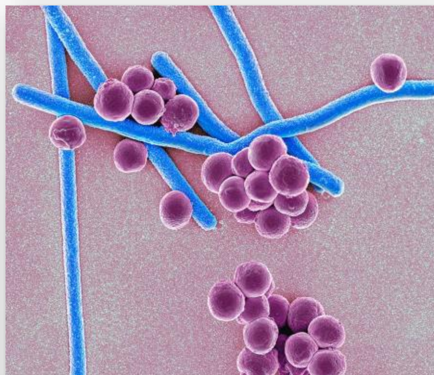
Washington State University

Infectious Disease Journal Club - Bacteria



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Streptococcus equi subsp. *equi*

Clostridial enteritis

Common species:
- *C. perfringens* type A
- *C. perfringens* type C
- *C. difficile*

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Salmonellosis

Rhodococcus equi

- Gram positive aerobic coccobacillus
- Young foals worldwide
- Immunosuppressed adult horses
- Immunosuppressed humans
- Infected early in life

2

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Streptococcus equi subsp. *equi*

3

Pathogenesis

1. Inhalation, ingestion
2. Neutrophils recruited, abscess forms
3. Fever 3-14 days after exposure
4. Nasal shedding 2-3 days after fever
5. Local, hematogenous, lymphatic spread

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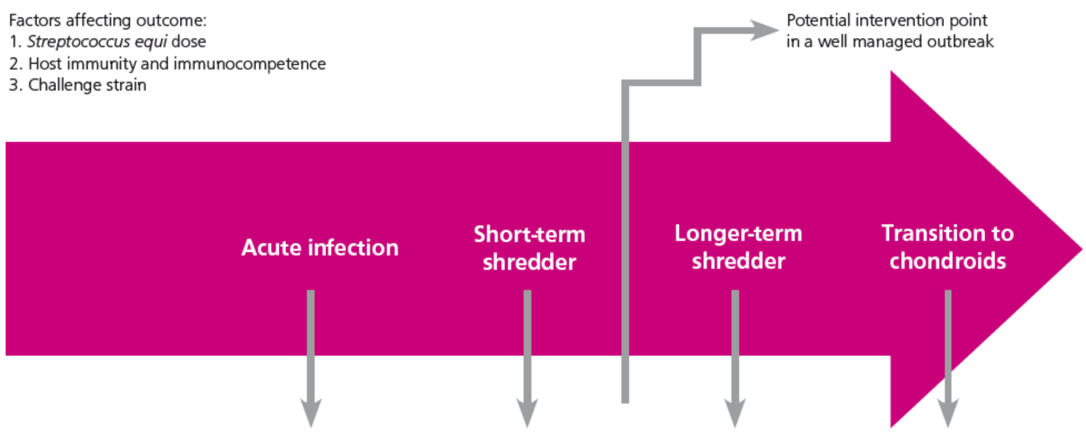

Clinical signs	Typically present	Typically absent	Typically absent	Typically absent. Occasional purulent nasal discharge
Nasopharyngeal swab PCR	Typically positive	Intermittently positive	Intermittently positive	Intermittent
Guttural pouch lavage PCR	Initially negative	Positive	Positive	Positive
Serology	Unlikely to be positive until day 7–14	Positive	Diminishing response	Can be negative

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RESEARCH ARTICLE

Differences in the genome, methylome, and transcriptome do not differentiate isolates of *Streptococcus equi* subsp. *equi* from horses with acute clinical signs from isolates of inapparent carriers

Ellen Ruth A. Morris[1], Ashley G. Boyle[2], Miia Riihimäki[3], Anna Aspán[3], Eman Anis[4], Andrew E. Hillhouse[5,6], Ivan Ivanov[7], Angela I. Bordin[1], John Pringle[3], Noah D. Cohen[1]*

PLOS ONE | https://doi.org/10.1371/journal.pone.0252804 June 14, 2021

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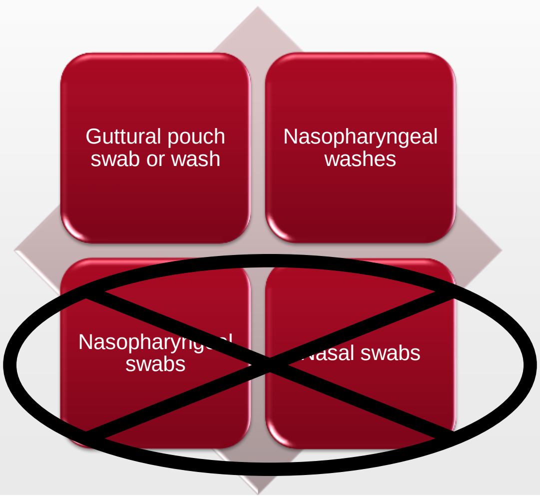
Are convalescing horses and their healthy contacts infectious?



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Markers of long term silent carriers of *Streptococcus equi* ssp. *equi* in horses

John Pringle[1] | Monica Venner[2] | Lisa Tscheschlok[2] | Andrew S. Waller[3] | Miia Riihimäki[1]

J Vet Intern Med. 2020;34:2751–2757.

Failure of serological testing for antigens A and C of *Streptococcus equi* subspecies *equi* to identify guttural pouch carriers

Andy E. Durham[1] | Jeremy Kemp-Symonds[2]

Equine Vet J. 2021;53:38–43.

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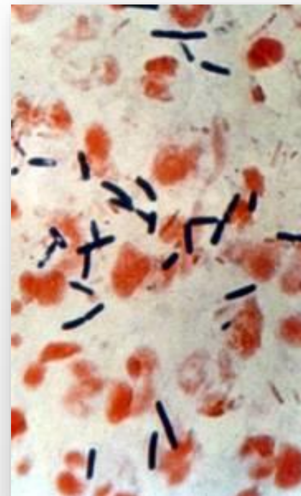
Clostridial enteritis

Common species:
- *C. perfringens* type A
- *C. perfringens* type C
- *C. difficile*



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Types of Toxins

- **Exotoxin:** soluble toxin, secreted by a micro-organism, which can damage the host by destroying cells or disrupting cell metabolism
- **Cytotoxin:** any substance that has a toxic effect on cells
- **Enterotoxin:** a cytotoxin specific for the cells of the gastrointestinal tract

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Clostridium perfringens

- Five types, designated A to E
- At least 5 major toxins
  - Alpha
  - Beta
  - Epsilon
  - Iota
  - Enterotoxin (CPE)

	TOXINS					
Type	Alpha	Beta	Epsilon	Iota	Beta-2	Enterotoxin
A	**X**				**±**	**±**
B	X	X	X		±	±
C	**X**	**X**			**±**	**±**
D	X		X		±	±
E	X			X	±	±

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Pathogenesis: *C. perfringens*

- Toxins may be trypsin sensitive
- Antiprotease activity in colostrum/milk may prevent inactivation of toxins
- Disease appears to be more prevalent in foals with good passive transfer

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Clostridium difficile

- Produces at least 5 toxins
- Toxin A: enterotoxin
- Toxin B: cytotoxin

Toxin A (enterotoxin):
increases permeability, chemotaxin

Toxin B (cytotoxin):
cytotoxic to mucosal epithelium, exacerbates inflammatory response

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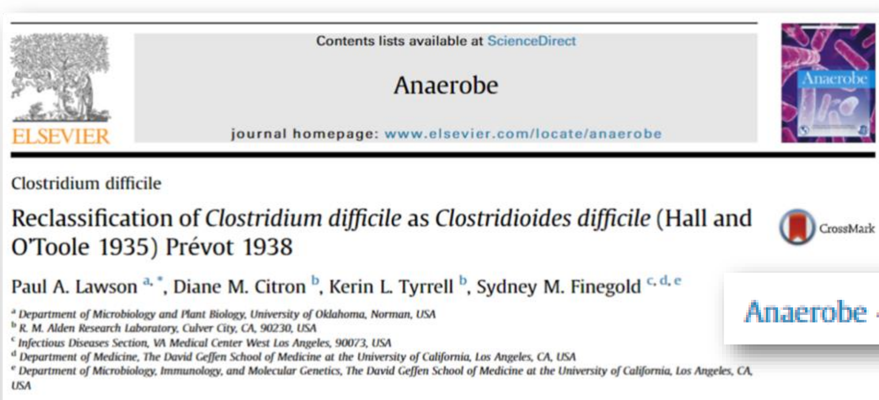

Contents lists available at ScienceDirect
Anaerobe
journal homepage: www.elsevier.com/locate/anaerobe

Clostridium difficile

Reclassification of *Clostridium difficile* as *Clostridioides difficile* (Hall and O'Toole 1935) Prévot 1938

Paul A. Lawson [a,*], Diane M. Citron [b], Kerin L. Tyrrell [b], Sydney M. Finegold [c,d,e]

[a] Department of Microbiology and Plant Biology, University of Oklahoma, Norman, USA
[b] R. M. Alden Research Laboratory, Culver City, CA, 90230, USA
[c] Infectious Diseases Section, VA Medical Center West Los Angeles, 90073, USA
[d] Department of Medicine, The David Geffen School of Medicine at the University of California, Los Angeles, CA, USA
[e] Department of Microbiology, Immunology, and Molecular Genetics, The David Geffen School of Medicine at the University of California, Los Angeles, CA, USA

Anaerobe 40 (2016) 95–99

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

Journal of Veterinary Diagnostic Investigation
2020, Vol. 32(2) 230–238
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DOI: 10.1177/1040638720904714
jvdi.sagepub.com

Iman Mehdizadeh Gohari,[1] Stefan Unterer, Ashley E. Whitehead, John F. Prescott

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

Veterinary Record (2016) doi: 10.1136/vr.103606

I. Mehdizadeh Gohari, V. R. Parreira, J. F. Timoney, L. Fallon, N. Slovis, J. F. Prescott

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Fecal PCR testing for detection of *Clostridium perfringens* and *Clostridioides difficile* toxin genes and other pathogens in foals with diarrhea: 28 cases

Journal of Veterinary Diagnostic Investigation
2022, Vol. 34(3) 396–401
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DOI: 10.1177/10406387211047529
jvdi.sagepub.com

K. Gary Magdesian,[1] Samantha Barnum, Nicola Pusterla

- Foals < 30 days of age with diarrhea between 2017- 2020
- Foal diarrhea PCR panel performed
- Looked at results from all foals testing positive for clostridial disease

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Table 3. Comparison of age and clinical pathology data between foals with clostridial and "other" diarrhea.

	Unit	Clostridial group	Other group	*p*
Age	d	2 (0.5–20)	12 (2–27)	0.0029
Eosinophils	$\times 10^9$/L	0.00 (0.00–0.07)	0.02 (0.06–1.22)	0.03
Hematocrit	L/L	0.39 ± 0.05	0.32 ± 0.08	0.0087
Hemoglobin	g/L	135 ± 16	110 ± 26	0.0067
Red blood cells	$\times 10^{12}$/L	9.83 ± 1.35	8.23 ± 2.07	0.028
Total protein	g/L	53 ± 5	59 ± 9	0.045

Foals with clostridial diarrhea:

- Younger
- More hemocon-centration
- Lower plasma protein
- More band neutrophils

13/14 foals with clostridial diarrhea had IgG > 800 mg/dL

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Received: 14 October 2020 | Accepted: 19 February 2021
DOI: 10.1111/jvim.16094
Journal of Veterinary Internal Medicine ACVIM Open Access American College of Veterinary Internal Medicine

STANDARD ARTICLE

Clostridioides (_Clostridium_) _difficile_ in neonatal foals and mares at a referral hospital

Jeffrey Scott Weese[1] | Nathan Slovis[2] | Joyce Rousseau[1]

Foals admitted to the NICU in 2017 ***without suspected infectious diarrhea or any other suspected infectious disease*** were included. Rectal swabs were obtained from the mare and the foal approximately every 3 days and samples were cultured for *C. difficile*. Isolates were characterized by toxin gene PCR and ribotyping. A total of 97 mare-foal pairs and 16 unaccompanied foals from 76 farms were enrolled (113 foals and 97 mares).

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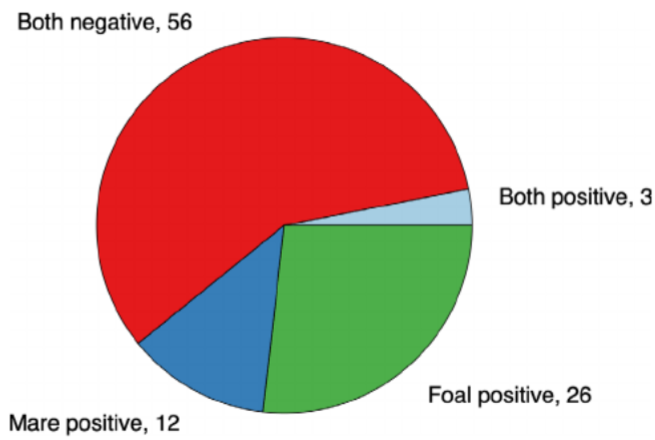

FIGURE 2 *C. difficile* shedding status of 97 mare-foal pairs at admission to an equine referral hospital

15 foals had 2 positive samples during hospitalization. In only 6/15 was the same strain identified both times.

"These findings suggest that *C. difficile* shedding is variable, sporadic, and dynamic in horses, rather than a situation in which a strain colonizes the gastrointestinal tract and persists."

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Salmonellosis

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Widespread Environmental Presence of Multidrug-Resistant *Salmonella* in an Equine Veterinary Hospital That Received Local and International Horses

*Paula Soza-Ossandón[1], Dácil Rivera[1,2], Rodolfo Tardone[1], Roberto Riquelme-Neira[1,2], Patricia García[2,3], Christopher Hamilton-West[4], Aiko D. Adell[1,2], Gerardo González-Rocha[2,5] and Andrea I. Moreno-Switt[1,2,6]**

[1] Escuela de Medicina Veterinaria, Facultad de Ciencias de la Vida, Universidad Andres Bello, Santiago, Chile, [2] Millennium Initiative for Collaborative Research on Bacterial Resistance (MICROB-R), Santiago, Chile, [3] Facultad de Medicina, Pontificia Universidad Católica de Chile, Santiago, Chile, [4] Unidad de Epidemiología Veterinaria, Departamento Medicina Preventiva Animal, Facultad de Ciencias Veterinarias y Pecuarias, Universidad de Chile, Santiago, Chile, [5] Laboratorio de Investigación de Agentes Antimicrobianos, Departamento de Microbiología, Facultad de Ciencias Biológicas, Universidad de Concepción, Concepción, Chile, [6] Escuela de Medicina Veterinaria, Pontificia Universidad Católica de Chile, Santiago, Chile

frontiers in Veterinary Science

BRIEF RESEARCH REPORT
published: 10 July 2020
doi: 10.3389/fvets.2020.00346

Collected 545 samples from the environment and from hospitalized patients with monthly sampling over a 1-year period. Isolates were tested for antimicrobial resistance, serotype, and molecular typing via pulsed-field gel electrophoresis. This racetrack-based hospital had numerous local and international horses as patients during that time. ***No disease outbreaks or hospital-acquired infections due to Salmonella occurred in this time.***

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Overall, 21 of 545 samples (3.9%) were positive. The one isolate from feces came from a colic patient. The highest number of samples were obtained in spring (September) and winter (June).

TABLE 1 | Results of *Salmonella* spp. on samples collected in the equine veterinary hospital during the study.

Sample origin	No. of samples	No. positive samples	% positive samples
Animal feces	53	1	1.88
Environmental/surgery (SA)[a]			
Stalls (1–4)	48	1	2.08
Surgery room floor	12	2	16.67
Bed	12	0	0
Pharmacy	12	1	8.33
Washing room	12	1	8.33
Dressing room	12	0	0
Personal entrance	12	0	0
Office	12	0	0
Induction/recovery room	12	0	0
Area Floor	12	0	0
Environmental/hospitalization (HA)[a]			
Stalls (5–10)	72	3	4.17
Floor	12	1	8.33
Environmental/proceeding (PA)[a]			
Pharmacy	12	1	8.33
Floor	12	1	8.33
Main office	12	2[b]	16.67
Environmental/equipment (EQ)[a]			
Twitches (3×)	36	1	2.78
Endoscope	12	1	8.33
Gastroscope	12	1	8.33
Pitchforks (2×)	24	2	8.33
Waterers (1×)	120	1	0.83
Environmental/exterior (EA)[a]			
Manure collection site	12	1	8.33
Total	545	21	3.85

Multiple PFGE and antimicrobial resistance patterns were observed. Most isolates were multidrug resistant. Positive samples were obtained primarily from human contact surfaces. Numerous positive samples came from equipment.

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Hindawi
Case Reports in Veterinary Medicine
Volume 2020, Article ID 7062408, 5 pages
https://doi.org/10.1155/2020/7062408

Case Report

Atypical *Salmonellosis* in a Horse: Implications for Hospital Safety

Kristina L. Rothers,[1] Eileen S. Hackett,[1] Gary L. Mason,[2] and Brad B. Nelson[1]

[1]*Department of Clinical Sciences, Colorado State University, 300 West Drake Road, Fort Collins, CO 80523, USA*
[2]*Veterinary Diagnostic Laboratory, Colorado State University, 300 West Lake Road, Fort Collins, CO 80523, USA*

A 17-year-old Quarter Horse mare was treated for duodenitis-proximal jejunitis (fever, nasogastric reflux, colic). The horse was euthanized. Aerobic culture of jejunal contents yielded *Salmonella enterica* serovar Hadar. This mare had produced large volumes of gastric reflux during hospitalization. What was the risk to individuals who treated this mare?

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Journal of Equine Veterinary Science 88 (2020) 102951

Contents lists available at ScienceDirect

Journal of Equine Veterinary Science

journal homepage: www.j-evs.com

ELSEVIER

Original Research

Nasogastric Intubation as Health and Safety Risk in Equine Practice—A Questionnaire

Karolina Drozdzewska [a,*], Eva Potocnik [b], Bianca Schwarz [c]

[a] Freie Universität Berlin, Equine Clinic, Surgery and Radiology, Berlin, Germany
[b] Tierklinik Maischeiderland, Großmaischeid, Germany
[c] Pferdeinternist – Dr. Bianca Schwarz, DipECEIM, Saarlouis, Germany

Online survey conducted in April 2019.

- Gender, years in practice?
- Do you use your mouth?
- Have you ever swallowed stomach contents?
- Have you ever aspirated stomach contents?
- Have you had a medical problem after intubation of a horse?
- Use mouth with suspect poisoning?
- Use mouth with fever, reflux, diarrhea?
- Wash, disinfect, or sterilize after each use?

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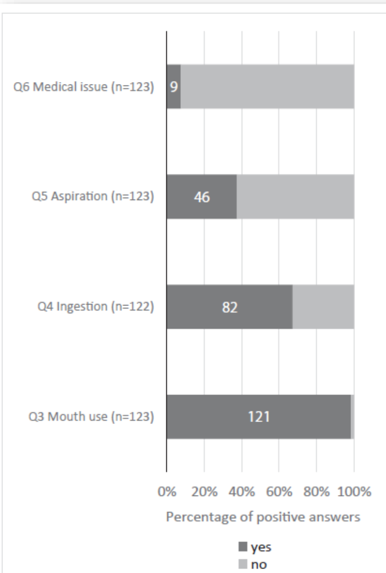

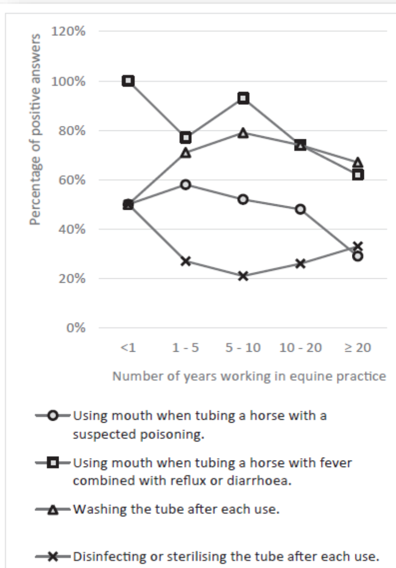

Medical issues related to nasogastric intubation included 4 respondents with cough (1 with pneumonia, 1 with fever), 3 respondents with diarrhea (1 diagnosed with salmonellosis), and 1 hospitalized after zinc phosphide inhalation.

Four respondents mentioned ascarids coming from the tube or into their mouth. One respondent mentioned a colleague with MRSA infection associated with intubation.

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Rhodococcus equi

- Gram positive aerobic coccobacillus
- Young foals worldwide
- Immunosuppressed adult horses
- Immunosuppressed humans
- Infected early in life

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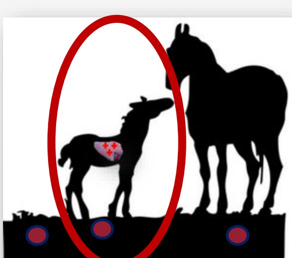

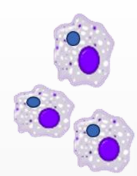

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American Society for Microbiology
Antimicrobial Agents and Chemotherapy
Volume 63, Issue 1, January 2019
https://doi.org/10.1128/AAC.01714-18

Epidemiology and Surveillance

Emergence of Resistance to Macrolides and Rifampin in Clinical Isolates of Rhodococcus equi from Foals in Central Kentucky, 1995 to 2017

Laura Huber[a], Steeve Giguère[a], Nathan M. Slovis[b], Craig N. Carter[c], Bonnie S. Barr[d], Noah D. Cohen[e], Justine Elam[b], Erdal Erol[c], Stephan J. Locke[c], Erica D. Phillips[c], and Jacqueline L. Smith[c]

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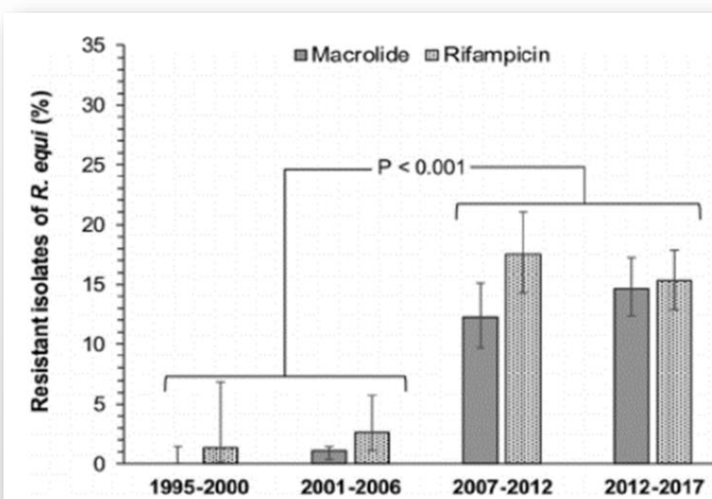

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Association between antimicrobial treatment of subclinical pneumonia in foals and selection of macrolide- and rifampicin-resistant *Rhodococcus equi* strains at horse-breeding farms in central Kentucky

Laura Huber DVM, MSc
Steeve Giguère DVM, PhD†
Kelsey A. Hart DVM, PhD
Nathan M. Slovis DVM
Maggie E. Greiter BS
Cody A. Dailey MPH
Noah D. Cohen VMD, MPH, PhD

JAVMA | MAR 15, 2021 | VOL 258 | NO. 6

- 10 farms with 5-year history of ultrasound and treatment
- 10 farms that didn't use ultrasound screening
- Data from 2019 foaling season

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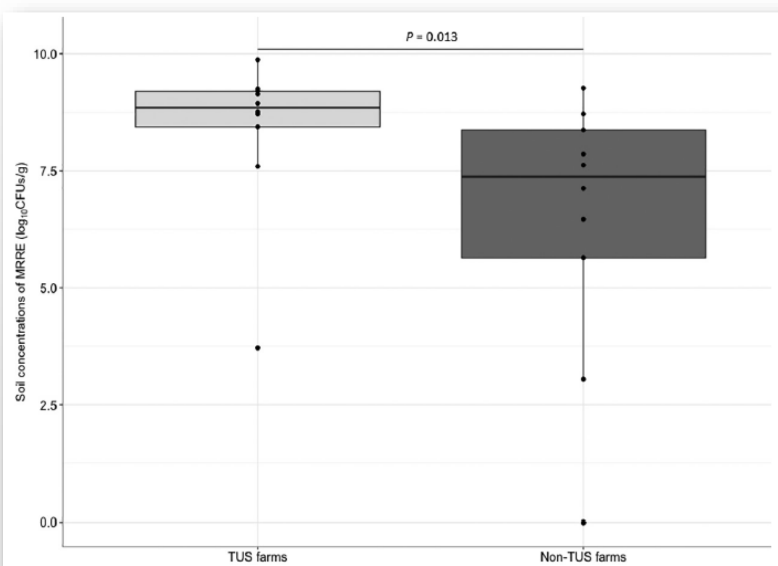

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Journal of the American Veterinary Medical Association
July 1, 2010, Vol. 237, No. 1, Pages 74-81
https://doi.org/10.2460/javma.237.1.74

Determination of the prevalence of antimicrobial resistance to macrolide antimicrobials or rifampin in *Rhodococcus equi* isolates and treatment outcome in foals infected with antimicrobial-resistant isolates of *R equi*

Steeve Giguère, DVM, PhD, DACVIM; Elise Lee, BS; Elliott Williams, BS; Noah D. Cohen, VMD, PhD, DACVIM; M. Keith Chaffin, DVM, MS, DACVIM; Natalie Halbert, PhD; Ronald J. Martens, DVM; Robert P. Franklin, DVM, DACVIM; Carol C. Clark, DVM, DACVIM; Nathan M. Slovis, DVM, DACVIM

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Foal	Antimicrobial resistance*	Antimicrobial treatment administered†	Treatment outcome‡
1	M and R	D + R →C + R → V + G	Dead
2	M, R, and CL	D + R → C + R → V + C + R	Survived
3	M, R, and CL	D + R → C + R → V	Survived
4	M, R, and C	A→C + R →V	Dead
5	R	A + R	Survived
6	M, R, and CL	A + R	Dead
7	M, R, and CL	A + R → C + R	Survived
8	M, R, and CL	NA	Dead
9	R	C + R	Dead
10	M, R, and CL	NA	Dead
11	M, R, and CL	C + R	Dead
12	M and R	C + R	Dead
13	M, R, and CL	A → V	Survived
14	M, R, and CL	C + R → D → V	Dead
15	M, R, and CL	C + R → D + R	Survived
16	M, R, and CL	NA	Dead
17	M, R, and CL	A + R → C + R → D + R	Dead
18	M, R, and CL	A + R	Survived
19	M, R, and CL	NA	Dead

A = Azithromycin. C = Clarithromycin. CL = Clindamycin. D = Doxycycline. G = Gentamicin. M = Macrolide antimicrobials. NA = Not available. R = Rifampin. V = Vancomycin.

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Changing policy to treat foals with *Rhodococcus equi* pneumonia in the later course of disease decreases antimicrobial usage without increasing mortality rate

Denise Arnold-Lehna[1] | Monica Venner[2] | Londa J. Berghaus[3] | Roy Berghaus[4] | Steeve Giguère[3]

Equine Vet J. 2020;52:531–537.

- 330 foals per year with pneumonia
- Weekly physical exam, CBC, thoracic ultrasound
- 2008 to 2011: every foal with pulmonary abscesses was treated
- 2012 to 2016: only foals with severe abscesses were treated

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TABLE 2 Comparison of outcome variables between the two time periods (all foals included)

Variables	2008-2011 (n = 1215)	2012-2016 (n = 1541)	*P*
Treated for pneumonia (%)	81.9	50.9	<.001
Total duration of antimicrobial therapy (d)[a]	41 (0-93)[b]	23 (0-53)	<.001
Death from pneumonia or *R equi* infection (%)[c]	0.41	0.58	.593
Death from all causes (%)	1.15	1.65	.333

[a]Duration of therapy entered as 0 for foals that were not treated.
[b]Median (5th and 95th percentiles).
[c]Also includes death from extrapulmonary infections caused by *R equi*.

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Prevention

- Hyperimmune plasma
- Does **NOT** prevent infection
- Ultrasound evidence of infection
- Product variability

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Rhodococcus equi hyperimmune plasma decreases pneumonia severity after a randomised experimental challenge of neonatal foals

March 12, 2016 | Veterinary Record

M. G. Sanz, A. Loynachan, D. W. Horohov

- 9 foals received hyperimmune plasma at 1 – 2 days of age
- 9 foals were untreated
- All foals challenged with intratracheal inoculation of R. equi
- Monitored for 8 weeks

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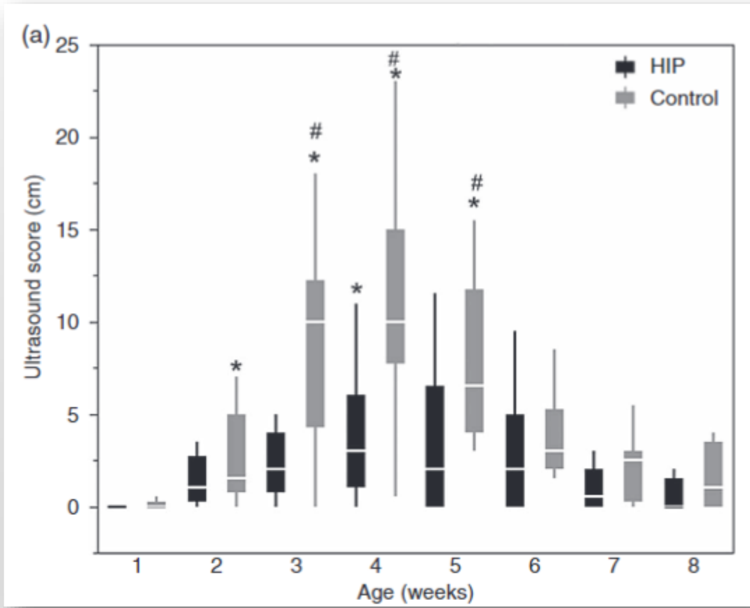

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Transfusion With 2 L of Hyperimmune Plasma is Superior to Transfusion of 1 L or Less for Protecting Foals Against Subclinical Pneumonia Attributed to *Rhodococcus equi*

Journal of Equine Veterinary Science 79 (2019) 54–58

Susanne K. Kahn [a], Glenn P. Blodgett [b], Nathan M. Canaday [b], Kari E. Bevevino [a], Joana N. Rocha [a], Angela I. Bordin [a], Noah D. Cohen [a,*]

[a] *Equine Infectious Disease Laboratory, Department of Large Animal Clinical Sciences, Texas A&M University, College Station, TX*
[b] *6666 Ranch, Guthrie, TX*

- Retrospective cohort study on a single farm
- 85 foals received 1 liter HIP
- 62 foals received 2 liters HIP
- US at 5,7 and 9 weeks
- 32% vs 12% subclinical pneumonia

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