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Risk factors for delays between intake and veterinary approval for adoption on medical grounds in shelter puppies and kittens

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Abstract

To maximize their capacity to save lives and optimize resource allocation, animal shelters need to identify highly adoptable animals that are unlikely to be delayed on medical grounds before they can be made available for adoption. In this retrospective cohort study, our objective was to identify risk factors for delays from intake to approval for adoption on medical grounds in shelter puppies and kittens. Shelter medical records from 2008 for 335 puppies and 370 kittens were selected randomly at a large metropolitan adoption-guarantee shelter. Data including signalment, source shelter, intake veterinary examination findings, clinical history and days from intake until approval by a veterinarian for adoption on medical grounds were extracted from shelter records and analyzed using multivariate Cox regression. Puppies and kittens with clinical signs of respiratory or gastrointestinal disease at intake took significantly longer to receive approval for adoption on medical grounds (puppies - respiratory $p < 0.0001$; gastrointestinal $p < 0.0001$; kittens - respiratory $p < 0.0001$; gastrointestinal $p = 0.002$). Stray kittens were more likely to be delayed than owner-relinquished kittens or those transferred from other shelters ($p < 0.01$). Older kittens were less likely to be delayed ($p < 0.0001$). Administration of oral or parenteral antibiotics to puppies and kittens with respiratory and/or ocular signs within 24 hours of intake significantly reduced time to approval on medical grounds for adoption (puppies $p = 0.02$; kittens $p = 0.03$). The analyses suggested that puppies and kittens with respiratory or gastrointestinal signs on intake are more likely to experience delays between intake and veterinary approval for adoption on medical grounds. Prompt antimicrobial treatment of animals with respiratory and/or ocular signs may decrease length of stay in the shelter.

Keywords

Animal shelter; Infectious disease; Adoption; Epidemiology

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1. Introduction

Animal shelters care for 6–8 million dogs and cats annually in the United States (HSUS website) and management to optimize the health of shelter pets and minimize the introduction of infectious disease in the face of a constantly changing population, potential overcrowding and limited funds remains a major challenge in shelter medicine (Peterson et al., 2008). Since shelters are composed of populations of animals, a focus on population management is an essential component of maintaining the health of individual shelter pets. The concepts developed for efficient management of emergency room triage in human hospitals are relevant to animal shelters, since they maximize the utilization of the available facilities for an incoming population (Albin et al., 1975). Medical triage protocols are used to guide resource allocation during resource scarcities and under ideal circumstances are based on evidence and ethical principles (Christian et al., 2006). Similarly, individualized evidence-based protocols could be used as management tools to guide animal selection and care in an animal shelter.

It is self-evident that the ability of an animal shelter to maximize the number of homeless animals saved is increased when highly adoptable animals such as puppies and kittens are selected and when the time taken for approval as suitable for adoption on medical grounds is minimized. Our aim was to analyze shelter records from a group of puppies and kittens taken into an adoption guarantee shelter in 2008 to determine risk factors for delays from intake until approval by a veterinarian as suitable for adoption on physical examination findings. We hypothesized that delays were more likely in animals with clinical signs of disease at the intake veterinary examination.

2. Materials and methods

2.1. Animals

Shelter records for puppies and kittens (6–26 weeks old) taken into PAWS Chicago Rescue and Recovery Center during 2008 were reviewed and analyzed. PAWS Chicago is an adoption-guarantee shelter that sources its intake mainly from the local municipal shelter, Chicago Animal Care and Control, but also accepts some transferred animals from other shelters within the same region. Puppies and kittens are selected for admission to PAWS Chicago daily by shelter staff, who make their selection decisions based on the requirements of the PAWS Chicago Adoption Center regarding breed size for puppies and coat color for kittens. On intake, puppies are housed separately from adult or ill dogs. Kittens are separated from other shelter cats and kittens according to day of intake or by age. All healthy animals are sent to foster homes, depending on availability, within 2–7 days. Foster carers sometimes take animals with mild clinical signs of illness, but only if the animal is still eating and requires only oral medication, if any. Any unwell animals that require injectable medications or daily recheck examinations by a shelter veterinarian are housed at the shelter. Treatments are usually administered to these animals while they are in their cages, but sometimes treatments are given during recheck veterinary examinations in a consulting room at the shelter.

Clinical data was unavailable from any previous stays at other source shelters, but information was collected regarding which shelter the animal came from, and in the case of animals from Chicago Animal Care and Control, whether the animal was stray or owner-relinquished. Intake veterinary examinations were conducted by a staff of approximately 5 part time veterinarians and occurred within 48 hours of each animal's arrival at the shelter. The following information was recorded - age, breed, gender (including spay/neuter status) and bodyweight (kg) at intake; physical examination findings by a veterinarian at intake; clinical history during the stay at PAWS Chicago; and the number of days from the intake

veterinary examination until approval by a veterinarian that the animal was clinically healthy on physical examination and therefore suitable for adoption from a medical perspective.

Veterinary approval for adoption was granted purely on medical grounds and was not influenced by other factors related to the potential adoptability of the animal, such as gender or breed. Approval was granted after the animal had undergone an intake examination, received intake vaccinations, was spayed or neutered, and had been found healthy at a pre-adoption veterinary examination. The method of random systematic sampling used was to select records alphabetically by the pet's name. Puppies and kittens that were less than 6 weeks old at the time of intake were excluded from the study as it was shelter policy dictated that animals must be at least 6 weeks old before receiving approval for adoption by a veterinarian.

2.2. Statistical analysis

Statistical computations were performed using Stata 11.1 (StataCorp. College Station, TX). The log-rank test was used to evaluate equality of time to veterinary approval for adoption between variable categories for each species. Multivariate Cox regression models for kittens and for puppies, with time to veterinary approval for adoption as the dependent variable, were used to estimate odds ratios adjusted for other variables included in the model. Tests of Cox regression assumption were conducted for each species to ensure that model assumptions were not violated. This test evaluates non-zero slope in a generalized linear regression of the scaled Schoenfeld residual for both individual variables and the global model over time. The null hypothesis (zero slope) of the test is that the log hazard-ratio function does not change over time, indicating that the model assumptions were not violated (Schoenfeld, 1982; Therneau and Grambsch, 1994). Mann-Whitney U-tests were used to compare the interval between intake and veterinary approval for adoption in groups of puppies and kittens.

3. Results

During the study period, a total of 1764 dogs and 1343 cats were taken into the shelter. Descriptive statistics and the most commonly recorded problems by body system on the intake veterinary examination are reported in Table 1. Table 2 reports the number and frequency of single and multiple clinical signs in the population. The results of Cox model assumption testing for each species were not statistically significant ($P>0.05$), indicating that the model assumptions were not violated.

3.1. Puppies

Of 501 puppies taken into PAWS Chicago in 2008, records from 333 puppies (66.96%) were included in the analysis. Of the 333 puppies, 139 (41.7%) had no abnormalities identified on a physical examination at the time of intake performed by a shelter veterinarian and of those, 1 puppy subsequently became ill before it was granted approval by a veterinarian for adoption on medical grounds. In the multivariate model (Table 3), puppies with skin diseases, respiratory diseases and digestive diseases at the intake veterinary examination had significantly higher odds of a delay before veterinary approval for adoption (skin OR=1.61; $p=0.01$; respiratory OR=2.4; $p<0.0001$; digestive OR =1.55; $p < 0.0001$).

3.2. Kittens

Of 607 kittens taken into PAWS Chicago in 2008, records from 364 kittens (60.96%) were included in the analysis. Of the 364 kittens in the study, 104 (28.5%) did not have any abnormalities identified on a physical examination performed by a shelter veterinarian at the

time of intake. Of the 104 healthy kittens, 5 subsequently became ill before they were eventually granted approval by a veterinarian for adoption on medical grounds. In kittens, the 4 most commonly recorded problems by body system were respiratory (n=162; 44.51%), gastrointestinal (n=143; 39.29%), ocular (n=96; 26.37%) and skin (n=42; 11.54%). In the multivariate analysis (Table 3), kittens with respiratory disease or digestive disease identified on the intake veterinary examination were more likely to undergo delays before veterinary approval for adoption (respiratory OR=3.95 $p < 0.0001$; digestive OR=1.50 $p = 0.002$). Kittens transferred from other shelters had significantly lower odds of a delay until veterinary approval for adoption compared with stray kittens (OR=0.57; $p = 0.01$). The odds of delays to approval for adoption reduced by 2% for each week increase in the kitten's age at the time of intake. The test of Cox model assumption indicated that the model assumptions were not violated.

3.2 Antimicrobial usage

Decisions regarding antimicrobial treatment were made by the attending shelter veterinarian and were based on individual clinical judgment. The most commonly used first-line antimicrobial was amoxicillin/clavulanic acid (puppies - 53/107 initial prescriptions; 50.0%; kittens - 131/182 initial prescriptions; 72.0%), followed by clindamycin for kittens (35/182 initial prescriptions; 19.2%) and doxycycline for puppies (14/107 initial prescriptions; 13.1%). A single antimicrobial was usually prescribed initially (puppies - 84/107 initial prescriptions; 78.5%; kittens - 157/182 initial prescriptions; 86.3%). Clinical decisions such as changing or adding antimicrobials to treatment regimens, or commencing other treatments, such as topical preparations and fluid therapy, were made by shelter veterinarians depending on clinical response.

Of 88 puppies that had clinical signs of respiratory and/or ocular disease on the intake veterinary examination (sneezing, coughing, abnormal respiratory tones on auscultation, nasal or conjunctival discharge), 14 (15.9%) commenced a course of antimicrobial treatment prescribed by a shelter veterinarian within 24 hours of the intake examination. Of the remaining 74 puppies, 64 (86.5%) subsequently received antimicrobials prescribed after a veterinary examination during their shelter stay. Of puppies with respiratory and/or ocular signs at intake, those that received antimicrobials in the first 24 hours had significantly reduced time to veterinary approval for adoption ($p = 0.02$; median time to approval = 12.5 days compared to 20 days). Of 182 kittens with clinical signs of respiratory and/or ocular disease at intake, 19 (10.4%) received antimicrobials prescribed by a shelter veterinarian within 24 hours and of the remaining 163 kittens, 93 (57.1%) went on to receive antimicrobials prescribed after a further veterinary examination during their stay. Commencement of antimicrobial treatment within 24 hours of intake significantly reduced the interval between intake and veterinary approval for adoption in kittens that had respiratory and/or ocular signs on intake ($p = 0.03$; median time to approval = 29 days compared to 39 days).

4. Discussion

This study analyzed shelter records to identify risk factors for delays from intake to approval on medical grounds for adoption in shelter puppies and kittens so that recommendations for animal selection could be developed. The shelter used was a well-resourced adoption-guarantee shelter in a large metropolitan area, so animal intake and facilities available for care may not be typical of shelters elsewhere. However, our results could provide a useful starting point for other kinds of shelters where decisions are made about animal selection in the face of limited resources. It would be interesting to repeat this study at an open-admission shelter, or at a shelter in a more rural location to compare the results and draw conclusions about why differences (or similarities) in risk factors for delays to approval for

adoption may occur. In order to achieve the end goal of maximizing lives saved, animal selection also needs to take into account the types of animals being presented to shelters and the needs and preferences of potential adopters. The concepts of shelter supply and demand may modify selection against potentially at-risk animals, so the results of this study could be used instead to develop targeted recommendations for extra care in at-risk animals.

Respiratory tract disease is the most common and difficult to manage infectious problem in animal shelters (Foley and Bannasch, 2004; Pedersen et al., 2004) and in dogs and cats, the major syndromes are kennel cough and upper respiratory tract infection (Foley and Bannasch, 2004). A limitation of this study is the lack of microbiological data for the animals with respiratory and/or oral ocular disease on intake, but most shelters do not have the resources for diagnostic testing prior to treatment or final disposition. A previous study on respiratory disease in shelter cats found that the most common pathogens were feline herpesvirus (FHV), feline calicivirus (FCV), *Bordetella bronchiseptica*, *Chlamydophila felis*, and *Mycoplasma* species (Bannasch and Foley, 2005). Our study confirms the results of another study of shelter cats, which reported that cats with upper respiratory infections (URI) tended to be younger than uninfected cats and that purulent ocular and nasal discharge was commonly associated with all URI pathogens investigated (Bannasch and Foley, 2005). Canine kennel cough complex is caused by *Bordetella bronchiseptica* (Bemis et al., 1977) and/or co-infecting viruses or bacteria and is a significant cause of morbidity in shelter dogs (Appel and Percy, 1970).

Both puppies and kittens in this study that had clinical signs of gastrointestinal disease at intake were more likely to be delayed before they were approved as adoptable on medical grounds ($p < 0.001$). An investigation of disease prevalence in shelter dogs reported that coughing and diarrhea were the most common clinical signs in unwell dogs and that vomiting, diarrhea and parvovirus were more common in puppies than in juveniles or adults (Wells and Hepper, 1999). Similarly, a paper that compared the frequency of disease among puppies acquired from various sources, reported that pups from pet stores and animal shelters were significantly more likely to have intestinal tract disease (Scarlett et al., 1994) than those acquired from private owners or breeders.

In this population, the presence of skin disease delayed time to veterinary approval for adoption in puppies ($P = 0.01$), but not in kittens ($P = 0.51$). This could be related to the relative prevalence of different causative factors for dermatological disease in each species, although unfortunately specific information of this kind was not available. This finding could be explained if skin disease in kittens was due predominately to flea infestation, which is quickly and easily cured, while conditions that required longer courses of treatment, such as *Demodex* or bacterial infections, predominated in puppies.

Delays before approval for adoption on medical grounds were less likely in kittens that were owner-relinquished or transferred from another shelter rather than stray; female; and/or older at the time of intake (stray status $p < 0.001$; gender $P = 0.029$; age $p < 0.0001$). It is possible that kittens that have been owned or have previously been taken into a shelter are more likely to have been vaccinated than stray kittens, thereby reducing their risk of developing feline panleukopenia or the more severe clinical effects of FHV and/or FCV. Additionally, the immune system in older kittens is also more likely to be developed than in younger kittens, although waning maternally-derived immunity could reduce the protection afforded by age. However, a recent study documenting the response to vaccination of feral cats at the time of neutering reported that only some of the cats had protective serum antibody titers against FPV (33%), FHV (21%) and FCV (64%) (Fischer et al., 2007). It could be speculated therefore that maternally-derived immunity against these common shelter

pathogens in stray kittens is not common, in part explaining the higher risk for delays on medical grounds before clearance for adoption in younger kittens.

For both puppies and kittens in this study, prompt oral or parenteral antimicrobial treatment for respiratory and/or ocular disease on intake was significantly associated with reduced time before approval as suitable for adoption on medical grounds puppies ($P = 0.02$; kittens $P = 0.03$). The decision to prescribe antibiotics was made purely on the clinical judgment of the attending shelter veterinarian and it is possible that bias could have been introduced if the animals that received antibiotic treatment had initially presented with more severe clinical signs. However, if that was the case, treated animals would be less likely to reach approval on medical grounds for adoption before untreated animals – the opposite of the findings reported here. Our findings agree with the results of previous studies which reported that prolonged shelter time was a major risk factor for feline URI³ and the development of coughing in dogs (Edinboro et al., 2004). Early antimicrobial treatment of puppies and kittens with respiratory and/or ocular signs admitted to animal shelters is also likely to be cost effective, as the cost of most antimicrobial drugs compare favorably with the daily costs of providing shelter care.

A limitation of this study is that the outcome variable (approval for adoption on medical grounds by a veterinarian) may not have been based on uniform and objective criteria. Misclassification bias could have been caused by inter- or intra-observer variability in the physical examination findings between different veterinarians working at the shelter. The direction of this potential bias is unlikely to be in only one direction, thereby reducing its net effect, but its magnitude is difficult to predict.

Further prospective studies, performed at a range of shelters with different admission policies and in a range of locations, could enable more targeted recommendations to be made to optimize selection policies in animal shelters. Facilitating a smooth transition from intake to approval for adoption will potentially increase shelter intake, an important factor in reducing pet homelessness.

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Table 1

Descriptive statistics for information collected at the veterinary examination at the time of intake for puppies (n=333) and kittens (n = 365) entering an adoption-guarantee animal shelter. N/A = Not applicable.

Variable	Puppies		Kittens	
	n	%	n	%
Skin disease present	40	12.01	42	11.54
Respiratory disease present	72	21.62	162	44.51
Digestive disease present	127	38.14	143	39.29
Gender				
Male	167	50.15	182	50.00
Female	166	49.85	182	50.00
Source				
Stray	92	28.13	125	34.72
Owner relinquished	149	45.57	196	54.45
Transferred from another shelter	86	26.30	39	10.83
Breed				
Canine mixed breed	308	93.05	N/A	N/A
Canine - not mixed breed	23	6.95	N/A	N/A
Feline - Domestic medium hair	N/A	N/A	34	9.34
Feline - Domestic longhair	N/A	N/A	16	4.40
Feline - Domestic shorthair	N/A	N/A	308	84.62
Feline - Siamese mix	N/A	N/A	6	1.64
Age (weeks)	Median = 11	Range = 6–26	Median = 10	Range = 6–26

Table 2

Number and proportion of single and multiple clinical signs in the population at the intake veterinary examination*.

Clinical sign/s	Puppies		Kittens	
	n	%	n	%
No Signs	163	48.95	139	38.19
Digestive only	77	23.12	46	12.64
Respiratory only	30	9.01	73	20.05
Respiratory and digestive	23	6.91	64	17.58
Skin only	9	2.7	2	0.55
Skin and digestive	12	3.6	15	4.12
Skin and respiratory	5	1.5	7	1.92
Skin, digestive and respiratory	14	4.2	18	4.95
Total	333	100	364	100

* Clinical signs were included in the proportional hazard model as individual variables, but not as overlapping multiple clinical signs, to avoid multicollinearity.

Table 3

Results of multivariable analysis of information collected at the veterinary examination at the time of intake for puppies and kittens entering an adoption-guarantee animal shelter. An odds ratio >1 indicates increased odds of delay from intake to veterinary approval for adoption on medical grounds. NA = Not applicable¹.

Variable	Puppies		Kittens	
	Odds Ratio (95% Confidence Intervals)	p-value	Odds Ratio (95% Confidence Intervals)	p-value
Skin disease present *	1.61 (1.12 – 2.32)	0.01	1.12 (0.80 – 1.58)	0.51
Respiratory disease present *	2.40 (1.80 – 3.19)	<0.0001	3.95 (3.01–5.18)	<0.0001
Digestive disease present *	1.55 (1.22 – 1.98)	<0.0001	1.50 (1.17 – 1.93)	0.002
Gender				
Male	1.00	Reference	1.00	Reference
Female	0.96 (0.76 – 1.20)	0.697	0.78 (0.62–0.97)	0.092
Source				
Stray	1.00	Reference	1.00	Reference
Owner relinquished	1.02 (0.76 – 1.35)	0.896	0.82 (0.63 – 1.07)	0.136
Transferred from another shelter	0.91 (0.69 – 1.21)	0.517	0.57 (0.38 – 0.87)	0.01
Breed				
Canine mixed breed	1.00	Reference		
Canine - not mixed breed	0.74 (0.47 – 1.17)	0.194		
Feline - Domestic medium hair			1.00	Reference
Feline - Domestic longhair			0.18 (0.31 – 1.25)	0.182
Feline - Domestic shorthair			0.52 (0.61 – 1.29)	0.515
Feline - Siamese mix			0.28 (0.27 – 1.65)	0.379
Age (weeks)	0.98 (0.96–1.00)	0.062	0.94 (0.92 – 0.96)	<0.0001

* Clinical signs were included in the proportional hazard model as individual variables, but not as overlapping multiple clinical signs, to avoid multicollinearity.