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PREVALENCE OF METHICILLIN-RESISTANT *STAPHYLOCOCCUS AUREUS* IN MAMMALS OF THE ROYAL ZOOLOGICAL SOCIETY OF ANTWERP, BELGIUM

Francis Vercammen, D.V.M., Luc Bauwens, Redgi De Deken, D.V.M., Ph.D., and Jef Brandt, D.V.M., Ph.D.

Abstract: Contrary to the numerous reports on methicillin-resistant *Staphylococcus aureus* (MRSA) in domestic animals, only three articles concerning zoo animals are documented in the literature. A skin infection of an African elephant (*Loxodonta africana*) calf was most likely acquired from an infected caretaker. Another zoo detected MRSA in the rumen content of a mouflon (*Ovis aries*), and, in a third facility, it was reported in a fistulous wound at the coronary band of a digit of an Indian rhinoceros (*Rhinoceros unicornis*). In the present study, which lasted 13 months and involved 93 different individual mammals that belonged to 40 species and 19 families housed in the Royal Zoological Society of Antwerp, Belgium, this study reports the absence of MRSA in swabs of nostrils, skins, conjunctiva, vulva, abscess, and arm rests in public spaces. Samples were enriched overnight and inoculated on a selective chromogenic medium.

Key words: Methicillin-resistant, *Staphylococcus aureus,* zoo animals.

BRIEF COMMUNICATION

Although methicillin-resistant *Staphylococcus aureus* (MRSA) has been reported in several domestic animal species (dogs, cats, horses, swine, cattle), data on its prevalence in zoo animals are very scarse.[5,6] Methicillin-resistant *Staphylococcus aureus* MRSA can be of either human origin in the case of household pets, or of animal origin, in the case of horses and pigs.[6] In North American facilities, MRSA was detected in an African elephant (*Loxodonta africana*) calf that got infected by an infected caretaker[4,6] and in an Indian rhinoceros (*Rhinoceros unicornis*) with a fistulous wound at the coronary band of a digit.[12] Whereas, in an Eastern European zoo, MRSA was found in the rumenal content of a mouflon (*Ovis aries*).[7] Yet, MRSA is a risk, given that, often, a zoo veterinarian has to calculate an antibiotic dose regime based upon estimated body weights and metabolic allometric scaling, which may lead to potentially underdosing. Therefore, this study's aim was to screen mammals in the Royal Zoological Society of Antwerp, Belgium

From June 2008 until July 2009, 93 different mammals, which belonged to 40 species and 19 families (Bovidae, Camelidae, Caviidae, Cercopithecidae, Cervidae, Colobidae, Elephantidae, Equidae, Felidae, Hydrochoeridae, Hylobatidae, Leporidae, Mustelidae, Myocasteridae, Pongidae, Suidae, Tapiridae, Tayassuidae, Viverridae), in the Royal Zoological Society of Antwerp (see Table 1) were sampled. A total of 99 swabs were taken from live animals, six of which had double swabs, and another 5 swabs were taken in different public spaces next to the animal enclosures. As with other reports,[5,8,11] the majority of the samples were randomly taken of the nostrils ($n = 84$) and skin surfaces ($n = 12$). In addition, one conjunctiva, one vulva, and one abscess were sampled. Swabs also were taken of arm rests in five public spaces, i.e., the small monkey house, the big ape house, the aquarium, the sea lion house, and the elephant house.

Swabs were immediately placed into Amies gel transport medium (Copan, I-25125 Brescia, Italy), kept at 4°C, and, within 24 hr enriched overnight at 37°C in brain heart infusion broth (Lab M™, Lancashire, BL9 6AU, United Kingdom), which contained 7.5% NaCl.[2] The next day, they were inoculated on a commercial selective chromogenic medium (MRSA ID, bioMérieux S.A., F-69280 Marcy l'Etoile, France), which enabled direct and definitive identification of MRSA based on the spontaneous green coloration of glucosidase that produced colonies in the presence of the antibiotic cefoxitin. These plates were further incubated at 37°C for 48 hr. This technique has a reported sensitivity and specificity of 98.8% and 89.7%, respectively.[3] Only one sample yielded suspected colonies. These were tested for susceptibility by the disc diffusion

From the Centre for Research and Conservation, Royal Zoological Society of Antwerp, K. Astridplein 26, B-2018 Antwerp, Belgium (Vercammen, Bauwens, Brandt); and Animal Health, Institute of Tropical Medicine, Nationalestraat 155, B-2000 Antwerp, Belgium (De Deken). Correspondence should be directed to Dr. Vercammen (francis.vercammen@kmda.org).

Table 1. Number of mammalian species, sampling sites, and samples.

Species	Common name	No. of animals	Sampling site	No. of samples per animal	Total no. of samples
Babyrousa babyrussa	Babirusa	1	Nostril	1	1
Bison bison	American bison	3	Nostril	1	3
Bison bonasus	European wisent	2	Nostril	1	2
Bos grunniens grunniens	Yak	1	Vulva	1	1
B. grunniens grunniens	Yak	2	Nostril	1	2
Camelus bactrianus	Bactrian camel	1	Nostril	1	1
Capra hircus	Goat	2	Skin	1	2
Capra ibex	Alpine ibex	2	Nostril	1	2
Cavia aperea	Brazilian guinea pig	1	Skin	1	1
Cercopithecus hamlyni	Owl-faced monkey	5	Nostril	1	5
C. hamlyni	Owl-faced monkey	1	Nostril	2	2
Cervus elaphus nelsoni	American elk	1	Nostril	1	1
Cervus nippon dybowskii	Dybowski deer	2	Nostril	1	2
Connochaetes taurinus taurinus	Blue wildebeest	3	Nostril	1	3
Elephas maximus indicus	Indian elephant	4	Nostril	1	4
Equus asinus asinus	Donkey	3	Nostril	1	3
Equus asinus asinus Poitou	Poitou donkey	1	Skin and nostril	2	2
Equus burchelli antiquorum	Damara zebra	1	Nostril	1	1
Equus caballus przewalskii	Przewalski's wild horse	1	Nostril	1	1
Equus grevyi	Grevy's zebra	1	Nostril	1	1
E. grevyi	Grevy's zebra	1	Nostril	2	2
Gazella leptoceros	Sand gazelle	1	Nostril	1	1
Genetta tigrina	Genet	1	Skin	1	1
Hydrochaeris hydrochaeris	Capybara	2	Nostril	1	2
Hylobates lar	Gibbon	1	Nostril	1	1
Macaca nigra	Sulawesi crested macaque	1	Nostril	1	1
Mandrillus sphinx	Mandrill	3	Nostril	1	3
Meles meles meles	Badger	1	Nostril	2	2
Myocastor coypus	Coypu	1	Abscess	1	1
Oryctolagos cuniculus	Rabbit	6	Skin	1	6
O. cuniculus	Rabbit	4	Nostril	1	4
Oryx dammah	Scimitar-horned oryx	4	Nostril	1	4
O. dammah	Scimitar-horned oryx	1	Nostril	2	2
Oryx leucoryx	Arabian oryx	2	Nostril	1	2
Pan paniscus	Bonobo	4	Nostril	1	4
Pan troglodytes	Chimpanzee	1	Skin and nostril	2	2
Panthera pardus orientalis	Amur leopard	1	Nostril	1	1
Papio hamadryas	Hamadryas baboon	2	Nostril	1	2
Rangifer tarandus	Reindeer	1	Conjunctiva	1	1
Sus scrofa scrofa	Wild boar	3	Nostril	1	3
Syncerus caffer caffer	Cape buffalo	2	Nostril	1	2
Tapirus indicus	Malayan tapir	2	Nostril	1	2
Taurotragus oryx	Common eland	8	Nostril	1	8
Tayassu pecari	White-lipped peccary	1	Nostril	1	1
Trachypithecus auratus auratus	Javan silvered leaf monkey	1	Nostril	1	1
Total		93			99

method with oxacillin 1 μg Neo-Sensitabs® (Rosco, DK-2630 Taastrup, Denmark), the preferred method to detect methicillin resistance in staphylococci and often used as a screening test.[9,10] In this test, the suspected colonies proved to be sensitive to oxacillin 1 μg, which indicated the absence of methicillin resistance.

In domestic animal species, the reported MRSA prevalence can vary greatly, i.e., as low as 0–1.1% in dogs,[1,11] 0.7% in cats,[1] 0–5.2% in horses,[1,11] and as high as 44.2–70.8% in pigs.[2,8] Although more research on a larger number of different animals species is needed, in this present study, the absence of MRSA in the captive zoo

mammals within the Royal Zoological Society of Antwerp is documented. However, continuous surveillance will monitor this situation.

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