



MRSA and Horses

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Lecturer in Bacterial Zoonotic Disease

FVE MRSA Meeting 8th April 2008

What I am going to talk about

- MRSA in horses
 - Community-acquired (CA) and hospital-acquired (HA)
 - Clinical cases of MRSA in horses
- Molecular epidemiology of equine MRSA
- Public health significance of equine MRSA
- Conclusions

Molecular methods

- Resistance conferred by *mecA* gene, which encodes penicillin-binding protein 2a (PBP2)
- Encoded on a mobile gene cassette
 - SCC*mec* of which there are a five main types (I-V).
 - PCR assays to determine SCC*mec* types and subtypes (IV)
- Macro-restriction PFGE (gold standard)
- *Spa* gene typing (protein A)
- Multi-locus sequence typing

Typing of Methicillin-Resistant *Staphylococcus aureus* in a University Hospital Setting by Using Novel Software for *spa* Repeat Determination and Database Management

Dag Harmsen,^{1,2} Heike Claus,⁴ Wolfgang Witte,³ Jörg Rothgänger,² Hermann Claus,³ Doris Tumwald,⁴ and Ulrich Vogel^{1*}

Multilocus Sequence Typing for Characterization of Methicillin-Resistant and Methicillin-Susceptible Clones of *Staphylococcus aureus*

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Community versus hospital-acquired infection



In Canada

- Nasal swabs collected from 2,283 horses admitted to OVC-VTH (Oct 02-Jun 04)
- MRSA isolated from 120 horses (5.3%)
 - Community-associated carriage rate- 2.7%
 - Nosocomial carriage rate- 2.3%
 - Nosocomial MRSA infection rate- 0.18%
 - Horses positive on admission were significantly more likely to develop clinical MRSA infections

Community versus hospital-acquired infection



Slovenia

– Nasal swabs from 300 horses – No MRSA found¹



Denmark

– Nasal swabs from 100 horses- No MRSA found²



Holland

– Nasal and pastern swabs from 200 horses-No MRSA found³

¹Vengust *et al*, 2006. Lett.Appl.Microbiol.43;602-6.

²Bagcigil *et al*, 2007. Vet.Microbiol.121;307-15.

³Busscher *et al*, 2005, Vet.Microbiol.113;131-6.

Community versus hospital-acquired infection (cont-)



Austrian equine hospital found a higher mean incidence of infection with MRSA, of 0.48%, over a two year period.

- All found to be the same strain



- German study

Of 135 equine clinical cases where *S. aureus* was implicated, 8% were MRSA.

¹Cuny *et al*, 2006, *Eurosurveillance*.11(1);1101-7.

² Walther, 2007, Ph.D Thesis, Free University of Berlin, Berlin, Germany.

Community versus hospital-acquired infection (cont-)



North-American community surveillance study

– 4.7% of horses (n=972) and 13% of in-contact humans (n=107) positive for Canadian epidemic MRSA-5.

- > 20 horses was a risk factor for equine colonisation.
- Regular contact with >20 horses was a risk factor for human colonisation.
- On all premises with colonised horses, at least one in-contact human had an identical strain.

Weese *et al*, 2005, J.Am.Vet.Med.Assoc. 226: 580-3



Community versus hospital-acquired infection

- Nasal carriage
 - Community-acquired
 - Hospital-acquired
- 3 Large equine tertiary referral hospitals (May 2005 to July 2005)
- Results
 - 633 nasal samples were collected (365 horses).
- MRSA was not isolated from any of these samples.

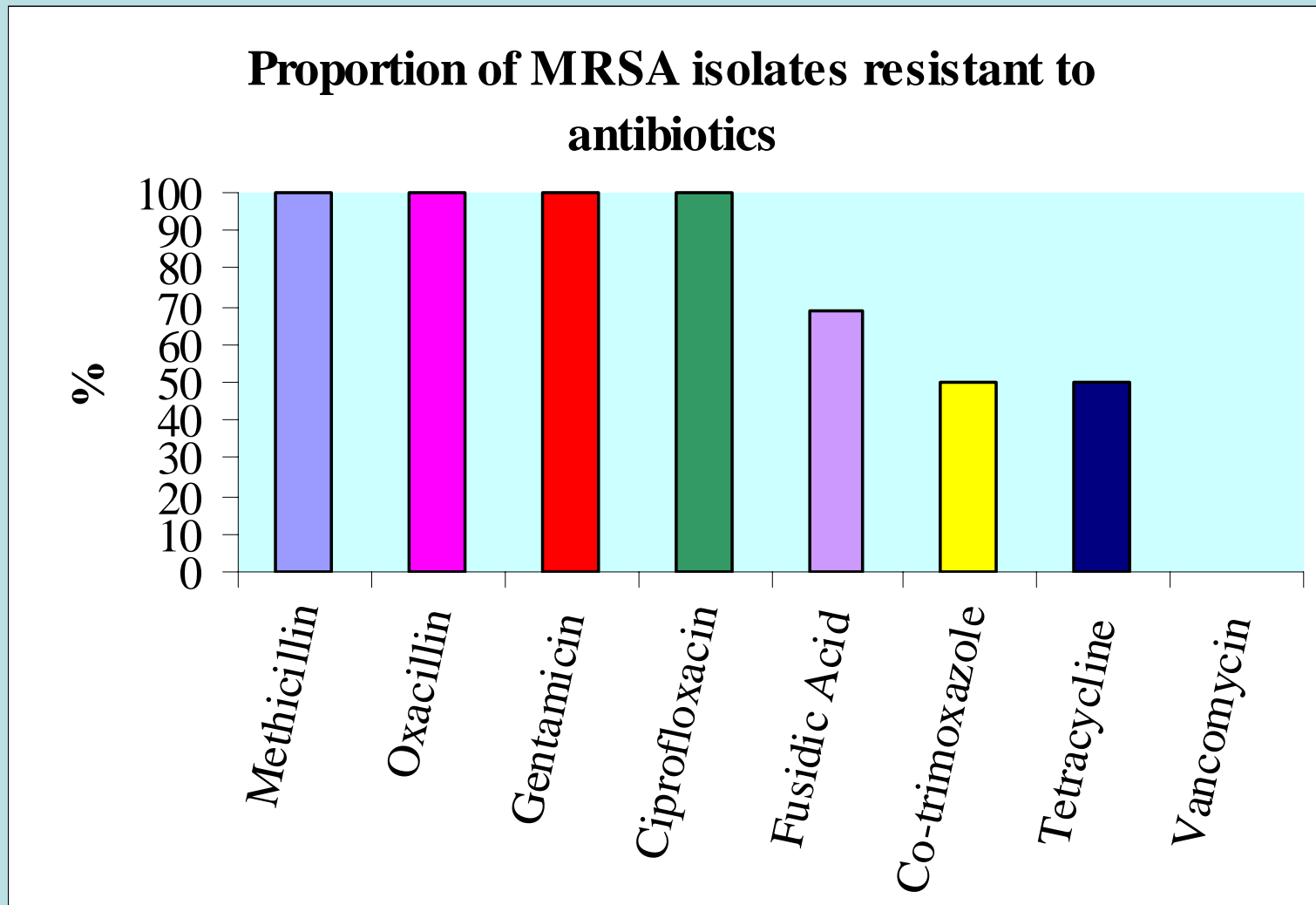


MRSA in horses at the Philip Leverhulme Equine hospital (PLEH)

- Nasal, perineum and skin swabs taken from 67 horses (Nov 2003-Feb 2004)
- 12% positive (n=8 nasal and n=2 skin)
- 40 horses screened in the community, none positive for MRSA
- May 2004- Two clinical cases
 - Pleuropneumonia case and Joint infection
- June 2004
 - Clinical case- Dermatitis
- May 2005
- Clinical case- Joint infection
- 12 veterinary staff screened, none positive for MRSA

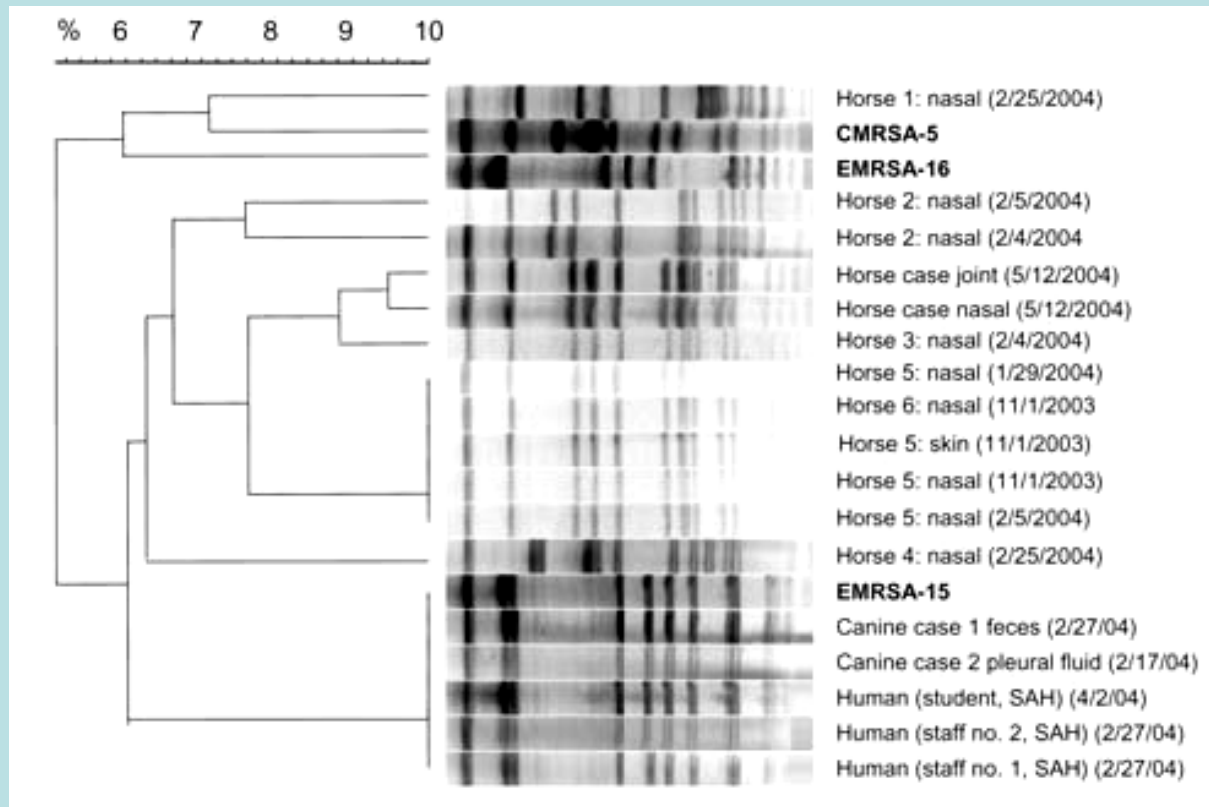


Antimicrobial susceptibility testing





MRSA PFGE typing



- PFGE revealed a number of distinct equine strains
- Not related to **EMRSA-15 (ST22)**, **EMRSA-16 (ST36)** or Canada type 5 MRSA (CMRSA-5)



Summary of types of horse MRSA isolates at PLEH

No of isolates	Source	Date	ST*	Spa gene type	SCCmec
11	Carriers(nasal/skin)	Nov 03- Feb 04	254	t036 ¹	IV
1	Pleuropneumonia	May 04	254	t216 ¹	IV
1	Joint infection	May 04	660	t036 ¹	IV
1	Nasal carrier	Feb 04	658	ND	II
1	Dermatitis	June 04	ND	t127(CC1) ¹	IV
1	hock wound	May 05	ND	t020(CC22) ¹	IV
1	Carrier (nasal)	Oct 06	ND	t064 (CC8)	ND
3	Carrier (nasal)	Jun 07	ND	ND	ND
1	Carrier (nasal)	Feb 07	ND	ND	ND
3	Carrier (nasal)	May 07	ND	t032 (CC22)	ND

All isolates were *pvl* negative

ND- not done

¹Moodley *et al*, 2006, J.Antimicro.Chemother.58: 1118-23.

CC- clonal complex

* MLST results in collaboration with Mark Enright, Imperial college, UK.

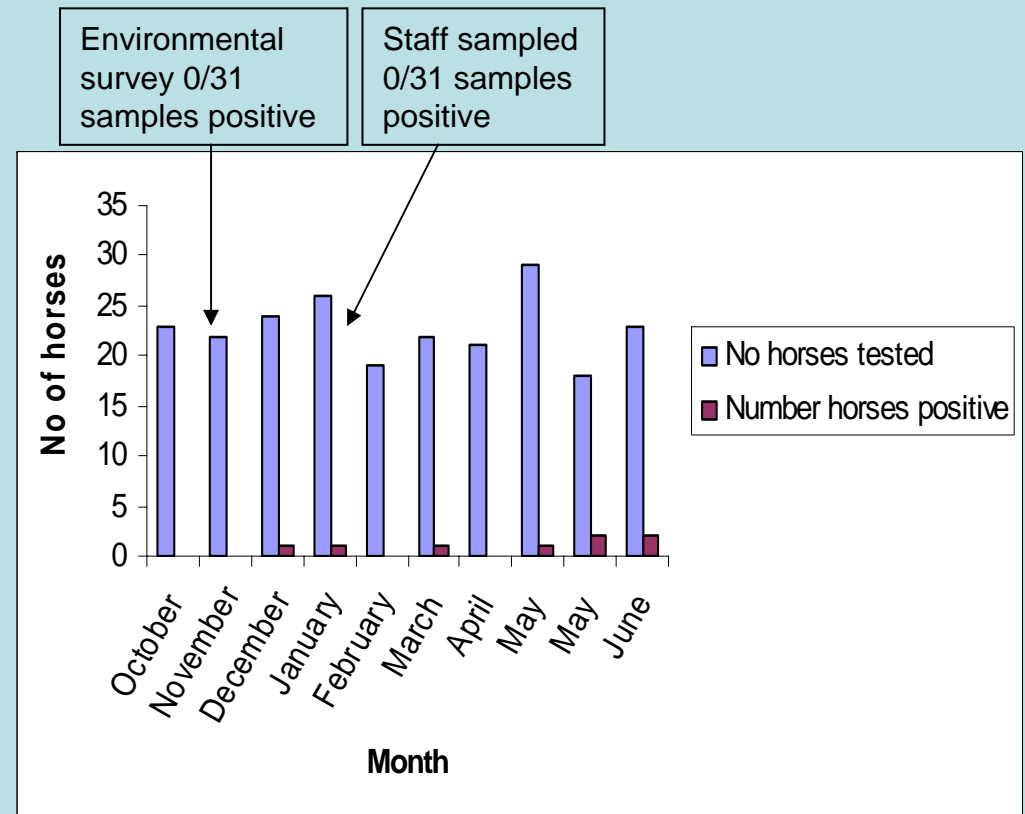


MRSA Surveillance at PLEH

(Claire Scantlebury)

- 10 months surveillance (Oct 2006-Jul 2007)
- Each month nasal swabs were taken from all horses present in the hospital

- Overall 8/182 (3.52%) horses positive



Clinical MRSA infection in the horse

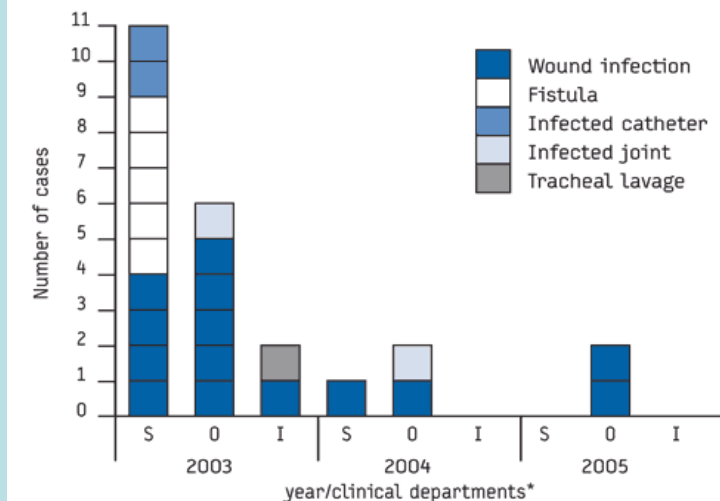
- Joint/Synovial Infection
- Bone infection
- Skin infection
- (Pleuropneumonia)



Austria

FIGURE 1

Emergence of 24 infections with MRSA in horses in different clinical departments from 2003 to 2005



* Clinical departments: S = surgery; O = orthopaedics; I = internal medicine

Cuny *et al* (2006). *Eurosurv*,11, 44-47.

North America

- Community Acquired (n=33)
 - Joint 30%
 - Incision 21%
 - Soft tissue 21%
 - Bone/tendon 12%
 - Lung, sinus, udder (2 each)
- Hospital Acquired (n=49)
 - Incision 61%
 - Catheter 16%
 - Soft tissue 8.2%
 - Lung, joint and eye (3 each)

83% survived, 17% died

Weese *et al*. 2008 (unpublished)

Molecular Epidemiology of MRSA in Horses

- In Europe



Equine hospital

- Isolates from horses identical to each other and those isolated from veterinary personnel by PFGE.
- MLST - ST254 (EMRSA-10)
- However, differed from human clinical type strain of ST254 on PFGE and gentamicin resistant.
 - SCC*mec* type IVd found in equine ST254, compared to type IVc in human ST254.



Two equine cases in Austria with wound infections with ST398, t011, pvl negative².

- SCC*mec*IVa and were additionally resistant to gentamicin.

¹Cuny *et al*, 2006, *Eurosurveillance*.11(1);1101-7.

² Witte *et al*, 2007, *Emerg.Infect.Dis.* 13(2): 255-8

Molecular Epidemiology of MRSA in Horses



Ireland

- Equine isolates distinct from small animal isolates by PFGE and unrelated to human epidemic strains.
- All resistant to gentamicin, kanamycin, tetracycline¹.
- Equine isolates were ST8² and found to carry SCC*meclVd*³.



UK

- Small number of equine MRSA subject to MLST and found to be ST8⁴.

¹ O'Mahony *et al*, 2005, *Vet.Microbiol.*(109) 285-296.

² O'Mahony, *et al*, 2006, 1st International Conference on MRSA in Animals, 19-21st June, University of Liverpool, UK.

³ Maeda *et al*, 2007, *Vet.Rec.* 161,1: 35-6.

⁴ Waller A, 2005. MRSA update. DEFRA/AHT/BEVA.Eq.Quart.Dis.Surv.Rep.1 (2) April-June.

Molecular Epidemiology of MRSA in Horses



North America



- Canadian epidemic MRSA-5 (USA-500) is the predominant clone in horses in both Canada and USA, but is rare in humans.
- CMRSA-5 (ST8), SCC*mecIV*, PVL negative¹.



Japan

- MRSA from horses found to be distinct by PFGE from the predominant human MRSA strains².

¹In Weese, S. 2004. *Vet.Clin.Equine*, (20);601-613.

² Shimuzu *et al*, 1997.*J.Vet.Med.Sci.*59(10);935-7.

Equine MRSA and public health

- True zoonotic infections are rare.



Skin infection in three veterinary staff treating a neonatal foal (foal watch) with a CA-MRSA infection

- Isolates were Canadian epidemic MRSA-5.
- Transmission occurred despite barrier nursing precautions
- Infection in otherwise healthy individuals with no risk factors for opportunistic infection¹.



MRSA colonization may be an occupational risk for veterinary staff.

- MRSA has been isolated from the nasal swabs from 7.0% of vets and 12.0% of nurses sampled at a North American Congress
- Canadian epidemic CMRSA-5 was only isolated from large animal clinicians².

¹ Weese *et al*, 2006. *Vet.Microbiol.* 114, 160-4.

² Hanselman *et al*, 2006. *Emerg.Infect.Dis.* 12(12): 1933-8.



Equine vets and MRSA

- **British Equine Veterinary Association Annual Congress 2006**
 - 274 delegates provided nasal swabs
 - 20 (7.3%) were positive for MRSA
 - 17 vets, 1 nurse, 2 vet students
 - 43/274 had dealt with a MRSA positive case in the previous 3 months
 - 1/43 positive for MRSA



Equine vets and MRSA

No of isolates	Resistance profile	Strain type*
1	Ox	ST1, t127
1	Ox	ST22
7	Ox, Cip	ST22, t032
12	Ox, Cip*, Co-trim*, Rif*, Tet*, Gent	ST8 (mostly t064)
1	Ox, Cip, Gent, Rif, Co-trim	ST612 (DLV)
1	Ox, Cip, Gent, Co-trim, tet	ST254

Ox- oxacillin, Cip-ciprofloxacin, Co-trim- co-trimoxazole, Gent-gentamicin, Rif-rifampicin, Tet- tetracycline

DLV- Double locus variant

*MLST in collaboration with Mark Enright, Imperial College, UK.



Conclusions

- Prevalence of MRSA in horses in the community is unknown
 - Horses have strains which are uncommon in the human population
- This may indicate that some MRSA may be circulating in the equine population independently from the human population
- Origin of MRSA in horses and the level of carriage of MRSA in the equine community?

Conclusions (cont-)

- Likely that transmission occurs both ways between humans and horses
- Horses may act as a reservoir and source of infection to humans in close contact
- Currently not much evidence to suggest that equine MRSA is a big public health risk!
- However, vets should be considered as a high risk group for community-acquired infection (BSAC 2007).

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