Special Report

Risk reduction and management strategies to prevent transmission of infectious disease among dogs at dog shows, sporting events, and other canine group settings

Jason W. Stull VMD, PhD
Jennifer I. Kasten DVM
Michelle D. Evason DVM
Robert G. Sherding DVM
Armando E. Hoet DVM, PhD
Jeanette O'Quin DVM, MPH
Mary Jo Burkhard DVM, PhD
J. Scott Weese DVM, DVSc

From the Departments of Veterinary Preventive Medicine (Stull, Kasten, Hoet, O'Quin), Veterinary Clinical Sciences (Sherding), and Veterinary Biosciences (Burkhard), College of Veterinary Medicine, The Ohio State University, Columbus, OH 43210; Michelle Evason Veterinary Internal Medicine & Nutrition Consulting, Columbus, OH 43214 (Evason); and the Department of Pathobiology, Ontario Veterinary College, and Centre for Public Health and Zoonoses, University of Guelph, Guelph, ON N1G 2W1, Canada (Weese).

Address correspondence to Dr. Stull (Stull.82@osu.edu).

Approximately 35% of households in the United States and Canada own 1 or more dogs, totaling an estimated 75 million dogs in the United States and Canada.[1,2] Despite continuous development of health promotion and disease prevention products and strategies, infectious disease remains an important contributor to disease and death for dogs. Hundreds of pathogens infectious to dogs have been identified, with more emerging over time.[3] Some of these pathogens can also cause disease in people, leading to published recommendations to reduce the risks of human disease associated with animal settings.[4,5]

Many opportunities for transmission of infectious disease are amplified when dogs are brought together in a shared environment.[6–8] Settings that involve the temporary congregation of numerous dogs for competition, play, or boarding (often from various geographic locations) are of particular infectious disease concern. Such canine group settings are popular; some of these activities may involve thousands of dogs attending events over several days. Infectious agents introduced into these group settings may lead to disease outbreaks, with the potential for further spread into the communities where the dogs reside, putting many dogs (and potentially humans) at risk.[9]

The process of preventing or reducing the transmission of infectious diseases is complex. Disease agents vary in environmental stability, transmission modes, infectivity (ability to spread between hosts), pathogenicity (ability to cause disease), and virulence (ability to cause severe disease). Additionally, a combination of individual-, population-, and environment-level factors influences the development of infectious diseases in dogs. Individual-level factors include age, immune and health status, acquired immunity (previous infection or vaccination), diet, preventive care (eg, ecto- and endoparasite control), and hand hygiene by the people that handle them. Population- or event-level factors include herd immunity, dog density, event cleaning and disinfection practices, and degree of direct and indirect dog-to-dog contact. Environment-level factors include exposure to infectious agents through pathogen-infected vectors (influenced by geography, time of year, and degree of contact with vector-dense locations) or wildlife or their contaminated environment (eg, urine- or feces-contaminated water).

Some factors have individual- and event-level components requiring an integrated approach to risk management. For instance, to reduce indirect pathogen spread, individual efforts, such as the practice of hand hygiene between handling of dogs and use of effective disinfectants, must complement event-level procedures, such as policies and availability of disinfectant and hand hygiene products.

Given the complexity and importance of integrating individual- and event-level efforts, effective disease prevention in canine group settings would be facilitated by evidence-based guidelines that could be widely disseminated and flexibly applied to create disease prevention, risk mitigation, and control programs. In human group settings, disease prevention programs involving standards, recommendations, and regulations are commonly used[10]; similar programs are also being applied in equine group settings.[11] On the other hand, limited standards, guidelines, recom-

ABBREVIATIONS

CAV-2	Canine adenovirus type 2
CDV	Canine distemper virus
CIV	Canine influenza virus
CPiV	Canine parainfluenza virus
CPV-2	Canine parvovirus type 2
RMSF	Rocky Mountain spotted fever

mendations, or regulations currently exist regarding infectious disease prevention for canine group settings. For instance, the American Kennel Club has limited rules for addressing infectious disease opportunities during its dog events,[12] and although policies have been developed for many dog parks and privately owned boarding facilities, no standard set of recommendations exists to guide such policies.

Animal shelters house concentrated populations of dogs and have developed resources to guide disease prevention and control programs in their facilities[13,14]; however, such settings involve a largely unowned population, necessitating somewhat different strategies. The objectives of the literature review reported here were to identify the specific risks of infectious disease transmission among owned dogs in transient group settings in the United States and Canada and use this information to develop prevention and control recommendations.

Materials and Methods

The authors of the present report were intentionally selected for their expertise on infectious diseases affecting dogs, representing various backgrounds and topic-relevant expertise. A list of pathogens believed to be a concern for transmission in canine group settings was developed on the basis of the authors' experiences as well as review of the veterinary peer-reviewed literature and relevant textbooks **(Table 1)**. Group settings were defined as dog shows (eg, for conformation or obedience), sporting events (eg, agility events, field trials, herding tests, lure coursing, hunting tests, and earthdog tests), off-leash dog parks, private kennels, and dog daycare and boarding facilities.

Literature review

Canine infectious disease textbooks,[3,15,16] published expert panel consensus guidelines and compendia,[17–24] and a relevant website[25] were reviewed to identify primary literature sources and generally accepted information regarding clinical signs, transmission, and epidemiologic characteristics of the identified list of pathogens. Additionally, targeted literature database searches were conducted to identify reports involving pathogens infectious to dogs and related outbreaks by use of PubMed, Web of Science, and CAB Abstract search engines and a combination of pathogen names, common disease names, and various dog and group setting terms.

Searches were performed to identify recent literature regarding canine infectious disease by use of search terms and Boolean operators (eg, pathogen AND dog term), limiting the search results to the last 5 years and articles in English. Searches were also performed to identify reported outbreaks involving infectious diseases in canine group settings by use of Boolean operators (eg, pathogen AND dog term AND [group setting term OR outbreak]), limiting the search results to articles in English, without a limit on publication date. All article types and study designs were eligible for inclusion.

Articles were screened by title and, as indicated, by abstract and full article. Those with a focus on epidemiologic characteristics of the disease in dogs, such as incidence, transmission routes or sources, clinical signs, outcomes, outbreaks, or factors influencing infection or disease prevention were retained.

Development of prevention and control recommendations

Two authors (JWS and JIK) reviewed and synthesized the identified primary literature from the review, formulating evidence-based draft recommendations to prevent and control infectious disease in canine group settings. Because animal shelters were considered unique in dealing with a largely unowned population that necessitates somewhat different strategies, development of these recommendations excluded consideration of shelter-specific concerns.

Over a series of meetings, all authors systematically debated and refined each recommendation on the basis of level of risk and evidence as an effective control or prevention method. An evidence-ranking metric was used to rate the quality of evidence considered in the development of each recommendation **(Appendix)**, similar to one used in the development of other recommendations[26] for infection control and prevention associated with animal activities. The degree of consensus among the authors was categorized as consensus (≥ 70% agreement among authors) or nonconsensus (< 70% agreement).

Results

Literature review

The literature searches identified 7,039 publications. Of these, 6,606 were eliminated because they were duplicates or did not involve the epidemiology, transmission, clinical presentation, risk factors, or prevention of 1 or more of the targeted pathogens in dogs. Four hundred twenty-eight articles were retained and used to inform recommendations. Retained articles included literature reviews (n = 136), case reports (14), case series (15), outbreak reports (50), cross-sectional studies (145), case-control or cohort studies (16), experimental studies (17), randomized or nonrandomized clinical trials (21), and miscellaneous study designs (14; surveillance, modeling, or meta-analysis).

Published reports[9,27–41] of outbreaks involving canine infectious diseases in canine group settings were identified. Several common themes were identified as contributing to these outbreaks, including high dog density and dog-to-dog contact,[9,35,39] inadequate quarantine of new or returning dogs,[27] poor dog confinement or wildlife exclusion,[9,40] inadequate vaccination,[9] poor vector control,[41] and inadequate disinfection practices.[9,39] Anecdotally, these reports appeared to far underestimate the occurrence of such outbreaks.

Table 1—Epidemiologic characteristics of pathogens of concern in canine group settings and methods for preventing their spread.

Pathogen	Prevalence and risk factors	Disease severity	Transmission mode	Prevention methods most important for group settings
Viruses				
Canine coronavirus (enteric)	Unknown; highest prevalence in young, kenneled dogs[106–108]	Mild to moderate	Direct contact; fomites (feces)	• Cleaning and disinfection • Feces control • Reduction of exposure through fomites • Hand hygiene • Isolation of infected dogs • Separation (reduce dog-to-dog contact)
CDV	Unknown; highly contagious; outbreaks in high-density settings with unvaccinated dogs[9]	Mild to severe (most common)	Direct contact; aerosols; fomites	• Cleaning and disinfection • Reduction of exposure through fomites • Hand hygiene • Isolation of infected animals • Separation (reduce dog-to-dog contact) • Vaccination • Prevention of wildlife exposure*
Canine herpesvirus-1	Unknown prevalence; naïve pregnant dams and their fetuses at greatest risk[109]	Moderate to severe	Direct contact; aerosols; fomites	• Cleaning and disinfection • Reduction of exposure to infectious fluids during the whelping or postpartum period • Reduction of exposure through fomites • Hand hygiene • Separation (reduce dog-to-dog contact) • Prevention of wildlife exposure*
Canine adenovirus type 1	Uncommon; highly contagious	Severe	Direct contact; fomites	• Careful attention to cleaning and use of specific disinfectants • Reduction of exposure through fomites • Hand hygiene • Isolation of infected dogs • Separation (reduce dog-to-dog contact) • Vaccination • Prevention of wildlife exposure*
Canine infectious respiratory disease complex† (kennel cough)	Common especially among those in group housing or high dog-to-dog contact[a]; highly contagious	Mild to moderate	Direct contact; aerosols; fomites	• Cleaning and disinfection • Reduction of exposure through fomites • Hand hygiene • Isolation of infected dogs • Separation (dog-to-dog contact)
CIV	Unknown prevalence; highly contagious[110]; dogs in group settings at increased risk[57,58,111,112]; large outbreaks reported	Mild to severe	Direct contact; aerosols; fomites	• Cleaning and disinfection • Reduction of exposure through fomites • Hand hygiene • Isolation of infected dogs • Separation (reduce dog-to-dog contact) • Vaccination
CPV-2	Common, particularly in young unvaccinated[50,51] and purebred dogs[113]; highly contagious	Severe (particularly for dogs 6 wk to 6 mo of age)	Direct contact; fomites (feces or vomit)	• Careful attention to cleaning and use of specific disinfectants • Feces control • Reduction of exposure through fomites • Hand hygiene • Isolation of infected dogs • Separation (reduce dog-to-dog contact) • Vaccination • Prevention of wildlife exposure
Pseudorabies	Uncommon; hunting dogs with swine contact at risk[40]	Severe	Direct contact with wildlife; fomites	• Reduction of exposure to swine and raw pork products[114]
Rabies	Approximately 80 canine cases/y in the United States and Canada[115]	Severe	Animal bites; contact with saliva	• Isolation of infected dogs • Vaccination • Prevention of wildlife exposure*
Papilloma	Common, particularly in young and immunosuppressed dogs	Mild; rarely severe	Direct contact	• Cleaning and disinfection • Reduction of exposure through fomites • Hand hygiene • Separation (reduce dog-to-dog contactc)
Bacteria				
Anaplasma phagocytophilum, *Anaplasma platys* (anaplasmosis)	Unknown; seasonal pattern (spring through fall) on the basis of tick exposure[74]	Mild	Tick bites	• Ectoparasite control (tick) • Limiting or controlling exposure to outdoor environments with infected vector

Table 1—Epidemiologic characteristics of pathogens of concern in canine group settings and methods for preventing their spread (continued).

Pathogen	Prevalence and risk factors	Disease severity	Transmission mode	Prevention methods most important for group settings
Bartonella henselae, *Bartonella vinsonii* (bartonellosis)	Unknown	Mild, but potentially severe (endocarditis)	Flea and tick bites	• Ectoparasite control (flea, tick) • Limiting or controlling exposure to outdoor environments with infected vector • Separation (reduce dog-to-dog contact)
Bordetella bronchiseptica (bordetellosis)	Common, particularly in young or group-housed dogs or those with high dog-to-dog contact;[a] highly contagious	Mild	Direct contact; aerosols; fomites	• Cleaning and disinfection • Reduction of exposure through fomites • Hand hygiene • Separation (reduce dog-to-dog contact) • Vaccination
Borrelia burgdorferi (Lyme disease)	Clinical signs uncommon; geographic and seasonal pattern (spring through fall) on the basis of tick exposure[44]	Mild to severe	Tick bites	• Ectoparasite control (tick) • Limiting or controlling exposure to outdoor environments with infected vector • Vaccination
Brucella canis (brucellosis)	Uncommon; most common in large breeding kennels[28]	Mild to severe	Direct contact; fomites	• Isolation of infected dogs • Gonadectomy • Testing (surveillance) program[116]
Campylobacter spp (campylobacteriosis)	Common, particularly in young dogs or dogs in group settings[45,97,117]	Mild to moderate	Fomites (feces); raw food	• Cleaning and disinfection • Feeding of commercial or homemade cooked diet • Feces control • Reduction of exposure through fomites • Hand hygiene
Coxiella burnetti (Q fever)	Uncommon; highly contagious	Mild to moderate	Direct contact; fomites	• Feeding of commercial or homemade cooked diet • Reduction of exposure to infected livestock and their birthing materials
Ehrlichia canis, *Ehrlichia chaffeensis*, *Ehrlichia ewingii* (ehrlichiosis)	Unknown; higher prevalence in Southern United States than elsewhere[44,75,118]	Mild to moderate	Tick bites	• Ectoparasite control (tick) • Limiting or controlling exposure to outdoor environments with outdoor vector • Prevention of wildlife exposure*
Escherichia coli, including MDR strains	Common; greater risk in dogs with recent antimicrobial administration or from group settings[77] or with reported coprophagia[119]	Mild to severe	Direct contact; fomites	• Cleaning and disinfection • Reduction of exposure through fomites • Hand hygiene • Separation (reduce dog-to-dog contact)
Francisella tularensis (tularemia)	Uncommon; highly infectious	Severe	Direct contact; fomites; insect bites	• Feeding of commercial or homemade cooked diet • Reduction of exposure to wild rodents and rabbits • Ectoparasite control (tick) • Limiting or controlling exposure to outdoor environments with infected vector
Leptospira interrogans (leptospirosis)	Unknown	Mild to severe	Fomites (urine)	• Reduction of exposure to environmental water sources or livestock • Vaccination • Prevention of wildlife exposure*
Staphylococcus spp, including MDR (or methicillin-resistant) strains	Common; greater risk in dogs with recent veterinary clinic visit or antimicrobial administration or those owned by a healthcare worker[120,121]	Mild to severe	Direct contact; fomites	• Cleaning and disinfection • Reduction of exposure through fomites • Hand hygiene • Separation (reduce dog-to-dog contact)
Mycoplasma spp (respiratory or hemotrophic mycoplasmosis)	Unknown prevalence; respiratory infection perhaps common[a]; high-density kennel environment increases risk of respiratory infection[122]	Respiratory: moderate; hemotropic: mild to severe	Respiratory: direct contact, aerosols, fomites; hemotropic: ectoparasites (ticks speculated)	Respiratory: • Hand hygiene • Separation (reduce dog-to-dog contact) Hemotropic: • Ectoparasite control speculated
Rickettsia rickettsii (RMSF)	Unknown prevalence; geographic and seasonal pattern (spring through fall) on the basis of tick exposure[44,72,73]	Moderate	Tick bites	• Ectoparasite control (tick) • Limiting or controlling exposure to outdoor environments with infected vector
Salmonella spp (salmonellosis)	Moderate prevalence (varies with study groups and diet, from 1%–69%)[84–86,123]	Variable (generally mild)	Fomites (feces); raw food	• Cleaning and disinfection • Feces control • Reduction of exposure through fomites • Isolation of infectious dogs • Feeding of commercial or homemade cooked diet
Streptococcus equi ssp *zooepidemicus*	Uncommon (more common with high dog density)[99,124]	Variable	Direct contact; aerosols; fomites	• Cleaning and disinfection • Reduction of exposure through fomites • Hand hygiene • Separation (reduce dog-to-dog contact)

Table 1—Epidemiologic characteristics of pathogens of concern in canine group settings and methods for preventing their spread (continued).

Pathogen	Prevalence and risk factors	Disease severity	Transmission mode	Prevention methods most important for group settings
Parasites				
Trypanosoma cruzi (American trypanosomiasis, Chagas disease)	Uncommon but emerging[68–71]	Severe	Triatomine bug feces	• Ectoparasite control (triatomine bug) • Limiting or controlling exposure to outdoor environments i with infected vector
Babesia canis vogeli, *Babesia gibsoni* (babesiosis)	Unknown	Mild	Tick bites; dog bites	• Reduction of exposure to fighting dogs • Ectoparasite control (tick) • Limiting or controlling exposure to outdoor environments with infected vector
Cheyletiella yasguri (mites)	Uncommon; highly contagious	Mild to severe	Direct contact; fomites	• Ectoparasite control (mite) • Separation (reduce dog-to-dog contact)
Cryptosporidium parvum, *Cryptosporidium canis* (cryptosporidiosis)	Common in group settings[82]	Mild to moderate	Fomites (oocysts in feces)	• Careful attention to cleaning and use of specific disinfectants • Reduction of exposure to contaminated water sources • Feces control • Reduction of exposure through fomites • Hand hygiene • Isolation of infected dogs • Separation (reduce dog-to-dog contact)
Dirofilaria immitis (heartworm)	Unknown; increased prevalence in South or Southeastern United States[44]	Mild to severe	Mosquito bites	• Ectoparasite control (mosquito) • Endoparasite control
Encephalitozoon cuniculi (encephalitozoonosis)	Highly variable[125]	Mild to severe	Fomites (spores from urine or feces)	• Feces control
Giardia duodenalis (giardiasis)	Common, particularly in young dogs and and dogs in high-density housing[95,96,126,127]	Mild to moderate	Fomites (cysts in feces)	• Cleaning and disinfection • Feces control • Reduction of exposure through fomites • Hand hygiene • Separation (reduce dog-to-dog contact)
Hepatozoon americanum (hepatozoonosis)	Uncommon but emerging[128,129]	Mild to severe	Tick ingestion	• Ectoparasite control (tick) • Limiting or controlling exposure to outdoor environments with infected vector • Prevention of wildlife exposure*
Ancylostoma caninum, *Ancylostoma tubaeforme*, *Uncinaria stenocephala* (hookworm)	Common, particularly in young dogs and dogs in high-density housing (varies with with hookworm species)[79,96]	Mild to severe	Fomites (larvae in feces)	• Endoparasite control • Feces control
Cystoisospora spp (*Isospora* spp; coccidiosis)	Common, particularly in young dogs[96]	Mild	Fomites (oocysts in feces)	• Careful attention to cleaning and use of specific disinfectants • Feeding of commercial or homemade cooked diet • Endoparasite control • Feces control
Leishmania infantum (leishmaniasis)	Rare (but common in endemic countries and emerging)[64,93]	Mild to severe	Sandfly bites; dog bites	• Ectoparasite control (sandfly) • Limiting or controlling exposure to outdoor enviroments with infected vector
Otodectes cyanotis (ear mites)	Common; highly contagious	Mild to moderate	Direct contact	• Ectoparasite control (mite) • Separation (reduce dog-to-dog contact)
Toxocara canis, *Toxascaris leonina* (roundworm)	Highly prevalent, particularly in young dogs[78–80]	Mild to severe	Fomites (eggs in environment from feces)	• Endoparasite control • Feces control • Prevention of wildlife exposure*
Sarcoptes scabiei (sarcoptic mange)	Unknown prevalence; young dogs at greater risk than others[7]	Moderate to severe	Direct contact	• Ectoparasite control (mite) • Reduction of exposure through fomites • Separation (reduce dog-to-dog contact)
Dipylidium caninum (tapeworm)	Common[79,130]	Mild	Ingestion of infected fleas	• Ectoparasite control (flea) • Prevention of wildlife exposure*
Trichuris vulpis (whipworm)	Common[79]	Mild	Fomites (eggs in feces)	• Endoparasite control • Feces control
Fungi				
Microsporum canis, *Trichophyton mentagrophytes* (dermatophytosis)	Common	Mild to moderate	Direct contact; fomites (spores)	• Reduction of exposure through fomites • Hand hygiene • Isolation of infected dogs • Separation (reduce dog-to-dog contact)

*An example of how to prevent wildlife exposure is building fences around outdoor kennels. †Viruses involved in this complex include CAV-2, CPiV, and coronavirus.
MDR = Multidrug resistant.

Reporting bias, whereby only outbreaks involving novel pathogens, unusual epidemiologic features, or new diagnostic techniques were reported, appeared to be at least partially responsible for the limited number of published outbreak reports. Additionally, few local, regional, or national animal health entities have established companion animal disease surveillance programs.[42] Furthermore, the epidemiology of infectious disease in companion animals is a relatively underserviced field that is still developing, compared with the epidemiology of infectious disease in humans and food animals. The limited surveillance and research efforts likely limited the detection or reporting of canine infectious disease outbreaks and therefore likely affected the availability of evidence to support the recommendations.

Rationale and recommendations to reduce infectious disease transmission in canine group settings

The paucity of reports of canine infectious disease outbreaks and incidence data greatly impaired the ability to perform a quantitative risk assessment. As such, a qualitative approach was used.[26] On the basis of summarized disease characteristics and modes of transmission, prevention and control recommendations were developed and grouped into related categories. These categories included general recommendations, vaccination, insect and wildlife control, vector control and vector-borne disease prevention, enteric disease prevention, environmental disinfection and hygiene, additional exclusionary measures, facility design and traffic control, and disease recognition and response.

In total, 64 recommendations were developed, which were grouped into the aforementioned categories (**Supplemental Document S1**, available at http://avmajournals.avma.org/doi/suppl/10.2460/javma.249.6.612. All recommendations achieved consensus (100% agreement) by the authors.

GENERAL RECOMMENDATIONS

Numerous attributes of a group setting will alter the risk of spreading infectious disease among dogs, and, in some situations, to people as well. These attributes include but are not limited to the setting (eg, indoor or outdoor),[43] geographic characteristics,[44] ages involved,[45] degree of dog-to-dog and dog-to-person contact,[46] and infection prevention methods used.[47] Setting and infectious disease expertise is required to effectively evaluate or identify specific risks inherent in each situation. In most group setting environments, such expertise is likely limited.[48]

Recommendation: Every canine group setting should have an attending or consulting veterinarian available who is familiar with the environment and purpose of the setting (category IB). This individual, on- or off-site, should provide assistance in developing and implementing site-specific protocols for infectious disease prevention (category IB).

Recommendation: Training for all involved staff on the risks of and methods for prevention of infectious diseases within the group setting should be required and documented. Staff knowledge on this topic should be assessed periodically (category IB).

Given the highly contagious nature of many of the pathogens of concern in canine group settings (Table 1) and the frequent direct and indirect contact among dogs in these settings, exclusion of dogs known to be at increased risk of shedding infectious agents is important.

Recommendation: Only dogs without clinical evidence of infectious disease should participate in group settings (category IA). Dogs that are suspected to have an infectious disease, or with signs of infectious disease not verified by a veterinarian to be due to a noninfectious cause, should be excluded from the setting (category IA). As applicable, dogs suspected to have an infectious disease should be immediately reported to the setting veterinarian or responsible official (category IA).

To control the spread of pathogens, many countries, states, and provinces require that incoming dogs have a valid health certificate. Where they exist, these regulations should be enforced in conjunction with the regulatory authority; where they do not exist, setting coordinators should consider implementing and enforcing this requirement to help reduce translocation of pathogens.

Recommendation: Valid health certificates for dogs traveling to a group setting from out of the state, province, or country should be required for entry into that setting (category IC).

Because dogs with infectious disease do not always have readily identifiable clinical signs,[49] successful disease prevention must extend beyond exclusion of dogs with overt signs of disease to include additional prevention efforts. A formal process should be used to ensure risks are appropriately evaluated and that prevention measures are reasonable and do not excessively overburden setting participants or detract from the intended benefits of the setting.

Recommendation: Disease prevention and control protocols should be developed on the basis of a risk assessment for the setting. This assessment should take into account the location and nature of the setting (eg, indoor or outdoor, amount of expected dog-to-dog and person-to-dog contact, event duration, population turnover, and ages of dogs involved; category IB).

Recommendation: A complete infection prevention and control plan should include strategies aimed at the individual dog, the population of dogs in that setting, and the local environment (eg, exposure to pathogen-infected vectors or wildlife; category IB).

Infection control and prevention plans are of little use if they are not put into action. Therefore, steps are necessary to maximize compliance with and therefore success of these protocols.

Recommendation: Requirements for involvement in group settings (including pertinent jurisdictional

regulations and the rationale for such requirements) should be clearly articulated to human participants prior to their arrival, and these requirements should be uniformly enforced (category II).

VACCINATION

Although a fairly limited number of the infectious diseases included in this report are preventable or reduced in severity through vaccination, several of the included high-consequence pathogens (ie, those resulting in high morbidity rates, high mortality rates, or both) are effectively controlled through vaccination. For example, CPV-2 is an important cause of severe (and potentially fatal) diarrhea in unvaccinated (or inadequately vaccinated) dogs,[50,51] and given that this virus is an environmentally tolerant pathogen spread through the fecal-oral route, it is of high concern in canine group settings.[39] Consequently, vaccination guidelines[17,24] established for shelter-housed dogs and pet dogs should be applied for dogs in canine group settings.

Recommendation: Dogs should be up-to-date on vaccinations[17,24] considered core for shelter populations (ie, vaccines against CDV, CAV-2, CPV-2, *Bordetella bronchiseptica*, CPiV, and rabies virus; category IA).

Recommendation: If the vaccination status of the dog is unknown or not up-to-date, at a minimum a single dose should be administered prior to entry, with an adequate time provided for the development of immunity (category IA).

Existing vaccination guidelines[17,24] suggest that, when only a single dose is to be administered, vaccine administration should occur in advance of event entry to allow for development of immunity (ie, at least 1 week before event entry for vaccines against CDV, CAV-2, and CPV-2; at least 3 days prior to event entry for intranasally or orally administered vaccines against *B bronchiseptica* and CPiV; and at least 28 days prior to event entry for vaccines against rabies virus).

Recommendation: All dogs should be vaccinated against rabies (and certificates required) in accordance with the jurisdictional laws that apply where the dog lives and the group setting is located (category IC).

Dogs should have received all core vaccines as appropriate for their age prior to involvement in the group setting.[17] Puppies that have not completed their core vaccine series because of their age may not yet have mounted an effective immune response because of maternal antibody interference. In such circumstances, the risk of infectious disease appears to be manageable, particularly when related preventive measures are strictly enforced.[52]

Recommendation: When the benefits of involving young dogs are high (eg, well-organized puppy socialization or obedience classes), other preventive measures should be taken, such as appropriate environmental cleaning and disinfection and strict exclusion of dogs with signs of respiratory or gastrointestinal illness (category IB).

Considerable controversy exists surrounding the usefulness of serum antibody titers as evidence for protective immunity. As recommended by existing guidance on this topic,[17,24] serum antibody titers are considered valid indicators of protective immunity against CDV, CAV-2, and CPV-2 and may be used to guide revaccination against these infections caused by these pathogens. Antibody titers regarding vaccines other than those against CDV, CAV-2 and CPV-2 have limited value, given that antibody may only persist for a short period and there is no known correlation between routine laboratory-measured serum antibody titers and protection.[17,24]

Coordinators of group events in which dogs are allowed to swim, drink, or otherwise have contact with environmental water sources (most notably standing water possibly contaminated by wildlife urine)[43,53] should encourage an up-to-date vaccination status against leptospirosis prior to participation, particularly if leptospirosis is known to occur in the region. With the reported increase in the prevalence of canine leptospirosis in urban environments, this disease is not only a rural concern.[54]

Vaccination against Lyme disease is encouraged for dogs at locations and event types where exposure to *Borrelia burgdorferi*–infected ticks is likely (eg, living, visiting, or attending events, particularly those in the outdoors or in the Northeast United States, Mid-Atlantic United States, and some regions of the Midwestern United States and Ontario, Canada.[24,44,55] High-risk activities for tick exposure include those that take place in wooded and tall grassy areas.

Over the past decade, CIV has resulted in several large outbreaks among dogs associated with Greyhound race tracks, shelters, and boarding facilities.[36,37] When evidence exists to indicate ongoing transmission of a vaccine-preventable strain of CIV in a region, vaccination should be encouraged for all dogs traveling to or from that region to participate in a group setting.[56–58] Similar to the situation with core vaccines, delivery of noncore vaccines should be timed to allow for maximum protection at time of anticipated dog exposure.[17,24]

Recommendation: Noncore vaccines (eg, against *Leptospira* spp, *B burgdorferi*, or CIV) should be considered on the basis of the epidemiologic characteristics of those pathogens specific to the setting location when expected activities pose an elevated risk of transmission (category II).

Vaccine failures do occur, even in properly vaccinated dogs. Some contraindications exist against vaccination (eg, compromised health), and some human participants in canine group events may knowingly or unknowingly fail to follow vaccine guidelines. Provided these participants remain a minority of the population, herd immunity of participating dogs will provide some protection from vaccine-preventable diseases. For this reason, it is important to enforce the specific requirements for the setting.

The ability to verify vaccination status will undoubtedly vary with the group setting. Some settings such as dog parks are minimally monitored for vaccination status or the large number of canine participants may make monitoring logistically difficult. However, given the highly infectious nature and severe consequences of several of these vaccine-preventable diseases together with the high degree of protection resulting from vaccination, substantial efforts to ensure protective vaccination status are warranted.

Recommendation: The vaccination status of all dogs should be individually verified on the basis of a reliable source (eg, veterinary medical record; category IB).

Recommendation: Because vaccination does not guarantee protection, preventive measures in addition to vaccination must also be considered for these diseases (category IA).

INSECT AND WILDLIFE CONTROL

Many pathogens that affect dogs have wildlife reservoirs (Table 1). Wildlife, including rodents, can spread infectious diseases directly, indirectly, and via vectors to dogs. Canine infectious disease outbreaks have occurred in group settings, at least in part, because of lapses in wildlife exclusion and poor dog containment.[9,40] Furthermore, efforts aimed at wildlife and nuisance animal exclusion (eg, fencing) have resulted in a reduction in environmental contamination with infectious pathogens.[59]

The risks of wildlife-derived infections vary on the basis of the prevalence of pathogens circulating in the local wildlife and the degree of wildlife contact afforded by the setting.[40] Although complete exclusion of wildlife is unlikely or unrealistic for most outdoor group settings, efforts should be directed to areas where close contact between dogs and wildlife is most likely to be unmonitored (eg, dog housing). The incidence of vector-borne diseases, such as Lyme disease, anaplasmosis, bartonellosis, and RMSF, can be further reduced through dog and environmental vector control.

Recommendation: Group setting coordinators should actively try to limit insects, rodents, and other wildlife from accessing or inhabiting the facility or dog housing areas (category IB).

Recommendation: When feasible, measures should be taken to exclude wildlife from dog areas (category IB).

Recommendation: Feces, unnecessary organic debris, and garbage (including uneaten human and dog food) should be immediately removed to assist in controlling insects, rodents, and other wildlife (category IB).

Recommendation: A safe and effective insect and wildlife control program should be used in and around buildings, parks, and kennels (category IB).

VECTOR CONTROL AND VECTOR-BORNE DISEASE PREVENTION

Fleas, ticks, flies, mosquitoes, lice, and triatominae (ie, kissing bug) vectors spread many canine pathogens that are of concern in group settings (Table 1). In some situations, infected dogs can increase the risk of spreading disease within the setting by serving as a pathogen source for local vectors, which can then subsequently infect other animals.[8,60] For some pathogens, the duration of vector feeding required for transmission is short (eg, several minutes for *Leishmania infantum*).[61] Additionally, dogs that become infected in a group setting can serve to transport the pathogen into geographically distant communities.[62] As such, vector control is an essential method for the prevention of infectious disease in canine group settings.

The risks of vector-borne infectious disease vary considerably by geography, season, and degree of contact with vectors associated with the type of setting. Because many vector-borne diseases that affect dogs can also affect humans and are reportable conditions with established surveillance programs, human-based surveillance data can be helpful in guiding prevention decisions for dogs by region and season.[63]

Preventive products for individual dogs are widely available and well-established in their ability to decrease the degree of ectoparasite exposure and thereby prevent the transmission of infectious diseases by these vectors, including RMSF,[47] leishmaniasis,[64] ehrlichiosis,[65,66] anaplasmosis, and borreliosis.[67] Additionally, parasites such as mites (*Cheyletiella* spp, *Otodectes cyanotis*, and *Sarcoptes scabiei*), although not known to spread pathogens infectious to dogs, are themselves transmissible, most notably in group settings.[7] Fleas are the most common ectoparasites of dogs. These highly transmissible insects can serve as vectors for infectious disease and result in various dermatologic conditions, including pruritus, hair loss, and dermatitis in dogs and other animals.

Recommendation: Effective ectoparasite and related pathogen (eg, heartworm) preventive products for topical or oral administration should be used prior to and during group event involvement on the basis of season, weather, geography, and the type of group setting (eg, indoor vs outdoor; category IA).

Recommendation: Integrated environmental vector control measures should also be taken on the basis of the risk for ectoparasite-borne disease (category IB).

Environments, both indoor and outdoor, can also play an important role in vector-borne disease transmission. Vectors may use the indoor environment for short periods while moving between dogs or, in some situations, become established indoors (eg, the brown dog tick [*Rhipicephalus sanguineus*], fleas, or triatomine bugs).[8]

Recommendation: Dogs entering group settings should be monitored for the presence of ectoparasites, particularly fleas and ticks (category II). If fleas or ticks are found, dogs should be treated with a rapid-kill insecticide product and excluded from entry (or placed in isolation) until confirmed to be free of the ectoparasite (category IB). Individual ticks can be manually removed, but this must be done by someone who is familiar with proper tick removal technique

(category II). Steps should be taken to determine the source of the ectoparasite and, when possible, use individual dog strategies, environmental strategies, or both to mitigate ectoparasite risk (category II).

Materials used in construction and proper maintenance of indoor or housing environments can influence the ability of vectors to survive and propagate indoors.

Recommendation: Surfaces that promote flea infestation, such as carpet and upholstery, should be kept to a minimum in the group setting environment (category II).

The brown dog tick is commonly found in buildings and outdoor dog runs and kennels, where there are cracks and crevices. When ticks are established within a physical structure used for canine group events, acaricides such as permethrin or pyrethroids should be used to control ticks.[47]

American trypanosomiasis, transmitted by infected triatomine bugs, is an emerging infectious disease for dogs in some regions of North America, with disease currently restricted to the Southern and Southwestern United States.[68–71]

Recommendation: In areas where American trypanosomiasis is a concern and the disease-causing triatomine vector is known to be present, insecticides should be used to reduce vector prevalence (category IB). In areas where triatomine bugs are endemic, dogs should be housed indoors whenever possible to decrease exposure to the vector (category II).

Risks of outdoor vector-borne disease are related to biological characteristics of the vector and ecological characteristics of the infectious disease. Many factors including geography, climate, and abundance of host animal species are responsible for the seasonal and regional variations in disease risk. In general, the risk of tick-borne disease (eg, RMSF, Lyme disease, anaplasmosis, and ehrlichiosis) is greatest from spring through fall, with risk of many of the diseases having a pronounced regionally dependent component.[44,72–75]

Recommendation: Whenever possible, outdoor events to be held in locations with a high prevalence of tick-borne disease should be scheduled when the risk of tick exposure is lowest (eg, November to March in some regions; category IB).

Outdoor contact with optimal vector habitat (eg, tall grass and wooded areas) also increases the risk of dogs acquiring an infectious disease.

Recommendation: Where and when the risk of exposure to potentially infected ticks is high, outdoor group events should be held away from wooded areas and tall grass (category IB).

Recommendation: Grass in outdoor areas with which dogs have contact should be kept short and free of litter and brush (category IB).

If, as part of a group event, dogs must enter an area where their risk of exposure to potentially infected ticks is high, a full-body inspection of the dog (with removal of ticks) immediately after the event (or at multiple points daily for all-day or several-day events) is advised. In a similar manner, dog contact with environments with propagating mosquito populations increases the risk of heartworm infection.

Recommendation: To minimize mosquito exposure, canine group settings should be located away from standing water, such as stagnant ponds or catch basins, whenever possible. Human-provided water sources (eg, water bowls) should be changed at least twice per week to prevent mosquito larvae from developing (category IB).

The setting veterinarian can guide specific recommendations by conducting a risk assessment. The aforementioned individual dog and environmental control efforts have been shown to dramatically reduce the incidence of infectious disease attributable to ectoparasites in at-risk canine populations.[47]

ENTERIC DISEASE PREVENTION

Enteric pathogens with a potential for fecal-oral transmission were frequently identified in the literature as important to control in canine group settings (Table 1). For many of these pathogens, dogs in group settings have an elevated risk of infection, compared with dogs in other settings.[76,77] Furthermore, the prevalence of some enteric pathogens, notably endoparasites, varies geographically, in part because of differences in temperature and other environmental conditions important for pathogen survival.[78–80]

Preventive products for individual dogs such as core vaccines (eg, CDV and CPV-2) and anthelmintics are widely available and are highly effective in preventing many enteric infectious diseases.[17,81]

Recommendation: All dogs should be on an effective endoparasite prevention program prior to and during group setting involvement on the basis of season, geography, and type of group setting (eg, indoor vs outdoor; category IA).

Additionally, given the prolonged environmental stability of many of these enteric pathogens, it is logical that environmental management through feces removal and prevention of feces consumption (coprophagia) would be important for reducing the risk of infectious enteric disease. Several studies[80,82,83] have revealed an increased risk of enteric infection (ie, *Giardia* spp, *Campylobacter* spp, or *Cryptosporidium* spp) for unleashed dogs at dog parks, compared with the risk for leashed dogs; increased exposure to canine feces is likely one of the factors contributing to this increased risk.

Recommendation: Prompt removal and disposal of dog feces should be encouraged and canine coprophagia discouraged in group settings (category IB).

Considerable evidence exists to suggest that dogs fed raw (uncooked or unpasteurized) meat-, egg-, or milk-based products or treats are more likely to shed enteric pathogens such as *Salmonella* spp, *Campylobacter* spp, and *Escherichia coli*, potentially increasing the risk for outbreaks of infections with such pathogens in dogs in group settings.[84–86]

Recommendation: All dogs in group settings should be fed a standard commercial diet that has been processed to reduce or eliminate foodborne bacteria (eg, heating, irradiation, or high pressure pasteurization) or a thoroughly cooked homemade diet to decrease the risk of spreading enteric pathogens (category IB).

In situations in which feeding uncooked (raw) animal product-based food or treats that have not been treated to reduce pathogen contamination is permitted, it is important that owners or handlers be directly responsible for ensuring that only their dogs eat them and for managing related factors that increase the risk of infectious disease (eg, by promptly cleaning and disinfecting bowls and locations used to feed and prepare food items, promptly removing feces, and hand washing).

ENVIRONMENTAL DISINFECTION AND HYGIENE

Many of the pathogens identified as important to control in canine group settings have biological attributes, such as environmental stability, or highly infectious properties that facilitate transmission through fomites (Table 1). Furthermore, fomites (eg, water and food bowls, obstacles used in agility events, retrieval objects, and grooming items) and environmental surfaces (eg, flooring or kennels) are commonly encountered in group settings with substantial shared contact. When inadequately cleaned and disinfected, such objects have been associated with infectious disease outbreaks.[9,46,51,87,88] Existing guidance is available to direct appropriate cleaning and disinfection for fomites and the environment.[89,90]

Recommendation: A cleaning and disinfection program should be developed and implemented for indoor and outdoor exercise, grooming, and housing areas. Key principles such as prompt removal of gross debris, cleaning with detergent and water, and correct use of a disinfectant (appropriate product, dilution, and contact time required for killing or inactivating pathogens that dogs may encounter in the setting) should be followed (category IA).

Some pathogens are easily eliminated with routine household disinfectants, whereas others, notably nonenveloped viruses (eg, CPV-2), are more difficult to remove and require a more aggressive disinfection protocol and product.[90] For cleaning and disinfection to be successful, items and locations with close, repeated dog contact should be made of materials amenable to cleaning and disinfection or they should be dedicated for individual dog use. Organic surfaces such as grass and dirt are impossible to disinfect and are consequently nonideal for infectious disease prevention.

Recommendation: Whenever possible and applicable, the flooring in the group setting should be made from nonporous material that is easy to clean and disinfect (category IA).

Recommendation: As appropriate for the group setting, owners or handlers should bring their own items (eg, bedding, toys, grooming tools, and water or food bowls) and be discouraged from sharing those items with other dogs, owners, or handlers (category IB). Equipment and soft goods provided by the setting coordinators, such as leashes, collars, toys, and bedding, should be for dedicated single animal use (category II). Following use, equipment (notably clipper blades, grooming tools, water or food bowls, and nondisposable medical items such as thermometers) should be routinely cleaned and disinfected, particularly prior to use with a different dog (category IB).

In settings in which semipermanent dog subgroups are established (eg, dog daycare), cleaning and disinfection precautions are most important when moving items between dog subgroups.

Hand hygiene is an established and essential method for general infectious disease control. In canine group settings, hand hygiene plays an important role because of the close contact between people and dogs, the high likelihood for an individual person to have contact with multiple dogs, and the environmental stability and ease of transmission characteristic of many pathogens of concern.

Recommendation: Setting coordinators should encourage staff, owners, handlers, and others with dog contact to wash hands with water and liquid soap (or apply an alcohol-based hand sanitizer when hands are not visibly soiled) on entry to and exit from the group setting and between contact with each dog (category IB).

When this is not practical because of the circumstances of the group setting, hands should be washed or sanitized between groups of dogs. It should be kept in mind that alcohol-based hand sanitizers are not effective against nonenveloped viruses and some other pathogens (eg, CPV-2, *Clostridium* spp, and *Cryptosporidium* spp) or when the hands are visibly dirty. Given the importance of pathogen spread through hands and role of hand hygiene in reducing that spread, the setting should be designed to facilitate compliance.

Recommendation: Hand washing or alcohol-based hand sanitizer stations should be readily accessible in group settings to encourage hand hygiene and reduce pathogen spread (category IB).

Similar to the hands of owners, handlers, and setting personnel, the coat and skin of dogs may carry pathogens.

Recommendation: To reduce fecal contamination, ectoparasites, and other pathogens on the coats of dogs, owners should be encouraged to bathe dogs with a routine pet shampoo prior to entry into a group setting (category II). For group settings involving repeated entries, such as dog daycare, bathing should be performed on a regular basis or whenever debris is visible on a dog. Regular brushing may be useful when frequency of bathing is impractical (category II).

ADDITIONAL EXCLUSIONARY MEASURES

Several infectious diseases of concern in canine group settings are emerging or rare in Canada and

the United States, with higher prevalences and risks of disease in other countries. Currently, leishmaniasis and American trypanosomiasis are perhaps most well known as high-risk diseases associated with travel to endemic areas. These have the potential for extension into Canada and the United States given the presence of competent vectors,[69,91–93] but other infectious diseases are likely to emerge in the near future. Given the evolving nature of infectious disease emergence, a single specific high-risk region cannot be predicted. Many infectious diseases in dogs may go unnoticed for days to weeks because of long incubation periods or subclinical shedding of responsible pathogens, so dogs with recent travel to a high-risk region may pose an increased risk for pathogen spread when entering a group setting.

Although incubation periods vary for those pathogens of concern in canine group settings, many have an incubation period of ≤ 2 weeks. Signs of disease that develop in a dog within 2 weeks after returning from travel should be assessed by a veterinarian and reported to the group setting coordinator before the dog is allowed to participate.

Recommendation: Dogs that have originated from or spent time outside Canada and the United States should be excluded from group settings for 2 weeks following their return or entry (category II).

Dog age is perhaps one of the greatest risk factors for acquiring (and transmitting) many of the infectious diseases of concern to canine group settings. In general, dogs < 1 year of age are at the greatest risk for acquiring an infectious disease.[45,78,80,94–98] This increased risk is attributable to various factors, including inadequate vaccination, waning maternal antibodies, exposure to novel pathogens, and behaviors (eg, chewing of fomites, close play with other dogs, and mouthing activity) that increase the likelihood of direct and indirect pathogen spread. As mentioned in the vaccination recommendations, ensuring that young dogs have received their core vaccination series will assist in reducing these risks. Additional prevention efforts should be considered when involving young dogs in a group setting.

Recommendation: Dogs not formally involved in a group setting, such as those brought to a dog show for socialization or sale, can contribute to an increase in the overall risk of infectious disease and, particularly young dogs, should be excluded from the setting (category IB).

FACILITY DESIGN AND TRAFFIC CONTROL

Reducing unnecessary direct and indirect dog-to-dog and dog-to-person contact is important for reducing opportunities for infectious disease transmission. This has been illustrated in several documented outbreaks of canine infectious disease,[7,35,39,57,99,100] in which high population density or an increase in direct contact among dogs were evident and considered to have contributed.

Recommendation: To reduce the risk of spreading pathogens, high-density kennel situations should be avoided (category IA). This is particularly important for young dogs (puppies) and dogs that have not received their full core vaccination series (category IA). Dog density should not interfere with the ability to appropriately disinfect the setting environment or maintain adequate air quality (category IB).

Recommendation: Unnecessary dog-to-dog contact should be minimized, while still allowing any intended benefits of the group setting (category IA). When dog-to-dog contact is an integral part of the setting (eg, dog daycare), semipermanent small subgroups (cohorts) should be established to reduce new contacts and infectious disease transmission (category IB).

Attention to traffic flow is commonly used in hospital settings to reduce unnecessary and higher-risk contact among people, and a similar approach is appropriate for canine group settings.

Recommendation: Careful attention should be paid to anticipated or potential dog and person movement when developing a facility or setting layout to minimize unnecessary dog-to-dog and dog-to-person contact (category IB).

Several of the pathogens of greatest concern in canine group settings can become aerosolized (ie, spread via droplets), whereby particles can travel short distances, further complicating the determination of space requirements needed for reducing pathogen exposure (Table 1). The ability to minimize unnecessary dog-to-dog and dog-to-person contact varies with the event. In many settings, this can be addressed by establishing distinct areas where the general public is restricted from entering and ensuring adequate space and instructions so dogs from different owners or handlers are housed far enough apart (eg, at least 1 m) to reduce transmission opportunities.[101] Dogs with clinical illness (eg, coughing or sneezing) may exhale droplet particles greater distances (eg, 6 m); therefore, maximization of the distance among dogs when reasonable and prompt removal of dogs with clinical illness are important.[101] It is also important to provide a separate housing location for those dogs that need immediate removal from shared spaces because of a suspected infectious disease but cannot be removed from the premises at that time.

Recommendation: Group settings should have a dedicated isolation area where dogs known or suspected to have an infectious disease can be immediately segregated from other dogs in the setting (category IA). The location of this area should allow for physical and procedural separation from other dogs (category IA).

DISEASE RECOGNITION AND RESPONSE

Surveillance programs, whereby specific infectious diseases or conditions are reportable to organizers of canine group settings, allow for early recognition of disease transmission and outbreaks. Established programs are frequently used in human group setting environments, where they play an important role in reduc-

ing the risk of infectious disease transmission. Deficiencies in surveillance have, at least in part, been responsible for the occurrence or extended duration of outbreaks in canine group settings.[37,39]

Recommendation: Coordinators of group settings should have a surveillance program in place to monitor for infectious diseases, focusing on dogs that develop clinical signs at the setting.

Although incubation periods vary by pathogen, a period of 2 weeks following a group event represents a reasonable timeframe for identification of probable instances of infectious disease transmission attributable to that event.

Recommendation: Owners or handlers should be encouraged to report suspected or confirmed cases of infectious disease that develop in their dogs within 2 weeks after attending a group event (category IB).

Clear disease case definitions will assist in ensuring data are reliable and can be used to identify when pathogen-specific response strategies are indicated. Standard disease case definitions for dogs are being developed and used by some entities,[102,103] and these definitions may serve this purpose for other settings. Effective case definitions generally include pathogen-specific clinical signs and diagnostic test results but can also include syndromic signs (eg, cough, diarrhea, or vomiting) that do not indicate a specific cause but suggest the presence of an infectious disease.

Definitions should also be provided for both confirmed cases (strongly supported by laboratory data) and suspected cases (epidemiologically linked lacking adequate laboratory data).[103] Additionally, it is useful to include case definitions for syndromes or nonspecific-infection cases and outbreaks (eg, acute respiratory disorder: evidence of upper or lower respiratory tract disease evidenced by coughing, sneezing, nasal discharge, abnormal lung sounds, tachypnea, or dyspnea).[104]

To ensure a prompt response is possible, historical records of suspected or confirmed cases of infectious disease and at-risk dogs are important to determine the existence and scope of disease transmission as well as potentially exposed dogs.

Recommendation: Group setting coordinators should use record-keeping systems that capture individual dog information regarding dates of involvement in the setting, location and housing during their attendance, required health documentation, reported disease or syndrome concerns, and contact information for owners or handlers (category IB).

When identification of individual dogs is not reasonable (eg, dog parks), alternative methods of communication with owners or handlers should be established (eg, specific website, email distribution list, or posted park signage) and maintained.

For many pathogens, minimal contact is required for successful spread between dogs with an infectious disease and dogs susceptible to that disease. Furthermore, dogs with an infectious disease can cause widespread contamination of fomites and the shared environment, which can lead to secondary transmission. As such, quick identification and removal of affected dogs from group events is important to halting or reducing further transmission.

Recommendation: Staff, handlers, and owners should visually monitor dog health and report dogs with any of a predetermined set of signs (syndromic surveillance) to the setting coordinator or veterinarian (category IB).

Recommendation: Any dog that becomes ill or is believed to have an infectious disease should be immediately removed from the group setting (to isolation or removed from the premises), pending evaluation by a veterinarian (category IB). While a dog is in isolation, physical and procedural measures appropriate for the suspected pathogen should be used to reduce the risk of disease transmission to other dogs and contamination of the environment, as recommended by the setting veterinarian (category IB). To further reduce the risk of transmission, dogs exposed to dogs with infectious disease should be identified, given that these dogs may develop infectious disease following the pathogen-specific incubation period.

Recommendation: Susceptible dogs with known exposure to another dog or dogs with infectious disease should be excluded from the group setting for a quarantine period of 2 weeks, or as recommended by a veterinarian (category IB).

To ensure all protocols and parties responsible for individual components of a response to suspected or confirmed cases of infectious disease are evident, a disease management (outbreak) plan should be developed that is specific for the group setting.

Recommendation: A plan for responding to reports of suspected or confirmed infectious disease in dogs involved in group settings should be developed to describe how information will be acquired and evaluated to identify disease transmission associated with the setting, general and pathogen-specific approaches for how affected and exposed dogs will be handled, and actions that will be taken to contain pathogen spread. Identification of a person who will be responsible for overseeing response actions and communication with the public is strongly encouraged as part of the plan (category IB).

Conclusions

Although difficult to quantify, the risks of infectious disease transmission in canine group settings are clearly evident and substantial. Dog-to-dog contact is likely, and severe consequences can ensue when dogs leaving these settings spread pathogens back into the community and potentially over large geographic areas. Risks can be minimized by addressing key areas in disease prevention planning, including insect and wildlife control, vector-borne disease prevention, enteric disease prevention, environmental disinfection and hygiene, facility design and traffic control, vaccination, and surveillance and outbreak management.

Because risks vary within and between settings, it is important for people involved in canine group settings to adopt recommendations that are most in line with the risks specific to their setting and geographic location and to seek the assistance of individuals knowledgeable in the event setting. Further tailoring recommendations to the risk of disease transmission is currently hindered by a lack of high-quality studies, few of which specifically target dogs in group settings, and limited surveillance to allow documentation of disease outbreaks or establishment of background disease incidence rates or modifiable factors associated with disease in these settings. Devoted attention to these research areas will be important to the development of prevention recommendations specific to each individual canine group setting or activity.

An important (and unmet) need exists for veterinarians to partner with other stakeholders in canine group settings to ensure successful development, implementation, and training of staff in prevention and risk mitigation recommendations that protect both dog and human health. Although not a specific objective of the recommendation development process and outcomes reported here, it is important to acknowledge that many of the pathogens important in canine group settings also cause disease in people. The recommendations reported here and others specific to prevention of human disease in animal settings[4,5,23,26] are also important to ensure the health and safety of people attending, participating in, and working in canine group settings.

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Footnotes

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Appendix

Classification system used to categorize the quality of evidence used to develop recommendations to mitigate the transmission of canine infectious diseases in canine group settings.[105]

Category	Description
IA	Strongly recommended for implementation and strongly supported by well-designed experimental, clinical, or epidemiologic studies
IB	Strongly recommended for implementation and supported by certain experimental, clinical, or epidemiologic studies and a strong theoretic rationale
IC	Required by provincial or territorial, state, or federal regulation, or representing an established association standard
II	Suggested for implementation and supported by limited clinical or epidemiologic studies or by a theoretic rationale
Unresolved	No recommendation offered; no scientific consensus or insufficient evidence exists regarding efficacy