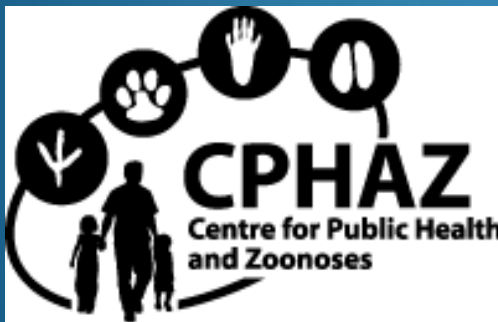
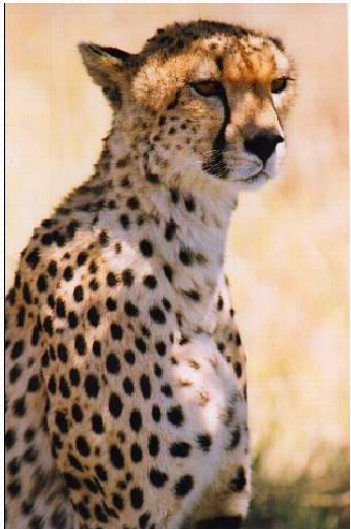


Prevalence and characterization of *C. difficile* in horses

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Tradizione e cambiamento al centro del Mediterraneo



C. diff in horses

- Leading cause of colitis in many regions
 - 28% of diarrheic horses (CTA) (Baverud et al 2003)
 - 22% of diarrhea adult horses and 13% of diarrheic foals (Toxin A/B ELISA) (Weese et al 2001)
 - 14% of diarrheic adults (Toxin A ELISA) (Donaldson et al 1999)
- Implicated in duodenitis/proximal jejunitis (Arroyo et al 2006)
- Experimental reproduction of disease in foals (Arroyo et al 2004)
- Minority of cases antimicrobial-associated (Weese et al 2001, Weese et al 2006)
 - Link to low-dose erythromycin exposure in mares in Sweden (Gustafsson et al 1997, Baverud et al 1998)

Country	Population	Prevalence	Reference
Sweden	Normal horses	0% (0/140)	Baverud et al 1997
Canada	Healthy adults	0.4% (1/255)	Weese et al 2001
Canada	Healthy foals	0% (0/47)	Weese et al 2001
Sweden	-Healthy mares -Healthy foals <14d of age -Healthy foals >1 month -Non-diarrheic foals tx with erythromycin/rifampin	0% (0/273) 29% (16/56) 0.6% (1/170) 44% (7/16)	Baverud et al 2003
Italy	Healthy adults Healthy foals	25% (6/24) 44% (8/18)	Ossiprandi et al 2009
US	4H club horses	8% (2/25)	McNamara et al 2010

Objectives

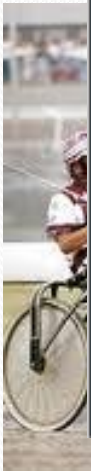
- To determine and compare the prevalence of *C. difficile* shedding by different types of horses.
- To characterize recovered isolates.

Methodology



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Methodology

- Enrichment culture
 - 1g feces into 9ml CDMN broth with 0.1% sodium taurocholate / 7 day incubation at 37C / alcohol shock / inoculation onto CDMN agar
- Ribotyping (Bidet et al 1999)
- Detection of *tcdA*, *tcdB*, *cdtA* by PCR (Kato et al 1991, 1998, 1999, Stubbs et al 2000)
- Toxinotyping (Rupnik et al 1998)

Results

- Prevalence: 52/742 (7.0%) (95% CI 5.3-9.1%)

Group	Thoroughbred	Standardbred	Other	Total
Racing horses	25/324 (7.7%)	16/216 (7.4%)	NA	41/540 (7.6%)
Breeding horses	2/75 (2.7%)	NA	NA	2/75 (2.7%)
Foals	5/45 (11.1%)	NA	NA	5/45 (11.1%)
Referral hospital	1/30 (3.3%)	1/20 (5%)	2/32 (6.3%)	4/82 (4.9%)
Total	33/474 (7.0%)	17/236 (7.2%)	2/32 (6.3%)	52/742 (7.0%)

		<i>n</i>	Positive (%)	95% CI	<i>P</i>
Gender	F	416	23 (5.5%)	3.5 – 8.2	0.08
	M	326	29 (8.9%)	6.0 – 12.5	
Age	< 6 m	45	5 (11.1%)	3.1 – 24.1	0.24
	> 6 m	697	47 (6.7%)	5.0 – 8.9	
Use	Racing	566	43 (7.6%)	5.6 – 10.1	0.31
	Other	176	9 (5.1%)	2.4 – 9.5	

- 2006: 3/340 (9.7%)
- 2007: 8/200 (4.0%)

$P=0.023$

Ribotype	<i>n</i>	<i>tcdA</i>	<i>tcdB</i>	<i>cdtA</i>	Toxinotype
027	14	+	+	+	III
001	13	+	+	—	0
H _{ovc}	5	—	—	—	NT
078	3	+	+	+	V
017	3	—	+	—	VIII
C	2	+	+	+	IX
Q	2	+	+	—	0
N	1	+	+	+	III
F	1	+	+	—	0
V	1	+	+	—	0
X	1	+	+	—	0
Y	1	+	+	—	0
AD	1	+	+	—	0
AK	1	+	+	—	0
RT	1	+	+	—	0
B _{ovc}	1	—	—	—	NT
C _{ovc}	1	—	—	—	NT

Human CDI strains: 13/14 toxigenic ribotypes, 98% of toxigenic isolates

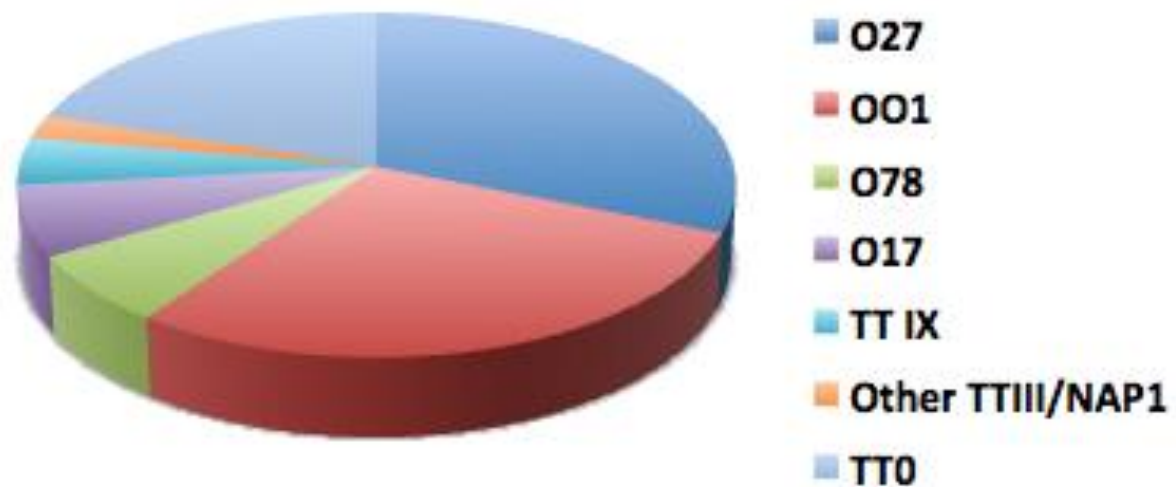
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Y	1	+	+	—	0
AD	1	+	+	—	0
AK	1	+	+	—	0
RT	1	+	+	—	0
B _{ovc}	1	—	—	—	NT
C _{ovc}	1	—	—	—	NT

Discussion

- Higher prevalence than most other studies involving healthy horses: 7.0%

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- Ribotype distribution somewhat surprising



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- Ribotype distribution somewhat surprising
 - Commonness of ribotype 027
 - Predominance of strains found in humans
 - Human-animal?
 - Animal-human?
 - Common source infection?



Modified from <http://www.halloweenforum.com>

Mainly Canada (n=20)	5% ribotype 078 5% ribotype 001 No ribotype 027 or 017	Keel et al 2007
Canada (n=48)	<i>tcdA</i> , <i>tcdB</i> : 52% <i>tcdA</i> , <i>tcdB</i> , <i>cdtA</i> : 4% <i>tcdB</i> : 17% Non-toxigenic: 27%	Arroyo et al 2007
Healthy horses, Italy	1 <i>tcdA/tcdB</i> 6 <i>tcdB</i> 7 non-toxigenic	Ossiprandi et al 2009
Foal	Single isolate: toxinotype XIa, <i>cdtA</i>	Avbersek et al 2009
Horse with colitis	Single isolate: ribotype 027/NAP1	Songer et al 2009
4H club horses	2 toxinotype o	McNamara et al 2010

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- Is ribotype 078 an emerging strain in Canadian horses?

- Is ribotype 078 an emerging strain in Canadian horses?
 - This study: 5.8%
 - Keel et al 2007: 5.0%
 - Arroyo et al 2007: 4% *tcdA*, *tcdB*, *cdtA*
- Ongoing longitudinal study (Schoster et al)
 - 6/10 ribotype 078
 - 1/10 ribotype 001
 - 3/10 ribotype C (toxintype IX, *tcdA*, *tcdB*, *cdtB*)
- Shifting ribotypes, different types in different populations?

Conclusions

- *C. difficile* is common in healthy horses in Canada
 - Higher than older studies
 - Emerging/true increase in prevalence
 - Better isolation
- No difference between ages and groups
 - Careful concluding age risk (or lack thereof) given small foal population)
- Wide range of different strains are present
 - Virtually all of relevance in humans

The End

