



Risk factors affecting length of stay of cats in an animal shelter: A case study at the Guelph Humane Society, 2011–2016



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ABSTRACT

There is a strong need for animal shelters to determine strategies to decrease the incidence of healthy animals being euthanized due to a lack of space. Thus, the Capacity for Care program was implemented at the Guelph Humane Society during August 2014. One objective of the Capacity for Care program is to decrease length of stay of cats within the shelter to improve individual welfare and increase the number of successful adoptions. The current study uses data collected from the Guelph Humane Society between 2011 and 2016. A Cox proportional hazards regression model was used to determine factors affecting a cat's time-to-adoption (length of stay). Cats' length of stay decreased by 24% after the implementation of the Capacity for Care program ($p < 0.001$). Exotic breeds were found to have a length of stay 64% shorter than domestic shorthairs ($p < 0.01$), while males had a length of stay 20% shorter than females ($p < 0.001$). Adult cats' length of stay was 13% shorter than kittens ($p \leq 0.01$), which is expected as a result of calculating length of stay from date of admission rather than date available for adoption. This study provides evidence that the Capacity for Care program is associated with a reduced length of stay for cats; suggesting it is a suitable program to improve cat welfare and address cat overpopulation.

1. Introduction

Animal shelters have the common goal of providing a safe and comfortable environment for homeless animals, while attempting to either rehome or reunite animals with their owners. In the United States, it has been estimated that approximately 1.3 million cats are adopted from animal shelters each year, however, approximately 40% of cats that enter shelters are euthanized (Pet Statistics, 2016). Likewise, in Canada, a recent animal shelter statistics report found that Canadian animal shelters had a euthanasia rate of 27% in 2014, of which 1.5% were healthy animals upon intake (CFHS, 2015). The euthanasia rate of cats appears to have been decreasing since 2008, however when only considering the number of cats that were healthy upon intake and subsequently euthanized during the same time period, the euthanasia rate increased in 2013 and 2014 compared to 2012 (CFHS, 2015). According to the Canadian Federation of Humane Societies (CFHS, 2015) report, the rationalization for the increased euthanasia rate of animals that are healthy on intake is that healthy animals are entering shelters but are often kept in crowded and stressful

conditions causing them to become ill during their stay and as a result are euthanized before being adopted. This justification powerfully accentuates the need for a new management approach in animal shelters, which will decrease the incidence of illness, thereby decreasing the number of healthy animals being euthanized as a result of becoming ill due to crowded conditions.

An animal's Length of Stay (LOS) in a shelter is the amount of time it takes for an animal to be adopted, once it has been admitted to a shelter. It has been observed that as a cat's LOS increases, the more likely it is to develop negative behavioural traits (Gouveia et al., 2011) and risk of contracting a disease (Dinnage et al., 2009; Dybdall and Strasser, 2014), which may decrease its likelihood of being adopted (Gouveia et al., 2011). Considering that a cat's behaviour has been found to primarily influence potential adopters' choice in selecting a cat (Kry and Casey, 2007; Fantuzzi et al., 2010; Weiss et al., 2012), it is important for shelters to adopt strategies that will not negatively influence cat behaviour and that will positively contribute to decreasing each animal's LOS in a shelter.

In an attempt to decrease the LOS of shelter cats and improve the

Abbreviations: C4C, capacity for care; CFHS, Canadian Federation of Humane Societies; GHS, Guelph Humane Society

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overall welfare of animals in their care, several shelters in Canada and the United States have begun to implement the Capacity for Care (C4C) shelter management program. The fundamental goal of the C4C program is to maintain the shelter cat population at or below the shelter's capacity at all times with the goal of reducing illness among shelter cats and decreasing LOS (CFHS, 2012). The C4C program promotes several strategies to control the flow of animals through the shelter system including: reducing intake through appointment based relinquishments, expanding the physical capacity of the shelter, and reducing LOS by reducing overcrowding and providing alternatives to unadoptable cats (Karsten, 2015). The C4C management program suggests that improving housing conditions is an ideal starting point when introducing the C4C program into a shelter (Karsten, 2015). Not only can housing improvements enhance the overall welfare of cats in a shelter environment, but improved housing can subsequently lead to decreased risk of disease, which in turn, helps decrease LOS, allowing more cats to be adopted because cats remain visible to the public in adoption rooms rather than spending time out of sight in recovery rooms. The housing guidelines for cats in shelters using the C4C program include a recommendation for double compartment cages for singly housed cats (Karsten, 2015). Having two compartments allows each cat to have its litter in a separate compartment from its food, water, and sleeping area. The creation of portals between adjacent cages for a singly housed cat also allows for fewer cats on the adoption floor at one time, creating a less overwhelming experience for adopters trying to select a cat. It is also recommended that cages provide cats with an area to perch, as well as an area to hide (Gourkow and Fraser, 2006).

Although behaviour of the cat has been found to be an important aspect for potential adopters (Weiss et al., 2012; Dybdall and Strasser, 2014), there are several risk factors that can positively or negatively affect the LOS of shelter cats. Traits that have been previously studied include; breed, coat colour, coat pattern (Brown and Morgan, 2014), source/entry type (Dybdall and Strasser, 2014), age (Weiss et al., 2012; Zito et al., 2015), position within adoption room, and presence of toys (Gourkow and Fraser, 2006; Fantuzzi et al., 2010). Given these previous findings, these factors must be controlled for in any statistical analysis that is aimed at drawing inference about the effect of C4C on LOS.

Brown and Morgan (2014) found that younger cats were adopted sooner than older cats and Onodera et al. (2014) found that age (kitten vs. adult) was the most important factor considered by adopters when choosing a shelter cat. The second most important factor considered by adopters when choosing a shelter cat has been found to be coat colour (Onodera et al., 2014). It has been found that black cats take the longest to adopt, followed by primarily black cats and finally by other coat colours, with black cats taking approximately 2–6 days longer to adopt than cats with other coat colours (Kogan et al., 2013). Brown and Morgan (2014) also found that lighter coloured cats were adopted sooner than darker coloured cats. As for breeds, Brown and Morgan (2014) found that 'exotic' breeds had the shortest LOS, whereas there was no difference found between Domestic Short Hair (DSH), Domestic Medium Hair (DMH) or Domestic Long Hair (DLH) cats.

Another factor which has been found to affect LOS is entry type/source of cats to shelters (Dybdall and Strasser, 2014). Dybdall and Strasser (2014) found that cats labelled as 'strays' took approximately 23% longer to get adopted than 'owner surrendered' cats. Although numerous studies have focused on physical characteristics of cats (Brown and Morgan, 2014; Kogan et al., 2013), various studies have demonstrated the importance of using enriched cage environments to improve the welfare of cats in shelters by reducing stress levels and encouraging innate feline behaviours (Gourkow and Fraser, 2006; Kry and Casey, 2007; Vince et al., 2014). Additionally, Dinnage et al. (2009), suggest utilizing foster care programs to reduce stress and risk to kittens while they await adoption, which is also one aspect of the C4C program. Understanding factors that affect an adopter's choice of a cat is not only important for shelter management strategies but can also benefit the welfare of shelter cats, yet, few studies have researched this

topic.

In 2014, the Guelph Humane Society (GHS) was one of two Canadian animal shelters designated as a pilot site by the CFHS for the implementation of C4C (CFHS, 2015). The goal of this study was to examine LOS of cats using data collected by the GHS between 2011 and 2016. The primary objectives of this study were to describe the LOS of cats entering the GHS sheltering system, to investigate known risk factors for the LOS of cats in shelters, such as, age, breed, coat colour, intake type, and sex and finally, to investigate the effect of the newly implemented C4C program on LOS of cats at the GHS. Based on previous findings, it is expected that risk factors for a decreased length of stay include, young, light coloured, female cats that were owner surrendered and are of an exotic breed. It is also hypothesized that the LOS of cats will decrease after the implementation of the C4C program at the GHS.

2. Materials and methods

2.1. Description of data

Data was collected from shelter intake and outcome data at the GHS between January 2011 and July 2016, using the GHS's shelter software (Pet Point). Data obtained from the GHS shelter records used in the current study included the animal identification number, date of admission, age, sex, neuter status at admission, intake type, outcome, breed, coat colour, and adoption location. LOS is the amount of time it takes for an outcome to occur once an animal has been admitted to a shelter and was calculated, in days, for each cat admitted to the GHS. For the purpose of this study, "kittens" were categorized as being six months of age or younger and "adults" were those greater than six months of age on their date of admission.

2.2. Capacity for care at the Guelph Humane Society

The C4C program was implemented at the GHS in August 2014. Some of the key elements that were implemented as part of the C4C program include fast-tracking cats to the adoption floor, removing tight restrictions for adoption and shortening the adoption application process (CFHS, 2015); all elements introduced at the GHS for the C4C program are included in Table 1. These elements were all implemented as part of the C4C pilot project in August 2014. The housing guidelines for C4C (Karsten, 2015) were also followed, thus portals were created, connecting two pre-existing, adjacent cages, permitting cats to roam between the cages, while also allowing for separation of food and water from the litter box (CFHS, 2015). Further details regarding the C4C case study at the GHS are provided by the CFHS (2015) report entitled "Capacity for Care (C4C) Case Studies".

2.3. Statistical analysis

Due to the nature of the data, a Cox proportional hazards regression model (Cox, 1972), and Kaplan–Meier estimators (Kaplan and Meier, 1958) were used, as censoring occurred for cats whose exact LOS were unknown. Censored cats were those that either remained in the shelter at the end of the study period or were transferred out of the shelter before getting adopted (for example, to another shelter), thus their time-to-adoption was unknown. Duplicates in the dataset were examined to ensure that records containing the same identification number were not clerical errors, but were actual re-entries of cats, and were kept in the dataset for analysis (N = 25). Exploratory analysis of the time-to-adoption data was performed using Kaplan–Meier estimators of the median length of stay of cats at the GHS by covariate (Kaplan and Meier, 1958). The log-rank test was used to compare the distributions of each covariate individually, before adding all covariates to the Cox proportional hazards model for analysis. Variables that were significant in the univariate analysis at a 20% significance level were

Table 1
Overview of Key Elements that were Implemented During Capacity for Care Case Study at the Guelph Humane Society in August 2014. Definitions extracted from the [Canadian Federation of Humane Societies \(2015\)](#).

Elements Implemented	Description
“Portalization” of Cages	Portals are created between adjacent cages, creating double compartment cage. Allows cats to chose where to spend their time, creates a separation of food and water from litter box, and minimizes disruptions while cleaning.
Scheduled Intake	Appointment-based relinquishment is used to help ensure that a shelter does not go over capacity, permitting cats to have adequate space while they await an outcome. It also provides an opportunity to discuss alternatives to relinquishments or acquire information about a cat’s medical history.
Fast-Tracking Adoptable Cats	Fast-tracking the most adoptable cats (for example, juveniles), decreasing the stray-hold period and providing earlier health examinations and vaccinations.
Shorter Adoption Forms/Fewer Restrictions Barn Cat Program	Fewer adoption restrictions, including shortening the application process to encourage a prompt adoption process. Rehomes cats that are not adoptable through the shelter system and places them in with families looking for a ‘barn cat’. These cats are spayed/neutered before being placed, ensuring that they do not contribute to the growing cat population.
Shelter-Neuter-Return	Healthy feral cats that are unadoptable through the shelter system are spayed/neutered and vaccinated, then returned to their home location. If it is not possible to place them in their home location then they are rehomed through the Barn Cat Program.
Categorical Pricing Adoption Specials/Events	Implementation of categorical pricing to promote the adoption of cats that are considered to be ‘less desirable’. Holding adoption events or specials to prevent the inventory of cats from exceeding the shelter’s capacity, especially if there are cats waiting to be relinquished.
Cage Enrichments (e.g. curtains, elevated beds)	Increasing cat welfare while in the shelter through improved cage enrichment by incorporating cat toys, elevated beds, cat curtains, etc.
Aim to Run At or Below Shelter Capacity	Ensuring that management, staff and volunteers are committed to ensuring that the shelter remains at or below capacity at all times. This could involve changes in shelter policies.

kept in the model. Backwards selection was used to identify the best fitting model for the data. The Grambsch–Therneau test was applied to ensure that the assumption of proportional hazards was not violated; i.e., the hazard functions of two groups are proportional over time (Grambsch and Therneau, 1994). DFBETAs were checked as a diagnostic tool to search for any highly influential observations in the Cox proportional hazards regression model. All statistical analyses were performed using R and RStudio statistical software (R Core Team, 2015; RStudio Team, 2015). A significance level of $\alpha = 0.05$ was maintained for all tests and confidence interval estimates. The research protocol was reviewed and approved by the Research Ethics Board at the University of Guelph.

3. Results

There were a total of 4089 records of cat admissions to the GHS between January 2011 and July 2016. Of these records, 1945 records were extracted, containing only those cats who were adopted or censored, i.e. excluding cats that were either euthanized (1069), dead on arrival (531), reunited with their owners (478), died in shelter (64) and missing outcome data (2). Only complete cases (i.e., cases with no missing data) were used in the analysis, leaving 1600 records to be analyzed. Of these 1600 cats, 1479 cats were adopted and 121 were censored as they were transferred out of the shelter or remained in the shelter at the end of the study. LOS ranged from 0 to 352 days with a median of 33 days and a mean of 42 days. All unconditional associations with the median cat LOS (i.e., the number of days until adoption), can be found in Table 2 for each independent variable.

A Cox proportional hazards model was applied to assess the effect of the proposed predictor variables. The results of this model are displayed in Table 3, showing the significance and hazard ratios of the final model. It was found that the LOS of cats decreased by 24% after the implementation of the C4C program compared to before ($p \leq 0.001$; see Fig. 1). The variables ‘coat colour’ and ‘intake type’ remained in the model despite their lack of significance because the effect size and direction of these predictors was of interest in this study, due to prior studies that linked these variables to LOS. ‘Neuter status’ was removed from the model after checking for confounding, as it was not significant at the 5% significance level and has not been previously found to affect LOS of cats in shelters. All remaining variables were found to be significant. LOS of adult cats was found to be 13% shorter than kittens ($p \leq 0.01$). DMH and DLH were found to have a LOS that was 19% shorter than DSH ($p = 0.012$), while exotic breeds had a LOS that was

Table 2
Univariable analysis using the log-rank test to compare Kaplan–Meier curves of risk factors affecting length of stay of cats at the Guelph Humane Society.

Name of Variable	Categories	N	Median No. Days	0.95 L CL	0.95 U CL
C4C	Before C4C (Referent)	1109	37	35	41
	After C4C	491	32	29	36
Log-Rank Test p-value: < 0.01					
Age	Kitten (Referent)	866	41	39	44
	Adult	734	31	29	33
Log-Rank Test p-value: < 0.01					
Breed	Domestic Shorthair (Referent)	1307	37	35	39
	Domestic Medium & Long Hair	261	31	28	36
	Exotic	32	26	17	46
Log-Rank Test p-value: < 0.01					
Coat Colour	Black (Referent)	266	41	36	46
	Other	1334	35	33	37
Log-Rank Test p-value: 0.14					
Sex	Female (Referent)	711	40	36	42
	Male	889	33	31	36
Log-Rank Test p-value: < 0.01					
Intake Type	Owner Surrendered (Referent)	281	31	29	39
	Stray	1233	37	35	40
	Other (Returned, Seized, Transferred in)	86	26	21	34
Log-Rank Test p-value: 0.016					
Neuter Status	Intact (Referent)	1308	37	35	40
	Neutered/Spayed	292	30	27	36
Log-Rank Test p-value: 0.015					

64% shorter than DSH ($p \leq 0.01$). It was found that male cats had a LOS that was approximately 20% shorter than female cats ($p \leq 0.001$). In summary, exotic, male, adult cats, following the C4C, had the shortest LOS. Conversely, risk factors for the longest LOS included, DSH, female, kittens prior to the C4C.

4. Discussion

The C4C program focuses efforts on reducing LOS and the risk of disease. One of the goals of this study was to determine if the C4C program had an effect on the average LOS of cats at the GHS. It was determined that the LOS of cats decreased 24% after the

Table 3
Cox proportional hazards model of risk factors affecting length of stay of cats at the Guelph Humane Society, 2011–2016.

Name of Variable	Categories	Hazard Ratio	Lower 0.95	Upper 0.95	p-value
C4C	Before C4C (Referent)	1.0			
	After C4C	1.23	1.10	1.38	< 0.001*
Age	Kitten (Referent)	1.0			
	Adult	1.12	1.02	1.25	0.024*
Breed	Domestic Shorthair (Referent)	1.0			
	Domestic Medium & Long Hair	1.19	1.04	1.37	0.012*
	Exotic	1.64	1.13	2.37	< 0.01*
Sex	Female (Referent)	1.0			
	Male	1.20	1.08	1.33	< 0.001*
Coat Colour	Black (Referent)	1.0			
	Other	1.09	0.95	1.26	0.198
Intake Type	Owner Surrendered (Referent)	1.0			
	Stray	0.89	0.77	1.02	0.082
	Other (Returned, Seized, Transferred in)	1.08	0.82	1.42	0.581

* Significant at $\alpha = 0.05$.

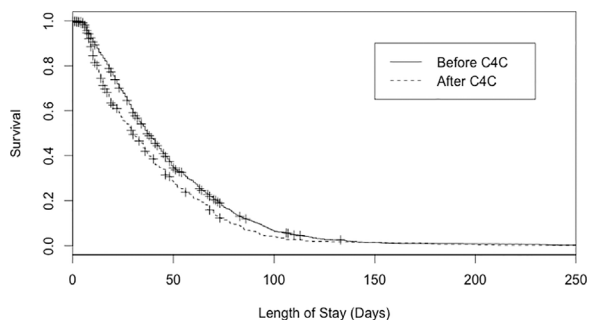


Fig. 1. Kaplan–Meier curves comparing before and after the Capacity for Care program at the Guelph Humane Society.

implementation of the C4C program. In addition, the median LOS significantly decreased from 37 to 32 days, from before to after the implementation of C4C. This is the first study to quantify the effects of the C4C program on LOS, while assessing risk factors that affect the LOS of cats at the GHS. Some of the elements of the C4C program which could be expected to result in a decreased LOS of cats include fast-tracking adoptable cats to the adoption floor, creating shorter adoption forms/fewer restrictions, the shelter-neuter-return program, the introduction of categorical pricing and adoption specials/events. Additionally, some of the key elements, including portalization of cages, improved cage enrichment and the goal to run at or below the shelter's capacity, may have a positive influence on the welfare of cats while in the shelter. Various studies have looked at the effect of enrichment on cat stress levels and found that cats that are provided with a perch and/or a hiding place, exhibit lower stress scores than cats in standard cage environments, demonstrating the importance of using enrichment to improve the welfare of cats in a shelter environment (Gourkow and Fraser, 2006; Kry and Casey, 2007; Vince et al., 2014). Furthermore, cat behaviour has been reported to influence an adopter's choice of cat (Weiss et al., 2012; Dybdall and Strasser, 2014), though this was not possible to analyze in the current study given the data provided.

The current study used variables which have been consistently collected at the GHS and therefore focused on physical characteristics of cats. The results of this study suggest that breed and sex significantly affect the rate of adoption for cats at the GHS, a result that has been confirmed for other shelters by previous studies as well (Brown and Morgan, 2014; Onodera et al., 2014). Additionally, this was the first study using survival analysis to assess the intervention effect of the C4C program, which is shown here to be associated with a decreased LOS.

In the current study, age as a predictor for LOS was dichotomized with kittens being less than 6 months old and adults being all cats greater than 6 months of age. LOS was found to be significantly

different for the two age groups different. Brown and Morgan (2014) found that younger cats were adopted sooner than older cats, therefore it was hypothesized that younger cats would have a shorter LOS than adult cats. Contrary to previous findings (Brown and Morgan, 2014), the present study found that adult cats have an increased rate of adoption compared to kittens (HR = 1.13). This is most likely due to the current data using 'date of admission' to calculate length of stay, whereas other studies have looked at the actual time the animal is available for adoption. Time spent weaning would therefore be included in the LOS calculations in the current study, which could potentially explain why adults were found to have a significantly shorter LOS than kittens, as kittens are generally not weaned until about six or seven weeks of age (Kitten Behaviour Basics, 2016).

Similar to the results of Kogan et al. (2013), black cats were found to take an average of 6 days longer to adopt than other coat colours, although this result was not significant. Breed was found to significantly affect the LOS for cats at the GHS. The DMH and DLH cats were adopted 19% sooner than DSH cats, while exotic breeds were adopted 64% sooner than DSH cats. Brown and Morgan (2014) also found that 'exotic' breeds had the shortest LOS, however, their study found no difference between DSH, DMH or DLH cats. Kogan et al. (2013) and Brown and Morgan (2014) reported concerns of inconsistent coding of coat colour and designation of breed due to the number of different people entering data, which could not be controlled for in their analysis. Inconsistent coding could also present concerns for the current study, as it is based on retrospective data, therefore shelter staff were not given specific directions for categorizing variables.

Onodera et al. (2014) found that sex was the third most important variable for adopters when choosing a cat and more than half of the adopters preferred female cats. Conversely, the current study found that male cats' LOS was approximately 20% shorter than females, and were adopted a median of 7 days sooner than females ($p = < 0.01$; See Table 2). Neuter status had no significant effect on LOS of cats at the GHS and was removed from the Cox proportional hazards model. It is likely that the difference in median LOS between the neutered and intact categories is due to the process of getting the intact cats neutered before they are adopted, as it is mandatory for animals to be neutered before getting adopted from the GHS; unfortunately, data was collected from the date of admission, rather than the date the animal was available for adoption. Another factor that has been previously found to affect LOS, is entry type/source of cat to the shelter. Dybdall and Strasser (2014) found that cats labelled as 'strays' took approximately 23% longer to get adopted than owner surrendered cats. Weiss et al. (2012), on the other hand, found that information regarding a cat's life prior to arriving at the shelter was the least important information to affect the adopters' choice of cat. Although there were no significant differences found between the 'intake types' in the current study, strays

were found to have the longest median LOS. This could be due to the fact that stray cats are more likely to be in need of medical treatment or are observed for behavioural issues, causing them to take longer to be placed on the adoption floor.

Fantuzzi et al. (2010) studied characteristics that influence the number of times a cat is viewed as well as the amount of time that a cat was viewed by adopters. In their study, it was found that cats at eye level, as well as cats with toys present in the cage had the greatest viewing times (Fantuzzi et al., 2010). Shelters could use the results of Fantuzzi et al. (2010) in combination with the results of the current study in order to focus efforts and management practices to decrease the LOS of cats that are at risk of having a longer time-to-adoption (LOS) based on the characteristics they portray. Additionally, Dinnage et al. (2009), suggest utilizing foster care programs to reduce stress and risk to kittens while they await adoption.

There are some study limitations which should be noted regarding the current study. Firstly, there is potential that a portion of records which were excluded from analysis should have been included as censored data. For example, if a cat was available for adoption but died of natural causes while in the shelter, or if a cat was available for adoption but was subsequently euthanized due health issues which developed while in the shelter. Unfortunately, given the data provided, it was not possible to determine whether cats that died or were euthanized were ever available for adoption to the public and should have been considered censored individuals. On further examination of the LOS of these particular categories of cats, it is not likely that the majority of these cats were available for adoption. More specifically, the mean LOS of euthanized cats was 8 days (median = 6, range = 0–175), while the mean LOS of cats that died in shelter was 10 days (median = 6.5, range = 0–47). Nonetheless, there is some potential bias on survival time if cats that should have been considered censored were excluded from the analysis, unfortunately it was not possible to determine which cats were available for adoption once categorized as ‘euthanized’ or ‘died in shelter’. A closer review of cats that were placed in the barn cat program revealed that the mean LOS of this group of cats was 48 days, with a median of 27 and a range of 9–211 days. While this program is highly valuable, as it provides homes for cats which would have otherwise been euthanized, there is potential for improvement. This program was created to provide homes for stray cats which do not have the temperament to be adopted into a typical home, hence, it would be advantageous to move these cats through the shelter faster, not only reducing their LOS but also providing space for cats that have more potential to be adopted.

This study was the first to examine the effects of the C4C program on the LOS of cats, using long-term data. The results supported the intended benefits of the C4C program on LOS, as it was found to be associated with a 24% decrease in cats’ LOS at the GHS. This is the first study, to best of the authors’ knowledge, to use survival analysis to study the time-to-adoption of shelter cats using several physical characteristics as covariates. Although the findings of the current study are specific to the GHS animal shelter and thus may not be generalized to other shelters, it is possible that the results of the current study may apply to shelters with similar characteristics as the GHS. This study provides a good foundation for the GHS to examine their current adoption strategies and how to decrease the LOS of cats at risk for a longer time-to-adoption based on the covariates examined. Additionally, the results of this study provide support for the C4C program, and encourage further examination of this program using long-term data from shelters who have also implemented the C4C program. In order to improve accuracy of study results, the researchers

also suggest that animal shelters collect information on when animals become available for adoption versus the date of admission to shelter, as this would increase the accuracy of reporting risk factors that affect adoption of animals at a shelter.

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References

- Brown, W.P., Morgan, K.T., 2014. Age breed designation, coat color, and coat pattern influenced the length of stay of cats at a no-kill shelter. *J. Appl. Anim. Welf. Sci.* 18 (2), 169–180.
- Canadian Federation of Humane Societies, 2012. A Comprehensive Report on the Cat Overpopulation Crisis. . Retrieve from http://cfhs.ca/athome/cat_overpopulation_crisis/.
- Federation of Humane Societies, 2015. Animal Shelter Statistics. Retrieved from http://cfhs.ca/athome/shelter_animal_statistics/.
- Cox, D.R., 1972. Regression models and life-tables. *J. R. Stat. Soc. Ser. B (Methodol.)* 34 (2), 187–220.
- Dinnage, J.D., Scarlett, J.M., Richards, J.R., 2009. Descriptive epidemiology of feline upper respiratory tract disease in an animal shelter. *J. Feline Med. Surg.* 11, 816–825.
- Dybdall, K., Strasser, R., 2014. Is there a bias against stray cats in shelters? People’s perception of shelter cats and how it influences adoption time. *Anthrozoos* 27 (4), 603–614.
- Fantuzzi, J.M., Miller, K.A., Weiss, E., 2010. Factors relevant to adoption of cats in an animal shelter. *Appl. Anim. Welf. Sci.* 13, 174–179.
- Gourkow, K., Fraser, D., 2006. The effect of housing and handling practices on the welfare, behavior and selection of domestic cats (*Felis sylvestris catus*) by adopters in an animal shelter. *Anim. Welf.* 15, 371–377.
- Gouveia, K., Magalhaes, A., de Sousa, L., 2011. The behaviour of domestic cats in a shelter: residence time, density and sex ratio. *Appl. Anim. Behav. Sci.* 130, 53–59.
- Grambsch, P.M., Therneau, T.M., 1994. Proportional hazards tests and diagnostics based on weighted residuals? *Biometrika* 81 (3), 515–526.
- Kaplan, E.L., Meier, P., 1958. Nonparametric estimation from incomplete observations? *J. Am. Stat. Assoc.* 53 (282), 457–481.
- Karsten, C., 2015. Managed Intake and Capacity for Care: The Tools for Remarkable Population Management (Parts 1 & 2). Retrieved from <http://veterinarycalendar.dvm360.com/managed-intake-and-capacity-care-tools-remarkable-population-management-parts-1-2-proceedings>.
- Kitten Behaviour Basics, 2016. The American Humane Society of the United States. Retrieved from http://www.humanesociety.org/animals/cats/tips/kitten_behavior_basics.html.
- Kogan, R.L., Schoenfeld-Tacher, R., Hellyer, P.W., 2013. Cats in animal shelters: exploring the common perception that black cats take longer to adopt. *Open Vet. Sci.* 7, 18–22.
- Kry, K., Casey, R., 2007. The effect of hiding enrichment on stress levels and behavior of domestic cats (*Felis sylvestris catus*) in a shelter setting and the implications for adoption potential. *Anim. Welf.* 16, 375–383.
- Onodera, N., Uchida, K., Kakuma, Y., 2014. Association between characteristics of cats and satisfaction of owners who adopted cats from an animal hospital in Japan. *J. Vet. Med. Sci.* 76 (5), 729–733.
- Pet Statistics, 2016. American Society for the Prevention of Cruelty to Animals. Retrieved from <http://www.aspc.org/animal-homelessness/shelter-intake-and-surrender/pet-statistics><http://www.aspc.org/animal-homelessness/shelter-intake-and-surrender/pet-statistics>.
- R Core Team (2015). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL <http://www.R-project.org/>.
- RStudio Team (2015). RStudio: Integrated Development for R. RStudio, Inc., Boston, MA URL <http://www.rstudio.com/>.
- Vince, C.M., Godijn, L.M., van der Leij, W.J.R., 2014. Will a hiding box provide stress reduction for shelter cats? *Appl. Anim. Behav. Sci.* 160, 86–93.
- Weiss, E., Miller, K., Mohan-Gibbons, H., Vela, C., 2012. Why did you choose this pet? Adopters and pet selection preferences in five animal shelters in the United States. *Animals* 2, 144–159. <http://dx.doi.org/10.3390/ani2020144>.
- Zito, S., Paterson, M., Vankan, D., Morton, J., Bennett, P., Phillips, C., 2015. Determinants of cat choice and outcomes for adult cats and kittens adopted from an Australian animal shelter. *Animals* 5, 276–314.