TOP 5

TOP 5 ZOONOTIC DISEASE CONCERNS IN HOSPITAL VISITATION DOGS

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A variety of animals may be encountered in human healthcare facilities, including service animals, patients' pets, therapy animals for animal-assisted therapeutic activities, and visitation animals.[1] The latter category, typically pets of volunteers brought to facilities to interact with patients, is the most common and the focus of this discussion.

Animal visitation programs, also referred to as *pet therapy* or *animal-assisted activities*, can have various positive impacts on patients[2-5]; however, any human–animal contact poses some degree of risk for transmission of zoonotic pathogens. Healthcare facilities contain large numbers of individuals with increased susceptibility to disease, heightening zoonotic disease concerns.

Most animals used for animal visitation programs are dogs, a relatively low-risk species for which there is a good understanding of pathogen carriage rates and risk factors and an ability to test temperament. Therefore, this article focuses on zoonotic concerns pertaining specifically to dogs.

A variety of bacteria, viruses, and fungi pose some degree of zoonotic risk, but the primary concerns typically involve opportunistic bacterial pathogens.

TOP 5 ZOONOTIC DISEASE CONCERNS IN HOSPITAL VISITATION DOGS

1. Methicillin-Resistant *Staphylococcus aureus*
2. *Clostridium difficile*
3. Extended-Spectrum β-Lactamase–Producing Enterobacteriaceae
4. *Salmonella* spp
5. Exposure to Pathogens from Bites & Scratches

PATHOGEN SCREENING

In general, pathogen screening is not considered useful because it shows a result from a single point in time and uses tests that are not 100% sensitive and cannot test for the wide array of potentially zoonotic pathogens. A negative result would show that the dog was "probably" negative (for the tested pathogens only) at the time of sampling but could have been exposed any time thereafter. A negative result would *not* show that the dog is not carrying a pathogen, that it poses no risk, or that precautions such as hand hygiene are not needed because of the range of other pathogens. Because pathogen screening does not modify required practices and can be expensive, the benefit is limited.

The incidence of dog-associated disease in healthcare facilities is unknown, possibly because it is rare. However, it is likely that infections occur, at least sporadically, and are undiagnosed. This is particularly true for pathogens that are common in hospitalized individuals (eg, multidrug-resistant bacteria), as identification of an infection might not trigger much investigation or consideration of potential animal sources. A collection of basic infection control and visitation practices can presumably reduce the risks that may be encountered.[1]

Following are the author's top 5 zoonotic disease concerns in hospital visitation dogs. Because evidence is empirical, this list is based on conjecture rather than data.

1 Methicillin-Resistant *Staphylococcus aureus*

Methicillin-resistant *Staphylococcus aureus* (MRSA) is a leading cause of hospital-associated infection in humans. This multidrug pathogen can colonize the nose, throat, skin, and GI tract of dogs and humans in the absence of disease. MRSA colonization has been identified in a small percentage of dogs and typically involves the same strains that infect humans.[6-9] These cases presumably occurred predominantly from human–dog transmission, but colonized dogs could be sources for subsequent infection of humans.

Hospital visitation dogs have been shown to be at elevated risk for MRSA colonization, presumably from contact with colonized patients.[10] Transient contamination of the haircoat can also occur during patient contact.[11]

Screening of visitation dogs for MRSA carriage is not recommended (see ***Pathogen Screening***).[1] MRSA prevention should be focused on practicing good hand hygiene before and after animal contact. Because antibiotic exposure increases the risk for MRSA colonization in dogs,[10] short-term exclusion of dogs that are receiving or have recently received antibiotics is recommended.[1] Dogs that participate in hospital visitation pro-

grams are more likely to encounter MRSA than are nonparticipating dogs; thus, culture and susceptibility testing of wound infections and other bacterial infections is warranted. Dogs with any wound infections should be excluded from visitation because of the potential involvement of pathogens such as MRSA, as well as the risk for exposure to other pathogens that could complicate the wound infection.

2 *Clostridium difficile*

Clostridium difficile is an important cause of morbidity and mortality in hospitalized humans. This fecal–oral pathogen can also be found in the GI tract of healthy dogs and humans.[12-15] Zoonotic transmission from dogs has not been clearly established, but the same strains have been found in dogs and humans.[16-18]

Hospital visitation dogs are at significantly elevated risk for *C difficile* shedding,[10] likely acquired through ingestion of *C difficile* spores from the hospital environment and patient hands. Risk reduction involves limiting exposure of dogs (eg, not visiting patients who are under enhanced precautions for *C difficile* infection, encouraging patients to practice good hand hygiene before contact with a dog, limiting contact with patients' living spaces) and reducing dog–human transmission (eg, through good fecal handling, preventing fecal accidents, and practicing good hand hygiene). As with MRSA, short-term exclusion of dogs that are receiving or have recently received antibiotics is recommended.[1] Screening of animals for *C difficile* shedding is not recommended (see ***Pathogen Screening***).

3 Extended-Spectrum β-Lactamase–Producing Enterobacteriaceae

A variety of multidrug-resistant gram-negative bacteria are important causes of infection in healthcare facilities, with some strains being near pan-resistant (ie, resistant to all available antimicrobials). Extended-spectrum β-lactamase (ESBL)–producing bacteria are widely distributed in healthy dogs, and strains that cause disease in humans are often identified in dogs,[19,20] which suggests the potential for both human–dog and dog–human transmission in healthcare facilities. Other resistant gram-negative bacteria that may be encountered include carbapenemase-producing Enterobacteriaceae, which may be extensively drug resistant. Colonization or infection of dogs with carbapenemase-producing Enterobacteriaceae is rare but possible,[21,22] and because these pathogens are increasingly found in human healthcare facilities, the potential for exposure and colonization in the GI tract is increased.

Because ESBL-producing bacteria are fecal–oral pathogens, preventive measures are similar to those described for *C difficile*, and screening of visitation animals is not recommended (see ***Pathogen Screening***). Exclusion of dogs actively or recently (ie, within the past month) treated with antimicrobials is recommended,[1] as antimicrobial exposure is a risk factor for ESBL acquisition[23,24] and, presumably, acquisition of other resistant gram-negative enteric pathogens.

4 *Salmonella* spp

Salmonellosis can be life-threatening in compromised dogs and humans. Although the prevalence of *Salmonella* spp shedding tends to be low in healthy adult dogs, higher rates can be found in some subpopulations, particularly dogs fed raw meat-based diets or treats.[25-27] Risk reduction involves prohibition of raw meat and/or raw animal-based treats to visitation dogs and exclusion of dogs with active or recent (ie, within the past week) diarrhea.[1] Good fecal handling practices and attention to hand hygiene can help further reduce the risk. Routine testing for *Salmonella* spp is not recommended (see ***Pathogen Screening***); however, culture or PCR testing of diarrheic therapy dogs may be useful in identifying animals that require a longer exclusion period after resolution of diarrhea.

ESBL = extended-spectrum β-lactamase
MRSA = methicillin-resistant *Staphylococcus aureus*

5 Exposure to Pathogens from Bites & Scratches

Although often overlooked in discussion of zoonotic diseases, bites and scratches may be the most common and potentially serious hazards associated with visitation dogs. The incidence of bites and scratches in healthcare facilities has not been reported, but they have been observed.[28] Bites are of particularly high risk because of the myriad opportunistic pathogens found in a dog's mouth, such as *Pasteurella* spp and *Capnocytophaga canimorsus*. Bites can also inoculate pathogens (eg, MRSA) that might be residing on a human's skin.[29] Scratches from dogs pose a lower risk for infection as compared with bites but can cause pain, and any disruption of the protective skin barrier may increase the risk for infection in high-risk individuals.

MRSA = methicillin-resistant *Staphylococcus aureus*

References

1. Murthy R, Bearman G, Brown S, et al. Animals in healthcare facilities: recommendations to minimize potential risks. *Infect Control Hosp Epidemiol*. 2015;36(5):495-516.
2. Cole KM, Gawlinski A, Steers N, Kotlerman J. Animal-assisted therapy in patients hospitalized with heart failure. *Am J Crit Care*. 2007;16(6):575-585.
3. Sobo EJ, Eng B, Kassity-Krich N. Canine visitation (pet) therapy: pilot data on decreases in child pain perception. *J Holist Nurs*. 2006;24(1):51-57.
4. Stasi MF, Amati D, Costa C, et al. Pet-therapy: a trial for institutionalized frail elderly patients. *Arch Gerontol Geriatr Suppl*. 2004:38(9)407-412.
5. Abate SV, Zucconi M, Boxer BA. Impact of canine-assisted ambulation on hospitalized chronic heart failure patients' ambulation outcomes and satisfaction: a pilot study. *J Cardiovasc Nurs*. 2011;26(3):224-230.
6. van Duijkeren E, Wolfhagen MJ, Box AT, Heck ME, Wannet WJ, Fluit AC. Human-to-dog transmission of methicillin-resistant *Staphylococcus aureus*. *Emerg Infect Dis*. 2004;10(12):2235-2237.
7. van Duijkeren E, Wolfhagen MJHM, Heck MEOC, Wannet WJB. Transmission of a Panton-Valentine leucocidin-positive, methicillin-resistant *Staphylococcus aureus* strain between humans and a dog. *J Clin Microbiol*. 2005;43(12):6209-6211.
8. Wedley AL, Dawson S, Maddox TW, et al. Carriage of *Staphylococcus* species in the veterinary visiting dog population in mainland UK: molecular characterisation of resistance and virulence. *Vet Microbiol*. 2014;170(1-2):81-88.

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References

1. Ruaux CG. Cobalamin in companion animals: diagnostic marker, deficiency states and therapeutic implications. *Vet J*. 2013;196(2):145-152.
2. Marks S. Diarrhea. In: Washabau RJ, Day MJ, eds. *Canine and Feline Gastroenterology*. St. Louis, MO: Elsevier Saunders; 2013:103-104.
3. Giger U, Smith J. Immunodeficiencies and infectious diseases. In: Greene CE, ed. *Infectious Diseases of the Dog and Cat*. 4th ed. St. Louis, MO: Elsevier Saunders; 2012:1108.
4. Bishop MA, Xenoulis PG, Berghoff N, Grützner N, Suchodolski JS, Steiner JM. Partial characterization of cobalamin deficiency in Chinese Shar Peis. *Vet J*. 2012;191(1):41-45.
5. Fyfe JC, Giger U, Hall CA, et al. Inherited selective intestinal cobalamin malabsorption and cobalamin deficiency in dogs. *Pediatr Res*. 1991;29(1):24-31.
6. Battersby IA, Giger U, Hall EJ. Hyperammonaemic encephalopathy secondary to selective cobalamin deficiency in a juvenile Border collie. *J Small Anim Pract*. 2005;46(7):339-344.
7. McLauchlan G, McLaughlin A, Sewell AC, Bell R. Methylmalonic aciduria secondary to selective cobalamin malabsorption in a Yorkshire terrier. *J Am Anim Hosp Assoc*. 2015;51(4):285-288.
8. Ruaux CG, Steiner JM, Williams DA. Early biochemical and clinical responses to cobalamin supplementation in cats with signs of gastrointestinal disease and severe hypocobalaminemia. *J Vet Intern Med*. 2005;19(2):155-160.
9. Berghoff N, Suchodolski JS, Steiner JM. Association between serum cobalamin and methylmalonic acid concentrations in dogs. *Vet J*. 2012;191(3):306-311.
10. Rossi G, Breda S, Giordano A, et al. Association between hypocobalaminaemia and hyperhomocysteinaemia in dogs. *Vet Rec*. 2013;172(14):365.
11. Torresson L, Steiner JM, Olmedal G, Larsen M, Suchodolski JS, Spillmann T. Oral cobalamin supplementation in cats with hypocobalaminaemia: a retrospective study. *J Feline Med Surg*. 2017;19(12):1302-1306.
12. Toresson L, Steiner JM, Suchodolski JS, Spillmann T. Oral cobalamin supplementation in dogs with chronic enteropathies and hypocobalaminemia. *J Vet Intern Med*. 2016;30(1):101-107.
13. Toresson L, Steiner JM, Suchodolski JS, Spillmann T. Oral cobalamin supplementation in dogs with exocrine pancreatic insufficiency (abstract). *J Vet Intern Med*. 2017;31(4):1283.
14. Batchelor DJ, Noble PJ, Taylor RH, Cripps PJ, German AJ. Prognostic factors in canine exocrine pancreatic insufficiency: prolonged survival is likely if clinical remission is achieved. *J Vet Intern Med*. 2007;21(1):54-60.
15. Cook AK, Wright ZM, Suchodolski JS, Brown MR, Steiner JM. Prevalence and prognostic impact of hypocobalaminemia in dogs with lymphoma. *J Am Vet Med Assoc*. 2009;235(12):1437-1441.
16. Texas A&M Gastrointestinal Laboratory. Cobalamin: diagnostic use and therapeutic considerations. Gastrointestinal Library website. http://vetmed.tamu.edu/gilab/research/cobalamin-information. Accessed October 4, 2017.

Suggested Reading

Texas A&M Gastrointestinal Laboratory. Cobalamin: diagnostic use and therapeutic considerations. Gastrointestinal Library website. http://vetmed.tamu.edu/gilab/research/cobalamin-information. Accessed October 4, 2017.

9. Weese JS, Dick H, Willey BM, et al. Suspected transmission of methicillin-resistant *Staphylococcus aureus* between domestic pets and humans in veterinary clinics and in the household. *Vet Microbiol*. 2006;115(1-3):148-155.
10. Lefebvre SL, Reid-Smith RJ, Waltner-Toews D, Weese JS. Incidence of acquisition of methicillin-resistant *Staphylococcus aureus*, *Clostridium difficile*, and other health-care-associated pathogens by dogs that participate in animal-assisted interventions. *J Am Vet Med Assoc*. 2009;234(11):1404-1417.
11. Lefebvre SL, Weese JS. Contamination of pet therapy dogs with MRSA and *Clostridium difficile*. *J Hosp Infect*. 2009;72(3):268-269.
12. Borriello SP, Honour P, Turner T, Barclay F. Household pets as a potential reservoir for *Clostridium difficile* infection. *J Clin Pathol*. 1983;36(1):84-87.
13. Struble AL, Tang YJ, Kass PH, Gumerlock PH, Madewell BR, Silva J Jr. Fecal shedding of *Clostridium difficile* in dogs: a period prevalence survey in a veterinary medical teaching hospital. *J Vet Diagn Invest*. 1994;6(3):342-347.
14. Weese J, Finley R, Reid-Smith RR, Janecko N, Rousseau J. Evaluation of *Clostridium difficile* in dogs and the household environment. *Epidemiol Infect*. 2010;138(8):1100-1104.
15. Galdys AL, Nelson JS, Shutt KA, et al. Prevalence and duration of asymptomatic *Clostridium difficile* carriage among healthy subjects in Pittsburgh, Pennsylvania. *J Clin Microbiol*. 2014;52(7):2406-2409.
16. Arroyo LG, Kruth SA, Willey BM, Staempfli HR, Low DE, Weese JS. PCR ribotyping of *Clostridium difficile* isolates originating from human and animal sources. *J Med Microbiol*. 2005;54(Pt 2):163-166.
17. Lefebvre SL, Arroyo LG, Weese JS. Epidemic *Clostridium difficile* strain in hospital visitation dog. *Emerg Infect Dis*. 2006;12(6):1036-1037.
18. Rupnik M. Is *Clostridium difficile*-associated infection a potentially zoonotic and foodborne disease? *Clin Microbiol Infect*. 2007;13(5):457-459.
19. Carvalho AC, Barbosa AV, Arais LR, Ribeiro PF, Carneiro VC, Cerqueira AM. Resistance patterns, ESBL genes, and genetic relatedness of *Escherichia coli* from dogs and owners. *Braz J Microbiol*. 2016;47(1):150-158.
20. Damborg P, Morsing MK, Petersen T, Bortolaia V, Guardabassi L. CTX-M-1 and CTX-M-15-producing *Escherichia coli* in dog faeces from public gardens. *Acta Vet Scand*. 2015;57(1):83.
21. Cui L, Lei L, Lv Y, et al. blaNDM-1-producing multidrug-resistant *Escherichia coli* isolated from a companion dog in China. *J Glob Antimicrob Resist*. 2017;13:24-27.
22. González-Torralba A, Oteo J, Asenjo A, Bautista V, Fuentes E, Alós JI. Survey of carbapenemase-producing Enterobacteriaceae in companion dogs in Madrid, Spain. *Antimicrob Agents Chemother*. 2016;60(4):2499-2501.
23. Belas A, Salazar AS, Gama LT, Couto N, Pomba C. Risk factors for faecal colonisation with *Escherichia coli* producing extended-spectrum and plasmid-mediated AmpC β-lactamases in dogs. *Vet Rec*. 2014;175(8):202.
24. Wedley AL, Dawson S, Maddox TW, et al. Carriage of antimicrobial resistant *Escherichia coli* in dogs: prevalence, associated risk factors and molecular characteristics. *Vet Microbiol*. 2017;199:23-30.
25. Joffe DJ, Schlesinger DP. Preliminary assessment of the risk of *Salmonella* infection in dogs fed raw chicken diets. *Can Vet J*. 2002;43(6):441-442.
26. Lefebvre SL, Reid-Smith R, Boerlin P, Weese JS. Evaluation of the risks of shedding Salmonellae and other potential pathogens by therapy dogs fed raw diets in Ontario and Alberta. *Zoonoses Public Health*. 2008;55(8-10):470-480.
27. Leonard EK, Pearl DL, Janecko N, et al. Risk factors for carriage of antimicrobial-resistant *Salmonella* spp and *Escherichia coli* in pet dogs from volunteer households in Ontario, Canada, in 2005 and 2006. *Am J Vet Res*. 2015;76(11):959-968.
28. Lefebvre SL. *Animal-Assisted Therapy Programs and Zoonoses* [thesis]. Guelph, Ontario, Canada: University of Guelph; 2013.
29. Oehler RL, Velez AP, Mizrachi M, Lamarche J, Gompf S. Bite-related and septic syndromes caused by cats and dogs. *Lancet Infect Dis*. 2009;9(7):439-447.