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You, the Clinic, and Methicillin-Resistant *Staphylococcus*

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Staphylococcus aureus is an opportunistic pathogen normally found on the skin, nasal cavity, nasopharynx, and perineum of humans and animals. *S. aureus* is a gram-positive, coagulase-positive, noncorrelating cocci found singly or in pairs, short chains, or irregular clusters. The virulence factors found in *S. aureus* allow it to adhere to environmental surfaces and damage or avoid the immune system. In addition, the organism can cause toxic effects,¹ thereby allowing animals or humans to be asymptomatic carriers and transmit the organism to other animals or humans or throughout the environment without knowing they are the source of contamination. Infection occurs with the entry and multiplication of microorganisms in the tissue of the host, which may or may not be associated with local or systemic disease. Most animal and human isolates are associated with colonization and not with infection.²

Methicillin-resistant *S. aureus* (MRSA) was first reported in 1961 — only 2 years after methicillin had been introduced to treat penicillin-resistant *S. aureus* in humans.¹ The resistance is attributed to the extensive, unnecessary, and improper use of antibiotics when treating simple infections.³

MRSA is resistant to β -lactam antibiotics, including penicillinase-resistant penicillins (e.g., methicillin, oxacillin, nafcillin) and the cephalosporins. MRSA has been reported in multiple species of animals — dogs, cats, horses, cattle, rabbits, chickens, and a few types of birds.^{4,5} Until recently, it was unknown whether resistant bacteria were transmitted from humans to animals or vice versa.

For animals, MRSA is not the most common form of resistant bacteria ([Figure 1](#)). *S. intermedius*, an opportunistic, coagulase-positive pathogen, is more common in animals but rarely is a component of normal human flora.⁵ This organism can be isolated from the skin, hair, and gingiva of colonized animals and, therefore, can be found in humans that have been bitten by a dog.⁶ Studies have shown that 45% of dog owners with methicillin-resistant *S. intermedius* (MRSI) are colonized with the same strain as their dogs.⁷ Another *Staphylococcus* species, *S. schleiferi*, also is associated with canine pyoderma and can be methicillin resistant, although it is not as common as *S. intermedius* resistance.⁷

MRSA infections acquired in human hospitals have become common, but to date that is not necessarily true of MRSA infections in veterinary hospitals. However, 10% of healthy dogs and 15% of healthy cats are colonized with MRSI, and 38% of recurrent pyoderma in companion animals has been attributed to MRSA or MRSI.⁷ Staff who work in a health care setting have a higher risk of carrying MRSA than the general population because of their association with a wide number of individuals.³

The mortality rates in humans and animals vary, with lower rates in individuals with superficial infections and higher rates in those with serious invasive diseases.⁷ In animals, the more severely affected are usually euthanized because owners find the cost of treatment to be prohibitive.¹ Typically, if an animal has a resistant infection, the owner likely is colonized. Therefore, technicians should advise owners to seek evaluation from their physician. If the owner is unsure as to the extent of the risk for infection, the veterinary staff can offer to communicate directly with

the physician and his or her staff.⁸

Zoonotic Concerns and Transmission

Initially, it was unknown whether animals are the primary source of resistant infections or become colonized after contact with human carriers, which is called reverse zoonosis. Studies now show that many MRSA infections in dogs and cats are acquired from owners and are, therefore, grouped as reverse zoonosis.^{5,9}

It also is now known that transmission can happen in many ways: environment to human, human to environment, human to pet, pet to human, pet to environment, and environment to pet.³ A contaminated environment shared by humans and animals will likely result in cross-contamination.⁵ Transmission usually involves direct contact with the nasal passages, throat, and skin or by indirect contact with walls, floors, counters, equipment, supplies, bedding, and dishes.^{7,10} Transmission can occur during surgery by contact with exudate that is present, tracheal tubes, and bone fragments.¹¹ Transmission also can occur from mother to infant during delivery.¹

There are multiple incidences of MRSA being isolated from a dog and transmitted to someone in a veterinary hospital. In one practice, a second dog was inoculated by the staff members, who were referred to their physicians for treatment; no other animal or staff members were infected.¹² In animals, most of the resistant infections are found in high-risk (immunocompromised) animals that acquired the infection from their owners.⁵

Healthy pets and humans can be colonized but not have an infection. Rather, the concern centers on whether an owner who is colonized and works in the health care profession could infect immunosuppressed patients.¹² In addition, if an owner has an infection that is nonresponsive to treatment, the animal can be a reservoir and inoculate the owner again. Therefore, treatment of both the owner and the animal may be necessary for the infection and carrier states to be cleared.¹³

Glossary

Bacteremia — the presence of bacteria in the bloodstream

Colonization — the presence of a microorganism in or on a host with growth and multiplication but without tissue invasion or damage

Dermatitis — inflammation of the skin

Epidemic — a large number of individuals in a population or community infected with the same pathogen

Fistula — abnormal passageway from an abscess or hollow organ to the skin surface; that is, a draining tract

Folliculitis — inflammation of the hair follicles

Furunculosis — multiple areas of inflammation and swelling of the hair follicle and surrounding tissue, usually having a hard core

Immunocompromised — decreased immune system; can be suppressed because of steroid use, chemotherapy, or recent surgery

Impetigo — acute skin disease characterized by vesicles and pustules

Infection — entry and multiplication of microorganisms in the host, causing damage to the tissue

Metritis — inflammation of the uterus

Nasopharynx — section of the pharynx connected to the nasal passages

Pathogen — a specific causative agent; typically bacterial or viral

Perineum — area between the anus and external portion of the genitalia

Personal protective equipment (PPE) — nonspecific equipment used to protect oneself during potentially hazardous jobs; typically latex gloves, gowns, face shields, booties, and bouffant in veterinary medicine

Purulent — containing or composed of pus

Pyoderma — skin infection; typically bacterial or fungal

Transmission — transfer of material from one object to another without knowledge that it is happening; object can be animate or inanimate

Virulence — the ability to overcome the body's defense mechanisms

Presentation

The clinical signs of MRSA in humans and animals vary only slightly. Humans can have skin and soft tissue infections, such as impetigo, furunculosis, abscesses, folliculitis, cellulitis, and wound infections. Humans also can present with pneumonia, endocarditis, septic arthritis, osteomyelitis, meningitis, and septicemia. Animals with MRSA or MRSI can present with skin and wound infections (Figure 2), such as abscesses, dermatitis, postoperative infections of the surgical site, fistulas, and infections at the intravenous catheter site and surgical implant site.

Internal infections can include pneumonia, rhinitis, bacteremia, septic arthritis, osteomyelitis, urinary tract infections, metritis, and mastitis.¹

MRSI is rarely a component of normal human flora, but it can be colonized in people who have considerable contact with animals.^{5,6} *S. intermedius* usually causes pyodermas and otitis in animals and tends to be a more superficial infection than that caused by *S. aureus*.¹⁴

Certain clinical scenarios should raise a warning flag that the patient should be considered infectious until proven otherwise. These include contact with animals from known MRSA households, nonhealing wounds, infections that are nonresponsive to antibiotics, septic or invasive infections, sores resembling spider bites, recurrent skin disease, recent or frequent antibiotic use, recurrent urinary tract infections, and draining tracts.^{15–17} In addition, contact with animals from known MRSA-infected households should be flagged.

Typically, infections appear between 4 and 10 days after contact, but asymptomatic colonization is common and the disease may not surface until several months after colonization.¹

Prevention in the Clinic

The best defense against MRSA and MRSI contamination is a good offense, and the best prevention of an outbreak in the clinic is good hand hygiene and environmental disinfection. All employees need to wash their hands with a good liquid antimicrobial soap before and after seeing or touching each patient. Bar soap should not be used because bacteria can grow on it. Staff should be advised to scrub their hands for at least 15 seconds and to put gloves on immediately before touching an infected patient and remove them immediately after or before touching any other surface.¹⁵ In addition, staff should wash their hands after removing the gloves in case they have microscopic holes in them.¹⁷ Face and eye protection is warranted if a staff member is lancing or draining an abscess. In addition, staff need to keep all scrapes and cuts covered. All stethoscopes, thermometers, leashes, muzzles, and dishes need to be disinfected at least once a week.¹⁵

Some personnel may be more susceptible to colonization than others are. Increased susceptibility comes from poor hand hygiene, close physical contact, and contaminated laundry, burns, cuts, or abrasions.⁸ If a patient is suspected of having a resistant bacterial infection, staff should be sure that a request to obtain culture samples has been made and that the samples are sent to a reputable laboratory for MRSA or MRSI analysis.

Any patients with signs of MRSA or MRSI infection should be treated as if they do have the infection until it is proven otherwise. Therefore, front-desk personnel should be familiar with the various clinical presentations so patients that are scheduled for an appointment because of skin infection or abscess can be identified before admittance.⁷

Suspect or positive animals should be given the latest appointment time possible and be placed directly into an examination room; it is better to have one room set aside for infectious animals. These animals should be carried or placed on a gurney or have an alternative entrance to keep the front waiting area from becoming contaminated. If the animal must be walked into the clinic, staff should be prepared to mop the front lobby immediately after the animal has been admitted. The patient should remain in the room until all diagnostics and treatments are finished.¹⁰

All wounds should be covered as soon as possible to prevent any leakage, and appropriate personal protective equipment (PPE) should be worn by attending staff — usually gloves and disposable gowns are all that are needed for bandaging. If a staff member has skin-barrier defects, such as eczema, psoriasis, or open wounds, he or she should not care for a patient with suspected MRSA or MRSI infection. Likewise, after a staff member has been assigned to the case, he or she should not handle sick or compromised animals to minimize the risk of spreading the infection.

If an animal must be hospitalized, it should be kept isolated from all other animals, including animals already housed in the isolation ward. The patient should have certain staff supplies and equipment assigned to it, including but not limited to pens, stethoscopes, thermometers, leashes, bowls, and anything else that touches the patient or is touched in the process of handling the patient.

If equipment cannot be completely disinfected after it has been used on an infectious animal, it must be disposed of. When the patient's cage is cleaned, the bedding must be disposed of or laundered at 60°C (140°F) and the cage and surrounding area disinfected once a day. If possible, it is best if the patient is bathed every 2 to 3 days with an antibacterial shampoo. The owner can visit the patient but must wear proper PPE and wash his or her hands before leaving.¹⁶

For discharged patients, all lesions must be covered. An animal should be discharged only if it is clinically fit and the lesion samples have been submitted for culture. Have the owner sign a consent form acknowledging that the animal is carrying a possible zoonotic disease and the owner is at risk of becoming infected.¹⁶

Deceased patients should be sealed in an impervious bag and cremated. If a necropsy is warranted, the necropsy staff should be advised that infectious disease is a possibility, and the remains should be incinerated after necropsy. Necropsy on a MRSA/MRSI patient is a high-risk procedure. There must not be any nonessential personnel around, and PPE must be worn, including latex gloves, mask, face shield, some sort of cut-proof gloves, and respiratory protection if a band saw or power equipment needs to be used.¹⁰

Because MRSA can survive up to 12 months in dust, bedding, and clothing, environmental screening of the clinic should be monitored for cleanliness. Cultures should be processed monthly to ensure that the cleaning protocol is adequate (see [Protocols for Cleaning and Disinfecting](#)).

Prevention Outside the Clinic

Animal-assisted therapy is growing in the companion animal world. Because this type of therapy typically involves children's hospitals, nursing homes, and grief support meetings, the animals as well as their human handlers should be routinely monitored for MRSA and MRSI colonization.⁵ In addition, the animals should be bathed and groomed before their visit and should not be in contact with any patients that have confirmed or suspected MRSA.⁷

There also is a growing concern in the equine world. Many affected horses carry MRSA in their nasal passages, so colonization can spread rapidly throughout an equine ward. Unfortunately, there is a lack of proven, safe, and acceptable options of eradication for this type of colonization, which can create a potential management problem.¹⁸

MRSA and MRSI can be disconcerting problems in the veterinary and human fields, but with a little foresight, prevention, and understanding of transmission, the chance of it becoming an epidemic can be greatly reduced.

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MRSA and PVL

MRSA is more common in patients that are immunosuppressed from cancer treatment, have been on steroids, have undergone extensive surgery, or have severe skin damage, such as burns and extensive abrasions.¹⁵ Because MRSA can cause deep, often purulent infections, the exotoxins produced by certain strains can cause a unique cytotoxin. The presence of panton-valentine leukocidin (PVL) is associated with increased virulence of certain strains (isolates) of *S. aureus*. It is present in most community-associated MRSA (CA-MRSA) isolates studied and is the cause of necrotic lesions involving the skin or mucosa.¹⁷

PVL, which was first reported in humans in 2005, can cause tissue necrosis, leukocyte distraction, and severe inflammation. Other strains of MRSA produce exfoliative toxins that can cause toxic shock syndrome or can cause the superficial dead skin layers of the epidermis to separate from the living layers, resulting in scalded skin syndrome.¹⁷

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