Vets versus pets: methicillin-resistant *Staphylococcus aureus* in Australian animals and their doctors





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Humans and animals intimately sharing the same environment will inevitably be exposed to each other's microbiota. When one of those organisms is a drug-resistant pathogen then logistics of disease prevention are raised to a new level of complexity. For this reason the study of methicillin resistant *Staphylococcus aureus* (MRSA) in man and animals is now a priority. Recent research has demonstrated the ease with which MRSA crosses species barriers and the grave potential for MRSA to cause serious disease in animals and man has been well established. However, a key feature of MRSA (as compared zoonotic, resistant *Salmonella* spp.) is that companion and performance animals appear to have pivotal roles in the ecology of spread of certain genotypes found in humans. In this article we summarise the major developments in animal-human MRSA with an emphasis on the most recent Australian data incriminating involvement of companion and performance animals in the ecology of spread.

Staphylococcus aureus is responsible for a wide range of opportunistic infections in both humans and animals. In humans, infections with methicillin-resistant *S. aureus* (MRSA), which first appeared in the 1960s, have traditionally been nosocomial in origin. Hospital-associated MRSA strains cause serious and potentially fatal disease in patients with a wide range of predisposing conditions[1]. In the past 15 years new strains of MRSA have emerged that transmit between humans outside of health-care settings. These community associated MRSA are responsible for a growing burden of disease in otherwise healthy people in Australia[2] and abroad[1].

Until relatively recently, animals were not reported to play a major role in the transmission of MRSA to humans[3,4]. To date, MRSA has been identified in dogs, cats, pigs, sheep, poultry, horses, cattle, rabbits, seals, psittacine birds and other exotics including a bat, a turtle, a guinea pig and a chinchilla[5]. Internationally, MRSA has emerged as a significant and growing problem in small animal and

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equine hospitals and intensive livestock facilities[6–9]. Surveys conducted in The Netherlands have shown MRSA prevalence in individual pigs on a single farm to be as high as 39%[10,11]. The strains colonising and causing infection in dogs and cats such as clonal-complex (CC) 22 most probably originated in humans but have not as yet become host-adapted in these companion animals[5,12]. By contrast, MRSA strains isolated from horses and livestock such as CC8 and ST398, which also originated in humans, have become adapted to their new hosts and are readily transmitted between individual animals. Strains of *Staphylococcus* normally associated with companion animals such as *Staphylococcus pseudintermedius* are also becoming resistant to methicillin, possibly via horizontal movement of *SCCmec* gene cassettes containing the *mecA* resistance gene into susceptible strains[13]. Internationally, veterinary personnel have much higher rates of MRSA nasal carriage compared to the general population and several cases of MRSA infection in humans have been attributed to close animal contact[14].

Australia is free of many animal diseases that are endemic in other countries thanks to strict enforcement of a robust quarantine policy, a ban on the importation of fresh meat and the absence of land borders with other countries[15]. To date, MRSA has not been reported in food-producing species in Australia. However, MRSA infections have been reported in companion animals in Australia, with the majority of strains belonging to CC22[4]. In addition, CC8 MRSA strains have been isolated from the nasal passage and occasionally, soft tissue infections in performance horses in New South Wales[16].

Given these existing parameters, we surveyed 771 Australian veterinarians attending various industry based conferences during the 2009 calendar year for MRSA nasal carriage (Table 1)[14]. Among the respondents, non-clinical veterinarians (who we regarded as our control population) had the lowest prevalence (0.9%). Veterinarians in mixed practice who indicated horses as a major area of work emphasis had a prevalence of 11.8% (13x the controls) and those who indicated that their major emphasis was only horses had a prevalence of 21.4% (23x the controls). Veterinarians with dogs and cats as a major activity had a 4.9% prevalence (5x the controls). These results confirm that animal contact in a clinical setting is an important risk factor for MRSA nasal carriage and highlight the need for better infection control, particularly in equine hospitals.

The CC identities of the 45 MRSA strains indicated that a high proportion of strains from companion animal veterinarians belonged to CC22 (76.9%). Many of these isolates showed resistance to ciprofloxacin whereas strains from equine practitioners belonged to CC8 (62.5%) and were more often resistant to gentamicin and rifampicin. One of the MRSA strains that was distinct from these CCs was isolated from a pig veterinarian with a recent history of international travel. This isolate has since been determined to belong to ST398[17]. While this result indicates that the major international animal-associated MRSA subtype ST398 does not appear to be prominent in Australia, more up to date studies are urgently required to determine how widespread it has become. Other major subtypes (CC22 and CC8) appear to be well established.

The prevalence of resistance to fluoroquinolones (used only in companion animals in Australia) was close to 100% in CC22 MRSA isolates sourced from veterinarians who worked exclusively with dogs and cats, but zero in isolates sourced from vets who worked exclusively with horses. Similarly, the prevalence of resistance to gentamicin and rifampin (used almost exclusively in horses) was much higher in isolates sourced from equine veterinarians compared with those who worked with dog and cats. As the resistance profiles of each respective CC closely match antibiotic usage patterns in each sector, this may indicate that the physical handling of antibiotics and administration to animals could be a significant risk factor for MRSA nasal carriage in veterinarians. Administration of antibiotics to animals can sometimes be a difficult and messy

Table 1. Results of the MRSA nasal swab survey undertaken for 771 Australian veterinarians attending conferences in 2009.

Conference	Number of swabs obtained	Number of web surveys completed	Number of swabs positive for MRSA	MRSA prevalence (%)
AVA[A]	477	461	14	2.94
APV[B]	29	27	1	3.45
ACVS Science Week[C]	168	158	11	6.55
Bain Fallon[D]	129	125	20	15.50
Total	803	771	46	5.73

[A]Australian Veterinary Association Annual Scientific Conference; [B]Australian Pig Veterinarians Conference; [C]Australian College of Veterinary Scientists Science; [D]Australian Equine Veterinarians Annual Scientific Conference.

process (for example administering rifampicin orally to foals with *Rhodococcus equi* infection).

Although there has been much progress in defining the ecology of MRSA in man and animals there remains considerable uncertainty. Enhanced surveillance and genetic analysis of the MRSA isolates so recovered would do much to address this. While on their own these activities do not lead to real-world progress they are, nevertheless, essential. For without such information it will be impossible to raise the importance of MRSA in the minds of those professionals (medical and veterinary) with the power to implement the infection control and prescribing practices needed to diminish the threat of MRSA.

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