Enteropathogens identified in cats entering a Florida animal shelter with normal feces or diarrhea

Stephanie J. Sabshin, DVM; Julie K. Levy, DVM, PhD, DACVIM; Tiffany Tupler, DVM; Sylvia J. Tucker, BS; Ellis C. Greiner, PhD; Christian M. Leutenegger, DVM, PhD

Objective—To determine the frequency of enteropathogens in cats entering an animal shelter with normal feces or diarrhea.

Design—Cross-sectional study.

Animals—100 cats evaluated at an open-admission municipal animal shelter in Florida.

Procedures—Fecal samples collected within 24 hours after admission from 50 cats with normal feces and 50 cats with diarrhea were tested by fecal flotation, antigen testing, PCR assay, and electron microscopy for selected enteropathogens.

Results—12 enteropathogens were identified. Cats with diarrhea were no more likely to be infected with ≥ 1 (84%) enteropathogens than were cats with normal feces (84%). Only feline coronavirus was significantly more prevalent in cats with diarrhea (58%) than in cats with normal feces (36%). Other enteropathogens identified in cats with and without diarrhea included *Clostridium perfringens* enterotoxin A (42% and 50%, respectively), *Cryptosporidium* spp (10% and 20%, respectively), *Giardia* spp (20% and 8%, respectively), *Cystoisospora* spp (14% and 10%, respectively), hookworms (10% and 18%, respectively), ascarids (6% and 16%, respectively), *Salmonella* spp (6% and 4%, respectively), astrovirus (8% and 2%, respectively), feline panleukopenia virus (4% and 4%, respectively), calicivirus (0% and 2%, respectively), and *Spirometra* spp (0% and 2%, respectively).

Conclusions and Clinical Relevance—In the present study, cats entered the shelter with a variety of enteropathogens, many of which are pathogenic or zoonotic. Most infections were not associated with diarrhea or any specific risk factors such as signalment, source, or body condition, making it difficult to predict which cats were most likely to be infected. It is not possible to test all shelter cats for all possible infections, so practical guidelines should be developed to treat routinely for the most common and important enteropathogens. (*J Am Vet Med Assoc* 2012;241:331–337)

Diarrhea is a common finding in cats and may be attributed to the effects of stress, dietary intolerance, primary intestinal diseases, and infections with enteropathogenic viruses, parasites, protozoa, and bacteria. Many of these enteropathogens have major zoonotic potential, although public health risk factors are believed to be more frequently related to shared environments than to direct contact with cats.[1,2] Several studies[3–9] have found some enteropathogens to be more common in shelter cats than in owned pet cats. This is likely due to lack of preventive health care provided to unwanted and neglected pets or to free-roaming homeless cats prior to their impoundment. The result is that shelter staff members are likely to encounter a higher prevalence of incoming cats infected with enteropathogens than are veterinary clinics.

From Maddie's Shelter Medicine Program, Department of Small Animal Clinical Sciences (Sabshin, Levy, Tupler, Tucker) and the Department of Infectious Diseases and Pathology (Greiner), College of Veterinary Medicine, University of Florida, Gainesville, FL 32610; and IDEXX Laboratories Inc, 2825 KOVR Dr, West Sacramento, CA 95605 (Leutenegger).

Supported by Maddie's Fund, the Merck-Merial Veterinary Scholars Program, IDEXX Laboratories Inc, and the Kissimmee Diagnostic Laboratory, Division of Animal Industry, Florida Department of Agriculture and Consumer Services.

Address correspondence to Dr. Levy (levyjk@ufl.edu).

Abbreviations

CI	Confidence interval
EM	Electron microscopy
FCoV	Feline coronavirus
FPV	Feline panleukopenia virus

Shelters are stressful environments for cats,[10,11] which may increase susceptibility to infections.[12] In addition to stress, impounded cats face crowding, mixing of animals from various environments, and exposure to other species. These factors facilitate the transmission of infectious diseases among animals in shelters and potentially to their human caregivers and shelter visitors. In a recent study,[13] new pet adopters reported that 10% of cats had parasites and 7% had diarrhea within a week after adoption from a shelter. Failure to manage enteric infections may frustrate the adopter experience and create a public health risk that cats may transmit enteric infections to other animals or to their new families following adoption.

It is estimated that approximately 4 million cats enter animal shelters in the United States each year.[14] Shelter managers must often make difficult decisions regarding the allocation of limited financial, staff, and

facility resources to meet competing needs. Although guidelines exist for vaccination of cats in shelters,[15] comparable guidelines tailored for this unique setting are not available for many other important issues, including management of common enteropathogens. Guidelines developed for pet cats[16] are often impractical in shelters because of limited funding, staffing, and technical expertise. Without guidelines customized for shelters, managers are left to make their own adaptations to manage infectious diseases, often without knowledge of what infections are common and in the absence of veterinary consultation. The purpose of the study reported here was to identify the prevalence of parasitic, bacterial, and viral enteropathogens in cats entering an animal shelter and to correlate enteropathogen infection with the presence of diarrhea.

Materials and Methods

Study site—The present study was conducted at an open-admission municipal animal shelter in Alachua County, Fla.[a] In 2009, this shelter admitted 3,715 dogs and 3,904 cats. Cats admitted to this shelter were either stray, owner surrendered, or confiscated. At admission, each cat received a brief physical examination by the intake technician; parenteral modified-live feline viral rhinotracheitis, calicivirus, and panleukopenia virus vaccination[b]; pyrantel pamoate[c]; and fipronil.[d] A veterinarian examined each cat to determine its health status 1 to 7 days later. Cats with signs of possible contagious illness such as upper respiratory disease, lethargy, and severe or bloody diarrhea were housed in an isolation ward away from healthy cats when space permitted. Most cats were housed singly in 18 × 18 × 18-inch stainless steel cages lined with newspaper. Queens with kittens or related cats were sometimes housed in groups. Cages were spot-cleaned daily with potassium peroxymonosulfate[e] during the time a cat occupied them and thoroughly cleaned and disinfected between occupants. Stray cats were held for 5 days and then evaluated for adoption, transfer, or euthanasia. Owner-surrendered cats could have immediate disposition. Confiscated cats were held until relinquished by their owners or court-ordered disposition.

Sample collection—Study investigators visited the shelter each morning before cat cages were cleaned from June 1 through July 1, 2009. Study cats were those that were admitted within the previous 24 hours and had feces in the litter box at the time the investigators were present. Fecal samples were collected from the first 50 cats found to have normal feces in their litter boxes and the first 50 cats found to have diarrhea in their litter boxes. Investigators scored fecal consistency from 1 to 7 on the basis of appearance and texture by use of a pictorial scoring chart.[f] A score of 1 was defined as feces that were very hard and dry and left no visible residue on the ground when removed. A score of 7 was defined as being textureless, watery, flat, and occurring in puddles. Fecal consistency scores were dichotomized into a normal category (score, 1 to 3; including all textures that maintained form when picked up) or a diarrhea category (score, 4 to 7; including all textures that lost form when picked up). To avoid cross-contamination of samples, each was collected with a newly gloved hand assisted by a fresh wooden tongue depressor or fresh syringe depending on the consistency of the sample. For each cat, 3 fecal aliquots were collected into fresh plastic screw-top jars. One jar from each cat was selected for PCR assay and was individually placed into its own zipper-lock plastic bag to further reduce the chance of cross-contamination. The second jar was designated for fecal flotation and antigen testing. The third jar was designated for EM. All supplies were disposed of after each sample and were not reused. Samples were transported in a cooler and were stored at 4°C pending analysis. For each sample, information about the cat was collected, including an estimated age (on the basis of dentition or owner report), sex, health condition, source, and identification number. Address of origin was used to determine whether the community from which the cat originated was primarily urban or rural on the basis of population density, number of residents, housing density, income, and land use.[17] Investigators assigned a body condition score of 1 to 9 for each cat on the basis of a pictorial chart. Body condition scores were converted into categorical variables for analysis, including undercondition (score, 1 to 3), adequate body condition (score, 4 to 6), and overcondition (score, 7 to 9). When > 1 cat occupied a cage, as in the case of litters, a single sample was collected and some individual animal-specific information such as sex was recorded as unknown if it could not be determined from which cat the sample came.

Testing protocol—Fecal samples were tested in the investigators' laboratory by gross examination and fecal flotation for macroparasites, parasite eggs, cysts, oocytes, and larvae within 24 hours after collection. Feces (approx 1 g) were mixed with sodium nitrate solution (specific gravity, 1.200)[g] in a standardized flotation device,[h] incubated with a coverslip for 15 minutes, and then evaluated qualitatively by light microscopy at 40× and 100×. Feces were tested in the investigators' laboratory for *Giardia* antigen by fecal ELISA within 24 hours after collection.[i] Reported sensitivity and specificity of the *Giardia* antigen test, compared with immunofluorescent antibody assay, is 95% and 99%, respectively.[j] Feces were tested in the investigators' laboratory for canine parvovirus antigen by fecal ELISA.[k] Reported sensitivity and specificity of the canine parvovirus antigen test in cats, compared with PCR assay, is 95% and 97%, respectively,[18] and compared with EM, is 60% and 100%, respectively.[19] Fecal samples were tested by real-time PCR assay for a panel of potential enteropathogens, including *Tritrichomonas foetus* 5.8S rRNA gene (AF339736), *Cryptosporidium* small-subunit rRNA gene (A093489), *Giardia* small-subunit rRNA gene (DQ836339), *Toxoplasma gondii* internal transcribed spacer-1 gene (L49390), *Clostridium perfringens* enterotoxin A gene (AM888388), *Salmonella* invasion A gene (EU348366), FPV VP2 gene (EU252145), and FCoV 7b gene (DQ010921.1), at a reference laboratory within 7 days after collection.[l] Real-time PCR was run with 7 quality controls, including PCR-positive controls, PCR-negative controls, negative extraction controls, DNA preanalytic quality control targeting the host 18S rRNA gene complex, RNA preanalytic quality control target-

ing the host 18S rRNA gene complex, an internal positive control spiked into the lysis solution, and an environmental contamination monitoring control. Finally, transmission EM was performed on each fecal sample to screen nonspecifically for viral particles at a reference laboratory within 7 days after collection.[m] One hundred fields were scanned at 3,000× for suspected viral particles. Visual identification of specific viruses on the basis of morphology was made at 85,000×. Reported sensitivity for this test is 10^5 to 10^6 viral particles/mL. In the case of enteropathogens evaluated by > 1 testing methodology (FCoV, FPV, and *Giardia* spp), the prevalence reported for each method was calculated. Given that there are no published reports comparing the accuracy of PCR assay and EM for virus diagnosis, for purposes of statistical analysis, cats were considered positive for FPV or FCoV if any of the test results were positive.

Risk factors—Cat risk factors for enteropathogen infection that were evaluated included age (juvenile [< 6 months old] or adult [≥ 6 months old]), sex (female, male, or unknown in the case of feral cats or multiple cats per cage), source (stray or owned), environmental origin (rural or urban), health status other than diarrhea (healthy or unhealthy), body condition (undercondition, adequate condition, or overcondition), and fecal consistency (normal or diarrhea).

Statistical analysis—Sample sizes were selected to detect a difference in infection prevalence of ≥ 30% between the group with normal feces and the group with diarrhea with a power of > 80% and $P < 0.05$. Each cat risk factor was evaluated for each enteropathogen in cats with normal feces and in cats with diarrhea by use of a χ^2 test or Fisher exact test as appropriate. Odds ratios and 95% CIs were calculated when appropriate. Values of $P < 0.05$ were considered significant. All analyses were performed with statistical software.[n]

Results

Of 480 cats admitted to the shelter during the study period, 98 (20%) were previously owned, 382 (80%) were strays, 190 (40%) were females, 177 (37%) were males, and the sex of 113 (24%) was unknown. These proportions were not significantly ($P \geq 0.30$) different from the source and sex of the 100 cats enrolled in the study (**Table 1**). All but 8 of the study cats were considered healthy (with the exception of diarrhea) at intake by the shelter veterinarian. Six of these cats had upper respiratory infection, 1 was injured, and 1 was infected with FIV. Most cats were juveniles, most were admitted as strays, and most originated from urban environments. The sex of 7 cats and the environmental origin of 2 cats were unknown. There were no significant ($P \geq 0.34$) differences in signalment, condition, or source between the group with normal feces and the group with diarrhea.

Twelve potential enteropathogens were identified in the cats in the present study, and most cats had multiple organisms (**Table 2**). There was no difference in the odds of cats with diarrhea having ≥ 1 enteropatho-

Table 1—Characteristics of cats having normal feces (n = 50) and cats having diarrhea (50) within 24 hours after admission to a municipal animal shelter in northern Florida.

		No. (%) of cats				
Variable	**Total**	**Normal feces**	**Diarrhea**	**OR**	**95% CI**	***P* value**
Age						
Adult	28	13 (26)	15 (30)	Referent		
Juvenile	72	37 (74)	35 (70)	0.82	0.31–2.15	0.66
Body condition						
Undercondition	11	4 (8)	7 (14)	Referent		
Adequate condition	89	46 (92)	43 (86)	NA	NA	0.34
Overcondition	0	0 (0)	0 (0)	NA	NA	NA
Sex						
Male	46	22 (44)	24 (48)	Referent		
Female	47	27 (54)	20 (40)	0.68	0.28–1.67	0.86
Unknown	7	1 (2)	6 (12)	5.50	NA	0.12
Source						
Stray	84	42 (84)	42 (84)	Referent		
Owned	16	8 (16)	8 (16)	1.00	0.30–3.29	1.00
Environment						
Rural	28	12 (24)	16 (32)	Referent		
Urban	70	37 (74)	33 (66)	0.67	0.25–1.77	0.37
Unknown	2	1 (2)	1 (2)	0.81	NA	1.00
Health status						
Healthy	92	46 (92)	46 (92)	Referent		
Unhealthy	8	4 (8)	4 (8)	1.00	NA	1.00

NA = Not applicable.

Table 2—Frequency of identification of multiple enteropathogens in fecal samples from the cats in Table 1.

	No. of enteropathogens						
Fecal consistency	**0**	**1**	**2**	**3**	**4**	**5**	**6**
Normal	8 (16)	12 (24)	13 (26)	13 (26)	3 (6)	1 (2)	0 (0)
Diarrhea	8 (16)	20 (40)	9 (18)	6 (12)	6 (12)	0 (0)	1 (2)

Data are given as number (%) of cats.

gen, compared with those for cats with normal feces (OR, 1.00; 95% CI, 0.30 to 3.29; *P* = 1.00). *Toxoplasma gondii* and *Tritrichomonas foetus* were not detected in any sample. All enteropathogens identified, with the exception of *Spirometra mansonoides* and calicivirus (which were present in only 1 cat each), were detected in cats both with and without diarrhea (**Table 3**). Of individual enteropathogens identified, only FCoV was significantly (*P* = 0.03) more common in cats with diarrhea than in cats with normal feces (OR, 2.46; 95% CI, 1.02 to 5.97).

Each cat risk factor was evaluated for each enteropathogen in cats with normal feces and in cats with diarrhea. Within the group of cats with diarrhea, the frequency of identification of FCoV was significantly (*P* = 0.01) higher among the owner-surrendered cats (8/8) than among stray cats (21/42 [50%]) and was significantly (*P* = 0.02) higher (OR, 5.33) among adults (12/15) than among juveniles (15/35 [43%]). Adult cats with diarrhea were also significantly (*P* = 0.01) more likely (OR, 5.00) to have *Giardia* spp (10/15) than were juveniles with diarrhea (10/35 [29%]). Within the group of cats with normal feces, the frequency of identification of FCoV was significantly (*P* = 0.02) higher (OR, 4.20; 95% CI, 1.05 to 17.65) among male cats (12/22 [55%]) than among female cats (6/27 [22%]), and the frequency of hookworms was significantly (*P* = 0.04) higher (OR, 5.16) among adults (5/13) than among juveniles (4/37 [11%]).

Three assays (PCR assay, ELISA, and fecal flotation) were used for the detection of *Giardia* spp. There was total agreement in test results for *Giardia* DNA by PCR assay and for antigen by ELISA, but *Giardia* spp was not identified in any samples by fecal flotation, which is recognized as an insensitive assay for *Giardia* spp. Three assays (PCR assay, ELISA, and EM) were used for FPV detection. One diarrheic sample was positive for FPV by all 3 test methods. A different sample was positive for FPV by PCR assay only, and 2 samples were positive for FPV by EM only. Prevalence of FPV in cats with normal feces was the same for all 3 test methods (2%) and increased to 4% when the criteria used included any positive result. Prevalence of FPV in cats with diarrhea was 2% for PCR assay and antigen testing and 4% for EM and remained at 4% when the criteria used included any positive result. There was more variability between 2 testing methods for FCoV (PCR assay and EM). Forty-seven samples were positive for FCoV by PCR assay (32) or EM (30), but only 15 samples were positive by both methods. Cats with normal feces had a prevalence of 22% by PCR assay and 18% by EM, which increased to 36% when the criteria used included any positive result. Cats with diarrhea had the same prevalence (42%) for both PCR assay and EM, and prevalence increased to 58% when the criteria used included any positive result. Results of EM were also positive for miscellaneous viruses that were not included in virus-specific PCR or antigen assays. Five samples, 4 of which were diarrheic, were positive for astrovirus, and 1 normal sample was positive for calicivirus.

Discussion

Most cats in the present study harbored infectious enteropathogens of animal or zoonotic importance at the time of intake at the shelter. Infections were found in cats both with and without diarrhea, and there were few correlations between the presence of enteropatho-

Table 3—Frequency of identification of specific enteropathogens in fecal samples from the cats in Table 1.

Enteropathogen	Fecal consistency	No. tested	No. (%) positive	OR	95% CI	*P* value
Cryptosporidium spp	Normal	50	10 (20)	Referent		
	Diarrhea	50	5 (10)	0.44	NA	0.16
Cystoisospora spp	Normal	50	5 (10)	Referent		
	Diarrhea	50	7 (14)	1.47	NA	0.54
Giardia spp	Normal	50	4 (8)	Referent		
	Diarrhea	50	10 (20)	2.88	NA	0.08
Toxoplasma gondii	Normal	50	0 (0)	NA		
	Diarrhea	50	0 (0)	NA	NA	NA
Tritrichomonas foetus	Normal	50	0 (0)	NA		
	Diarrhea	50	0 (0)	NA	NA	NA
Clostridium perfringens enterotoxin A	Normal	50	25 (50)	Referent		
	Diarrhea	50	21 (42)	0.72	0.30–1.72	0.42
Salmonella spp	Normal	50	2 (4)	Referent		
	Diarrhea	50	3 (6)	1.53	NA	1.00
Ascarids	Normal	50	8 (16)	Referent		
	Diarrhea	50	3 (6)	0.34	NA	0.11
Hookworms	Normal	50	9 (18)	Referent		
	Diarrhea	50	5 (10)	0.44	0.16–1.19	0.07
Spirometra mansonoides	Normal	50	1 (2)	Referent		
	Diarrhea	50	0 (0)	NA	NA	1.00
Astrovirus	Normal	50	1 (2)	Referent		
	Diarrhea	50	4 (8)	4.26	NA	0.36
Calicivirus	Normal	50	1 (2)	Referent		
	Diarrhea	50	0 (0)	NA	NA	1.00
Feline coronavirus	Normal	50	18 (36)	Referent		
	Diarrhea	50	29 (58)	2.46	1.02–5.97	0.03
FPV	Normal	50	2 (4)	Referent		
	Diarrhea	50	2 (4)	1.00	NA	1.00

gens and other risk factors such as source, age, or sex. This suggests that every cat entering a shelter should be considered as potentially infected with enteropathogens.

Viral enteropathogens were identified in most cats. Feline coronavirus was the only enteropathogen significantly more prevalent in diarrheic cats, among which previous ownership and being 6 months or older were risk factors for infection. This is consistent with previous observations in which pet and cattery cats have a higher prevalence of seropositivity for FCoV antibodies, presumably because of sharing of litter boxes, than do stray and feral cats, which roam outdoors and bury their feces individually.[20] Although only 4 cats in the present study had detectable FPV in their feces, this underscores the importance of vaccination at admission and rapid identification and removal of cats suspected to be infected with this highly infectious and lethal virus.[15] Outbreaks of FPV in shelters are common, and managers frequently resort to depopulation of the entire cat population for control.[21] However, considering that samples were collected < 24 hours after cats received a modified-live vaccine, it is possible that the assays detected vaccine virus and not wild-type virus. Virus particles consistent with astroviruses were identified by EM in 5 cats, similar to a previous study[22] in which astroviruses were observed in 7% of Australian shelter cats, both with and without diarrhea.

Two nematodes with zoonotic potential were commonly identified in cats in the present study. Hookworms have previously been reported to have the highest prevalence in the southeastern United States,[23] including shelter cats in Florida (75%)[24] and Connecticut (2%),[4] and in pet cats in Pennsylvania (8%)[25] and nationally (< 1%).[23] Ascarids have been reported to be more prevalent in the northern, mid-Atlantic and central states,[21] including Colorado (8%),[5] Connecticut (68%),[4] and New York (37%),[26] and in pet cats in Colorado (2%),[5] Connecticut (30%),[4] Pennsylvania (8%),[25] New York (27%),[26] and nationally (3%).[23] The cats in the present study received pyrantel pamoate < 24 hours before sample collection. It is possible that the frequency of hookworms and ascarids could have been underestimated if treatment was successful in rapid removal of ova-shedding parasites in some cats.

Three highly infectious protozoal infections, including 2 of zoonotic potential, were detected in this study. The zoonotic potential of *Giardia* spp and *Cryptosporidium* spp in cats is currently under debate.[27–30] Cats available for adoption in a New York shelter were found to have both host-adapted and zoonotic strains of *Giardia* spp.[31] Fourteen percent of the cats in the present study tested positive for *Giardia* spp, which is similar to findings in pet cats from Mississippi and Alabama (14%)[3] but higher than in sheltered cats in northern California (10%)[32] and New York (8%)[26] or in pet cats in Pennsylvania (2%)[25] and nationally (< 1%).[33] Fifteen percent of the cats in the present study tested positive for *Cryptosporidium* spp, a higher prevalence than in shelter cats in Colorado (8%)[5] and New York (5%).[26] The high prevalence of *Giardia* spp and *Cryptosporidium* spp presents a special challenge for shelters in that both diagnosis and treatment can be complicated, labor-intensive, and unsuccessful. Feline-specific coccidia were also detected more commonly in shelter cats in the present study (12%) than in a national survey of pet cats (1%).[33] Recently, the antiprotozoal drug ponazuril has gained popularity for treatment of coccidiosis in shelter cats, although it is not labeled for use in this species.[34] Although previous studies[3,35] have correlated the presence of *Giardia* spp, *Cryptosporidium* spp, and coccidia with diarrhea in cats, there were no significant differences in prevalence of infections relative to fecal consistency in the present study. *Tritrichomonas foetus* infection was not diagnosed in any cats. This is likely because cats were tested near the time of admission to the shelter and were housed individually. *Tritrichomonas foetus* is found most frequently in cats housed in crowded groups[36–40] versus free-roaming or individually housed cats.[39] *Toxoplasma gondii* was also not detected, likely because of the very short oocyst-shedding period following acute infection.

Potentially pathogenic bacteria were identified in most cats. Detection of the clostridial gene for *C perfringens* enterotoxin A was common in cats both with and without diarrhea in the present study, but identification of the toxin itself was not attempted. The role of this enterotoxin in feline diarrhea remains unclear because it is also commonly detected in cats with normal feces. However, 1 study[41] identified the toxin in diarrheic cats only. Potentially zoonotic *Salmonella* carriage was documented in 5% of cats in the present study.

Variable rates of discordancy were observed among different test methodologies for the same organism in the present study. Point-of-care tests such as fecal examination and antigen testing provide the most rapid and inexpensive diagnostic options but require appropriate staff training and equipment. In addition, point-of-care tests may not be as sensitive as some more expensive and slower laboratory-based assays such as PCR assay or EM. The high sensitivity of PCR assay can also create problems due to detection of clinically irrelevant trace contamination from the environment, cross-contamination of samples during collection or processing, or detection of nonpathogenic viruses or bacteria introduced by recent vaccination. Fecal antigen testing is unlikely to be affected by recent vaccination[21] but is less sensitive than PCR assay for detecting FPV infection.[19]

Many of the enteropathogens detected in the present study can be effectively managed with vaccines and parasiticides. National guidelines have not yet been published for routine control of nonviral enteropathogens in shelters. Regional differences in pathogen epidemiology should be taken into account, as should the length of time cats are expected to remain at the shelter and whether they are housed individually or comingled in groups. In shelters, it is often impractical to test each animal and to develop an individual treatment plan on the basis of the results. Instead, it is often more cost-effective to routinely administer inexpensive broad-spectrum parasite control, such as pyrantel pamoate, for control of zoonotic hookworms and ascarids. The CDC and the Companion Animal Parasite Council recommend routine treatment for these parasites every 2 weeks from 2 weeks to 2 months of age, after which monthly broad-spectrum parasite preventives should be administered.[42–45]

Practical treatments and preventives do not exist for some feline enteropathogens, such as *Cryptosporidium* spp, *T foetus*, and FCoV. Therefore, it is important that shelter staff understand and maintain appropriate cleaning and disinfection protocols to reduce transmission within the shelter. Nonenveloped viruses, such as FPV and calicivirus, are resistant to many commonly used disinfectants but are susceptible to sodium hypochlorite, potassium peroxymonosulfate, and accelerated hydrogen peroxide products.[46,47] Some pathogens, including coccidial oocysts and ascarid eggs are nearly impossible to eliminate from contaminated environments with disinfectants. Physical methods such as painting kennels or soil removal may be required for effective decontamination. Shelter workers and visitors should protect themselves and other animals by washing hands or changing gloves after handling cats. Alcohol hand sanitizers are convenient and can be used where handwashing stations are not available, but they do not inactivate calicivirus or FPV.[46,47]

In the present study, cats entered the shelter with a variety of enteropathogens, many of which are highly pathogenic or zoonotic. Guidelines that are logistically and financially feasible for use in shelters should be developed for control of the most common or important enteropathogens encountered in shelter cats. Regardless of whether specific or empirical treatment for enteropathogens is initiated, adopters should be informed and referred to a private veterinarian for follow-up testing and treatment tailored to the needs of their individual pet.

a. Alachua County Animal Services, Gainesville, Fla.
b. Fel-O-Guard Plus 4, Fort Dodge Animal Health, Fort Dodge, Iowa.
c. Strongid, Pfizer, New York, NY.
d. Frontline, Merial, Lyon, France.
e. Virkon S, DuPont, Wilmington, Del.
f. Fecal Scoring System, Nestle Purina, St Louis, Mo.
g. Fecasol Solution, Evsco Pharmaceuticals, Buena, NJ.
h. Fecalyzer, Evsco Pharmaceuticals, Buena, NJ.
i. SNAP *Giardia* Antigen Test, IDEXX Laboratories Inc, Westbrook, Me.
j. Package insert, SNAP *Giardia* Antigen Test, IDEXX Laboratories Inc, Westbrook, Me.
k. SNAP Parvo Test, IDEXX Laboratories Inc, Westbrook, Me.
l. RealPCR Comprehensive Feline Diarrhea Panel, IDEXX Laboratories Inc, West Sacramento, Calif.
m. Kissimmee Diagnostic Laboratory, Division of Animal Industry, Florida Department of Agriculture and Consumer Services, Kissimmee, Fla.
n. Epi Info, version 3.5.1, CDC, Atlanta, Ga.

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