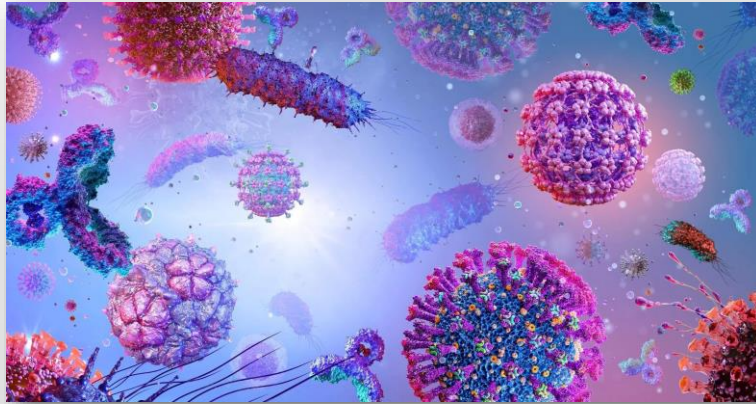


Infectious Disease Journal Club - Viruses



1

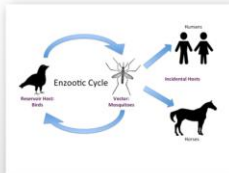
Equine Herpesviruses



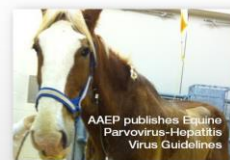
Equine Coronavirus



Eastern and Western Equine Encephalomyelitis Viruses



Equine Hepatic Viruses



2

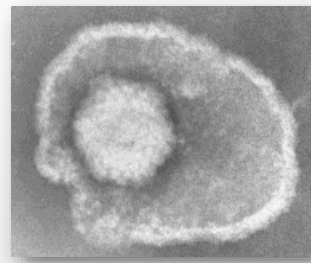
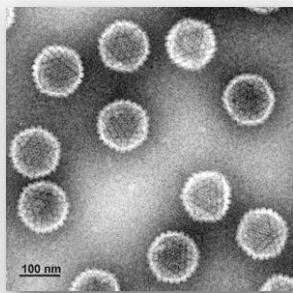
Equine Herpesviruses



3

Family: Herpesviridae Subfamily: Alphaherpesvirinae

- Genus: Varicellovirus
 - EHV-1
 - EHV-4

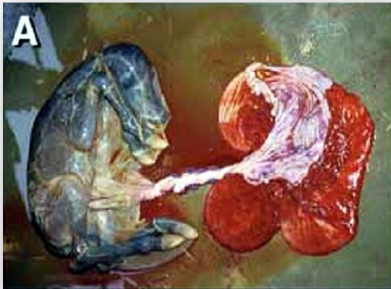


Relatives: herpes simplex virus, varicella zoster virus

4

EHV-1

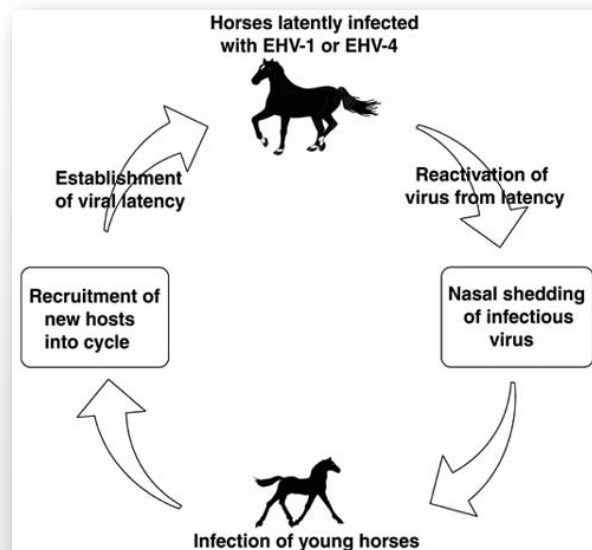
EHV-1, subtype 1
Equine virus abortion
Equine herpesvirus myeloencephalopathy (EHM)



EHV-4

EHV-1, subtype 2
Equine rhinopneumonitis

5



From Allen GP. In, *Equine Resp Dis*, Lekeux P (ed), 2002, www.ivis.org

6

Article

Frequency of Detection of Respiratory Pathogens in Clinically Healthy Show Horses Following a Multi-County Outbreak of Equine Herpesvirus-1 Myeloencephalopathy in California

Abigail Wilcox¹, Samantha Barnum¹, Cara Wademan¹, Rachel Corbin¹, Edlin Escobar¹, Emir Hodzic¹, Stephen Schumacher² and Nicola Pusterla^{1,*}

¹ Department of Medicine and Epidemiology, School of Veterinary Medicine, University of California, Davis, CA 95616, USA

² United States Equestrian Federation, Lexington, KY 40511, USA

* Correspondence: npusterla@ucdavis.edu; Tel.: +530-752-1039

Pathogens **2022**, *11*, 1161. <https://doi.org/10.3390/pathogens11101161>

7

Table 1. Summary of all positive swabs for common and less characterized respiratory pathogens categorized by week after the issuance of USEF guidelines. Total swabs from each week is indicated in the header.

	Week 1 (160 Swabs)	Week 2 (182 Swabs)	Week 3 (156 Swabs)	Week 4 (73 Swabs)	Week 5 (68 Swabs)	All Weeks (639 Swabs)
Common resp. pathogens						
EHV-1	5 (3.1%)	3 (1.6%)	10 (6.4%)	4 (5.5%)	2 (2.9%)	24 (3.8%)
<i>S. equi</i>	2 (1.3%)	3 (1.6%)	9 (5.8%)	3 (4.1%)	1 (1.5%)	18 (2.8%)
EHV-4	0	1 (0.5%)	5 (3.2%)	0	3 (4.4%)	9 (1.4%)
ERBV	1 (0.6%)	2 (1.1%)	4 (2.6%)	1 (1.4%)	0	8 (1.3%)
EIV	0	4 (2.2%)	0	0	0	4 (0.6%)
ERAV	0	0	0	0	0	0
Total	8 (5.0%)	13 (7.1%)	28 (17.9%)	8 (11.0%)	6 (8.8%)	63 (9.8%)
Less characterized resp. pathogens						
EHV-2	54 (33.8%)	60 (33.0%)	54 (34.6%)	20 (27.4%)	21 (30.9%)	209 (32.7%)
EHV-5	51 (31.9%)	69 (37.9%)	46 (29.5%)	23 (31.5%)	26 (38.2%)	215 (33.6%)
<i>S. zooepidemicus</i>	51 (31.9%)	49 (26.9%)	44 (28.2%)	18 (24.7%)	26 (38.2%)	188 (29.4%)
Total	111 (69.4%)	114 (62.6%)	93 (59.6%)	42 (60.3%)	43 (63.2%)	402 (62.9%)

8

Short Communication

Investigation of the EHV-1 Genotype (N_{752} , D_{752} , and H_{752}) in Swabs Collected From Equids With Respiratory and Neurological Disease and Abortion From the United States (2019–2022)

Nicola Pusterla*, Samantha Barnum, Kaila Lawton, Cara Wademan, Rachel Corbin, Emir Hodzic

Department of Medicine and Epidemiology, School of Veterinary Medicine, University of California, Davis, CA

Journal of Equine Veterinary Science 123 (2023) 104244

9

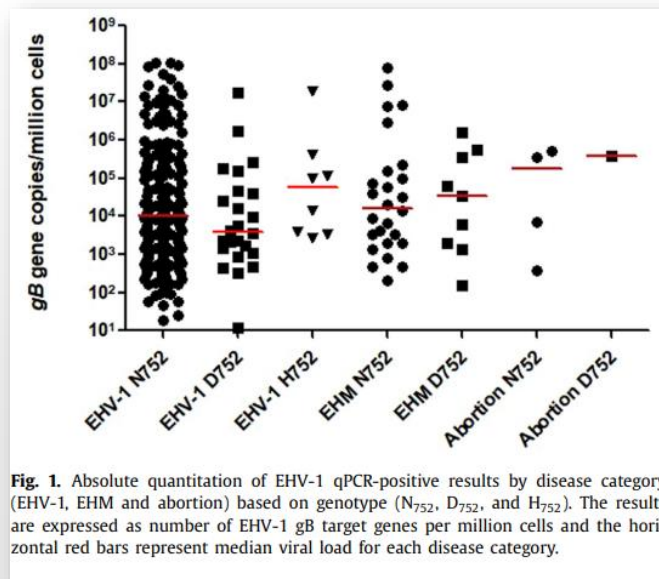


Fig. 1. Absolute quantitation of EHV-1 qPCR-positive results by disease category (EHV-1, EHM and abortion) based on genotype (N_{752} , D_{752} , and H_{752}). The results are expressed as number of EHV-1 gB target genes per million cells and the horizontal red bars represent median viral load for each disease category.

10



Coagulation parameters following equine herpesvirus type 1 infection in horses

M. E. WILSON, C. L. HOLZ, A. K. KOPEC, J. J. DAU, J. P. LUYENDYK and G. SOBOLL HUSSEY*

Department of Pathobiology and Diagnostic Investigation, College of Veterinary Medicine, Michigan State University, East Lansing, Michigan, USA.

*Correspondence email: husseyg@msu.edu; Received: 07.11.17; Accepted: 30.03.18

frontiers
in Veterinary Science

ORIGINAL RESEARCH
published: 28 May 2018
doi: 10.3389/fvets.2018.00106

Subcutaneous Administration of Low-Molecular-Weight Heparin to Horses Inhibits Ex Vivo Equine Herpesvirus Type 1-Induced Platelet Activation

Tracy Stokol^{1*}, Priscila B. S. Serpa¹, Marjory B. Brooks¹, Thomas Divers² and Sally Ness²

¹ Department of Population Medicine and Diagnostic Sciences, College of Veterinary Medicine, Cornell University, Ithaca, NY, United States, ² Department of Clinical Sciences, College of Veterinary Medicine, Cornell University, Ithaca, NY, United States

11

Combined Treatment with Valacyclovir and Heparin Reduces Incidence Rate of EHM and Improves Survival in Naturally Occurring EHV-1 Outbreaks

Megan Marchitello, DVM*; Abby M. Sage, VMD, DACVIM;
Nathaniel A. White DVM, MS, DACVS; and Krista Estell, DVM DACVIM

> Tierarztl Prax Ausg G Grosstiere Nutztiere. 2016 Oct 12;44(5):313-317. doi: 10.15653/TPG-150451. Epub 2016 Sep 21.

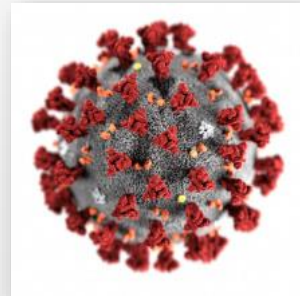
Prevention of equine herpesvirus myeloencephalopathy – Is heparin a novel option? A case report

[Article in English, German]

Jasmin Walter¹, Christoph Seeh, Kerstin Fey, Ulrich Bleul, Nikolaus Osterrieder

12

Equine Coronavirus



13

Risk factors associated with an outbreak of equine coronavirus at a large farm in North Carolina

Kate L. Hepworth-Warren^{1*}, Sara J. Erwin¹, Caroline B. Moore^{2†}, James R. Talbot², Kimberly A. S. Young¹, Michael J. Neault^{3†}, Jennifer C. Haugland^{4,5}, James B. Robertson¹ and Anthony T. Blikslager¹

¹Department of Clinical Sciences, College of Veterinary Medicine, North Carolina State University, Raleigh, NC, United States, ²Carolina Equine Hospital, Browns Summit, NC, United States, ³North Carolina Department of Agriculture and Consumer Services, Raleigh, NC, United States, ⁴Rollins Animal Disease Diagnostic Laboratory, North Carolina Department of Agriculture and Consumer Services, Raleigh, NC, United States, ⁵North Carolina Veterinary Diagnostic Laboratory System, North Carolina Department of Agriculture and Consumer Services, Raleigh, NC, United States

Front. Vet. Sci. 10:1060759.
doi: 10.3389/fvets.2023.1060759

14

TABLE 4 Clinical signs of affected animals (n = 17).

Sign	Yes, n (%)	No, n (%)	Unknown, n (%)
Fever	3 (17.6%)	11 (64.7%)	3 (17.6%)
Diarrhea	3 (17.6%)	11 (64.7%)	3 (17.6%)
Colic	6 (35.3%)	7 (41.2%)	4 (23.5%)
Anorexia	1 (5.9%)	12 (70.6%)	4 (23.5%)
Small colon impaction	3 (17.6%)	11 (64.7%)	3 (17.6%)

Significant Risk Factors

- Primarily housed in a stall (167)
- In work (27)
- Housed next to a positive horse (7.5)
- Fed rationed hay vs ad lib hay (1,558)
- Fed alfalfa hay (1,558)

15

Journal of Equine Veterinary Science 87 (2020) 102906

Equine Coronavirus-Associated Colitis in Horses: A Retrospective Study

Debora N. Mattei ^a, Jamie J. Kopper ^b, Macarena G. Sanz ^{b, *}

^a Equine Veterinary Medical Center, Member of Qatar Foundation, Doha, Qatar

^b Department of Veterinary Clinical Sciences, College of Veterinary Medicine, Washington State University, Pullman, WA

4/5 with diarrhea

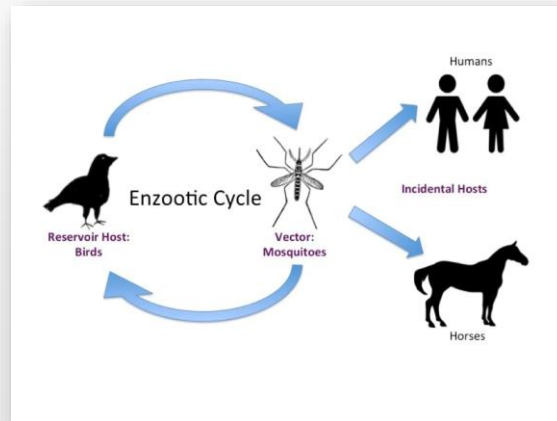
3 with abnormal large colon ultrasonography

2 with transient ventricular tachycardia

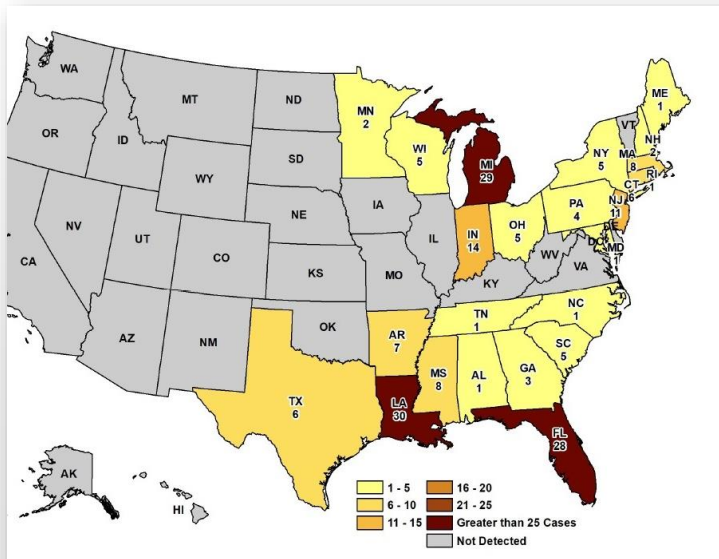
2 with clinical pathologic evidence of liver dysfunction

16

Eastern and Western Equine Encephalomyelitis Viruses



17



Eastern Equine Encephalitis

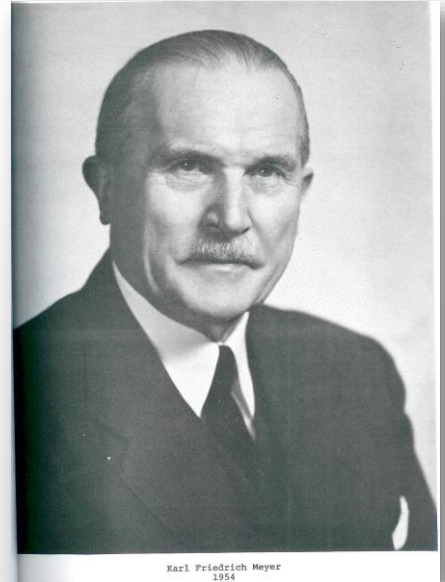
- Reportable disease
- Spring, summer cases
- 184 reported cases in 2019
- 107 reported cases in 2018
- Probably hundreds
- Poor vaccination history
- Often <3 years of age

18

What about WEE?

Karl Friedrich Meyer

The “**Pasteur of the 20th Century**”



https://en.wikipedia.org/wiki/Karl_Friedrich_Meyer

19

Western Equine Encephalomyelitis

Last human case in North America in 1998

Last substantial equine epizootic in 1975 in North Dakota and Manitoba

Smaller equine epizootics into the 1990s

Latest identification in mosquito pool in 2013 in Nevada

Recently removed from CDC surveillance system

Small surveillance study in Colorado in 2017 with no detection in mosquito pools

20

RESEARCH ARTICLE

“Submergence” of Western equine encephalitis virus: Evidence of positive selection argues against genetic drift and fitness reductions


Nicholas A. Bergren^{1,2*}, Sherry Haller^{1,3}, Shannan L. Rossi^{1,3}, Robert L. Seymour^{1,2}, Jing Huang¹, Aaron L. Miller⁴, Richard A. Bowen^{5,6}, Daniel A. Hartman⁵, Aaron C. Brault⁷, Scott C. Weaver^{1,2,3}

1 Institute for Human Infections and Immunity, University of Texas Medical Branch, Galveston, Texas, United States of America, **2** Department of Pathology, University of Texas Medical Branch, Galveston, Texas, United States of America, **3** Department of Microbiology & Immunology, University of Texas Medical Branch, Galveston, Texas, United States of America, **4** Department of Pediatrics, University of Texas Medical Branch, Galveston, Texas, United States of America, **5** Department of Microbiology, Immunology, and Pathology, Colorado State University, Fort Collins, Colorado, United States of America, **6** Department of Biomedical Sciences, Colorado State University, Fort Collins, Colorado, United States of America, **7** Division of Vector-Borne Diseases, Centers for Disease Control and Prevention, Fort Collins, Colorado, United States of America


PLOS Pathogens | <https://doi.org/10.1371/journal.ppat.1008102> February 6, 2020

21

Should EEE and WEE vaccines continue to be included by AAEP in their list of **CORE** vaccines recommended for **ALL** horses in the United States?



CORE VACCINATION



Folios and Weanlings*	Adult Horses**	Broodmares
Tetanus 3 dose series	Tetanus Annual	Tetanus Annual, 4-6 weeks pre-partum
Eastern/ Western Equine Encephalomyelitis 3 dose series	Eastern/ Western Equine Encephalomyelitis Annual-spring prior to vector season	Eastern/ Western Equine Encephalomyelitis Annual 4-6 weeks pre-partum
West Nile Virus (WNV) 3 dose series	West Nile Virus (WNV) Annual-spring, prior to vector season	West Nile Virus (WNV) Annual 4-6 weeks pre-partum
Rabies 2 dose series (refer to manufacture guidelines)	Rabies Annual	Rabies Annual

* First at 4-6 months, 2nd dose 4-6 weeks after first, 3rd dose at 10-12 months. ** Previously vaccinated against the disease indicated.

Always consult with your veterinarian for your horse's history and need for risk-based vaccinations

22

Received: 16 November 2021 | Accepted: 25 March 2022
 DOI: 10.1111/jvim.16417

STANDARD ARTICLE

Journal of Veterinary Internal Medicine

ACVIM
 American College of
 Veterinary Internal Medicine

Open Access

Prevalence of clinical signs and factors impacting expression of myosin heavy chain myopathy in Quarter Horse-related breeds with the *MYH1*^{E321G} mutation

Stephanie J. Valberg¹ | Abigail E. Schultz¹ | Carrie J. Finno² |
 Rebecca R. Bellone³ | Shayne S. Hughes⁴

¹Large Animal Clinical Sciences, College of Veterinary Medicine, Michigan State University, East Lansing, Michigan, USA

²Department of Population Health and Reproduction, School of Veterinary Medicine, University of California Davis, Davis, California, USA

Recommendations for horses who genotype N/My or My/My are:

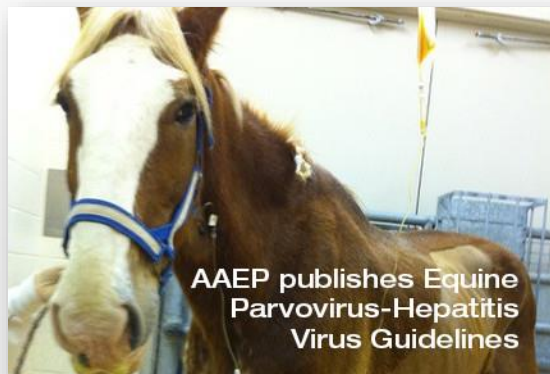
<https://vgl.ucdavis.edu/test/myhm>

1. Avoid any form of strangles vaccines
2. Use intranasal vaccines where possible and only use intramuscular vaccines that are necessary for horses in that region of the country
3. Spacing vaccines out over time is also recommended

23

WASHINGTON STATE UNIVERSITY

Equine Hepatic Viruses



AAEP publishes Equine
 Parvovirus-Hepatitis
 Virus Guidelines

24

Theiler's Disease or Serum Hepatitis

- Acute hepatocellular necrosis of horses
- Associated with recent (4 - 12 wks) administration of an equine-origin biologic (often tetanus antitoxin)
- Occurs worldwide, highly fatal
- In-contact horses may also develop disease, suggesting it can be infectious and contagious
- Pathology is similar to that observed with hepatitis virus in horses



1867-1936

25

Etiology?

FLAVIVIRIDAE

- Equine pegivirus (EqPgV, Pegivirus E)
- Theiler's disease associated virus (EqPgV, Pegivirus D)
- Equine hepacivirus (EqHV)

PARVOVIRIDAE

- Equine parvovirus-hepatitis (EqPV-H)



26

RESEARCH ARTICLE

Equine pegiviruses cause persistent infection of bone marrow and are not associated with hepatitis

Joy E. Tomlinson¹, Raphael Wolfisberg², Ulrik Fahnøe², Himanshu Sharma³, Randall W. Renshaw⁴, Louise Nielsen², Eiko Nishiuchi⁵, Christina Holm², Edward Dubovi⁴, Brad R. Rosenberg⁶, Bud C. Tennant⁷, Jens Bukh², Amit Kapoor³, Thomas J. Divers⁷, Charles M. Rice⁵, Gerlinde R. Van de Walle¹, Troels K. H. Scheel^{1,2,5}*

PLOS Pathogens | <https://doi.org/10.1371/journal.ppat.1008677> July 10, 2020

High viral loads only serum, bone marrow, spleen

Replication in the bone marrow

Persistent infection, but eventually cleared

Few or no clinical signs or enzyme elevation

27

Systematic Review

Equine Hepacivirus: A Systematic Review and a Meta-Analysis of Serological and Biomolecular Prevalence and a Phylogenetic Update

Giulia Pacchiarotti[†], Roberto Nardini^{*†} and Maria Teresa Scicluna

National Reference Center for Equine Diseases, Istituto Zooprofilattico Sperimentale del Lazio e della Toscana "M. Aleandri", via Appia Nuova 1411, 00178 Rome, Italy

* Correspondence: roberto.nardini@izslt.it

† These authors contributed equally to this work.

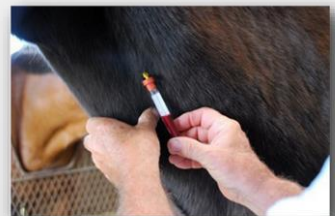
Animals 2022, 12, 2486. <https://doi.org/10.3390/ani12192486>

Transmission – iatrogenic, vertical, other?

Mild acute hepatitis with minimal to no signs

Chronic hepatitis with clinical signs?

Diagnosis is problematic



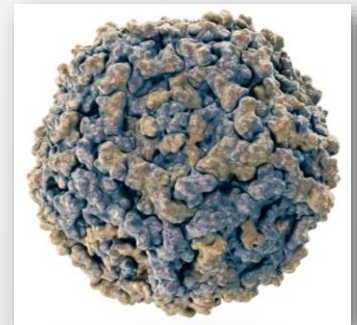
28

Viral testing of 18 consecutive cases of equine serum hepatitis: A prospective study (2014-2018)

Joy E. Tomlinson¹ | Amit Kapoor² | Arvind Kumar² | Bud C. Tennant³ |
Melissa A. Laverack⁴ | Laurie Beard⁵ | Katie Delph⁵ | Elizabeth Davis⁵ |
Harold Schott II⁶ | Kara Lascola⁷ | Todd C. Holbrook⁸ | Philip Johnson⁹ |
Sandra D. Taylor¹⁰ | Erica McKenzie¹¹ | Jessica Carter-Arnold¹² | Emilie Setlakwe¹³ |
Lisa Fultz¹⁴ | Jeff Brakenhoff¹⁵ | Rebecca Ruby¹⁶ | Sheetal Trivedi² |
Gerlinde R. Van de Walle¹ | Randall W. Renshaw¹⁷ | Edward J. Dubovi¹⁷ |
Thomas J. Divers³

J Vet Intern Med. 2019;33:251–257

- 18 horses with naturally occurring serum hepatitis
- PCR for hepacivirus, TDAV, pegivirus, parvovirus
- Horses received antitoxin, plasma, or stem cells before onset
- All samples TDAV negative
- Parvovirus detected in serum, liver, or both from all 18 horses
- All TAT samples tested were also positive



29

Tropism, pathology, and transmission of equine parvovirus-hepatitis

Joy Ellen Tomlinson^{1a}, Mason Jager^{1a}, Alyssa Struzyna^b, Melissa Laverack^c, Lisa Ann Fortier^d,
Edward Dubovi^{1c}, Lane D. Foil^e, Peter D. Burbelo^{1f}, Thomas J. Divers^d and Gerlinde R. Van de Walle^{1a}

^aBaker Institute for Animal Health, Cornell University College of Veterinary Medicine, Ithaca, NY, USA; ^bWalnridge Equine Clinic, Cream Ridge, NJ, USA; ^cNew York State Animal Health Diagnostic Center, Cornell University College of Veterinary Medicine, Ithaca, NY, USA; ^dDepartment of Clinical Sciences, Cornell University College of Veterinary Medicine, Ithaca, NY, USA; ^eEntomology Department, Louisiana State University, Baton Rouge, LA, USA; ^fDental Clinical Research Core, National Institute of Dental and Craniofacial Research, National Institute of Health, Bethesda, MD, USA

Virus identified in hepatocytes of naturally infected horses

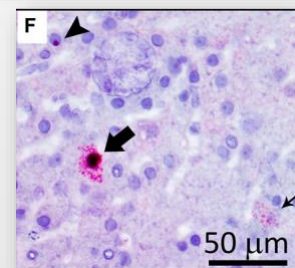
Hepatitis developed in 8/10 experimentally-infected horses;
1 progressed to liver failure

Iatrogenic transmission demonstrated

Insect transmission: failed

Oral, fecal and nasal shedding

Emerging Microbes & Infections
2020, VOL. 9
<https://doi.org/10.1080/22221751.2020.1741326>



30

Viral testing of 10 cases of Theiler's disease and 37 in-contact horses in the absence of equine biologic product administration: A prospective study (2014-2018)

Joy E. Tomlinson¹ | Bud C. Tennant² | Alyssa Struzyna³ | Dawn Mrad⁴ | Nimet Browne⁵ | Dorothy Whelchel⁶ | Philip J. Johnson⁷ | Camilla Jamieson⁸ | Christiane V. Löhr⁹ | Robert Bildfell⁹ | Erica C. McKenzie¹⁰ | Melissa Laverack¹¹ | Randall W. Renshaw¹² | Edward Dubovi¹² | Amit Kapoor¹³ | Richard S. Meirs³ | Rodney Belgrave¹⁴ | Julie Engiles¹⁵ | Gerlinde R. Van de Walle¹ | Thomas J. Divers²

J Vet Intern Med. 2019;33:258-265

10 cases on 6 farms

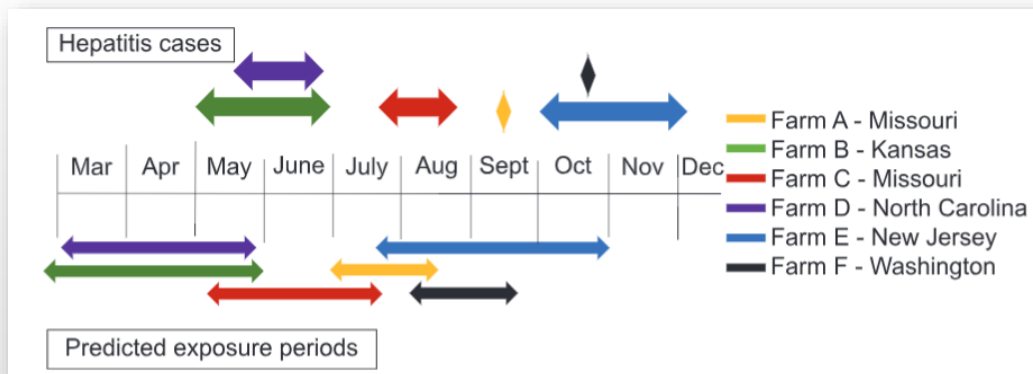
37 in-contact horses from 4 farms

No equine-origin biologics in past 4 months

PCR of serum and/or liver



9/10 affected horses and 54% contact horses positive

31



32

Nasal transmission of equine parvovirus hepatitis

Joy E. Tomlinson  | Gerlinde R. Van de Walle 

J Vet Intern Med. 2022;36:2238–2244

11 horses inoculated orally with equine parvovirus

No horses viremic and none seroconverted

8 weeks later the same horses were inoculated intranasally

5 horses viremic at 6 – 12 weeks and seroconverted

An additional 5 horses viremic at 19 – 22 weeks (horizontal transmission?)

Some horses had evidence of hepatitis

33

Conclusions



Equine pegivirus (EqPgv)

- Not hepatotropic
- Not pathogenic



Equine hepacivirus (EqHV)

- Mild, subclinical hepatitis
- Not associated with Theiler's



Equine parvovirus (EqPV)

- Hepatotropic, subclinical hepatitis
- Associated with Theiler's

34