

Epidemiological Analysis of Methicillin-Resistant *Staphylococcus aureus* Carriage among Veterinary Staff of Companion Animals in Japan

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ABSTRACT. Veterinary staff carrying methicillin-resistant *Staphylococcus aureus* (MRSA) can be a source of MRSA infection in animals. To identify risk factors of MRSA carriage among veterinary staff, MRSA carriage and epidemiological information (sex, career, contact with MRSA-identified animal patients and others) were analyzed from 96 veterinarians and 70 veterinary technicians working at 71 private veterinary clinics in Japan. Univariate analysis determined sex (percentage of MRSA carriage, male (29.2%) vs. female (10%); $P=0.002$) and career (veterinarians (22.9%) vs. veterinary technicians (10%); $P=0.030$) as risk factors. Multivariable analysis revealed that sex was independently associated with MRSA carriage (adjusted odds ratio, 3.717; 95% confidence interval, 1.555–8.889; $P=0.003$). Therefore, male veterinary staff had a higher risk of MRSA carriage than female staff.

KEY WORDS: carriage, MRSA, risk factor, veterinarian

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Methicillin-resistant *Staphylococcus aureus* (MRSA) is the major cause of nosocomial infections, but it is also prevalent in the community and veterinary medical practice [1, 10]. MRSA carriage and associated risk of opportunistic infection, is an occupational hazard for veterinarians [8, 9]. We have previously shown that MRSA spreads within Japanese veterinary medical practices, both in an academic veterinary hospital [8] and in private veterinary clinics [7]. The percentage of veterinarians carrying MRSA was high (22.9%) [7], and veterinary staff carrying MRSA can be a source of MRSA infection in animals [8]. Therefore, MRSA control among veterinary staff is needed. To identify risk factors for MRSA carriage among veterinary staff, we analyzed the association between MRSA carriage and various epidemiological factors among veterinary staff members working at private veterinary clinics in Japan.

Data for MRSA carriage among veterinary staff members collected in a previous study [7] were used in this investigation. Briefly, nasal swab samples for MRSA isolation were collected from 96 veterinarians and 70 veterinary technicians (VTs) who provided medical care for dogs and cats. Subjects worked at 71 private veterinary clinics in the Ishikari region around Sapporo, Hokkaido, during the period April–June 2008. MRSA was detected in 22 veterinarians (22.9%) and seven VTs (10%) [7].

The following information was gathered from veterinary staff: sex, career (veterinarian or VT; duration of clinical veterinary experience), previous contact with animal patients with confirmed MRSA, keeping companion animals at home and established risk factors for MRSA infection within human medical practices (hospitalization, surgery received, dialysis treatment, catheter insertion within the previous year, antibiotics taken within the previous month and living with human MRSA carrier). Human samples and questionnaire answers were coded to protect anonymity. This study was approved by the Ethics Committee of the Graduate School of Dairy Science, Rakuno Gakuen University, Japan (No. 09–1).

For univariate analysis, categorical comparisons were performed by a chi-square test. When at least one expected frequency was less than five, Fisher's exact test was used for comparison between two groups. P values were calculated by one-tailed test. An odds ratio (OR) for the number of years of clinical veterinary experience was calculated by logistic regression. A P value of less than 0.05 was considered significant. For multivariate analysis, variables with P values less than 0.2 in univariate analysis were analyzed by stepwise backward logistic regression. All statistical analyses were performed using SPSS Statistics 20.0 software (IBM Japan Co., Tokyo, Japan).

The results of univariate analysis are shown in Table 1. A significant difference in the percentage of MRSA carriage was observed between veterinarians and VTs ($P=0.030$). Eight veterinarians and three VTs provided only nasal swabs and no epidemiological information other than job type; therefore, these 11 individuals were excluded from the following analyses. The percentage of MRSA carriage in males was significantly higher than that in females ($P=0.002$).

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Table 1. Univariate analysis of risk factors for methicillin-resistant *Staphylococcus aureus* carriage in veterinary staff

| Variable | Value | Isolation rate (%) | OR | [CI ^{95%}] | <i>P</i> |
|---|------------------------|--------------------|-------|----------------------|----------|
| Career | Veterinarian | 22.9% (22/96)* | 2.676 | [1.072–6.677] | 0.030 |
| | Veterinary Technicians | 10% (7/70) | Ref | | |
| Gender | | | | | |
| Subtotal | | | | | |
| | Male | 29.2% (19/65) | 3.717 | [1.555–8.889] | 0.002 |
| | Female | 10% (9/90) | Ref | | |
| Veterinarian | | | | | |
| | Male | 30.2% (19/63) | 3.167 | [0.845–11.864] | 0.076 |
| | Female | 12% (3/25) | Ref | | |
| Veterinary Technicians | | | | | |
| | Male | 0% (0/2) | 0.967 | [0.924–1.013] | 0.828 |
| | Female | 9.2% (6/65) | Ref | | |
| Contact with MRSA-identified animal patients | | | | | |
| | Positive | 27.1% (13/48) | 2.278 | [0.985–5.269] | 0.051 |
| | Negative | 14.0% (15/107) | Ref | | |
| Risk factor for MRSA infection in human medical practices | | | | | |
| | Positive | 20% (5/25) | 1.163 | [0.369–3.420] | 0.487 |
| | Negative | 17.7% (23/130) | Ref | | |
| Keeping companion animals at home | | | | | |
| | Positive | 18.0% (24/133) | 0.991 | [0.307–3.193] | 0.594 |
| | Negative | 18.2% (4/22) | Ref | | |

OR, odds ratio; CI^{95%}, 95% confidence interval; Ref, reference; MRSA, methicillin-resistant *Staphylococcus aureus*;
*Isolation rate (No. of MRSA positive samples / No. of tested samples).

However, there was no significant difference in percentage of MRSA carriage by sex among veterinarians ($P=0.076$). The percentage of MRSA carriage amongst female veterinarians was approximately the same as that of female VTs (OR 1.341, 95% confidence interval (CI^{95%}) 0.308–5.831; $P=0.480$). There was no significant difference in percentage of MRSA carriage related to contact with MRSA-identified animals ($P=0.051$), having at least one risk factor of MRSA infection in human medical practice ($P=0.487$) and keeping companion animals at home ($P=0.594$) (Table 1). Moreover, years of clinical veterinary experience was not associated with MRSA carriage (OR 1.034, CI^{95%} 0.987–1.083; $P=0.163$), according to the logistic regression analysis.

For multivariate analysis, sex, career (veterinarian or VT; duration of clinical experience), contact with MRSA-identified animal patients ($P<0.2$ in the univariate analysis) and the interaction effect of sex and job type (veterinarian or VT) were selected. As a result of stepwise backward logistic regression, sex was the only variable independently associated with MRSA carriage (OR 3.717, CI^{95%} 1.555–8.889; $P=0.003$). The area under the curve plotted on a receiver operating characteristic curve was 0.658 ± 0.057 (CI^{95%} 0.547–0.770; $P=0.009$); therefore, the data were suggested to fit this final model.

This investigation revealed that male veterinary staff had a higher risk of MRSA carriage than female staff, based on the results of multivariate analysis. Hand-hygiene practice with soap and water was reported as a strong protective factor against MRSA colonization among veterinary personnel working with horses [2], and male sex was described as one

of the risk factors for poor adherence to recommended hand-hygiene practices in healthcare settings [4]. On the other hand, our study did not include hand-hygiene practices as a question item, and we could not analyze the association between MRSA carriage and hand-hygiene practices. Previous studies did not show a significant difference in MRSA carriage by sex among attendees of an international veterinary conference (9.4% (male) vs. 5.3% (female), $P=0.09$) [6] or those attending a veterinary surgery conference (16.7% (male) vs. 17.7% (female), $P=0.89$) [3]. These previous studies [3, 6] included veterinary staff working with both small and large animals (food-producing animals and horses), whereas our study included only veterinary staff for small animals. In the previous study, the percentage to carry MRSA among veterinary staff varied based on objective animal type (large or small) for medical care [6]. Moreover, the percentage of MRSA carriage (6.5%, 27/417) in a previous study [6] was much lower than that in this study (17.5%, 29/166). These differences between our study and previous studies might lead to differences in association between MRSA carriage and sex.

According to the multivariate analysis, the duration of clinical experience in the veterinary field was not associated with MRSA carriage. Previous studies established that the duration of MRSA carriage was generally brief following short-term exposure to MRSA-positive livestock animals [5, 11]. Moreover, Frana *et al.* reported that MRSA with *spa* type t002 was most common among veterinary students with short-term MRSA carriage [5]. Most MRSA (18/29) carried by veterinary staff in our study were also classified as *spa*

type t002 [7]. Therefore, MRSA with *spa* type t002 was likely cleared from healthy veterinary staff for small animals after a certain period of carriage.

In our previous study, contact with an identified animal MRSA case was associated with MRSA carriage among veterinary staff in an academic veterinary hospital (OR, 6.1; $P < 0.01$) [8]. Although almost a third of veterinary staff had contact with MRSA-identified animal patients, an association with MRSA carriage was not statistically established in the current study (OR, 2.278; $P = 0.051$). A detailed bacteriological examination is needed for diagnosis of animal MRSA cases. As the prevalence of MRSA among veterinarians (22.9%) was equivalent to that reported in an academic veterinary hospital [7, 8], the rate of identification of MRSA-infected animal patients in private veterinary clinics might be lower than that in an academic veterinary hospital.

In conclusion, this study found that male veterinary staff had a higher risk of MRSA carriage than female veterinary staff. MRSA carriage is likely to be intermittent in healthy veterinary staff. Hand-hygiene practice was reported as a strong protective factor against MRSA colonization among veterinary personnel for horses [2]. Therefore, veterinary staff, especially male staff, should prevent MRSA carriage by hand-hygiene practice while providing veterinary medical care.

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