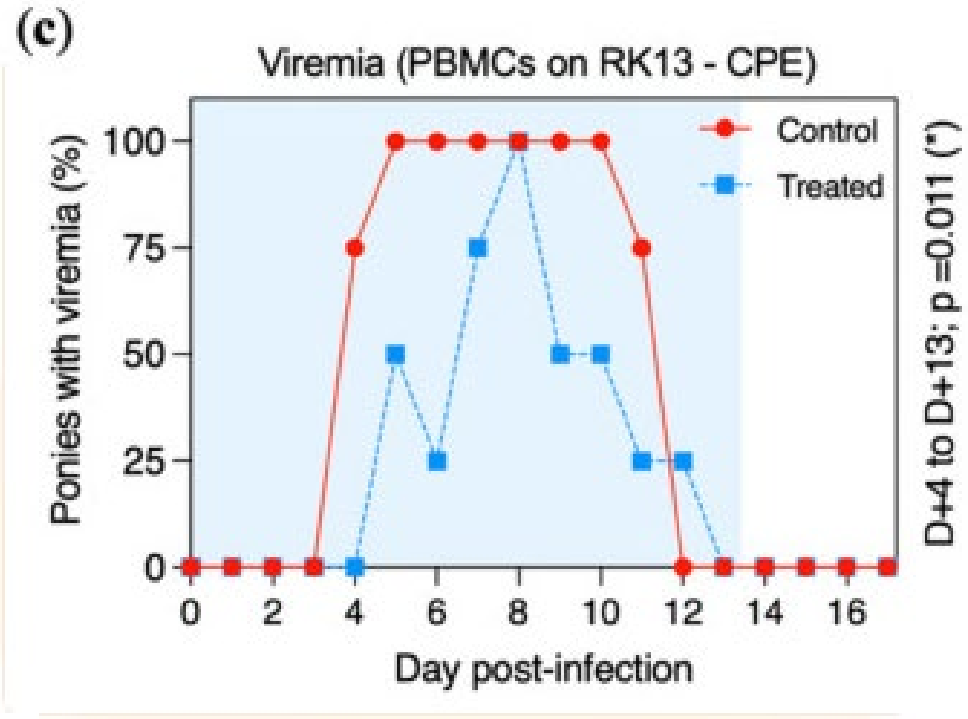
- There are few antiviral drugs that can be used for treating EHV-1 infection. Valacyclovir mildly reduces viral shedding and the degree of viremia in experimentally infected horses (Maxwell AJVR 2017), however it is unknown if valacyclovir is efficacious in the field.
- Infected horses are hypercoagulabe during the viremic phase of infection. Thrombosis occurs in vessels harboring EHV-1 antigen, causing hypoxic tissue injury and contributing to clinical symptoms associated with EHV-1
  - low-molecular-weight heparin was more effective than unfractionated heparin at inhibiting viral-induced platelet activation.(Stokol et al.)
  -unfractionated heparin administration was associated with a reduced incidence of EHM in one clinical outbreak (Walter J Acta Vet Scand. 2013)).

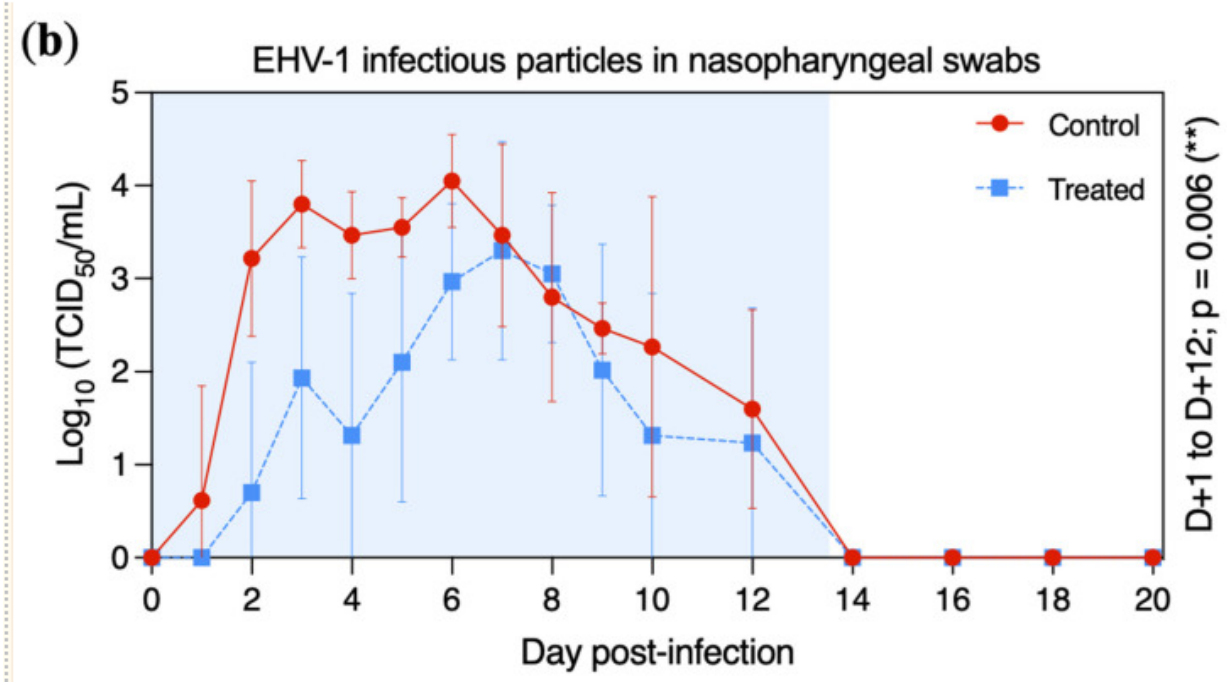


Oral Administration of Valganciclovir Reduces Clinical Signs, Virus Shedding and Cell-Associated Viremia in Ponies Experimentally Infected with the Equid Herpesvirus-1 C_{2254} Variant Thieulent CJ et al Pathogens. 2022

- Four ponies were administered VGCV immediately prior to experimental EHV-1 infection, while another four ponies received a placebo.
- The treatment consisted in 6.5 mg/kg body weight of valganciclovir administered orally three times the first day and twice daily for 13 days.
- Clinical signs of disease, virus shedding and viraemia were measured for up to 3 weeks. Oral administration of valganciclovir induced no noticeable side effect but reduced clinical signs of disease, infectious virus shedding and viraemia in ponies experimentally infected with the EHV-1 C_{2254} variant.

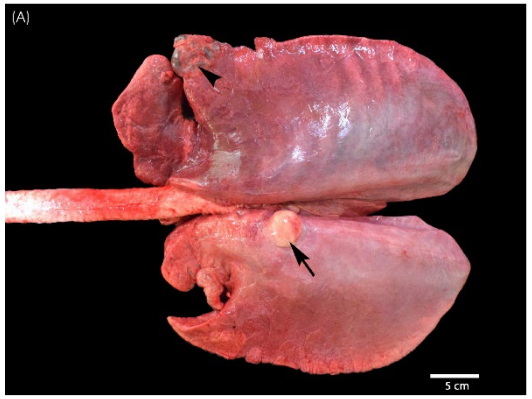
Oral Administration of Valganciclovir Reduces Clinical Signs, Virus Shedding and Cell-Associated Viremia in Ponies Experimentally Infected with the Equid Herpesvirus-1 C_{2254} Variant Thieulent CJ et al Pathogens. 2022





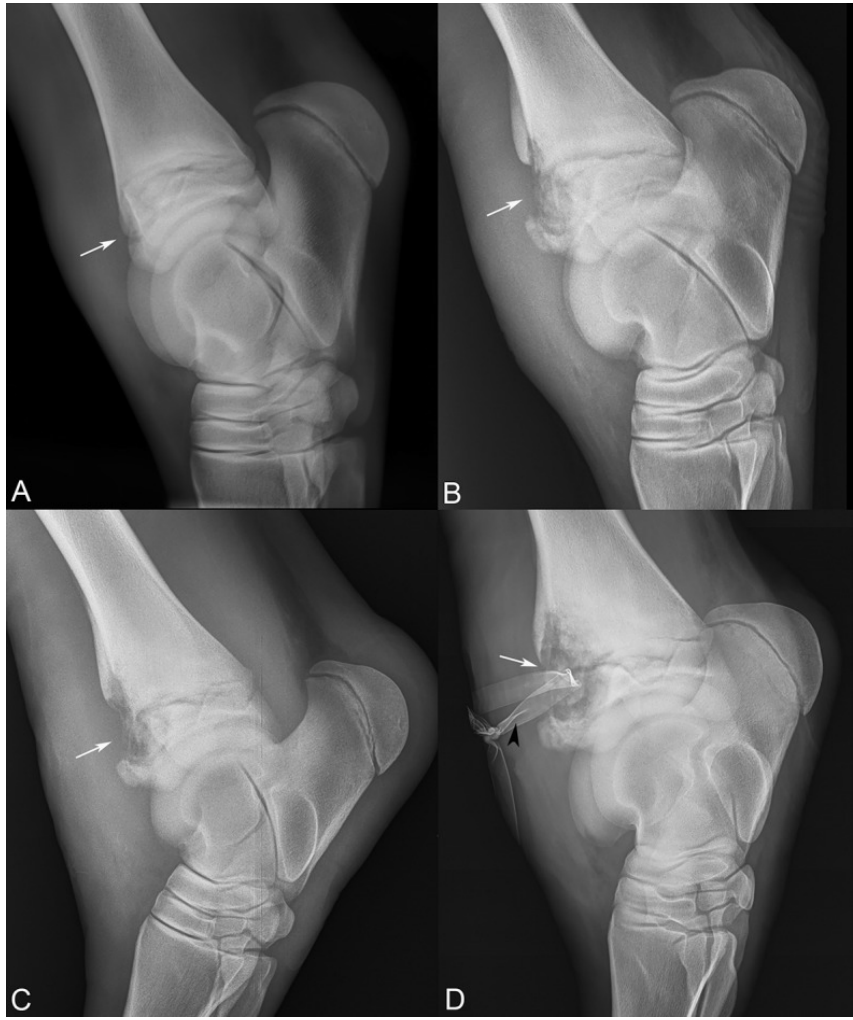
Acute interstitial pneumonia in foals: A severe, multifactorial syndrome with lung tissue recovery in surviving foals *Punsmann S, Hoppe J, Klopfleisch R, Venner M. Equine Vet J. 2020*

- Warmblood foals 2-5 months of age; 9 foals
- Clinical signs for foals with acute interstitial pneumonia were: marked dyspnoea, tachypnoea (respiratory rate: mean 103 ± 27/min), fever (mean 40.1 ± 0.5°C), leucocytosis (mean 24.4 ± 7.8 × 10^9 cells/L) in six foals and leucopenia (1.7 × 10^9 cells/L) in one foal. For all foals, ultrasonographic examinations of the lungs showed dramatically increased numbers of comet tail artefacts in large parts of the lungs and additionally nodular hypoechoic consolidations in three foals . Chest radiographs were performed on the day of diagnosis and revealed severe diffuse alveolar, interstitial or mixed pattern. Microbiology revealed Escherichia coli, Rhodococcus equi and Klebsiella pneumoniae as the most common bacterial pathogens. Equine herpesvirus 2 was detected in all foals by PCR. Those with high viral loads also displayed histopathological changes suggestive of viral infections. Pneumocystis carinii was detected in all acutely affected foals.
- 7 survived, 2 died.
- **Conclusions:** Acute interstitial pneumonia seems to be based on a multifactorial aetiology. Lungs from foals that have survived acute interstitial pneumonia appear to be able to regenerate completely, leaving no permanent changes.



Rhodococcus equi Joint Sepsis and Osteomyelitis Is Associated With a Grave Prognosis in Foals

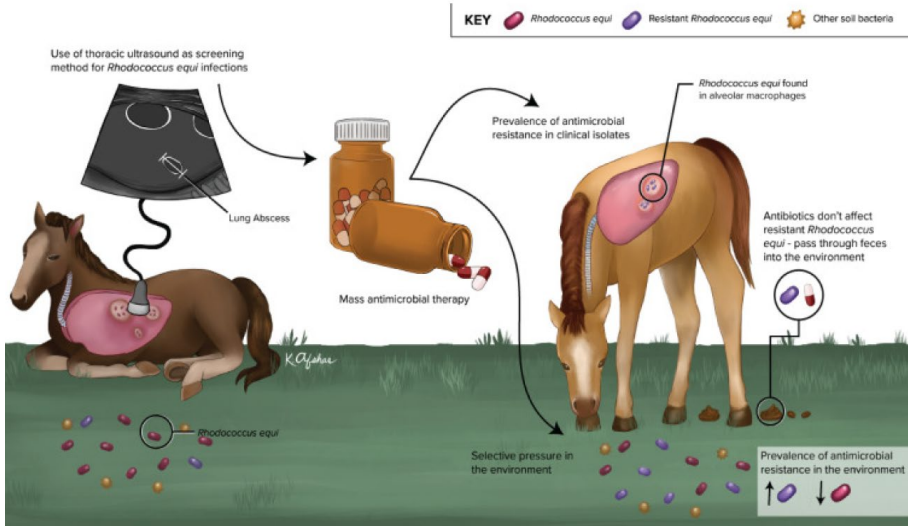
- We hypothesized that, despite advances in diagnostic imaging, antimicrobials and antimicrobial delivery methods, the prognosis for *R. equi* joint sepsis and osteomyelitis remains grave for athletic activity and poor for survival. The 12 cases that met the review criteria had a mortality rate of 84% (10/12), with one case lost to follow up after discharge and one case discharged with a grave prognosis for athleticism. Ruocco NA et al Front. Vet Sci 2020



R. Equi resistance is now a Big problem

- These findings illustrate that overuse of antimicrobial prophylaxis in animals can generate MDR pathogens with zoonotic potential. MDR R. equi and pRErm46-mediated resistance are currently disseminating in the United States and are likely to spread internationally through horse movements. *Álvarez-Narváez S et al Emerg Infect Dis. 2021*

- In a total of 256 R. equi isolates from each of the 256 necropsied foals with rhodococcosis, rifampicin, azithromycin, clarithromycin and erythromycin showed high rates of resistance, 22.65 %, 16.01 %, 14.84 % and 15.23 %, respectively. *Erol E et al. Vet Microbiol. 2020*



Alvarez-Narvaez 2021

Novel Quantitative PCR for *Rhodococcus equi* and Macrolide Resistance Detection in Equine Respiratory Samples Narváez SÁ et al. Animals (Basel). 2022

- With the emergence and spread of MDR *R. equi* to current antimicrobial treatment, new tools that can provide a fast and accurate diagnosis of the disease and antimicrobial resistance profile are needed.
- Here, we have developed and analytically validated a multiplex qPCR for the simultaneous detection of *R. equi* and related macrolide resistance genes in equine respiratory samples. The three sets of oligos designed in this study to identify *R. equi* housekeeping gene *choE* and macrolide resistance genes *erm*(46) and *erm*(51) showed high analytic sensitivity with a limit of detection (LOD) individually and in combination.
- Our new quantitative PCR is a trustable tool that will improve the speed of *R. equi* infection diagnosis, as well as helping in treatment selection.

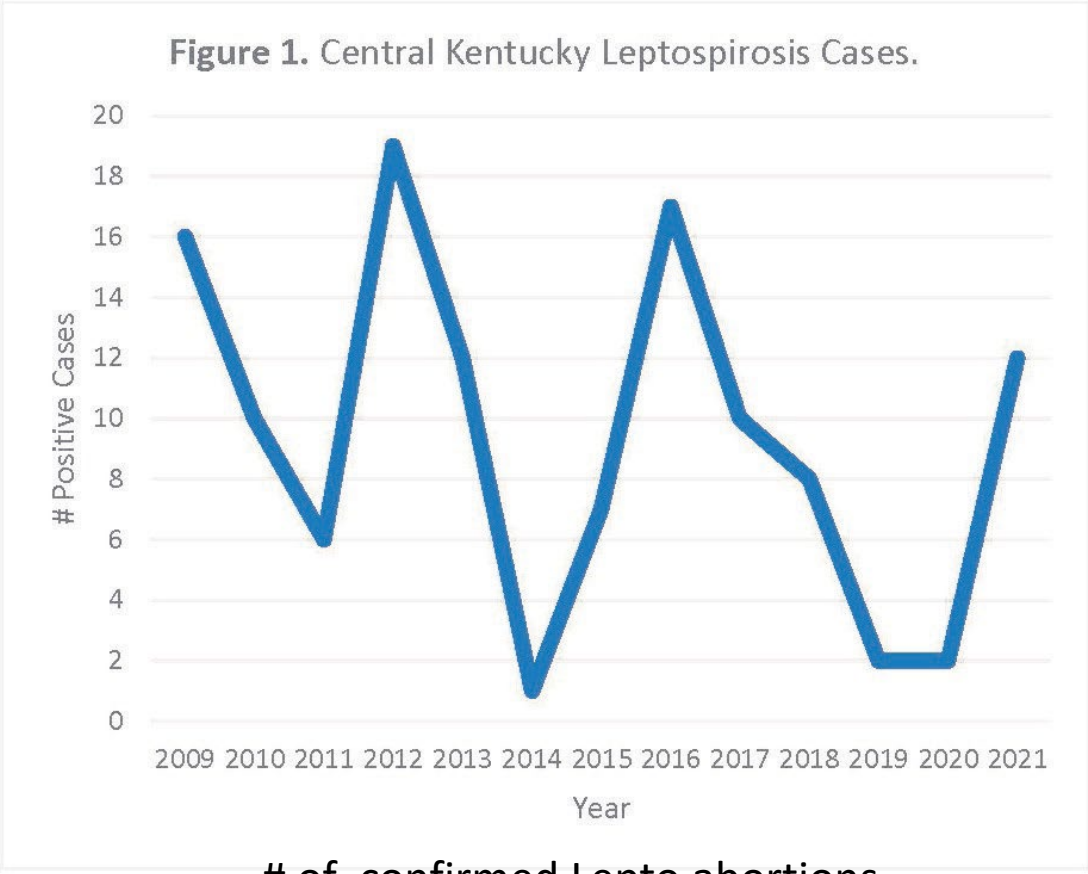
Rhodococcus equi foal pneumonia: Update on epidemiology, immunity, treatment and prevention

Bordin AI et al 2022 Equine Vet J. 2022

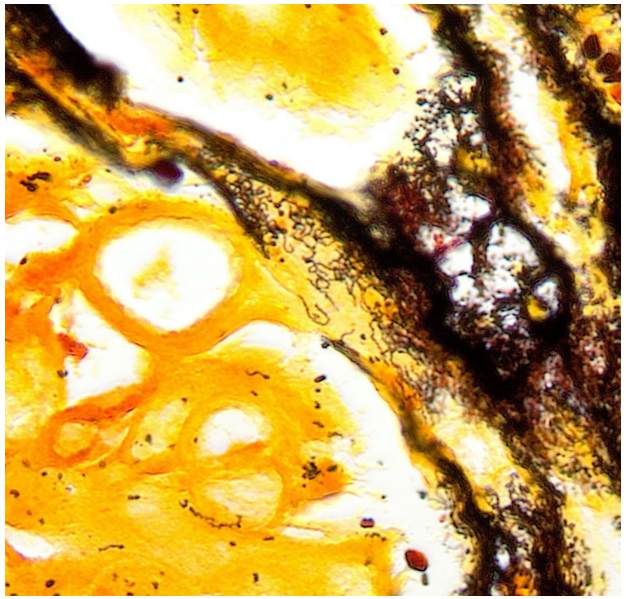
- In summary, a macrolide in combination with rifampin remains the recommended treatment for foals with *R. equi* pneumonia.
- Intramuscular administration of tulathromycin (2.5 mg/kg) in combination with once-daily oral administration of rifampin (10 mg/kg) may be an efficacious therapeutic approach.
- Nebulized gentamycin might provide some additional benefit
- Doxycycline might have efficacy against some resistant strains

		mic 50	mic 90
Doxycycline	≤2 to 16	≤2	≤2
Enrofloxacine	≤0.25 to >2	1	2

Leptospirosis- Abortions, Uveitis and Renal Failure



# of confirmed Lepto abortions



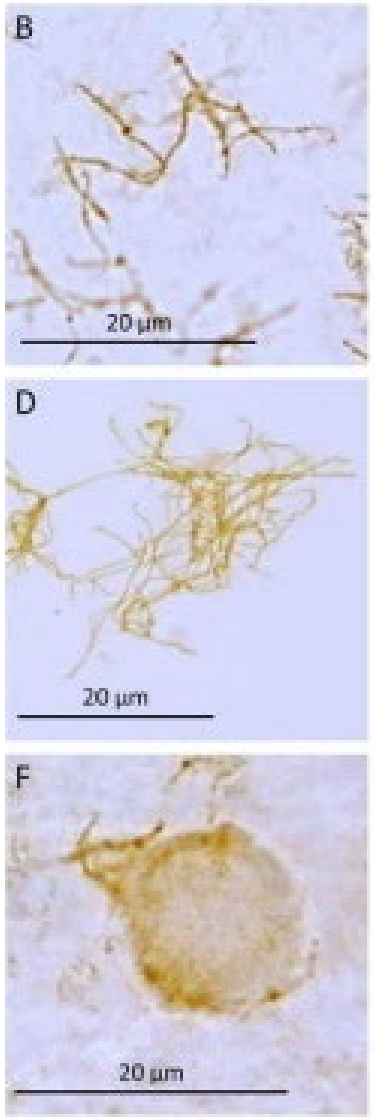
Melissa Swan DVM, MS, Dipl. ACVP

In Vivo Biofilm Formation of Pathogenic *Leptospira* spp. in the Vitreous Humor of Horses with Recurrent Uveitis

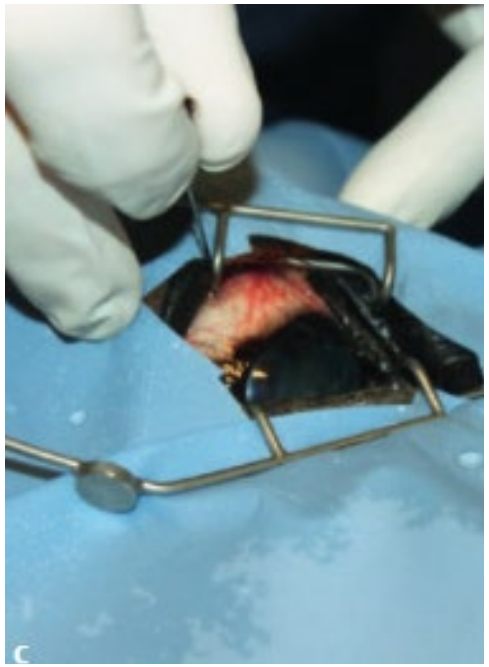
Ackermann k. et al.

Microorganisms 2021

- Leptospira infections of the eye are a common cause of recurrent uveitis in horses with Warmblood horses being genetically predisposed.
- Systemic treatments with antimicrobials know to kill Leptospira in vitro are mostly ineffective in treating the disease.
- Data from the present study show that ERU is a biofilm-associated intraocular leptospiral infection, which best explains the typical clinical course.



Gentamycin Intravitreal for ERU



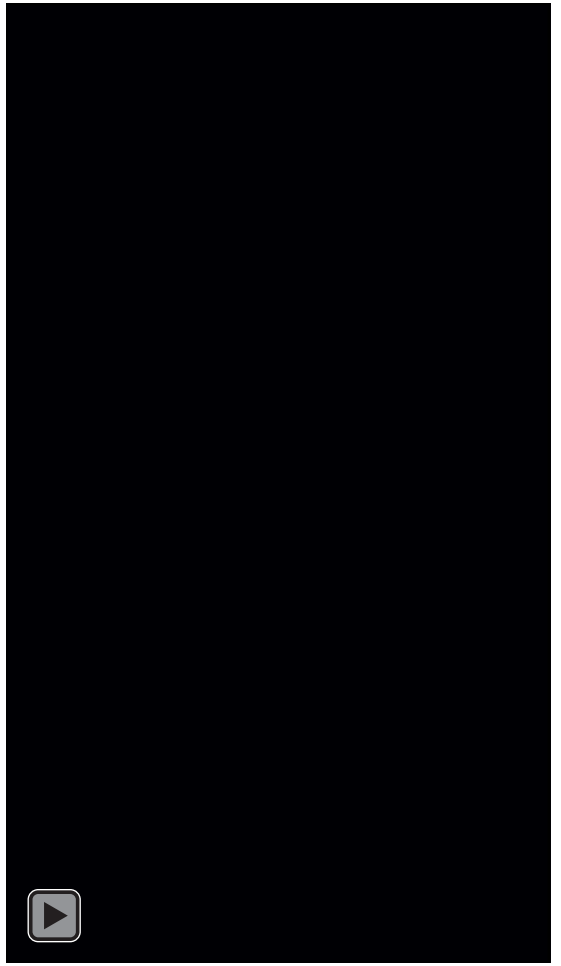
- 4 mg preservative free (pediatric formulation- 10 mg/ml)
  - 30g needle, twist on the way out to help seal hole
- 7-8 mm from limbus (10 or 2 O'clock position)
- Aim at middle of vitreous (do not aim straight down)
- Especially useful for Lepto associated ERU
- If glaucoma present; remove some aqueous before Intra-vitreal injection
- References

  - Fischer BM, McMullen RJ Jr, Reese S, Brehm W. Intravitreal injection of low-dose gentamicin for the treatment of recurrent or persistent uveitis in horses: Preliminary results. BMC Vet Res. 2019
  - Launois T, González Hilarión LM, Barbe F, Leurquin C, Bihin B, Hontoir F, Dugdale A, Vandeweerd JM. Use of Intravitreal Injection of Gentamicin in 71 Horses With Equine Recurrent Uveitis. J Equine Vet Sci. 2019 Jun;77:93-97.

Repeated nasopharyngeal lavage predicts freedom from silent carriage of Streptococcus equi after a strangles outbreak.

Pringle j. et al. J Vet Intern Med. 2022

- Previous work: at least 6 months after Strangles outbreaks 15-37% of horses remain PCR positive on GP lavage. 3X positive culture rate.
- An outbreak of strangles with 100% morbidity in 41 mature Icelandic horses was followed prospectively to investigate development of silent carriers. All were initially positive to S. equi on NPL. The farm was closed to horse movement during the entire study. No treatments provided.
- Testing for S. equi was performed by NPL at weeks 18, 28, 29, and 30 post index case and subsequently at week 45 by nasal swab, nasopharyngeal lavage and guttural pouch lavage “gold standard”.
- Results:
  - Sensitivity of detecting positive horses was greatest with single GP sampling (69%)and lowest with nasal swab.
  - GP visually appeared normal in many chronic carriers
- Even horses positive by qPCR but culture negative should be *suspected* carriers of live bacteria.

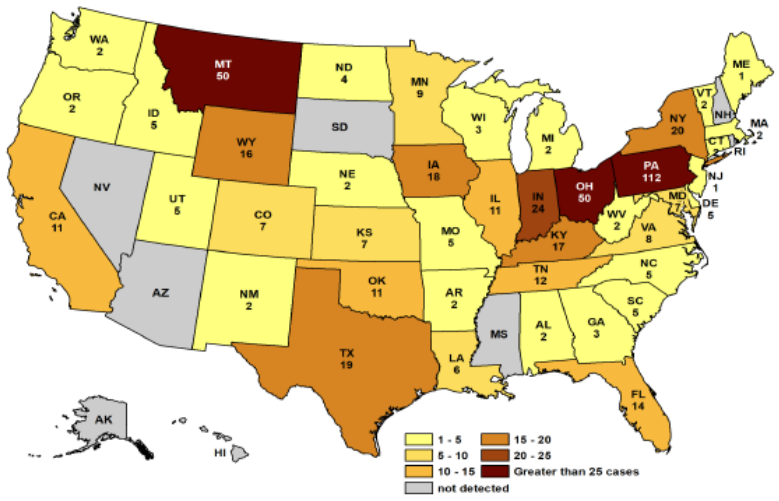


Equine Flu Kills 119 Horses At Colorado Wild Horse Facility

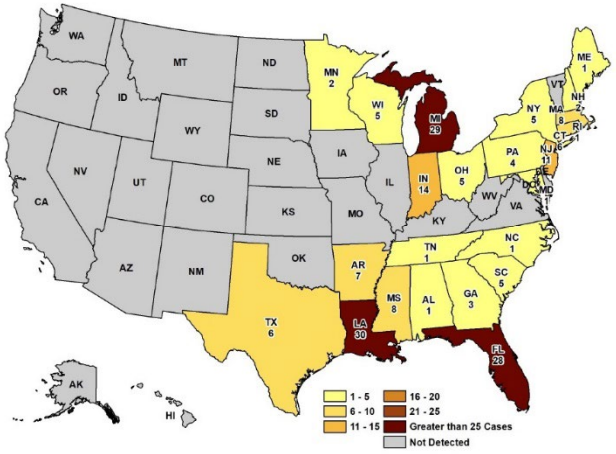
- The EIV H3N8 strain, American lineages (Fla. clade 1 and 2 sublineages) remains a major threat to horse populations. The ability of EIV to constantly accumulate mutations (antigenic drift) in its antibody-binding sites enables it to evade host protective immunity, making it a successful viral pathogen.
- Outbreaks occur among both vaccinated and unvaccinated horses, with reduced clinical manifestation observed in vaccinated horses, especially those with a history of appropriate and up-to-date vaccination over several years.
- Vaccination protocols may differ depending upon specific vaccine used but twice yearly boosters may be helpful in horses that are constantly being exposed to different populations of horses.

West Nile Virus (WNV) and EEE in Horses

- We are nearing the time of the year for WNV and EEE infections
- Incidence varies considerably year to year
- Mosquito spread RNA *flavivirus* (WNV)and *alphavirus (EEE)*- (Arboviruses)



WNV 2018 data; only 3 cases in 2021?



EEE 2019 data; only 1 case in 2021?

West Nile Virus (WNV) in the Horse

- Only 5 – 10% of infected horses show clinical signs
  (Kleiboeker *et al J Vet Diagn Invest 2004)*
- 90% of clinical cases are > 1 year of age

SPECIFIC CLINICAL SIGN	% CASES**
Fever*	21-65
Anorexia / lethargy	43-57
Weakness	53 – 94
Ataxia	44 – 72
Abnormal mentation	22 – 67
Fasciculations	35 – 61
Cranial nerve deficits	19 – 44
Recumbent	8 – 30

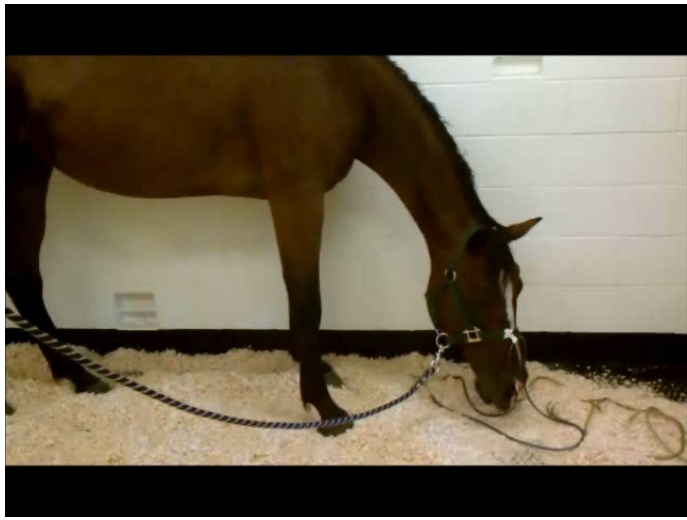
** Porter *et al* U. of Fla. 46 horses *JAVMA 2003*
Ward *et al* Purdue U. 136 horses *JAVMA 2004*
Salazar *et al* Colorado State U. 484 horses *JAVMA 2004*

Diagnosis WNV

- Epidemiologic information
- Clinical signs
- CSF - can be normal or show lymphocytic/neutrophilic pleocytosis
- Serum IgM antibody capture ELISA
- Paired IgG serology
    - a low % of cases are negative
    - IgM can be detected 5-8 days after infection and persists for < 2 months
    - Vaccination can occasionally cause positive IgM ELISA results

Outcome WNV

- Mortality rate in clinically affected horses has been variable, but generally < 30%.
- Horses with fulminant signs of encephalitis or recumbent horses have a worse prognosis.
- Clinically diseased horses that have rapid improvement in the first week of illness often appear to have full recovery (some horses may have residual CNS deficits).
- Three vaccines are currently available in the U.S.
  - All inactivated
  - All require an initial 2 shot series
  - Vaccine strains are from Lineage 1
    - the high degree of cross-reactivity between viruses from Lin 1 and 2 supports the efficacy of veterinary vaccines to prevent outbreaks associated with both lineages



Equine Eastern Encephalitis- Outcome

- The mortality rate in clinically affected horses and humans is approximately 90% and 35% respectively.
- Almost all cases are in unvaccinated horses.
  - In immune suppressed horses, vaccination is not always protective