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A pilot study to isolate *Staphylococcus aureus* and methicillin-resistant *S aureus* from environmental surfaces in the home

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Background: The major sources of *Staphylococcus aureus*, including methicillin-resistant *S aureus* (MRSA), in the home are colonized or infected individuals and pets, such as cats and dogs; however, the occurrence of MRSA on surfaces in healthy homes is not well documented.
Methods: A convenience sample comprising 35 homes of health care and non–health care workers, each with a child in diapers and either a cat or dog in the home, was recruited from the Boston area between January and April 2006. In each home, a total of 32 surfaces were sampled in kitchens, bathrooms, and living areas.
Results: *S aureus* was found in 34 of the 35 homes (97%) and was isolated from all surfaces in 1 or more homes, with the exception of the kitchen chopping board and the child training potty. MRSA was isolated from 9 of 35 homes (26%) and was found on a variety of household surfaces, including the kitchen and bathroom sinks, countertops, kitchen faucet handle, kitchen drain, dish sponge/cloth, dish towel, tub, infant high chair tray, and pet food dish. A positive correlation was indicated for the presence of a cat and the isolation of MRSA from surfaces.
Conclusions: This study has shown the presence of MRSA at hand-contact surfaces in healthy homes. This provides further evidence for the potential for infection transmission via inanimate surfaces and underscores the need for good hygiene practice in the home. (Am J Infect Control 2008;36:458-60.)

The major sources of *Staphylococcus aureus*, including methicillin-resistant *S aureus* (MRSA), in the home are colonized or infected individuals and pets, such as cats and dogs.[1] In contrast to health care–associated (HCA) MRSA, community-acquired (CA) MRSA is more prevalent among children and young adults, causing infections of cuts, wounds, and abrasions. CA-MRSA is readily transmissible within families. Skin-to-skin contact (including unabraded skin) and contact with contaminated objects (eg, towels, sheets, sports equipment) seem to represent the mode of transmission.[2] Once shed into the environment, *S aureus* can survive for long periods, and its presence on environmental surfaces in the home has been reported in numerous studies.[3]

The aims of this pilot study were to validate the test methodology, determine the likelihood of finding *S aureus* and MRSA on surfaces in healthy homes with children and pets but without reported infection or carriage, and identify risk factors for the presence of MRSA on surfaces in homes.

METHODS

Participants were recruited by fliers, word of mouth, and referrals. Qualified participants met the criteria of having a child in diapers and a dog or cat in the household and were located within a 30-mile radius of the city of Boston. The Simmons College Institutional Review Board approved this study, and informed consent was obtained. Each participant was asked to complete a questionnaire to obtain demographic and health symptom information as well as cleaning frequency and product use in the home.

Up to 32 surfaces were sampled in each home including kitchen, bathroom, office, infant, and pet

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Table 1. Percentage frequency of occurrence of *S aureus* and MRSA on household surfaces

Household surface	*S aureus* (%)	MRSA (%)
Kitchen		
Sponge/cloth (n = 33)	30	3
Dish towel (n = 31)	27	7
Sink	23	3
Drain	20	3
Floor (n = 34)	18	0
Phone (n = 34)	15	0
Table top	14	0
Countertop (n = 34)	12	3
Refrigerator handle	11	0
Faucet handle	12	6
Microwave touch pad (n = 34)	7	0
Garbage bin (n = 34)	6	3
Chopping board (n = 32)	0	0
Bathroom		
Tub	26	3
Sink	17	3
Toilet bowl (n = 34)	15	0
Toilet seat	14	0
Counter top (n = 33)	12	0
Door handle (n = 34)	12	3
Faucet handle	11	3
Toilet floor	11	0
Light switch (n = 34)	9	0
Flush handle (n = 34)	3	0
Child training potty (n = 10)	0	0
Other		
Child toy	34	0
Infant high chair tray (n = 26)	29	5
Infant changing mat (n = 24)	27	0
Pet food dish	15	3
TV remote (n = 34)	12	0
Phone (n = 22)	13	0
Computer mouse (n = 31)	10	0
Computer keyboard (n = 32)	3	0

n = 35 unless indicated otherwise.

surfaces, as shown in Table 1. Surfaces were sampled using sterile polyester swabs moistened in sterile 1 mL of quarter-strength Ringer's solution and sterile 25-cm^2 templates. Swabs were maintained at 4 to 5°C and returned to the laboratory within 2 hours of sampling. Swab samples were enriched in trypticase soy broth and incubated for 24 hours at 35°C. After incubation, the broth was streaked onto mannitol salt agar and incubated. All gram-positive, catalase-positive, and coagulase-positive isolates were plated onto BBL CHROMagar (BD Diagnostic Systems, Sparks, MD) and also tested for antibiotic sensitivity using 1-μg oxacillin discs (BBL Sensi-Disc [BD Diagnostic Systems]) on Mueller-Hinton agar. Zones of clearing of <10 mm were recorded as resistant, as indicated in the zone diameter interpretive chart (BBL Sensi-Disc Antimicrobial Susceptibility Test Discs [BD Diagnostic Systems]).

RESULTS

A total of 35 homes were sampled. *S aureus* was found in 34 of the 35 homes and at all sites sampled in 1 or more homes, with the exception of the chopping board and child training potty. Table 1 shows the frequency of occurrence of *S aureus* by site.

Nine of the 35 homes (26%) were contaminated with a total of 15 isolates of MRSA. In 6 of these 9 homes, MRSA was isolated from only 1 surface (ie, kitchen countertop, kitchen sink drain, kitchen faucet handle, pet food dish, bathroom sink, or bathroom door handle); in 2 homes, MRSA was isolated from 2 surfaces (ie, kitchen sink/dishtowel or kitchen faucet/bathroom faucet); and in 1 home, MRSA was isolated from 5 surfaces (ie, kitchen sponge, garbage bin, dishtowel, bathtub, and infant high chair). The questionnaire data recorded for this last home indicated the presence of 4 humans and 1 cat. Three of the 4 human occupants had experienced vomiting and diarrhea in the week before sampling. During the 6 months before sampling, 2 of the occupants had visited a physician for treatment of sinus infection, and an antibiotic (amoxicillin) had been prescribed for 1 occupant with an ear infection.

Of the 9 homes with MRSA, 44% had a child in daycare, 22% had an occupant working in health care, 44% had a dog, and 78% (7 homes) had a cat. Using Fisher's exact test, the presence of cats and the finding of MRSA in the home was the only positive correlation found ($P = .02$).

DISCUSSION

In the present study, most of the sites contaminated with MRSA corresponded to hand-contact surfaces, consistent with previous reports.[4] Our results indicate that homes with a cat were significantly more likely to have sites contaminated with MRSA than homes without a cat. Previous studies also have demonstrated a relationship between cats and MRSA.[5-7] In one example, a recurrent MRSA infection in a geriatric ward was attributed to the ward cat, and MRSA infections were not eliminated until the cat was treated.[8]

Another study found that CA-MRSA accounted for 40% of the MRSA infections in children up to age 18 years in southern New England, including southeastern Massachusetts, between 1997 and 2001.[9] Risk factors identified in 8 of the 23 CA-MRSA patients in that study included intrafamilial spread, frequent antibiotic exposure, and child-care attendance.

In our study, known risk factors for MRSA acquisition, including frequent antibiotic use, recent hospitalization, and MRSA infections in family members, were not reported for any of the households. Child-care attendance was reported in 44% of the MRSA-positive

homes but was not statistically significant. Possible risk factors for pets, such as recent illness, were not reported. The evidence suggests that cats and dogs may act as reservoirs of MRSA after exposure to colonized or infected humans, and thus likely do not constitute the primary reservoir for MRSA but do represent a small secondary reservoir.[7] The close contact between household pets and humans offers favorable conditions for the transmission of bacteria by direct contact, such as petting and licking, or indirect contact through contamination of food or furnishings.[7] The frequency of MRSA transmission between humans and animals appears to be low.[6] However, once present in the household environment, bacteria such as MRSA may be further disseminated throughout the home as a result of cleaning practices that can result in transfer to various surfaces, thus increasing the potential for transmission.[10]

Limitations of the present study include the lack of nasal swabs for all household members and pets, which could have indicated the source of MRSA in the home. Additional investigation of the association between the presence of cats and MRSA in the home environment is needed. The mechanism of bacterial transmission from human to cat and from cat to human also should be investigated. Future studies should include a larger sample size and should target hand-contact sites where MRSA was found at the highest frequencies, as well as homes with cats and surfaces contacted by pets. Genomic analysis would indicate the prevalence of Panton-Valentine leucocidin–producing strains.

In conclusion, this pilot study has demonstrated the presence of MRSA at hand-contact surfaces in healthy homes without reported infections or carriage. A positive correlation was found between the isolation of MRSA from surfaces and the presence of a cat in the home. This provides further evidence for the potential for infection transmission through inanimate surfaces and underscores the need for good hygiene practice in the home.

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