Zoonosis: Staphylococcus
A Cutaneous Perspective

Excerpts from the CDC and Pubmed

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Zoonotic diseases are infectious agents that demonstrate the ability to infect humans and animals. Recent evidence of the contagious nature of many of these organisms has resulted in a revision and simplification of terminology. Currently, zoonosis usually refers to any infection that can be transmitted from animals to people or from people to animals; either direction is possible.

Numerous organisms are have zoonotic potential; many are devastating, horrible diseases (Table Z at end of notes). However, some of the organisms that veterinary practitioners encounter on a daily basis (**Staphylococcus, Malassezia, Pseudomonas, and *Microsorium canis***) have recently demonstrated an increasing potential to cross the species barrier that most of us assumed protected ourselves, staff, and families.

Until recently, extremely resistant Staphylococci were limited to the species *Staphylococcus aureus* and remained primarily a human dilemma. Recent reports have identified *Staphylococcus aureus* infections in dogs that are multidrug resistant and potentially zoonotic. *Staphylococcus schleiferi* has recently emerged as a common cause of canine pyoderma. *Staphylococcus schleiferi* has the ability to develop multidrug resistance (using similar mechanisms as *Staphylococcus aureus)* and is known to be zoonotic.

The Human Experience

Staphylococcus bacteria are one of the most common causes of skin infection in the United States, and are a common cause of pneumonia and bloodstream infections. According to some estimates, as many as 100,000 persons are hospitalized each year with MRSA (Methicillin Resistant *Staphylococcus aureus*) infections, although only a small proportion of these persons have disease onset occurring in the community. Approximately 25 to 30% of the population is colonized in the nose with Staphylococcus bacteria at a given time.

Each year, nearly 2 million patients in the United States get an infection as a result of receiving health care in a hospital. These hospital-acquired infections are often difficult to treat because the bacteria and other microorganisms that causes them frequently are resistant to antimicrobial drugs.

Overall, 70% of the bacteria causing such infections are resistant to at least one of the drugs most commonly used to treat these infections. In some cases, these organisms are resistant to all approved antibiotics and must be treated with experimental and potentially very toxic drugs.

Of those patients, about 90,000 die as a result of their infection. Persons infected with drug-resistant organisms are more likely to have longer hospital stays and require

treatment with second- or third-choice drugs that may be less effective, more toxic, and/or more expensive.

http://www.cdc.gov/ncidod/hip/Aresist/am_res.htm http://www cdc.gov/drugresistance/healthcare/problem.htm

Not Just People

Outbreaks of methicillin-resistant *Staphylococcus aureus* in horses and humans in Canada have researchers concerned that MRSA infections in horses may be emerging as a serious zoonotic and veterinary nosocomial disease. Researchers are recommending that veterinary hospitals launch surveillance programs for the pathogen.

Between Oct. 1, 2000, and Nov. 16, 2002, scientists isolated MRSA from 82 horses and 29 humans. Although many clinically infected horses were seriously ill and required prolonged hospitalization, MRSA was implicated directly in the death of only one horse. Importantly, 50 percent of the equine cases were from one Thoroughbred farm. When researchers identified horse farms that had outbreaks, they tested people on the farms and commonly found that they, too, were infected.

The scientists found that 95 percent of the MRSA in horses and 93 percent of the MRSA in humans were the same strain, Canadian MRSA-5. This strain accounts for only about 5 percent of MRSA infections in humans in Canada.

http://www.avma.org/onlnews/javma/nov03/031115a.asp JAVMA Nov. 15, 2003

Molecular phylogenetic evidence for noninvasive zoonotic transmission of Staphylococcus intermedius from a canine pet to a human.
Tanner MA, Everett CL, Youvan DC. ; J Clin Microbiol. 2000 Apr;38(4):1628-31.
rRNA-based molecular phylogenetic techniques were used to identify the bacterial species present in the ear fluid from a female patient with otitis externa. We report the identification of Staphylococcus intermedius from the patient and a possible route of transmission. Analysis of 16S ribosomal DNA restriction fragment length polymorphisms indicated that the dominant species present was S. intermedius. A pet dog owned by the patient also was tested and found to harbor S. intermedius. In humans, the disease is rare and considered a zoonosis. Previously, S. intermedius has been associated with dog bite wounds, catheter-related injuries, and surgery. This study represents the first reported case of a noninvasive infection with S. intermedius.

Asymptomatic nasal carriage of mupirocin-resistant, methicillin-resistant Staphylococcus aureus (MRSA) in a pet dog associated with MRSA infection in household contacts.
Manian FA.; Clin Infect Dis. 2003 Jan 15;36(2):e26-8. Epub 2003 Jan 06.
Recurrent methicillin-resistant Staphylococcus aureus (MRSA) infection in a patient with diabetes and in his wife is described. Culture of nares samples from the family dog grew mupirocin-resistant (minimum inhibitory concentration >1024 microg/mL) MRSA that had a pulsed-field gel electrophoresis chromosomal pattern identical to the MRSA

isolated from the patient's nares and his wife's wound. Further recurrence of MRSA infection and nasal colonization in the couple was prevented only after successful eradication of MRSA from the family dog's nares.

Human-associated staphylococcal infection in Spanish imperial eagles.
Ferrer M, Hiraldo F.; J Wildl Dis. 1995 Oct;31(4):534-6.
At Donana National Park, Spain, we compared the prevalence of Staphylococcus spp. infections in the Spanish imperial eagle (Aquila adalberti) in 66 nestlings handled with bare hands and in 46 nestlings handled with gloved hands, 1986 to 1993. We detected staphylococcal infections in 30 (45%) of 66 chicks handled without gloves, and in two (4%) of 46 chicks handled with gloves.

A comparison of antibiotic resistance patterns and pyocine types between strains of Pseudomonas aeruginosa from animal and human sources (author's transl)
Kuchler R, Gunther D.; Zentralbl Bakteriol [Orig A]. 1976 Aug;235(4):413-20.
291 strains of Pseudomonas aeruginosa from human bacteriological samples were compared with 102 strains which had been isolated from animals for frequency of pyocine-types and patterns of antibiotic resistance. 146 strains had been isolated from hospitalized patients and 145 from out-patients. More strains of animal origin were sensitive to carbenicillin and tetracyclines compared to strains of human origin. Since the frequency of different pyocine-types is the same in all three groups, it is concluded, that antibiotic resistance may be transferred from man to animal and vice versa via transfer of Pseudomonas aeruginosa.

An epidemic of Malassezia pachydermatis in an intensive care nursery associated with colonization of health care workers' pet dogs.
Chang HJ, Miller HL, Watkins N, Arduino MJ, Ashford DA, Midgley G, Aguero SM, Pinto-Powell R, von Reyn CF, Edwards W, McNeil MM, Jarvis WR.; N Engl J Med. 1998 Mar 12;338(11):706-11.
BACKGROUND: Malassezia species are lipophilic yeasts that are emerging as nosocomial pathogens, particularly in low-birth-weight neonates who receive lipid emulsions. When a cluster of patients with Malassezia pachydermatis infection was identified in an intensive care nursery, we initiated an investigation. METHODS: A case patient was defined as any infant in the intensive care nursery who had a positive culture for M. pachydermatis between October 17, 1993, and January 18, 1995. We conducted a cohort study to identify risk factors for colonization and infection with M. pachydermatis. We collected cultures from the infants and the health care workers and from the health care workers' pets, since this organism has been associated with otitis externa in dogs. RESULTS: Fifteen infants met the case definition: eight with bloodstream infections, two with urinary tract infections, one with meningitis, and four with asymptomatic colonization. The case patients were significantly more likely than the other infants to weigh 1300 g or less (15 of 65 vs. 0 of 419, $P<0.001$). In a multivariate analysis of infants weighing 1300 g or less, the independent risk factors for colonization or infection with M. pachydermatis were a greater severity of concomitant illness (odds ratio, 19.7; $P=0.001$), arterial catheterization for nine or more days (odds ratio, 29.5; $P=0.027$), and exposure to Nurse A (odds ratio, 74.7; $P=0.004$). In a point-

prevalence survey, 9 additional infants, 1 health care worker, and 12 of the health care workers' pet dogs had positive cultures for M. pachydermatis. The isolates from all 15 case patients, the 9 additional colonized infants, 1 health care worker, and 3 of the 12 dogs had identical patterns of restriction-fragment-length polymorphisms. CONCLUSIONS: In this outbreak, it is likely that M. pachydermatis was introduced into the intensive care nursery on health care workers' hands after being colonized from pet dogs at home. The organism persisted in the nursery through patient-to-patient transmission.

Nosocomial ringworm in a neonatal intensive care unit: a nurse and her cat.
Drusin LM, Ross BG, Rhodes KH, Krauss AN, Scott RA.; Infect Control Hosp Epidemiol. 2000 Sep;21(9):605-7.
An outbreak of nosocomial ringworm involved five infants in a neonatal intensive care unit. The index case was a nurse infected with Microsporum canis by her cat. After standard infection control measures were initiated, the outbreak was resolved successfully by an interdisciplinary professional collaboration of physician and veterinary dermatologists and infection control personnel.

Tinea capitis in infants less than 1 year of age.
Romano C, Gianni C, Papini M.; Pediatr Dermatol. 2001 Nov-Dec;18(6):465-8.
Tinea capitis is the most frequent manifestation of dermatophyte infection in children, but because it is rare in the first months of life it is often misdiagnosed. Here we report 15 cases of tinea capitis observed in Italy in infants less than 1 year of age. There were 10 boys and 5 girls (mean age 6 months). Diagnosis was confirmed by mycologic examination. Microsporum canis was isolated in nine cases and Trichophyton mentagrophytes in three. These 12 infants were Italian and animals were the source of infection. Trichophyton erinacei was isolated in one Italian infant, and the source was soil. In the other two cases, Trichophyton tonsurans and Trichophyton violaceum were isolated; these infants were from Central America and India, respectively, and had contracted the infection from humans. All achieved clinical and mycologic recovery after systemic and topical antimycotic therapy.

Microsporum canis infection in a 5-year-old boy: transmission from the interior of a second-hand car.
Thomas P, Korting HC, Strassl W, Ruzicka T.; Mycoses. 1994 Mar-Apr;37(3-4):141-2.
Microsporum canis is one of the most common zoophilic dermatophytes. If transmitted to humans, inflammatory lesions may develop, e.g. on the scalp. M. canis was isolated from a 5-year-old boy living in a suburban area who suffered from a long-standing, mildly inflammatory lesion on the scalp that had been treated for several months with anti-eczematous regimens. There had been no contact with animals, e.g. cats or dogs, in the previous months, but the lesions had developed a few weeks after the family had bought a used car from a dog owner. Indeed, M. canis could be grown on contact plates from the car's interior. This case illustrates that attention should be paid to the often neglected diagnosis of M. canis-induced tinea capitis and to unusual routes of infection.

Solving the Problem: Appropriate Strategy

The infections are secondary to the primary/underlying disease. Obviously, aggressive antimicrobial therapies must be used to resolve the infection; however, **until the primary skin disease is identified and controlled, the infections will continue to recur due to the changes in the skin defenses.**

Changes that occur with skin disease the predispose to secondary skin infections.

Region	Function	Change with dermatitis
Epidermis -	Dehydrated	Increased moisture allows organism adherence and penetration
	Turnover every 21 days	Turnover rate is changed to prevent normal maturation and exfoliation of cells
	Essential fatty acids and waxes: antimicrobial	Composition is altered decreasing the antimicrobial functionality
	Langerhan's cells: search for antigens initiating a defense immune response	Langerhan's cells will preferentially stimulate an allergic response which is ineffective against organisms
Dermis	Vessels cool the skin	Vasodilatation increases skin temperature - warm
Glands	Sebum: antimicrobial	Increased and altered composition is less antimicrobial and provided nutrients for yeast
	Sweat: antimicrobial	Increased and altered composition increase skin moisture
	Acidity	Increases in pH are less antimicrobial
	Salts	Diluted salt concentrations decrease the antimicrobial effect
	IgA	Decreases in IgA and switched to IgG secretion decrease antimicrobial effect
General		Pruritus damages the skin and spreads organisms from the mouth to the skin.

In patients with Staphylococcus infections, it becomes paramount to find and control the underlying dermatoses. Aggressive diagnostic workups should be used to explore the endocrine status and identify any allergic disease. Cutaneous biopsies are often useful to determine if the patient has cutaneous changes typical of allergy, endocrine disease, autoimmune skin disease, or a keratinization defect.

Preferred antibiotics and doses for canine pyoderma:

Amoxicillin-clavulanate	22 mg per kilogram every 12 hours
Cephalexin	22 mg per kilogram every eight hours
	30 mg per kilogram every 12 hours
Clindamycin	10 mg per kilogram every 12 hours
Ormetoprim sulfadimethoxine	27.5 mg per kilogram every 24 hours
	(on the first day give two doses q12 hours)
Trimethoprim sulfa	15-30 mg per kilogram every 12 hours
Enrofloxacin	10-20 mg per kilogram every 24 hours
Marbofloxacin	5 mg per kilogram every 24 hours
Orbifloxacin	7.5 mg per kilogram every 24 hours

Treatment:

The three essential components of successful treatment of secondary bacterial pyoderma in dogs include the proper selection of antibiotic, treatment with appropriate dose and duration of antibiotic therapy(high dose for at least 21-30 days), and the identification and control of all underlying dermatoses (allergies, endocrinopathies, autoimmune diseases, keratinization defects). Bacterial pyoderma is a common cause of pruritus. For this reason, it is important to determine the cause of a patient's pruritus (pyoderma, yeast dermatitis, allergies) rather than treating the itch with steroids. Topical therapy is also of great benefit to help mechanically remove organisms as well as providing a nonantibiotic method of killing the organisms. Shampoos containing chlorhexidine or benzoyl peroxide are highly effective at reducing the superficial colonization of Staphylococcus.

Treat Appropriately with Antibiotics

Antibiotic resistance has been called one of the world's most pressing public health problems.

The number of bacteria resistant to antibiotics has increased in the last decade. Nearly all significant bacterial infections in the world are becoming resistant to the most commonly prescribed antibiotic treatments.

Every time a person takes antibiotics, sensitive bacteria are killed, but resistant germs may be left to grow and multiply. Repeated and improper uses of antibiotics are primary causes of the increase in drug-resistant bacteria.

Misuse of antibiotics jeopardizes the usefulness of essential drugs. Decreasing inappropriate antibiotic use is the best way to control resistance.

Antibiotic resistance can cause significant danger and sufferings for people who have common infections that once were easily treatable with antibiotics. When antibiotics fail to work, the consequences are longer-lasting illnesses; more doctor visits or extended hospital stays; and the need for more expensive and toxic medications. Some resistant infections can cause death.

http://www.cdc.gov/drugresistance/community/faqs.htm#facts

If the patient is on seemingly appropriate doses of antibiotic for an appropriate duration (minimum of 21 days) without clinical improvement in the papular crusting alopecia lesions, a resistant Staphylococcus infection should be suspected. Other dermatoses that can mimic pyoderma include Demodicosis, dermatophytosis, scabies, and pemphigus. Once these differentials have been eliminated, the skin lesions should be cultured and antibiotic sensitivity profile performed to help guide antimicrobial selection. It is especially important in these patients to use the highest possible antibiotic dose for sufficient duration to completely resolve the infection. The antibiotics should be continued for two to three weeks past complete clinical resolution to assure that the organisms have been eliminated. If antibiotic therapy is discontinued prematurely, the resistant Staphylococcus populations will be allowed to expand making additional treatment even more difficult.

Prevention of Contagion and Zoonosis

Hand Hygiene Guidelines Fact Sheet

Press Release October 25, 2002 Contact: CDC Media Relations
"Clean hands are the single most important factor in preventing the spread of dangerous germs and antibiotic resistance in health care settings," said Dr. Julie Gerberding, director of the CDC. "More widespread use of these products that improve adherence to recommended hand hygiene practices will promote patient safety and prevent infections."

Improved adherence to hand hygiene (i.e. hand washing or use of alcohol-based hand rubs) has been shown to terminate outbreaks in health care facilities, to reduce transmission of antimicrobial resistant organisms (e.g. methicillin resistant staphylococcus aureus) and reduce overall infection rates.

Handwashing with soap and water remains a sensible strategy for hand hygiene in non-health care settings and is recommended by CDC and other experts.

The use of gloves does not eliminate the need for hand hygiene. Likewise, the use of hand hygiene does not eliminate the need for gloves. Gloves reduce hand contamination by 70 percent to 80 percent, prevent cross-contamination and protect patients and health care personnel from infection. Handrubs should be used before and after each patient just as gloves should be changed before and after each patient.

Alcohol-based handrubs significantly reduce the number of microorganisms on skin, are fast acting and cause less skin irritation. Alcohol-based hand rubs take less time to use than traditional hand washing. In an eight-hour shift, an estimated one hour of an ICU nurse's time will be saved by using an alcohol-based handrub.

http://www.cdc.gov/od/oc/media/pressrel/fs021025.htm

Table Z

Bacterial	Fungal	Viral Diseases	Rickettsial	Parasitic
Brucellosis Salmonellosis Shigellosis Yersinia pseudotuberculosis Yersinia pestis Tuberculosis Leprosy Vibriosis Listeriosis Leptospirosis Borreliosis Lyme Disease Campylobacteriosis Colibacillosis Staphylococcal Dermatophilosis Erysipeloid Melioidosis Glanders Tularemia Streptococcosis Rat Bite Fever Pasteurellosis Anthrax Clostridial Infections Capnocytophaga Psittacosis Blastomycosis Cat Scratch Disease	Dermatomycoses Sporotrichosis Cryptococcosis Histoplasmosis	Contagious Ecthyma Monkey pox Yabapox Tanapox Herpesviruses Dengue Equine Encephalitides Kyasanur Forest Disease Rift Valley Fever St. Louis Encephalitis Yellow Fever Hantavirus Pulmonary Syndrome Hemorrhagic Fever With Renal Syndrome [HFRS] Other hemorrhagic fevers (arenaviruses) Lymphocytic Choriomeningitis California Encephalitis/La Crosse Encephalitis Marburg Virus Ebola Rabies Hepatitis A Measles Cytomegalovirus Disease Influenza Newcastle Disease	Q-fever Ehrlichiosis Rocky Mountain Spotted Fever Rickettsialpox Murine Typhus	<u>Protozoan Diseases</u> Babesiosis Toxoplasmosis Plasmodium spp. African Trypanosomiasis American Trypanosomiasis Amebiasis Balantidiasis Cryptosporidiosis Giardiasis. Leishmaniasis Microsporidiosis Encephalitozoon cuniculi <u>Nematode Zoonoses</u> Anisakiasis Trichinosis Angiostrongyliasis Ancylostomiasis Capillariasis Filariasis Visceral Larval Migrans Cutaneous Larval Migrans Oesophagostomiasis Strongyloidiasis Trichostrongylosis Ascariasis
http://research.ucsb.edu/connect/pro/disease.html				