Does Location Matter: Analyzing the Impact of Geographic Variation on Adoption Rates For Shelter Dogs

Robert E. Beran, Jr.

Thesis submitted to the faculty of the Virginia Polytechnic Institute and State University in partial fulfillment of the requirements for the degree of

Master of Science

In

Applied Animal Behavior and Welfare

Agricultural and Life Sciences

Lisa M. Gunter, Committee Chair
Erica N. Feuerbacher
Alix Guyn

December 17, 2025
Blacksburg, Virginia

Keywords: dog, age, size, geographic region, population density, shelter, intake, outcome

Does Location Matter: Analyzing the Impact of Geographic Variation on Adoption Rates For Shelter Dogs

Robert E. Beran, Jr.

Abstract

Unwanted companion animals are a significant problem in the United States, and the numbers of dogs entering the sheltering system has been increasing recently.
The interplay of numerous organizational and animal factors, such as where a shelter is located in the country, its population density, and the type of organization as well as the size and age of the dog, how it arrived to the shelter, and its outcome, can significantly impact the length of stay for dogs in shelters. The current study utilized records from 2023 collected by Shelter Animals Count, a nonprofit organization that maintains a centralized database of United States animal sheltering data, to investigate whether the lengths of stay of dogs residing in U.S. differ based on the shelter's geographic region or density of the population in that area to better understand how to address the time animals reside in shelters. The findings underscore a consistent trend across multiple regions: suburban shelters tend to achieve shorter stays for dogs compared to those in urban and rural areas with differences found by organization type. Generally, dogs' lengths of stay at Northern, Midwestern and Western shelters are shorter than dogs residing in shelters in other regions across the United States, although these stays differed by the type of organization. Furthermore, we found that a dog's size and its age affected its time in the shelter, such that older dogs have increased lengths of stay. This research provides a foundation for future study and offers an overview of the impact of geographic and animal variation on positive outcomes for dogs living in animal shelters.

Acknowledgements

My Heavenly Father. First and foremost, I thank God, whose guidance, grace, and provision have shaped my path, opened doors, and inspired my dedication to improving the lives of animals.

Dr. Lisa Gunter. Thank you for leading my committee as chair; your continuous guidance, support, knowledge, and communication made all the difference during this project.

Dr. Erica Feuerbacher and Alix Guynn. Thank you for serving on my committee; your steadfast support and generosity with your time have been invaluable in helping me reach this milestone.

Coach Mike Young, the Entire Basketball Staff, and Virginia Tech Athletics. Thank you for welcoming me into the Virginia Tech Men's basketball family, providing the opportunity to compete in the ACC, and enabling me to advance my education in applied animal behavior and welfare at an excellent academic institution.

Shelter Animals Count. A special thanks to Shelter Animals Count for providing the original data set critical to this research. In a field where there has traditionally been a lack of standardized and consistent data collection, your national database enables vital analysis, improves transparency, and supports progress across animal sheltering organizations.

Critter Calvary Rescue. Thank you for not only trusting and believing in the college student who desperately wanted a companion animal while away at school but also in kindling my passion for rescue animals.

My Dogs and Their Humans. A heartfelt gratitude to all my dogs, my first love and the reason I entered this field, and their other humans. Thank you for providing unconditional love and support, keeping life in perspective, teaching me the import of "saving the puppers," and reminding me that every dog deserves a loving home.

Table of Contents

Introduction

1.1 Unwanted Companion Animals in the Sheltering System

Unwanted companion animals are a significant problem in the United States. Approximately 6.3 million dogs and cats enter the animal sheltering system each year with a roughly even split between dogs and cats (Shelter Animals Count, 2023; American Society for the Prevention of Cruelty to Animals (ASPCA), 2022). The numbers of dogs entering the sheltering system has been increasing recently; in 2023, 3.25% more dogs entered the shelter system compared to 2022, which was an increase in canine intake from 2021 of over 10% (Shelter Animals Count, 2023). Nevertheless, intakes in 2024 were lower by 11.3% compared to 2019 (Shelter Animals Count, 2024). While some dogs entering U.S. animal shelters are reunited with owners, the number of reunifications decreased by 20,000 in 2024; only 16% of dogs were returned to owner in 2024 compared to 17% in 2019 (Shelter Animals Count, 2024). From 2021 to 2023, approximately 900,000 animals entered and remained in the sheltering system (Shelter Animals Count, 2023). Another 103,000 pets were added to the sheltered population in 2024 (Shelter Animals Count, 2024). Although efforts to prevent the euthanasia of healthy pets by providing needed medical and behavioral services have saved lives, it has contributed to an increase in the time dogs reside in the sheltering system (Stephen & Ledger, 2006). Combined, these factors have resulted in a current capacity crisis in the U.S. animal sheltering system (Shelter Animals Count, 2023).

The precise extent of homeless companion animals entering in shelters in the United States has been historically unknown because no government institution or animal organization was responsible for tabulating national animal welfare statistics across all types of agencies (Shelter Animals Count, 2023; ASPCA, 2022; HumanePro; American Veterinary Medical

Association, 2022). Much of the information about dogs and cats in animal shelters has been, as one industry expert described, “a statistical black hole” (Rowan, 1992, pp. 140–143). In fact, Rowan (1992) argued that the lack of accurate data contributed to many of the issues within the sheltering system, and this dearth of information obscured the true magnitude of the problem (Rowan, 1992). In recent years, organizations within this industry, such as Best Friends and Shelter Animals Count, have created national databases and are collating data from participating organizations to improve our understanding of U.S. animal sheltering (Shelter Animals Count, 2023). With better data about these animals, there is the possibility to identify problems and find solutions that will better their lives. A particular area in need of exploration, considering the advent of these national databases, is whether there are differences in the lengths of stay (LOS) for dogs residing in animal shelters based on where these organizations are located in the country.

1.2 Shelter System in the United States

The United States animal sheltering system is comprised of various entities that have common goals regarding the pairing of pets with prospective owners (Norris & Hastings, 2023; Turner et al., 2012). In 2024, Shelter Animals Count estimated there were over 13,527 sheltering organizations in the United States (Shelter Animals Count, 2024). Rescues or foster-based groups comprise approximately 69.6% of organizations, and the remaining 30.4% are shelters or traditional brick-and-mortar facilities (Shelter Animals Count, 2024). Shelters typically provide broad intake of companion animals with temporary housing and comprehensive services while rescues and foster-based groups are often more focused on specialized care and rehabilitation on a smaller scale (Goselin et al., 2011). There also are government animal services facilities owned and operated by municipalities across the United States (Goselin et al., 2011; Notaro, 2010).

The rescue and foster organizations in the U.S. sheltering system have unique characteristics, with associated benefits and challenges (Turner et al., 2012; Goselin et al., 2011). The financial resources available to these organizations can vary. Non-profit shelters and rescues that operate either partially or fully through a contract with a government agency receive municipal as well as donations and other forms of private funding (Goselin et al., 2011; Notaro, 2010). These organizations have a stable revenue stream but may have less operational flexibility due to regulatory policies and procedures (Goselin et al., 2011; Notaro, 2010). There are also non-profit shelters and rescues that operate without any type of government contract where resources are dependent on donations and other forms of private funding (Goselin et al., 2011). While financial resources may be unpredictable, these organizations often have greater autonomy in operations and decision-making regarding the overall running of their day-to-day operations (Goselin et al., 2011).

1.3 Intake and Reasons Why Pets End Up in Animal Shelters

Animals can enter the sheltering system in many ways, including being found as a stray, surrendered by their owner, removal from their owner due to cruelty or safety concerns, and being transferred in from one organization to another (Protopopova & Gunter, 2017; ASPCA, 2024; Notaro, 2010). The number of dogs surrendered by their owners to animal shelters has remained relatively consistent since 2021; however, between 2022 and 2023, the number of stray animals brought into shelters increased slightly from 45% to 46% (Sleight et al., 2024). In 2024, owner surrenders decreased by 4.5% but still accounted for 29% of all intakes (Shelter Animals Count, 2024). It is possible that these fluctuations may be a result of changes in pet owners' behavior or animal sheltering policies limiting the intake of owned pets (Mason, 2025).

Previous research suggests that pet-related issues are some of the most likely reasons that an animal enters the sheltering system. For example, a survey conducted by the ASPCA revealed that the most common reasons for surrender were aggression or other problematic behaviors, as well as dogs growing larger that the owner initially expected as well as pet health issues (ASPCA, 2022). A comprehensive study by Powdrill-Wells et al. (2021), utilizing data from 1,698 incoming calls between 2017-2019 to an animal welfare and rehoming organization in Cambridgeshire, England, found aggressive behavior to be the most common reason for owner surrender. In fact, a combination of aggression towards people and/or other animals was the basis for over two-thirds of surrenders by owners (Powdrill-Wells et al., 2021).

While issues with a pet is a primary reason for surrender, sometimes these issues may be temporary or specific to the individual owner. Payne et al. (2015) found that if an owner perceives a behavior to be problematic, their dog is more likely to be relinquished to a shelter. Yet, previous research has demonstrated that it is possible to modify the animal's behavior such that relinquishment may no longer be necessary (Bouma et al., 2020; Bennett & Rohlf, 2007; Patronek et al., 1996; New et al., 2000). For example, Bennett and Rohlf (2007) found that while certain dogs may have aggression issues that are difficult to remedy, other behaviors of the dog may be improved by training as well as engagement in other shared activities. Additionally, relinquishment is less likely if the owner will accept behavioral advice to address the issue (Powdrill-Wells et al., 2021).

Furthermore, Powdrill-Wells and colleagues (2021) found if that issue is not linked to aggression between dogs in the home, owners have a greater likelihood of accepting advice. Nevertheless, an owner's perception about the behavior also plays a role into whether advice is accepted. If an owner perceives the problem as less severe than it actually is, they may be less

inclined to accept advice. Additionally, Powdrill-Wells and colleagues (2021) found that sources of free behavioral advice have a greater likelihood of being pursued than those that require some sort of payment. However, other studies suggest that offering free advice or services to pet owners does not guarantee that they will accept or utilize those resources (Kogan et al., 2000; Gunter et al., 2017). As Protopopova and Gunter (2017) advocated in their review, there may be other factors beyond cost that prevent owners from accepting advice or services, such as time constraints, lack of awareness, or skepticism about the value of the offered assistance.

The surrender of pets to animal shelters may also be the result of unmet owner expectations. Some owners have certain perceptions about life with their future dog, which may be molded by previous experiences, comparisons to other dogs and owners, or media portrayals (Bouma et al., 2020). When expectations do not meet what the individual experiences with their pet, owners may forgo the animal's companionship (Powell et al., 2022; Bouma et al., 2020). Powell and colleagues found that owners who returned their dogs to shelters often had higher expectations for their pets and the human-dog relationship, even when the dogs did not exhibit dysfunctional behavior (Powell et al., 2021). In a study by Bouma et al. (2020) involving 183 owners who answered extensive survey questions before and after acquiring a dog, the researchers found that a new dog has approximately six months to meet the owner's expectations before relinquishment, especially if it is the person's first time owning a dog (Bouma et al., 2020).

The likelihood of owner relinquishment to the shelter increases if the time required to care for the pet is greater than expected, and some owners underestimate this time commitment (Bouma et al., 2020; Shore, 2005). Daily walking and obedience training are important for dog socialization as well as building the human-animal bond. Failing to invest in this relationship can

adversely impact a dog's behavior, increasing the risk of relinquishment even further (Bouma et al., 2020). In a one-year prospective cohort study conducted in 2005 involving 5,750 dogs and 4,500 owners in the United Kingdom, Diesel et al. (2008) found that owners who believed that dog ownership involved more work after acquiring the dog than initially anticipated had a nearly 10 times greater likelihood of returning their dog than those owners whose initial perceptions matched their actual time commitment.

It is also possible that an animal's relinquishment to the shelter may be unrelated to the pet itself and instead be a result of changes in the owner's circumstances (Reese & Li, 2023; Bouma et al., 2020; Miller et al., 1996; Diesel et al., 2008). Miller and colleagues (1996) found a positive correlation between childbirth and surrender, likely due to parents having less time for a pet after a new baby arrives (Miller et al., 1996). Relatedly, Diesel and colleagues (2008) found that households without children were less likely to surrender a dog than ones with children under the age of thirteen. Furthermore, pet ownership can be limited by one's living circumstances. Rental properties in the United States often prohibit tenants from keeping companion animals (Carlisle-Frank et al., 2005); and even when these units do allow pets, property owners often restrict the breed, weight, or size of tenants' pets, effectively banning larger dogs (Rose et al., 2020). As housing trends in the United States move towards a greater number of individuals renting instead of owning their domiciles, it is possible that more pets may be at risk of relinquishment (Reese & Li, 2023).

The United States has experienced a rise in inflation during the past three years (U.S. Bureau of Labor Statistics, 2024), which has negatively impacted pet ownership. From 2020 to 2021, the average yearly cost of owning a dog was $912, which included $339 for its food, $367 in veterinary costs, $79 for toys, $99 in grooming, and $28 for miscellaneous items (AVMA,

2022). In 2022, the price of pet products increased 12% as compared to 2021 prices; in the same period, food increased 15% while the cost of pet services increased by 9% (PBS, 2023). Previously, Friend and Bench (2020) found that financial resources can influence pet keeping decisions if an owner's finances are not sufficient to meet the cost of dog ownership without sacrificing other personal wants and needs. Moreover, Reese and Li (2023) found that the rates of pet ownership are lower in economically distressed areas than those that are more financially stable.

Along with being surrendered by the owner, dogs can also enter the shelter system through an arranged transfer between welfare organizations. The goal of such programs is to mimic a supply and demand economic model in order to optimize the supply of shelter animals in different areas of the country (Simmons & Hoffman, 2016). These programs can help shelters manage resources more effectively by considering shelter capacities, transportation logistics, and regional demands for specific types of animals in a way that maximizes adoption outcomes and enhances animal welfare (Simmons & Hoffman, 2016). For example, nearly a quarter of annual intake of animals in US shelters occurs in the South Atlantic while only 17% of the U.S. human population resides in this region. In contrast, a similar percentage of the human population resides in the New England and Mid-Atlantic regions (15%) yet shelter intake in these areas is approximately 7% (Democratic Statistical Atlas of the United States, n.d.; Shelter Animals Count, 2021). In collaboration with shelters and rescues across 40 states, the ASPCA transports more than 20,000 animals annually from less-resourced facilities with an overabundance of pets to geographic regions of the United States with more resources and greater demand for companion animals (ASPCA, n.d.; Thanawala, 2024).

Another potential cause of unwanted animals presently in the sheltering system may be related to the return to 'normal life' following the COVID-19 global pandemic. During the pandemic, many individuals acquired a pet with more time at home and a greater desire for companionship (Morgan et al., 2020), leading to an increase in companion animal adoption as well as fostering from animal shelters (Gunter et al., 2022; Fowler, 2023). As health restrictions subsided and life resumed to pre-COVID-19 conditions, changes in personal circumstances, such as return to in-person work and other activities outside of the home, likely changed the feasibility of pet ownership for some people. Gunter et al. (2022) found that, while fostering increased in the initial months of the pandemic, shelters' utilization of foster care returned to pre-COVID levels by June of 2020. Moreover, animal shelters across the US have experienced a significant decline in adoption compared to the pandemic-era boom, possibly because of the same factors that have impacted fostering (Bogage, 2023).

1.4 Outcomes and Related Factors for Outcomes Animals Experience in Shelters

Animals leave the animal shelter when they are returned to their owner; adopted to a new family; transferred to another organization for placement; euthanized because of health issues, behavioral concerns, or the shelter's limited resources; or die while in the organization's care (Powell et al., 2021; Cain et al., 2020; Thanawala, 2024). The interplay of factors, such as an animal's age, perceived breed, its behavior alongside the shelter's capacity and resources, can significantly influence the length of stay and ultimate outcomes for dogs in animal shelters.

Over the past 15 years, animal sheltering researchers have found a negative correlation between adoption rates and euthanasia, such that as shelter dog adoptions have increased concomitant reductions in the number of euthanized dogs have also been observed (Rowan & Kartal, 2018). In 2019, a comprehensive animal sheltering dataset of 710,000 dogs, representing

about 21% of dogs in U.S. animal shelters, demonstrated that 65% of shelter dogs were adopted and only 13% were euthanized (ASPCA, 2022). However, in 2023, non-live outcomes, such as euthanasia, unexpected death, or being lost in the organization's care, had increased by 24% for dogs in U.S. shelters as compared to 2022 (Sleight et al., 2024).

A dog's physical and behavioral characteristics may impact its outcome from the animal shelter. Gunter et al. (2016) found that dogs labeled as pit-bull-type breeds had three times longer lengths of stay than similarly looking dogs that were not labeled a pit-bull-type. In animal shelters in Florida and New York, removing breed labels improved the lengths of stay and live outcomes of dogs residing in animal shelters, and not just those that would have been labeled as pit-bull-types (Gunter et al., 2016; Cohen et al., 2020). Beyond breed labels, Gunter et al. (2018) found that dogs with pit-bull-type breed ancestry have significantly longer lengths of stay than dogs that did not have such breed ancestries. Moreover, receiving shelters that transport in dogs often place breed restrictions on dogs they will accept into their adoption programs further limiting live outcomes for pit-bull-type dogs and other breeds (Simmons & Hoffman, 2016).

Cain et al. (2021) found that an animal's age impacts its adoption likelihood. Younger dogs have a greater likelihood of adoption than those that are older (Brown et al. 2013; Zak et al., 2015). Additional evidence that a dog's characteristics may impact its shelter outcome was found by Cain and colleagues in an extensive study that examined a variety of phenotypic characteristics and the lengths of stay of dogs in U.S. shelters (Cain et al., 2020). Utilizing the data of 342 shelters located in five states, the authors found that shelter stays were shorter for puppies, small-sized dogs (less than or equal to 13.6kg), and those that had non-brachycephalic features. Similarly, Protopopova et al. (2012) also found that small dogs were more likely to be adopted than those that were medium-sized. In a subsequent study, Cain et al. (2021) observed

that short-nosed, brachycephalic, and "blockhead" dogs had a higher risk of euthanasia compared to medium-headed (mesocephalic) and long-headed (dolichocephalic) dogs. Other studies have found that long-haired dogs are more likely to be adopted and have shorter length of stay than those that are short-haired (Siettou et al., 2014; Protopopova et al., 2014) while black-colored dogs are significantly less likely to be adopted than partially black or non-black dogs (Sinski et al., 2016; Patronek & Crowe, 2018).

In shelters, animals with problematic behavioral issues are at risk of euthanasia (Gibeault, 2021; Lilly, 2020), especially when those issues pose serious safety risks to people and other animals (Euthanasia for Behavioral Issues: A Complicated and Difficult Decision, n.d.; Gibeault, 2021; Grigg & Donaldson, 2019; Marrs, 2021; Stremming, 2017; Alexander, 2012; Orenchuk, 2020). Prior studies have found that potential adopters view dogs exhibiting aggressive behavior in shelters as less adoptable (Hawes et al., 2020; Powell et al., 2021). Furthermore, shelter animals with behavioral concerns often need additional management (e.g., restricted physical activity, enrichment, or social engagement) that can restrict their quality of life (de Marinis, 2022; Euthanasia for Behavioral Issues: A Complicated and Difficult Decision, n.d.; Gibeault, 2021; Grigg & Donaldson, 2019; Marrs, 2021; McConnell, 2015; Orenchuk, 2020; Rayment, 2020). The additional management for the dogs with problematic behavioral issues is often not only needed while in the shelter but is also critical for the new owner in their adoptive home (Best Friends Animal Society, n.d.; Fieser, 2019; Rechtine, n.d.).

Nevertheless, the unfortunate reality is that physically and behaviorally healthy dogs continue to be euthanized in U.S. shelters (Cain et al., 2021; Notaro, 2010). Such an outcome can be the result of an organization's capacity for animal care, financial resources, or the perceived

adoptability of an animal as its length of stay increases in the shelter (Cain et al., 2021; Notaro, 2010).

1.5 Geographic Considerations

It is possible that the geographic region in which a shelter is located in the US may impact the experiences of animals that reside in its care (Cain et al., 2021; Cain et al., 2020; Reese & Li, 2023; Martinez et al., 2022). In a study of regional differences in dog adoption likelihood, Cain et al. (2020) found that dogs from shelters in the northern and western regions of the United States were more likely to be adopted compared to dogs residing in the South. The authors noted that the southern regions of the US traditionally have milder winters and less stringent dog ownership laws, which may contribute to larger stray dog populations and influence an individual dog's likelihood of adoption. Moreover, Gunter et al. (2018) identified regional differences in shelter dogs' lengths of stay in their exploration of the genetic breed heritages of dogs in U.S. animal shelters. Specifically, they found that pit-bull-type dogs had stays in the shelter that were half as long as dogs of the same breed ancestry that resided in San Diego, California; however, such differences may be indicative of the organizational differences and not the necessarily reflective of regional trends related to breed type and length of stay.

In a study conducted in Chile, Acosta-Jamett et al. (2010) found that the highest percentage of dog owners was in rural areas with a human to dog ratio ranging from 1.1 to 2.1, followed then by towns and cities. This study also reported significant differences in ownership practices, with rural dogs far more likely to roam freely and less likely to be vaccinated or neutered than urban dogs. Naughton et al. (2023) explored the rural and urban differences in basic care, living conditions, and perceptions in Northen Ireland. They noted that dogs living in

cities are kept predominantly indoors with daily walks, while dogs on farms are more often kept outdoors and exercise themselves.

Furthermore, the cultural norms associated with a particular population density, such as rural or urban, may impact an owner's perception of their dog's role and associated behavior in the home. In a study by Martinez et al. (2022), dogs in rural areas were viewed by their owners as guardians or protectors in comparison to dogs living in urban communities, where owners did not have such defined roles for their dogs. The authors found that territorial aggression and defensive behavior were more prevalent with rural dogs, and that the owners encourage this protective behavior while dogs living in urban areas had lower levels of aggressive behavior. In considering the findings by Martinez et al. (2022), it is unknown if these differences in preferred dog behavior found at the population density level might interact with regional differences as well.

1.6 Addressing Length of Stay Through Transfer Programs and Other Means

While transporting dogs from one area to another may reduce a dog's length of stay (LOS) in a particular shelter, such programs may negatively impact dogs' immediate welfare (Bergeron et al., 2002; Romaniuk et al., 2022; Tateo et al., 2022). Bergeron and colleagues (2002) found that the laboratory beagles had significantly higher salivary and plasma cortisol concentrations during transport, with loading on and unloading off airplanes appearing to be the most stressful component, based on the dogs' heart rates. A more recent study by Romaniuk et al. (2022) examined the impact of ground transportation on 383 puppies and found increased hormone and antibodies during transport, suggesting that the transportation experience was stressful (Romaniuk et al., 2022).

Careful selection of dogs for transport is critical. For example, early life stress may play a role in future dog behavior (Foraita et al., 2021). In a study by Foraita and colleagues (2021), the authors examined how environmental factors influence the development of dogs' executive functioning, which is crucial for an animal's self-regulation and behavioral control. Dogs facing extreme hardships early in life may experience negative impacts on their executive functioning later on while surmountable challenges can have a positive influence (Foraita et al., 2021). Logistical and medical requirements utilized in transport programs, such as quarantine policies, can negatively affect the socialization of dogs following relocation (Simmons & Hoffman, 2016). The various studies underscore the need to manage environmental changes carefully to ensure the present and future well-being of transported dogs.

Focusing on behaviors that most influence adopters' choices is another way to potentially address LOS. For example, previous research has found that a dog may be less desirable by potential adopters if it is perceived as "too active" or "too big" (Friend & Bench, 2020; Powell et al., 2021; Powell et al., 2022). By understanding which behaviors most influence adopters' choices, shelters may be able to implement more effective strategies to increase adoption and minimize time living in the shelter. A study by Protopopova et al. (2014) revealed that certain in-kennel behaviors of shelter dogs can predict their LOS and likelihood of adoption. These behaviors include increased back-and-forth motion in the kennel, more contact with the kennel enclosure (such as leaning or rubbing on walls) and facing away from the front of the kennel. Interestingly, some behaviors previously thought to be important, such as sitting, gazing at potential adopters, not barking, and not jumping on the kennel door, did not predict dogs' time in the shelter.

1.7 Current Study

The aim of the current study is to examine whether the lengths of stay of dogs residing in U.S. differ based on the shelter's geographic region or density of the population in that area to better understand how to address the time animals reside in shelters. Based on prior research, we hypothesized that dogs residing in shelters in the northeast and western regions of the United States would have shorter stays in the shelter and a greater proportion of live outcomes than dogs residing in other U.S. regions. Moreover, we hypothesized that dogs adopted from shelters in rural or urban shelters would have longer lengths of stay and fewer live outcomes than dogs from animal shelters in suburban areas. Additionally, we will explore if a shelter's organizational type as well as characteristics of the dog (i.e., intake type, sex, age, size, and outcome), are correlated with dogs' lengths of stay in the shelter and outcomes in the various geographic regions.

2. Methods and Materials

2.1 Dataset Acquisition

Beginning in 2016, Shelter Animals Count (SAC) began efforts to collate comprehensive data about the US animal sheltering system. Its efforts culminated in the development of The National Database with the stated goal "to measure progress in animal welfare, foster collaboration, and address the issues of pet homelessness . . . . . analyzing and sharing animal sheltering data to provide crucial information and insight to save lives" (Shelter Animals Count, 2024). The dataset for this study was provided by SAC and includes organizations using PetPoint, a cloud-based data management system developed by 24Pet Company in Rolling Meadows, Illinois. The 24Pet Company software is utilized by over 2,000 shelters and rescues across the United States (Rowan & Kartal, 2018), allowing for a broad representation of animal

welfare organizations within the dataset. These data encompass records from shelters in Washington D.C. and 46 states, except Delaware, North Dakota, Utah, and Wyoming, and pertains to animals in these shelters from January 1 to December 31, 2023.

2.2 Included Data Variables and Coding

The initial dataset contained records for 708,508 animals including the dogs, cats, small mammals, livestock, reptiles, and birds. Other dataset variables included were:

Animal Id describes an 8-digit numerical identifier for each animal within the welfare organization.

Intake Type describes the various ways an animal enters the shelter. These categories include stray, owner/guardian surrender and return, transport in, seized custody, clinic, and service in. *Stray* involves a dog born in the community, abandoned, or lost without identification when brought to the animal welfare organization (Stray Animal Care, 2023). *Owner/guardian surrender* occurs when a pet owner voluntarily relinquishes their animal to the shelter (Hawes et al., 2020). Similarly, a *return* is typically when a dog is brought back within 30 days of initial adoption, while longer periods are usually termed "owner/guardian surrender." *Transport in* involves animals relocated from one sheltering organization to another (Intake and Outcome Definitions, 2017). *Seized custody* refers to instances where animal welfare agents, with veterinary confirmation, remove an animal from its owner due to concerns about its care (Impound, Protective Custody, and Quarantine, 2024). *Clinic* indicates animals that received medical services without being admitted for rehoming. Lastly, *service in* refers to animals that received other services, such as cremation, and did not necessarily enter the animal welfare organization for rehoming purposes.

Intake Date describes the date on which the animal first entered the shelter.

Age describes the approximate age of the animal at its time of intake, calculated by subtracting its estimated or provided birth date from the intake date. This calculation of this variable was in months.

Outcome Type describes the animal's outcome from its stay in the animal shelter. These outcomes include includes return to owner/guardian, adoption, transfer out, clinic out, died, euthanasia, no outcome, and incorrect data entry. *Return to owner/guardian* involves reunion with the animal's owner. *Adoption* is a key variable that directly relates to the study's focus on placement with an owner into a new home. *Transfer out* represents dogs moved to another animal welfare organization, indicating inter-shelter cooperation and resource sharing. *Clinic out* involves an owned animal that was in the shelter for a specific medical purpose. *No outcome* involves animals remaining in the shelter at the end of data collection. *Died* and *euthanasia* represent less favorable outcomes of death, with the former involving a natural demise as a result of sickness, trauma, or unknown causes. The latter is humane euthanasia as of result of the animal posing a serious threat to humans and/or animals and/or being gravely ill; and unfortunately, the latter can also result by virtue of overcrowding in the system (Animal Welfare Glossary, 2025).

Outcome Date describes the date in which the animal experienced an outcome.

Length of Stay (LOS) describes the amount of time in days between the animal's intake and outcome from the animal welfare organization. This variable was added to the dataset through the calculation of subtracting the intake and outcome dates. This variable is calculated in days.

Sex Type describes the animal as female, male, and unknown. Unknown describes an animal whose sex was not identified or input into the animal's record during its stay.

Size Type describes the physical stature of animal with four categorization classes: Small (S), Medium (M), Large (L), and Extra Large (X).

Org Id describes a 4-digit number identifier for each animal welfare organization that hosted an animal.

Organization Type describes the type of animal welfare organization, including government animal services, animal shelter with a government contract, animal rescue with a government contract, animal shelter without a government contract, and animal rescue without a government contract. *Government animal services* are animal care services owned and operated by a municipality or local authority. *Animal shelter with a government contract* and *animal rescue with a government contract* are private organizations that partially or entirely receive funding from municipalities to provide the animal care and services (Goselin et al., 2011). *Animal shelters* involve brick and mortar locations that house the dogs where the public can visit and adopt pets while *animal rescues* involve the animal welfare organization that do not house the animals in a physical location but instead involve fostering of animals within their care.

Location State describes the U.S. state where the animal welfare organization is located and includes 45 states and Washington, D.C.

Geographic Region describes one of five regions in the United States where the animal shelter organization was located. This variable was not included in the initial dataset by SAC but was added. According to United States Census Bureau, there are four main regions in the United States: Northeast, Midwest, South, and West (U.S. Census Bureau, 2021). Other organizations, such as the National Geographic Society, further subdivide the southern region into two segments: Southeast and Southwest (O'Connor, 2023). As such, geographic variation utilized five regions: Northeast, Midwest, Southeast, Southwest, and West.

Location Zip describes the zip code of the physical address of the animal welfare organization.

Population Density describes the animal welfare organization as being located in an urban, suburban or rural area based on the number of people per unit of area. This variable was not included in the initial dataset by SAC but was added by (a) utilizing the ZIP Code Tabulation Area (2020) for stated population density in the 2020 U.S. Census (U.S. Census Bureau, 2020) for each Location Zip contained in the initial dataset and then (b) coding using the following criteria: Urban (over 1,000 people per square mile), Suburban (200 to 999 people per square mile), and Rural (less than 200 people per square mile).

2.3 Included but Cleaned Variable

As previously indicated, *Age* was an included variable in the dataset. However, some entries in the Shelter Animals Count dataset showed implausible ages (e.g., in excess of 40 years) that were likely a result of a recording error or possibly entering an excessively old entry to note that the dog's age was unknown given that in certain instances the date of birth was the same day and month as the *Intake Date* with a different year. As such, the dataset was further cleaned with regards to the *Age* variable, and only cases of dogs aged 20 years and younger remained in our dataset. This maximum age was set as life expectancy for dogs has been found to be approximately 11 years old, on average, although as old as 19 years old for a Jack Russell Terrier has been recorded (Teng et al., 2022). By setting our maximum dog age at 20 years old, the analysis allows for the rare, long-lived dogs while simultaneously addressing this recordkeeping issue.

2.4 Excluded Variables

Other variables were provided in the initial dataset from Shelter Animals Count that were ultimately excluded. These variables were either beyond the scope of our research question examining the impact of geographic variation on outcomes of dogs residing in U.S. animal shelters or contained potentially unreliable or subjective information. These variables include:

Fips Code is a numeric or alphabetic code issued by the National Institute of Standards and Technology (NIST) that standardizes identification of geographic information for all government agencies (U.S. Census Bureau, 2021).

Intake Reason is the reason the animal is in the organization's custody as reported by the individual delivering the animal and as such the stated reasons vary from shelter to shelter (Animal Welfare Glossary, 2025).

Intake Subtype provides more additional information about the animal's intake into the shelter and includes agency assist/unspecified transfer, abandoned, animal control/law enforcement officer, abuse/neglect, better placement options, boarding/temporarily fostering, born during shelter care, behavioral concerns, bite quarantine, breed restrictions, lifestyle changes, pet care/cost, courtesy hold, deployment, disaster/emergency response, does not want/like, euthanasia request, housing concerns, family concerns, legal processing/owner arrested, pet medical concerns, allergies, owner medical concerns, offsite custody, onsite custody, out-of-state transfer, owner died, protective custody, public drop-off, quarantine, rabies testing, return, unspecified stray, unspecified surrender, too many animals, trapped/feral, unspecified, unwanted litter, and unrestrained (Animal Welfare Glossary, 2025).

Location City describes the city of intake based on the physical address of the animal welfare organization. It was excluded given that Location Zip better specifies the shelter's location.

Outcome Reason is a non-standardized explanation as to why the animal left the organization's custody and can vary from shelter to shelter (Animal Welfare Glossary, 2025).

Outcome Subtype describes the animal's outcome as live or non-live.

Prealtered describes the animal's spay-neuter status upon entry and includes altered after intake into the shelter, unknown alteration status at time of intake, and altered before intake into the shelter.

Primary Breed describes the type of animal with identifiable characteristics that separates the animal from others in its species (Animal Welfare Glossary, 2025). Considering the unreliability of breed identification based on visual appearance (Gunter et al., 2018), this variable was excluded.

Primary Color describes the main color of the animal based on a visual inspection at the animal welfare organization.

Spayed/Neutered in Care indicates whether the animal was altered upon leaving the shelter's care.

Status Date/Time indicates the period in which the animal's reproductive status was determined (Animal Welfare Glossary, 2025).

Records of animals other than dogs were not included in the final dataset. Intake types (i.e., clinic services, service in) as well as outcome types (e.g., clinic out, service out) not involving the shelter's ownership of the animal were also removed. Animals with intake types (i.e., bite quarantine, euthanasia request, quarantine, trapped/feral) remained in the dataset if they

had a live, non-owner-related outcome. Additionally, animal records with the same intake and outcome type (i.e., both were stray, owner/guardian surrender, or seized custody) were excluded. Data from animal rescues (with and without government contracts) were also removed as they were not the focus of this study. Table 1 describes the animal records utilized in our final dataset.

Table 1

Included Variable Descriptives for Shelter Dog Records (N = 269,169)

Variable Subtype	*n*	% of Records
Intake type		
Owner/guardian surrender/return	70,000	26
Seized/custody	35,382	13
Stray	114,443	43
Transfer in	49,344	18
Animal type		
Dog	269,169	100
Outcome type		
Adopted	147,938	55
Euthanized/died	27,511	10
Returned to owner/guardian	53,704	20
Transfer out	40,016	15
Sex		
Unidentified	3,875	1
Male	139,409	52
Female	125,885	47
Size		
Small	82,399	31
Medium	88,728	33
Large	92,405	34
Extra large	5,637	2
Organization type		
Animal shelter without government contract	51,073	19
Animal shelter with a government contract	141,080	52
Municipal facility	77,016	29
Region		
Northeast (ME, NH, MA, RI, VT, NY, NJ, CT, PA)	14,877	5.5
Southeast (DE, MD, DC, WV, VA, KY, NC, SC, TN, GA, AL, MS, AR, LA, FL)	57,315	21.3
Midwest (OH, MI, WI, MN, ND, SD, NE, IA, KS, MO, IL, IN)	78,770	29.3
Southwest (OK, TX, NM, AZ)	59,811	22.2
West (CO, UT, WY, MT, ID, NV, CA, OR, WA, HI, AK)	58,396	21.7

2.5 Statistical Analysis

The dataset was provided by Shelter Animals Count as a Microsoft Excel file and preliminary data coding and cleaning was carried out in this program. Data analyses utilized IBM SPSS Statistics (Version 29).

Dogs' intake type, age (in months), sex, size, length of stay (in days), and live outcome type (i.e., adoption, return to owner, transfer out) were the final animal variables used in the data analysis**.** Dogs with lengths of stay less than one day were removed from the zero truncated model with all values greater than one rounded to the nearest whole integer. Dogs with ages less than one month were also excluded.

Due to the number of intake subtype categories and their tangential relationship to our research questions, this variable was limited to the categories of owner surrender, seized/custody case, stray, or transfer in. Variables about the organization, such as its type, the region of the United States that the shelter was located, and the population density of that area, were included.

To better understand the amount of time that animals resided in the shelter (length of stay) as related to the organization's geographic region and population density, a generalized linear model was utilized. This count model included a negative binomial distribution with a log link function. To reduce the possibility of detecting statistical main effects and interactions without practical significance, a 3% random sample of the final dataset (269,169 records of dogs with positive outcomes) was utilized for modeling. All independent variables and one covariate, age, were entered into the models as fixed effects. Two- and three-way interactions were retained based on model fit with the dependent variable of length of stay. To determine which model was a better fit for the data in each analysis, Bayesian Information Criterion (BIC) was used. Due to

the limited representation of rural and suburban sheltering organizations in the Northeast region, three-way interactions, including the variables of geographic region and population density, unable to be included in the final models.

3. Results

3.1 Descriptive Statistics

Shelter Demographics

The records of dogs from nonprofit sheltering organizations with government contracts comprised the majority of items in our dataset (52.1%), with municipal shelters (25.4%) and nonprofit organizations (22.4%) representing the remaining records (Figure 1). In terms of geographic location, the largest number of dogs were from animal shelters in the Midwest region of the United States (30.4%). The Southeast (21.8%), Southwest (21.5%), and West (20.9%) regions were similarly represented; and there was a small proportion of records from the Northeast (5.4 %; Figure 2). Dog records from animal shelters in an area with a population density constituting an Urban zone comprised the most records in our dataset (47.5%) with Rural (29.9%) and Suburban (22.8%) areas constituting the remaining records (Figure 2).

Figure 1

Proportions of Organization Types Represented Across Animal Shelters

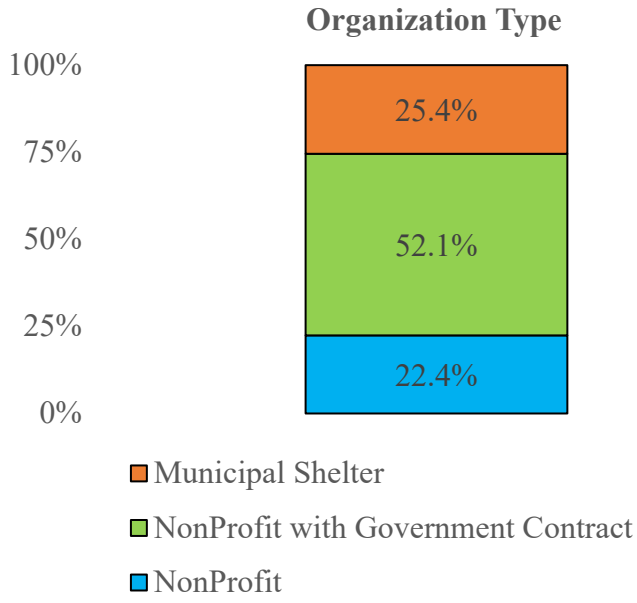
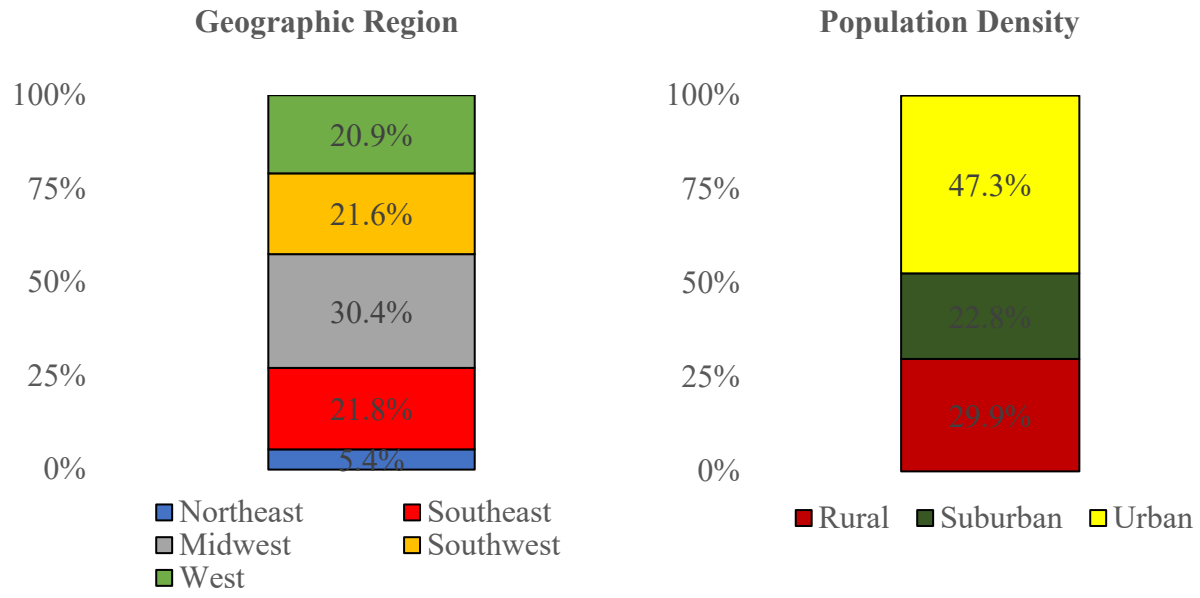


Figure 2

Proportions of US Regions and Population Densities Represented Across Animal Shelters



Animal Demographics

When describing the size of the animals in our dataset, dogs were categorized primarily as medium (34.1%), large (33.6%), and small (30.2%) with a few described as extra-large

(2.19%; Figure 3). The mean age of dogs entering the shelter was 50.4 months old (*SD* = 54 months) with a median of 119.6 months old and a range of 1 day old to 19.9 years old.

In our dataset, most dogs entered the shelter as strays (38.7%) followed by those that were surrendered by their owners (27.2%) and transported in from other organizations (22.4%); the smallest proportion of dogs in our dataset were brought to shelters as part of seizure or custody cases (11.8%; Figure 3). Regarding the dogs' positive outcomes, the largest majority were adopted, 71.9%, while 17.9% were transferred out of the facility for placement, and 11.9% were returned to owner (Figure 3). The mean number of days dogs spent in shelters' care was 24.9 days (*SD* = 31.6 days) with a minimum of exiting one day after intake (1 day) and a maximum of 354 days. The median LOS of the dogs in our dataset was 177.5 days.

Figure 3

Proportions of Animal Intake Types and Outcome Types Represented Across Animal Shelters

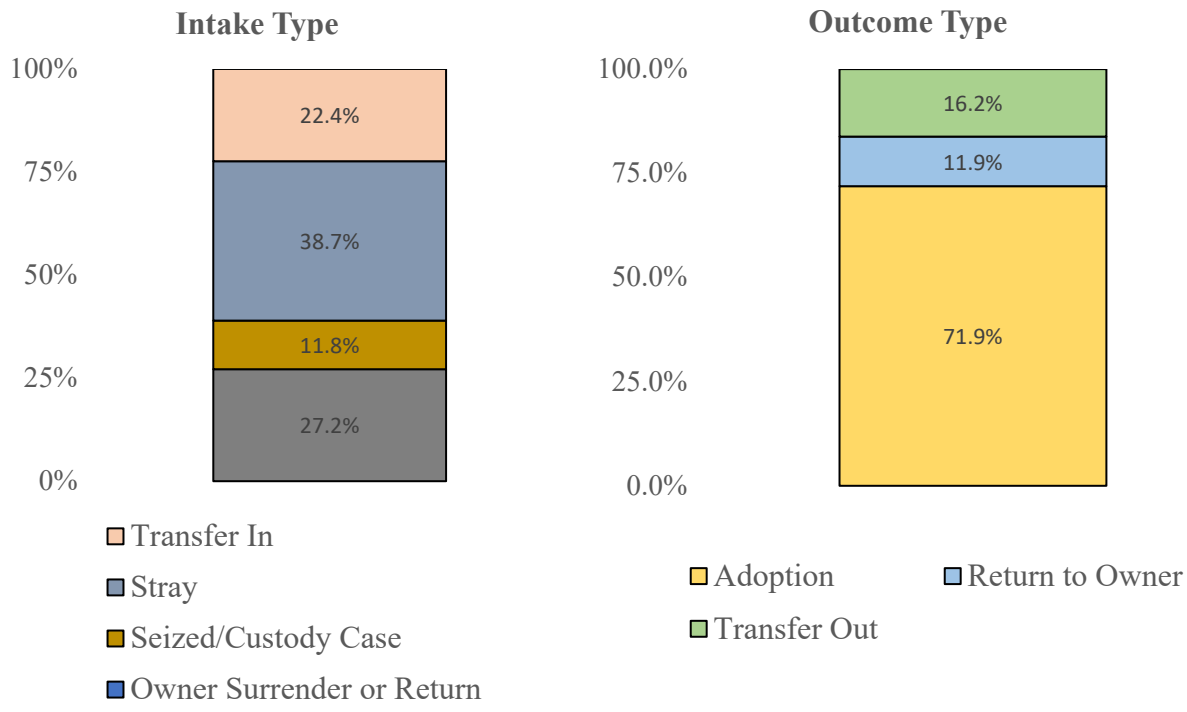
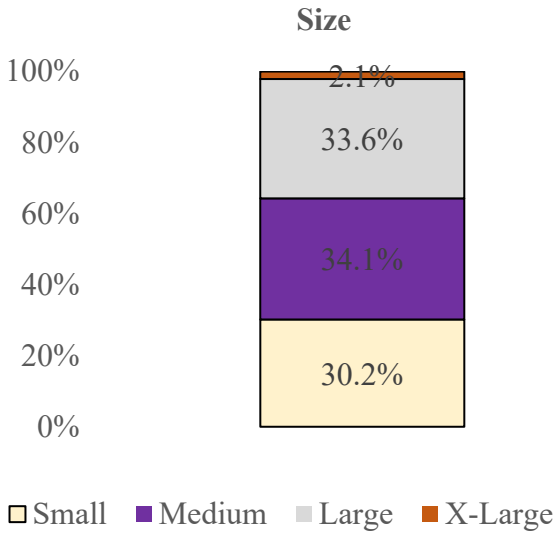


Figure 4

Proportions of Animal Sizes Across Animal Shelters



3.2 Predictors of Stay

A total of 5,771 dog records were used in our statistical analysis (a random 3% sample of the final dataset). We analyzed dogs' LOS using a generalized linear model to detect an effect of organization type, intake type, age (in months), size, population density, outcome type, geographic region, and their interactions. Various interactions with these variables were not retained in the final model as their removal led to improved fit as determined by BIC. The best-fitting model is described in Table 2.

Table 2

Generalized linear model predicting animals' length of stay

Variable	Wald Chi-Square	*df*	*p*
Intercept	2793.1	1	< .001
Intake Type	39.1	3	< .001
Org Type	5.9	2	.051
Geo Region	19.9	4	< .001
Pop Density Type	6.3	2	.042
Outcome Type	345.3	2	< .001
Size	83.1	3	< .001
Geo Region x Outcome Type	35.8	8	< .001
Pop Density Type x Outcome Type	16.6	4	.002
Geo Region x Pop Density Type	20.5	8	.009
Org Type x Geo Region	64.4	8	< .001
Org Type x Pop Density Type	65.4	4	< .001
Intake Type x Geo Region	34.0	12	< .001
Intake Type x Outcome Type	137.5	6	< .001
Age (months)	24.6	1	< .001

Size and Age of the Dog

As size and age were not the focus of this study, we did not include them in any of the interactions examined; however, we found that as main effects, both the size and age of the dog

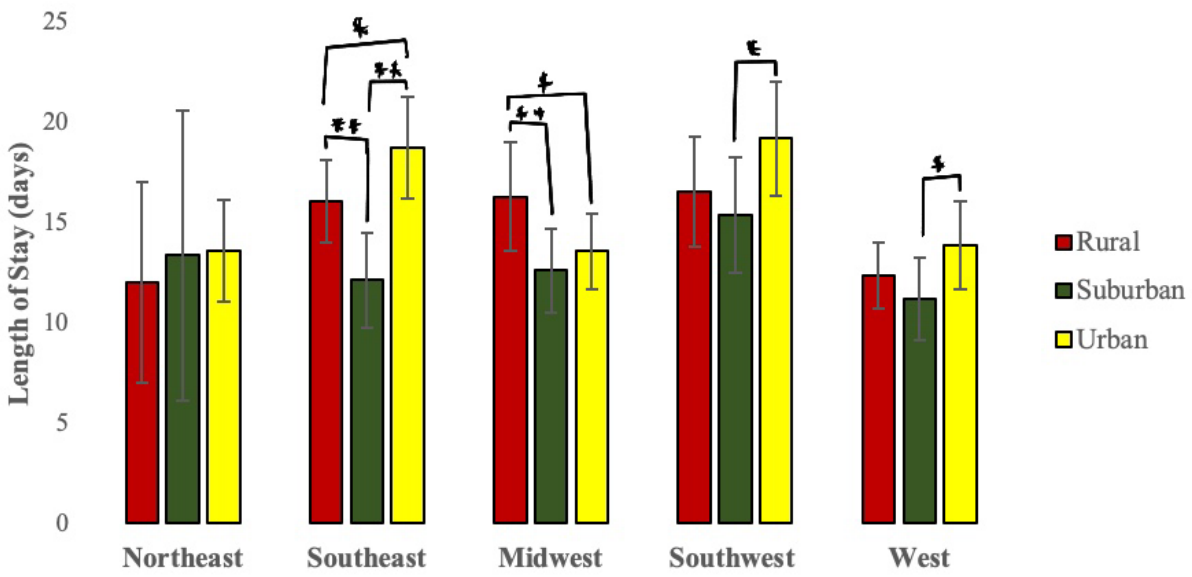
significantly influenced dogs' length of stay. With the age of the dog, we found that with each month the dog's age increased, its length of stay increased by three days. In exploring the impact of size, dog were categorized as small, medium, large, and extra-large with the last category used as our reference. We found that large dogs had significantly longer lengths of stay than those that were extra-large, such that large dogs' length of stay was 23.2% longer than those that were extra-large.

Geographic Region x Population Density

In describing our two-way interaction between geographic regions in the United States and population density related to the areas in which the shelters are located, we found differences in dogs' lengths of stay (Figure 5). Specifically, dogs' stays at Southeast shelters in suburban areas were significantly shorter than animals residing in Southeast shelters with urban or rural population densities ([SESUB – SEURB] Difference: -6.59, *95% CI* [-9.57, -3.61], $p < .001$; [SESUB – SERUR] Difference: -3.92, *95% CI* [-6.64, -1.20], $p = 0.005$). In the Midwest region, rural dogs had longer lengths of stay compared to dogs in suburban and urban areas of the Midwest ([MWRUR – MWSUB] Difference 3.68, *95% CI* [0.95, 6.4] $p = .008$; [MWRUR – MWURB] Difference: 2.74, *95% CI* [0.20, 5.29], $p = .035$). In both the Southwest and West, our model indicated that dogs' LOS was shorter when residing at shelters in suburban areas as compared to those in urban ([SWSUB – SWURB] Difference: -3.83, *95% CI* [-7.24, -0.43], $p = .0275$); [WSUB – WURB] Difference: -2.66, *95% CI* [-5.2, -0.12], $p = .04$).

Figure 5

Estimated Marginal Means of Length of Stay (in days) for Dogs by Geographic Region and Population Density



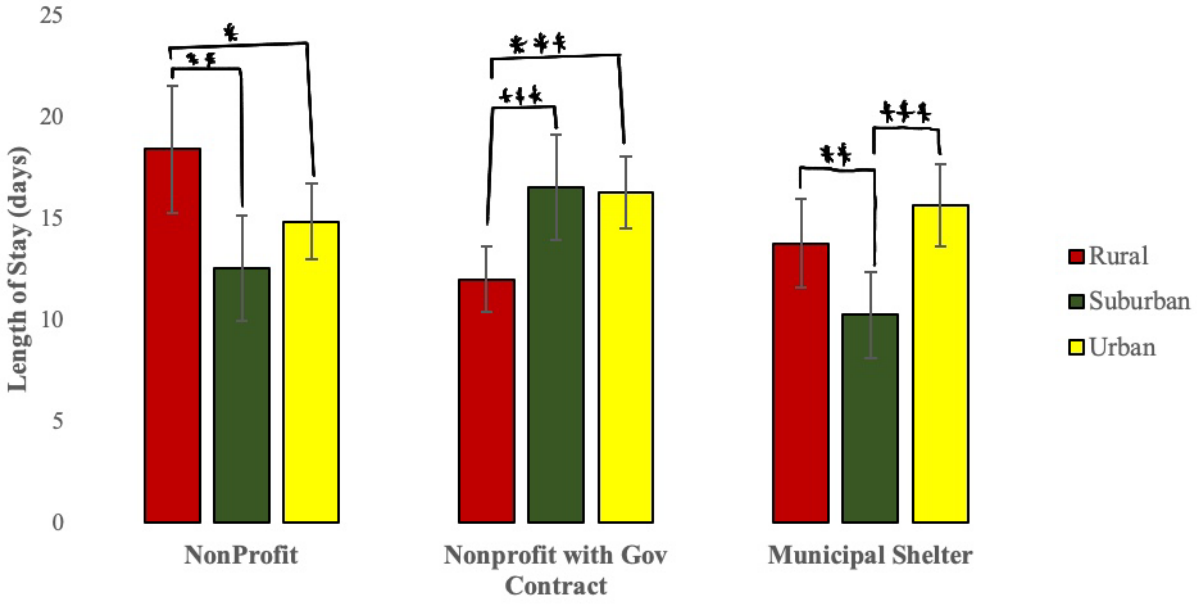
Note. *** p < 0.001; ** p < 0.01; * p < 0.05; if p > .05.

Population Density x Organization Type

Our model predicted that a dog's LOS differed by the population density and organization type in which the dogs resided (Figure 6). Particularly, we found longer LOS for rural dogs at nonprofit organizations compared to those in suburban ([RURNP – SUBNP] Difference: 5.89, *95% CI* [2.28, 9.49], $p = .001$) and urban ([RURNP – URBNP] Difference: 3.60, *95% CI* [0.21, 7.00], $p = .038$) areas. Longer LOS was also found for rural dogs residing in municipal shelters versus suburban, municipal shelters ([RURMUNI – SUBMUNI] Difference: 3.52, *95% CI* [1.10, 5.95], $p = .004$). Yet, we found shorter LOS for dogs residing at rural, nonprofit organizations with municipal contracts than dogs at similar organizations in suburban areas ([RURNPMC – SUBNPMC] Difference: -4.51, *95% CI* [-7.10, -1.92], $p < .001$) and urban areas ([RURNPMC – URBNPMC] Difference: -4.28, *95% CI* [-6.22, -2.33], $p < .001$).

Figure 6

Estimated Marginal Means of Length of Stay (in days) for Dogs by Population Density and Organization Type



Note. *** p < 0.001; ** p < 0.01; * p < 0.05; if p > .05.

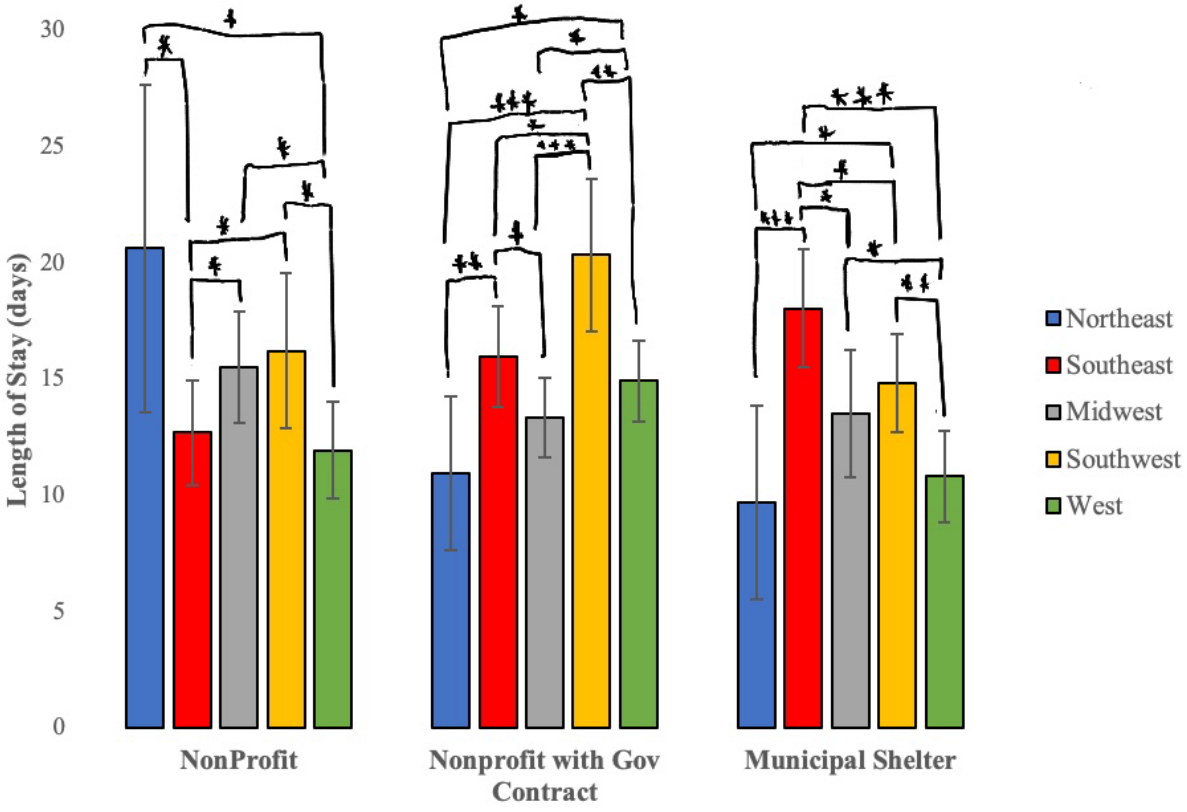
Geographic Region x Organization Type

In describing this two-way interaction, we found differences in dogs' LOS related to the US geographic region and organization type in which they resided (Figure 7). Notably, dogs at Northeast nonprofit shelters had longer stays than dogs residing in nonprofit shelters in the Southeast ([NENP – SENP] Difference: 7.92, *95% CI* [0.85, 15.00], $p = .028$) whereas a comparison of the same geographic region (SE) resulted in shorter lengths of stay for dogs at nonprofit organizations with municipal contracts ([NENPMC – SENPMC] Difference: -5.02, *95% CI* [-8.73, -1.31], $p = .008$) and municipal shelters ([NEMUNI – SEMUNI] Difference: -8.35, *95% CI* [-12.95, -3.74], $p < .001$). Regardless of organization type, dogs in Southwest shelters stayed longer than those in the West ([SWNP – WNP] Difference: 4.28, *95% CI* [0.55,

8.00], p = .024; [SWNPMC – WNPMC] Difference: 5.40, *95% CI* [2.03, 8.76], p = .002); [SWMUNI – WMUNI] Difference: 4.01, *95% CI* [1.37, 6.65], p = .003).

Figure 7

Estimated Marginal Means of Length of Stay (in days) for Dogs by Geographic Region and Organization Type



Note. *** p < 0.001; ** p < 0.01; * p < 0.05; if p > .05.

Moreover, dogs had shorter stays when residing at both nonprofit organizations with municipal contracts and municipal shelters in the Northeast compared to those in the Southwest, respectively ([NENPMC – SWNPMC] Difference: -9.30, *95% CI* [-13.76, -4.98], $p < .001$); [NEMUNI – SWMUNI] Difference: -5.12, *95% CI* [-9.47, -0.77], p = .021). Furthermore, we found dogs at Northeast nonprofit organizations had longer LOS than dogs at nonprofits in the West ([NENP – WNP] Difference: 8.69, *95% CI* [1.60, 15.78], p = .016), but dogs residing in

Northeast nonprofit shelters with municipal contracts had shorter stays than Western nonprofit organizations with municipal contracts ([NENPMC – WNPMC] Difference: -3.97, *95% CI* [-7.52, -0.43], $p = .028$). Our model also predicted that dogs had longer LOS in the Southeast compared to the Midwest for dogs residing at nonprofit with municipal contract ([SENPMC – MWNPMC] Difference: 2.63, *95% CI* [0.16 ,5.11], $p = .037$) and municipal shelters (([SEMUNI– MWMUNI] Difference: 4.53, *95% CI* [1.10, 7.96], $p = .010$). Lastly, we found shorter LOS for dogs at nonprofit organizations with municipal contracts in the Southeast when compared to those in the Southwest ([SENPMC – SWNPMC] Difference: -4.35, *95% CI* [-7.95, -0.74], $p = .018$).

Geographic Region x Intake Type

In describing our two-way interaction between the intake type of dogs arriving at shelters and the US geographic region in which the organization is located, we found differences in dogs' LOS. Dogs entering shelters in the West via transfer programs had significantly shorter stays than dogs that had been transferred in to Midwest facilities ([WTRI – MWTRI] Difference: -3.22, *95% CI* [-5.48, -0.96], $p = .005$), Southwest organizations ([WTRI – SWTRI] Difference: -7.78, *95% CI* [-11.71, -3.84], $p < .001$), and Southeast shelters ([WTRI – SETRI] Difference: -7.76, *95% CI* [-11.00, -4.38], $p < .001$). Dogs who had been transferred into Midwest shelters had shorter LOS in comparison to those in the Southwest ([MWTRI – SWTRI] Difference: -4.55, *95% CI* [-8.41, -0.70], $p = .021$). When comparing dogs that entered shelters in the Northeast to those in the Southwest, those entering through seizure has a shorter LOS ([NESEIZ – SWSEIZ] Difference: -5.62, *95% CI* [-11.23, -0.02], $p = .049$) as did those entering as strays (([NESTRAY – SWSTRAY] Difference: -4.17, *95% CI* [-7.64, -0.69], $p = .019$). Stray dogs in the Northeast had shorter LOS than those in the Southeast ([NESTRAY – SESTRAY]

Difference: -3.56, *95% CI* [-7.05, -0.08], $p = .045$). Dogs that had been surrendered by their owners had a shorter LOS in the Southeast than those in the Southwest ([SESUR – SWSUR] Difference: -3.88, *95% CI* [-7.70, -0.06], $p = .047$). The estimated marginal means, standard errors, and statistical significance of LOS comparisons by intake type and geographic region is described in Table 3.

Table 3

Table of Significance of Estimated Marginal Means of Dogs' Length of Stay (in days) by Intake Type and Geographic Region

Variable	Mean	SE	Northeast	Southeast	Midwest	Southwest
Owner Surrender/Return						
Northeast	19.88	3.43				
Southeast	16.71	1.34	0.359			
Midwest	17.66	1.50	0.523	0.573		
Southwest	20.59	1.89	0.843	**0.047**	0.147	
West	15.34	1.41	0.190	0.397	0.174	**0.008**
Seized/Custody Case						
Northeast	12.41	2.28				
Southeast	15.92	1.54	0.193			
Midwest	15.76	1.61	0.206	0.942		
Southwest	18.04	1.85	**0.049**	0.364	0.327	
West	15.73	1.75	0.231	0.934	0.989	0.345
Stray						
Northeast	9.80	1.56				
Southeast	13.36	0.94	**0.045**			
Midwest	12.41	0.97	0.143	0.452		
Southwest	13.96	0.94	**0.019**	0.626	0.224	
West	12.11	0.70	0.166	0.257	0.790	0.092
Transfer In						
Northeast	11.79	2.59				
Southeast	15.90	1.87	0.130			
Midwest	11.43	1.14	0.886	**0.006**		
Southwest	15.98	2.17	0.150	0.969	**0.021**	
West	8.21	1.02	0.156	**<.001**	**0.005**	**<.001**

Note. Bolded p values indicated significance less than $p < .05$.

Population Density x Outcome Type

In describing this two-way interaction, we found differences between the types of positive outcomes dogs experienced and the population density where the organization was located, specifically dogs that were transferred out. These dogs' LOS was longer at urban organizations as compared to those in suburban ([URBTO – SUBTO] Difference: 8.38, *95% CI* [12.50, 4.26], $p < .001$) and rural areas ([URBTO – RURTO] Difference: 4.92, *95% CI* [8.96, .89], $p = .017$). The estimated marginal means, standard errors, and significance of LOS comparisons by positive outcome type and population density are described in Table 4.

Table 4

Table of Significance of Estimated Marginal Means of Length of Stay (in days) for Dogs by Outcome Type and Population Density

Variable	Mean	SE	Rural	Suburban
Adoption				
Rural	28.40	1.50		
Suburban	26.32	1.73	0.291	
Urban	26.42	1.03	0.193	0.955
Return to Owner				
Rural	5.89	0.67		
Suburban	5.46	0.74	0.584	
Urban	6.18	0.55	0.666	0.349
Transfer Out				
Rural	18.33	1.66		
Suburban	14.87	1.60	0.058	
Urban	23.25	1.82	**0.017**	**<.001**

Note. Bolded p values indicated significance less than $p < .05$.

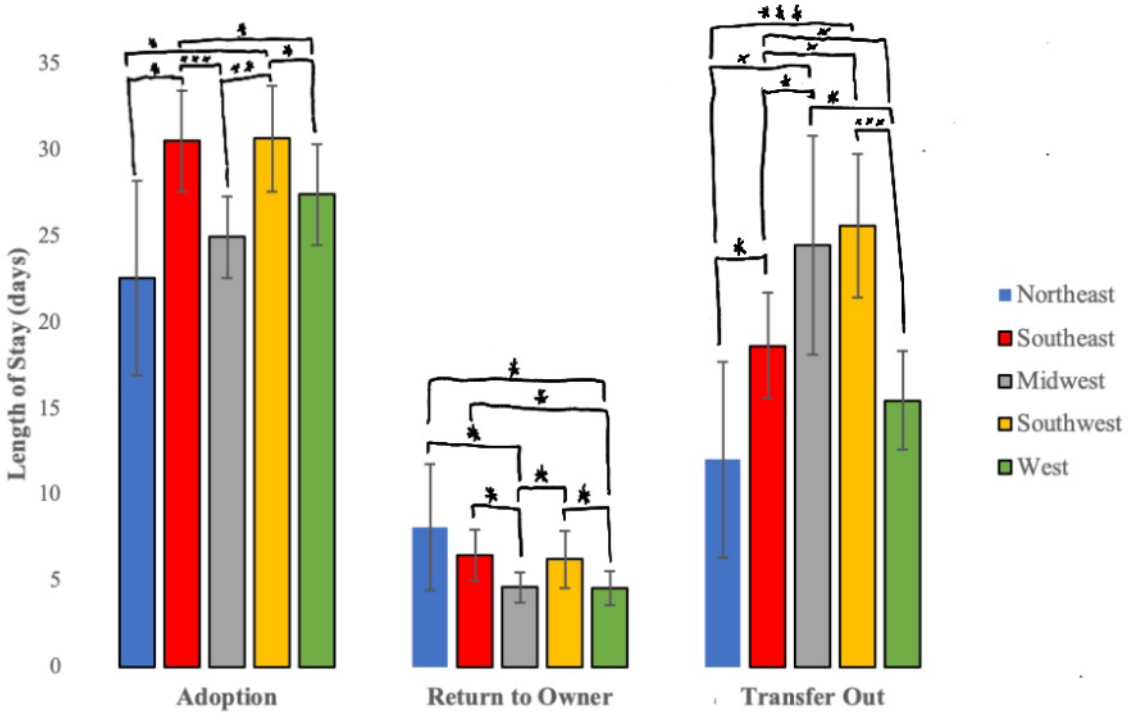
Geographic Region x Outcome Type

In describing our two-way interaction between positive outcome type and US geographic region, we found that a dog's LOS differed depending on the shelter's region and the type of

outcome the dog experienced (Figure 8). Particularly, adopted dogs' LOS at Northeast shelters were significantly shorter than dogs that were adopted from the Southwest and Southeast ([NEA – SWA] Difference: -8.09, *95% CI* [-14.24, -1.79], $p = 0.010$; [NEA – SEA] Difference: -7.95, *95% CI* [-14.11, -1.78], $p = .011$). We also found that adopted animals' LOS at Midwest shelters were significantly shorter than animals that were adopted from Southwest and Southeast regions ([MWA – SWA] Difference: -5.73, 95% CI [-9.16, -2.39], $p = 0.001$; [MWA – SEA] Difference: -5.60, 95% CI [-8.89, -2.29], $p < .001$).

Figure 8

Estimated Marginal Means of Length of Stay (in days) for Dogs by Geographic Region and Outcome Type



Note. *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$; if $p > .05$.

We found that dogs that were returned to their owners had significantly shorter stays in Midwest shelters than dogs that were returned to their owners in the Northeast and Southeast ([MWRO – NERO] Difference: -3.50, *95% CI* [-6.99, -0.01], $p = 0.050$; [MWRO – SERO]

Difference: -1.85, *95% CI* [-3.38, -0.33], $p = .017$), as were the LOS of dogs returned to their owners in the Western region of the US compared to the Northeast and Southeast ([WRO – NERO] Difference: -3.54, *95% CI* [-7.07, -0.01], $p = 0.049$; [WRO - SERO] Difference: -1.90, *95% CI* [-3.43, -0.373], $p = .015$).

Our model predicted significant differences in the LOS for dogs that were transferred out of their organization by geographic region. Transferred out dogs in the Northeast had significantly shorter stays than dogs transferred out in the Southwest ([NETO – SWTO] Difference: -13.60, 95% *CI* [-20.13, -7.07], $p < .001$), Midwest ([NETO – MWTO] Difference: -12.45, *95% CI* [-20.66, -4.25], $p = .003$), and Southeast (NETO – SETO] Difference: -6.61, *95% CI* [-12.69, -0.53], $p = .033$). Transferred out dogs' LOS in the West were shorter than dogs transferred out in the Midwest ([WTO – MWTO] Difference: -9.00, *95% CI* [-15.84, -2.16], $p = .010$) and Southwest ([WTO – SWTO] Difference: -10.15, *95% CI* [-14.58, -5.72], $p < .001$).

Intake Type x Outcome Type

In describing our two-way interaction between intake type and outcome type, we found significant differences across dogs' LOS differed across multiple intake and outcome types (Table 5). Stray, owner-surrendered dogs, and dogs from seizure and custody cases had significantly shorter LOS when returned to their owners as compared to adoption ([SRO – SA] Difference: -28.10, *95% CI* [-30.84, -25.36], $p < .001$; [OSRO – OSA] Difference: 15.54, *95% CI* [9.73, 17.35], $p < .001$); [SCRO – SCA] Difference: -22.55, *95% CI* [-26.17, -18.92], $p < .001$). Owner-surrendered dogs that were adopted had longer length of stays than dogs that were transferred out of the facility for adoption ([OSA – OSTO] Difference: 5.39, *95% CI* [1.62, 9.16], $p = .005$).

Table 5

Table of Significance of Estimated Marginal Means of Length of Stay (in days) for Dogs by Intake Type x Outcome Type

Variable	Mean	SE	Adoption	Return to Owner
Owner Surrender/Return				
Adoption	25.14	1.16		
Return to Owner	11.60	1.76	**< .001**	
Transfer Out	19.75	1.78	**.005**	**< .001**
Seized/Custody Case				
Adoption	27.75	1.16		
Return to Owner	5.20	.45	**< .001**	
Transfer Out	25.58	3.24	0.534	**< .001**
Stray				
Adoption	30.88	1.44		
Return to Owner	2.78	0.21	**< .001**	
Transfer Out	21.32	1.52	**< .001**	**< .001**
Transfer In				
Adoption	24.77	1.34		
Return to Owner	6.89	1.55	**< .001**	
Transfer Out	10.87	1.55	**< .001**	0.062

Note. Bolded p values indicated significance less than $p < .05$.

4. Discussion

4.1 General Overview

This study examined the animal records of a sample of 5,779 dogs at 227 U.S. animal shelters from a larger dataset of 269,169 dogs in order to gain a better understanding as to whether the lengths of stay of dogs with live outcomes differed based on characteristics of the shelter. Our findings revealed significant differences in dogs' length of stay by geographic region that varied according to the population density surrounding the shelter. Collectively, these findings underscore a consistent trend across multiple regions: suburban shelters tend to achieve shorter stays for dogs compared to those in urban and rural areas; and generally, dogs' lengths of stay at Northern, Midwestern and Western shelters is shorter than dogs residing in shelters in

other regions across the United States. Furthermore, we found that a dog's age and its size affected its time in the shelter, such that older dogs have increased lengths of stay in animal shelters and extra large dogs have shorter LOS than large dogs.

Our findings also revealed significant variation in dogs' lengths of stay associated with both the population density of the shelter and its organizational type, once again favoring with shorter LOS suburban shelters especially in the context with nonprofit shelters. Moreover, we found significant regional differences in LOS across various dog intake types, suggesting that both geographic location and how dogs enter shelters play critical roles in outcomes, particularly for stray dogs in the Northeast compared to stray dogs in the Southwest and Southeast. In our study, LOS varied significantly across nearly all intake and outcome combinations with stray, owner surrendered, and seized/custody dogs having the shortest LOS when returned to their owners as compared to adoption, underscoring the importance of the reunification process. Taken together, these results suggest that geographic and population density differences along with characteristics of the dog can influence a dog's experience in the animal shelter and warrant further examination.

4.2 Relationship Between Size and Age of the Dog and Length of Stay

With regards to dog characteristics, such as size and age, our results are consistent with prior studies that have found significant relationships between these variables and length of stay (Cain et al., 2021; Brown et al., 2013; Zak et al., 2015, Clancy & Rowan, 2003). In our present study, the effect of these variables, particularly dogs of larger sizes and greater ages, corresponds with increased lengths of stay. Cain et al. (2021) found that adult dogs were more likely to be euthanized than puppies. Specifically, older dogs, between the ages of 10 and 12 years, have the greatest likelihood of euthanasia (Cain et al., 2021). Similarly, multiple studies have found that

younger dogs have a greater likelihood of adoption (Brown et al., 2013; Zak et al., 2015). One potential explanation is that older dogs may be less desirable because of a perception of health issues and associated costs (Clancy & Rowan, 2003). Garrison and Weiss (2015) also demonstrated that puppies are the most adoptable age group, with the shortest length of stay in shelters, and this preference is influenced by the expectation that younger dogs can be more effectively trained and socialized during critical early development periods (Bir et. al, 2016).

As for size, our study only found statistical relevance between large and extra-large dogs, with large dogs having longer stays than those that are extra-large. At first glance, these results appear inconsistent with prior research, such as Protopopova et al. (2012), who found that smaller dogs have shorter lengths of stay in the shelter. In their study, Protopopova et al. (2012) found, among other things, that a dog being smaller in size increased adoption likelihood and reduced these dogs' lengths of stay. A possible explanation for our findings might be related to the relatively few extra-large dogs in our dataset. Only 2.1% of all dogs in our dataset were extra large compared to 33.6% that were large. It is possible that their rarity may have increased their attractiveness to potential adopters (Holland, 2019) or these dogs are less representative of extra-large dogs and do not reflect this group's actual variation in the population (Cao et al., 2024).

4.3 Relationship Between Population Density and Geographic Region with Regards to Length of Stay

Our study's findings reveal significant regional differences in LOS that vary according to both geographic and community contexts, indicating that these variables interact to play a critical role in shaping positive outcomes for dogs in shelters. Specifically, dogs in suburban shelters in

the Southwest and West had shorter stays than those in Southwestern and Western urban shelters. In the Southeast, dogs' LOS differed significantly across all population densities, such that their stays at Southeastern suburban shelters were also significantly shorter than animals residing in Southeastern shelters with urban or rural population densities. Collectively, we found that suburban shelters tend to achieve shorter LOS for dogs compared to urban or rural shelters.

The possible explanations for these differences by population density may be influenced by several factors. In urban areas of the United States, homeowners represent a significantly smaller proportion of the population compared to those in suburban or rural areas. In 2023, only 51.2% of individuals in urban households owned their homes compared to 73.0% in suburban areas and 74.1% in rural areas (USA Facts). Similar to how housing restrictions may negatively impact the desirability of large dogs as discussed above, these shorter LOS for dogs in suburban in comparison to urban shelters could be a product of rental properties in the United States effectively prohibiting tenants from keeping companion animals (Carlisle-Frank et al., 2005).

Our study found that dogs in rural Midwestern and Southeastern shelters remained longer than those in suburban and urban shelters of the same region, suggesting that these shelters appear to encounter obstacles in placing their dogs. Researchers from the University of Wisconsin have highlighted that rural adopters often need to travel much farther to visit shelters, which might severely reduce foot traffic and deter adoption, increasing LOS for dogs residing in these shelters (Shelter Medicine Program, UW–Madison, 2025). Rural areas of Midwestern states represented in our dataset, including North and South Dakota, Nebraska, and Kansas, have population densities that are well below the less than 200 people per square mile rural threshold. For example, North Dakota and South Dakota have statewide average population densities

between 11 and 12 residents per square mile while Nebraska averages 24.7 people, and Kansas, while slightly more dense, at 35.6 people per square mile (WorldAtlas, n.d.).

Woodruff and Smith (2020) reported that Midwestern shelters have lower levels of dog intake in comparison to other areas of the country, which might be related to a combination of differences in laws and climate. The researchers noted stringent leash and sterilization laws along with colder weather that may reduce the number of stray animals entering shelters (Woodruff & Smith, 2020). Another reason dogs in rural Midwest shelters may have remained longer than those in suburban and urban shelters in the same region could be attributed to perceptions about a dog's role within the household. Prior studies have found that dogs in rural areas are viewed by their owners as guardians or protectors in comparison to dogs living in urban communities, where owners did not have such defined roles for their dogs (Martinez et al., 2022). Considering that such perspectives may be more generally pervasive in rural regions of the country, potential adopters visiting rural shelters in the Midwest may not perceive the shelter as viable option for dog acquisition.

.

4.4 Relationship Between Population Density and Organization Type with Regards to Length of Stay

Our findings revealed significant variation in dogs' lengths of stay associated with both the population density surrounding the shelter and its organizational type. Specifically, dogs with live outcomes that were housed in rural nonprofit shelters experienced significantly longer stays compared to their counterparts in suburban nonprofit shelters. An analysis performed by Best Friends Animal Society (2022) found that rural areas have lower median incomes and higher

proportions of families living below the poverty line, which might, in turn, result in less donations and community support for their local animal shelters.

Similarly, dogs residing in rural municipal shelters demonstrated longer LOS than those in suburban municipal shelters, indicating that the influence of population density, particularly in rural areas that are less dense, likely has a negative impact on municipally operated facilities as well. While identifying the reasons for this disparity is beyond the scope of this investigation, prior research suggests that it may be a result of fewer potential adopters; there often is limited public transportation and less foot traffic in rural areas (Adams, 2020).

In contrast to these trends, an important nuance emerged for rural nonprofit shelters that maintain municipal contracts. Dogs in these shelters experienced significantly shorter LOS compared to nonprofit shelters with municipal contracts in suburban and urban areas. It is possible that the presence of a municipal contract, alongside an organization's nonprofit status, may enhance the operational resources of rural shelters, thereby providing more accessibility to pets available for adoption and ameliorating the typically longer stays dogs experience in these areas. Adams (2020) explored private and municipal partnerships in McDowell County, West Virginia, and found that a partnership between the animal shelter and a local fire station allowed for the provision of community veterinary services in a rural area that struggles with extreme animal neglect and is a known food desert with the lowest life expectancy of any county in the United States (Adams, 2020). It is possible that these types of service relationships might help improve the welfare of pets and their owners, particularly in areas that face geographic constraints and limited resources.

4.5 Relationship Between Geographic Region and Organization Type with Regards to Length of Stay

Our data highlight significant disparities in LOS across different U.S. regions and shelter types, suggesting that geographic context and organizational structure can play critical roles in shaping outcomes for shelter dogs. Dogs housed in nonprofit shelters located in the Northeast exhibited longer lengths of stay compared to those in the Southeast and West. The longer LOS in the Northeast compared to the Southeast and West for nonprofit shelters could be explained by findings by Woodruff and Smith (2020), reporting that shelters in the Northeast, irrespective of organization type, are the least likely to transfer out a dog to another shelter, and instead transfer dogs in to increase these dogs' likelihood of adoption. It is possible that Northeastern nonprofit shelters have fewer dogs and the resources to help those with behavior and medical needs.

In the Southeast, dogs at municipal shelters and those at nonprofit shelters with municipal contracts had longer stays compared to nonprofits, by approximately five and three days, respectively. These findings appear contrary to findings by Woodruff and Smith (2020), reporting that municipal shelters and private nonprofits with municipal contracts euthanized dogs and transferred dogs out of their facilities more quickly than private nonprofits, which suggests shorter LOS for the former (Woodruff and Smith (2020). Nevertheless, a potential explanation for our findings is that the nonprofit shelters in the Southeast may facilitate more transfers while municipal-nonprofit partnerships and municipal shelters are under-resourced, and dogs are staying in these shelters longer awaiting placement directly to adopters.

Dogs in the Southwest had significantly longer LOS than dogs in the same organization in the West, a result that could be explained by the differences in socio-economic status between the regions. As previously reported by Best Friends Animal Society, shelters in the Southwest, in

particular, have increased intake pressure attributed to higher poverty rates and less access to veterinary care, such as spay and neuter services (Best Friends Animal Society, n.d.). Comparatively in the West, overall income levels are higher and shelters have additional resources (Best Friends Animal Society, n.d.).

In our study, dogs at nonprofit organizations with municipal contracts and municipal shelters in the Northeast had significantly shorter LOS than these shelters in the West and Southwest. Historically, the Northeast region has the fewest number of dogs entering their shelters (Woodruff & Smith, 2020), which may explain dogs' shorter lengths of stay. A potential explanation for dogs' stays residing in nonprofit organizations with municipal contracts and municipal shelters in the West is that this region has historically had a greater population and larger percentage of household providing for pets than the Southwest (Clancy & Rowan, 2003), which might increase the number of potential adopters visiting shelters in search of a companion animal.

4.6 Relationship Between Geographic Region and Intake Type with Regards to Length of Stay

The results of our study also revealed significant regional differences in dogs' stays across various intake types, suggesting that both geographic location and intake pathways play a critical role in shelter outcomes. Dogs entering shelters through transfer-in programs in the Western US experienced significantly shorter LOS compared to transferred-in dogs in the Southwest and Southeast. This is consistent with findings by Cain et al. (2020) in which they found that dogs from shelters in the western region of the United States were more likely to be adopted compared to dogs residing in the South, noting that the southern regions of the US

traditionally have milder winters and less stringent dog ownership laws, which may contribute to larger stray dog populations and influence an individual dog's likelihood of adoption.

Our study also revealed that dogs entering shelters through transfer-in programs in the West also experienced slightly shorter stays compared to transferred-in dogs in the Midwest region, which could be explained by the fact that the West historically had a larger percentage of households providing for pets than the Midwest (Clancy & Rowan, 2003). When evaluating these transfer-in programs that may, in certain regions, have a positive impact on the eventual outcomes of animals, it is important to consider that transport itself may negatively impact dogs' welfare in the short term (Bergeron et al., 2002; Romaniuk et al., 2022; Tateo et al., 2022); thus, there is a need to manage environmental changes carefully to ensure the present and future well-being of transported dogs.

Stray dogs in the Northeast stayed fewer days in the shelter than dogs in the Southwest and fewer days than dogs in the Southeast, and, overall, these results are consistent with an earlier study of regional differences in dog adoption likelihood (Woodruff & Smith, 2020). In addition to longer LOS results related to stray and transferred-in intake types in the Southwest discussed above, dogs in the Southwest region experienced longer lengths of stays for other intake types in comparison to other regions, which suggests systematic issues with and for sheltering system in the Southwest. Specifically, owner surrender dogs in the Southwest region experienced longer LOS than owner surrender dogs in the Southeast and West regions. In addition, seized dogs in the Southwest experienced longer LOS than seized dogs in the Northeast. As previously noted and reported by Best Friends Animal Society, there are higher poverty rates in the Southwest; the limited resources of its human population could limit the number of people able to adopt and thus be an explanation for the longer LOS for the animals in

the Southwest shelters. The reduced access to veterinary care in the Southwest and its resulting higher accidental litters (Best Friends Animal Society, n.d.), likely further explains why dogs in the Southwest have longer lengths of stay.

4.7 Relationship Between Population Density and Outcome Type with Regards to Length of Stay

Our results revealed significant differences in LOS for transferred-out dogs based on the population density of the shelter's location. Dogs that were transferred out of urban shelters experienced a substantially longer LOS than those from suburban, as well as a longer LOS in comparison to transferred-out dogs in rural shelters. This may reflect several urban-specific challenges, including higher intake rates leading to overcrowding, more complex transfer procedures, and logistical constraints associated with coordinating transfers within densely populated environments (Simmons et al., 2016; Mason et al., 2007).

In contrast, suburban shelters may encounter fewer operational bottlenecks or may benefit from more streamlined or less congested transfer pathways. While rural shelters have their own constraints as discussed above, the smaller difference between the LOS for transferred-out dogs in rural shelters and dogs that were transferred out of urban shelters could be explained by prominence of rural transferring programs, especially in the South (Brown, n.d.).

4.8 Relationship Between Geographic Region and Outcome Type with Regards to Length of Stay

Our results highlight that both shelter location and outcome type can significantly influence LOS, potentially due to differences in shelter resources, socio-economic

characteristics, community attitudes toward pet adoption, and local policies. Dogs adopted from shelters in the Northeast region, as well as the Midwest region, experienced a significantly shorter LOS compared to those adopted from both the Southwest and Southeast regions. This could be explained by a supply and demand type analysis: historically, the Northeast region has fewer adoptable dogs in shelters (Clifton, 2014) but a significant human population, a percentage of which may desire to adopt. Historically, southern animal shelters have a large supply of dogs with fewer adopters (Brown, n.d.). The difference in the Midwest region could be further explained by the Simmons and Hoffman (2016) study, which found that Midwest shelters often decline certain breeds of dogs for transfer into their shelters because of insurance requirements and breed specific laws. The combination of the Simmons and Hoffman (2016) findings and our own suggest that dogs' LOS at Midwest shelters may be shorter because of what are perceived to be more favorable adoptability characteristics, although population density of the community may also play a role.

For dogs returned to their owners, our LOS analyses indicated that shelters in the Midwest and Western regions achieved significantly faster reunifications. Numerous jurisdictions in the West and Midwest have microchipping requirements, such as the state of Hawaii; Los Angeles County, California; City of Las Vegas, Nevada; Grant Park, Illinois, and the City of Dearborn Heights, Michigan, which may influence the speed in which owners are reunited with their pets. As further discussed below, lost dogs with microchips are returned to their owners at a rate of 52.2%, compared with just 21.9% for those without (AAHA, 2024).

When considering dogs that were transferred out of shelters, our analyses revealed that dogs in the Northeast region had the shortest LOS, followed by dogs at shelters in the West. Our findings appear contrary to the findings of Woodruff & Smith (2020) in which they found that

shelters in the Northeast, followed by those in the West, were the least likely to transfer a dog to another shelter (Woodruff & Smith, 2020); however, it is possible that while the outcome of transfer out occurs infrequently for dogs in the Northeast and West, it may occur quickly. Northeast shelters have more resources and less dogs (Woodruff & Smith, 2020), which suggests these shelters may be able to identify and meet the needs of their dogs in a more timely matter in order to accomplish a positive outcome for the dog.

Overall, these findings demonstrate that dogs in the Northeast and West regions consistently experienced shorter stays in the shelter across multiple outcome types, suggesting the possibility of more effective operational strategies, community engagement, or network partnerships. In contrast, dogs in Southwest and Southeast regions often experienced longer stays, indicating potential barriers to dogs being adopted directly from the shelter as well as being transferred out to other organizations that warrants further investigation.

4.9 Relationship Between Intake Type and Outcome Type with Regards to Length of Stay

In our study, LOS varied significantly across nearly all intake and outcome combinations, except for certain seizure/custody intake scenarios, demonstrating that both how a dog enters and exits the shelter are can influence its time in the organization's care. Stray dogs exhibited the shortest LOS when returned to their owners, compared to those adopted, underscoring the importance of reunification processes. The process for a dog's return to its owner is, by its nature, as well as legal requirements, normally shorter than adoption (Wisch, 2003). As previously discussed, the lengths of stay could potentially be further reduce by community microchipping clinics and public education, and intakes could possibly be reduced by providing pet owners information about effective ways to reunite with a lost dog such as actively searching its neighborhood (Weiss et al., 2012).

Dogs entering shelters due to seizure or custody cases also had a significantly shorter LOS when returned to their owners compared to adoption, which may reflect the influence of legal delays on adoption versus return to owner timelines. After seizure, there is often a legally mandated period of time to allow the dog's owner to reclaim and challenge any seizure that occurred (Wisch, 2003), which results in longer LOS for the animals. Sometimes there is confusion over the specific legal requirements (Falconer, 2025), which may cause additional delay for the dogs. Although not measured by this dataset, the result suggests that shelters may be able to reduce LOS, as well as limit liability, by better understanding legal nuances through programs such as Shelter Policy and Legal Services (Shelter PALS), a California free legal services program launched in 2020 (Falconer, 2025).

Among owner-surrendered dogs, those that were adopted experienced significantly longer LOS than those who were returned to owners or transferred out. It is possible that dogs that are surrendered and then returned to their owners as well as those that are transferred out might struggle with behavioral issues in the shelter's care that warrant more creative solutions to meet their needs. Several studies have demonstrated that behavioral reasons play a significant role in owner surrender (Carter & Tayler, 2018; Kwan & Bain, 2013; Diesel et al., 2008). Powell et al. (2021) report that in UK rehoming centers, 65.6% of dogs euthanized were originally surrendered due to the owner's perception of their behavioral problems, with aggressive and destructive behaviors being especially prominent. Nevertheless, utilization of same-day availability for owner-surrendered dogs that are already altered and have known behavioral and medical histories that meet adoption criteria could be helpful in decreasing their time in the shelter.

4.10 Limitations

A number of limitations exist related to the dataset used in our study and the influence on our findings. As previously indicated, a dog's age was a variable in the dataset; however, some entries in the Shelter Animals Count dataset showed implausible ages (e.g., in excess of 40 years) that were likely the result of data entry errors. Other date and information may have similar recording errors. Size was designated by the dog's physical stature, possibly resulting in difference designations for similarly sized animals based on the individual entering the data, be it at the same shelter or across different organizations. The dataset contained information that pertains to animals in shelters from January 1 to December 31, 2023. A one-year period may not be reflective of the experience of dogs gained through a multiple year analysis, and the results described here from this short period could be influenced by isolated or unusual events, such as its extreme and record-breaking US weather events (Thornton, n.d.).

Northeastern shelters were underrepresented in our dataset with only 5.4% shelters located in this region, limiting the strength of the conclusions we may be able to draw, particularly regarding the influence of population density. Conversely, nonprofit with municipal contract facilities, being 52.1% of shelter organizations represented, and urban shelters, with 47% of the population densities represented, may have been overrepresented in the dataset. Over representation in a sample may not correctly reflect the population's true characteristics, leading to skewed results, introducing biases, and reducing the precision of the results (Andrade, 2020). In addition, this dataset does not account for differences in dogs' behavior or appearance which has been shown to influence length of stay and outcomes in the shelter (Protopopova & Gunter, 2017; Stephen & Ledger, 2006).

4.11 Future Directions

Future research should further investigate underlying causes for these geographic, population, and organizational disparities, including resource availability, demographic factors, and local laws to inform resource allocation and policy development that supports areas where homeless dogs stay longer in the shelter awaiting a positive outcome. For example, given the results of our findings and others regarding increased LOS for dogs sheltered in less dense areas (Shelter Medicine Program, UW–Madison, 2025), future research could explore the mechanisms by which municipal contracts influence operational efficiencies in rural settings and assess targeted interventions designed to decrease LOS by enhancing shelter capacity and community engagement in lower-density regions similar to the private and municipal partnerships in McDowell County, West Virginia (Adams, 2020). In addition, systematically evaluating the effects of intake as well as outcome type on length of stay could identify bottlenecks and guide evidence-based interventions.

Further research could also assist in determining reasons for the regional differences in uniting lost dogs with their owners. Our LOS analyses indicated that shelters in the Midwest and Western regions achieved significantly faster reunifications for dogs returned to their owners than other regions in the United States. The dataset contained no information about microchipping so it was not possible to analyze whether the success in Midwest and Western regions was due to microchipping. Stray dogs exhibited the shortest LOS when returned to their owners, compared to those adopted, underscoring the importance of reunification processes.

Consistent with earlier studies (Cain et al.; 2020), our results also suggest that dogs in shelters in the Southwest and Southeast could benefit from further research to confirm why animals adopted from shelters in the Northeast region, as well as the Midwest region,

experienced a significantly shorter LOS compared to those adopted from both the Southwest and Southeast regions. Further research could also help identify why within the Southeast, municipal shelters and those operating with municipal contracts had longer LOS compared to nonprofits in the same region. Further research could focus on if the municipal partnerships or direct municipal management organizations are under-resourced, and dogs are staying in the shelter longer waiting for adopters, along with ways to address the systemic issues.

5. Conclusion

In a field whose industry information was once characterized as a "statistical black hole" (Rowan, 1992, pp. 140–143), our study demonstrates how shelter animals can benefit from continued comprehensive, standardized data collection to help develop and refine targeted adoption strategies. Utilizing data records from shelters in Washington D.C. and 46 states, the current study found that the interplay of numerous organizational and animal factors, such as where a shelter is located in the country, its population density, and the type of organization as well as the size and age of the dog, how it arrived to the shelter, and its outcome, can significantly impact the length of stay for dogs in shelters.

Our findings highlight how older dogs have increased LOS, underscoring the need for age-specific strategies to reduce time in care for these vulnerable animals. The regional disparities identified in the current study also suggest a need for targeted approaches. In the Southern regions, whether it be the Southwest or the Southeast, stray dogs stay longer in the shelters than those in the Northeast. Moreover, dogs adopted from shelters in the Northeast region, as well as the Midwest region, experienced a significantly shorter LOS compared to those adopted from Southern regions. Dogs' length of stay differed in the Southeast region for all

population densities, with dogs' stays at Southeast shelters in suburban areas being significantly shorter than animals residing in Southeast shelters with urban or rural population densities. Taken together, our findings highlight the difficulties shelters in the Southern regions face, such as limited resources and capacity constraints, resulting overall in longer LOS for dogs housed in those areas. Our findings suggest a need for more transport programs, moving dogs from less resourced, overcrowded Southern facilities to areas with a greater demand for companion animals or better resources or both. While our findings support the utilization of additional transport programs, prior studies dictate that the programs must be tailored to manage environmental changes for the well-being of transported dogs.

The current study also suggests that rural and urban shelters need targeted strategies. Dogs that were housed in rural nonprofit shelters experienced significantly longer stays compared to their counterparts in suburban nonprofit shelters. Dogs that were transferred out of urban shelters experienced a substantially longer LOS than those from suburban, as well as a longer LOS in comparison to transferred-out dogs in rural shelters. All in all, these results suggest that rural and urban shelters face unique challenges, and their dogs could benefit from inter-organizational collaboration with suburban shelters, including tailored transport programs.

The regional disparities identified in this study point to the need for continuing data collection, sharing best practices, and developing region specific strategies to reduce lengths of stay, minimize overcrowding, and optimize positive outcomes for shelter dogs. By identifying the pathways associated with prolonged length of stay, this study provides actionable insights for shelter operations—highlighting opportunities to reduce shelter stay durations and improve dog welfare outcomes.

References

Acosta-Jamett G, Cleaveland S, Cunningham AA, Bronsvoort BM. Demography of domestic dogs in rural and urban areas of the Coquimbo region of Chile and implications for disease transmission. Prev Vet Med. 2010 May 1;94(3-4):272-81. doi: 10.1016/j.prevetmed.2010.01.002. Epub 2010 Jan 22. PMID: 20096943.

Adams, B. W. (2016, Spring). The long road: Meeting the animal welfare challenges of low-income rural communities. Animal Sheltering Magazine. https://humanepro.org/magazine/articles/long-roadhumanepro

American Animal Hospital Association. (2024, June 30). The priceless benefits of microchipping your pet. AAHA. https://www.aaha.org/resources/the-priceless-benefits-of-microchipping-your-pet/

American Humane. (2021, February 25). Animal population control. American Humane. https://www.americanhumane.org/position-statement/animal-population-control/

American Society for the Prevention of Cruelty to Animals. (2022). Pet statistics. https://www.aspca.org/helping-people-pets/shelter-intake-and-surrender/pet-statistics

American Society for the Prevention of Cruelty to Animals. (2024). Shelter intake and surrender. https://www.aspca.org/helping-people-pets/shelter-intake-and-surrender

Andrade, C. (2020). Sample size and its importance in research. Indian Journal of Psychological Medicine, 42(1), 102–103. https://doi.org/10.4103/IJPSYM.IJPSYM_504_19

ASPCA. (2024). Shelter collaboration. American Society for the Prevention of Cruelty to Animals. https://www.aspca.org/helping-shelters-people-pets/shelter-collaboration

ASPCA. (2025). U.S. animal shelter statistics: Shelter intake and surrender. American Society for the Prevention of Cruelty to Animals. https://www.aspca.org/helping-shelters-people-pets/us-animal-shelter-statistics

American Veterinary Medical Association. (2022). AVMA pet ownership and demographics sourcebook (2022 ed.). American Veterinary Medical Association.

Bednarik, Z. (2022, January 20). Rural-urban classification used by NCRCRD. North Central Regional Center for Rural Development. https://ncrcrd.ag.purdue.edu/2022/01/20/rural-urban-classification-used-by-ncrcrd/

Bennett, P. C., & Rohlf, V. I. (2007). Owner-companion dog interactions: Relationships between demographic variables, potentially problematic behaviours, training engagement and shared activities. Applied Animal Behaviour Science, 102(1–2), 65–84. https://doi.org/10.1016/j.applanim.2006.03.009

Bergeron, R., Scott, S. L., Emond, J. P., Mercier, F., Cook, N. J., & Schaefer, A. L. (2002). Physiology and behavior of dogs during air transport. Canadian Journal of Veterinary Research = Revue Canadienne de Recherche Veterinaire, 66(3), 211–216.

Best Friends Animal Society. (2021). Analysis of shelter data: Rural vs. urban areas. Best Friends Network. https://bestfriends.org/network/studies-publications/rural-vs-urban-areas

Best Friends Animal Society. (2022). Analysis of shelter data: Rural vs. urban areas. Best Friends Network Partner Resources. https://bestfriends.org/network/studies-publications/rural-vs-urban-areasbestfriends+1

Bogage, J. (2023, December 25). As the pandemic adoption boom cools, pet shelters overflow. The Washington Post. https://www.washingtonpost.com/business/2023/12/25/pet-shelters-overflow-economy/

Bouma, E. M. C., Vink, L. M., & Dijkstra, A. (2020). Expectations versus reality: Long-term research on the dog–owner relationship. Animals, 10(5), 772. https://doi.org/10.3390/ani10050772

Brown, W. P., Davidson, J. P., & Zuefle, M. E. (2013). Effects of phenotypic characteristics on the length of stay of dogs at two no-kill animal shelters. Journal of Applied Animal Welfare Science, 16(1), 2–18. https://doi.org/10.1080/10888705.2013.740967

Cafazzo, S., Maragliano, L., Bonanni, R., Scholl, F., Guarducci, M., Scarcella, R., Di Paolo, M., Pontier, D., Lai, O., Carlevaro, F., Bucci, E., Cerini, N., Carlevaro, L., Alfieri, L., Fantini, C., & Natoli, E. (2014). Behavioural and physiological indicators of shelter dogs' welfare: Reflections on the no-kill policy on free-ranging dogs in Italy revisited on the basis of 15 years of implementation. Physiology & Behavior, 133, 223–229. https://doi.org/10.1016/j.physbeh.2014.05.046

Cain, C. J., Woodruff, K. A., & Smith, D. R. (2020). Phenotypic characteristics associated with shelter dog adoption in the United States. Animals, 10(11), 1959. https://doi.org/10.3390/ani10111959

Cain, C. J., Woodruff, K. A., & Smith, D. R. (2021). Factors associated with shelter dog euthanasia versus live release by adoption or transfer in the United States. Animals, 11(4), 927. https://doi.org/10.3390/ani11040927

Cao, Y., Chen, R. C., & Katz, A. J. (2024). Why is a small sample size not enough? The Oncologist, 29(9), 761–763. https://doi.org/10.1093/oncolo/oyae162

Carter, J., & Taylor, C. S. (2018). Socio-economic factors in companion animal relinquishment on the Sunshine Coast, Australia. Society & Animals, 28(5–6), 531–549. https://doi.org/10.1163/15685306-12341473

Clancy, E. A., & Rowan, A. N. (2003). Companion animal demographics in the United States: A historical perspective. In D. J. Salem & A. N. Rowan (Eds.), The state of the animals II (pp. 9–26). Humane Society Press

Diesel, G., Pfeiffer, D. U., & Brodbelt, D. (2008). Factors affecting the success of rehoming dogs in the UK during 2005. Preventive Veterinary Medicine, 84(3–4), 228–241. https://doi.org/10.1016/j.prevetmed.2007.12.004

Falconer, J. (n.d.). Helping animal shelters navigate (and change) laws: Groundbreaking program provides California shelters and rescues with free legal services and more. HumanePro.

https://humanepro.org/magazine/articles/helping-animal-shelters-navigate-and-change-laws

Finch, L. (2023). Setting the stage for strategic intake: Why your shelter should consider changing the rules around accepting owner surrender animals. Best Friends Network. https://network.bestfriends.org/proven-strategies/program-spotlights/setting-stage-strategic-intake

Fowler, I. (2023, April 18). How are animal shelters addressing their overpopulation issues? KXAN. https://www.kxan.com/news/local/how-are-animal-shelters-addressing-their-overpopulation-issues/

Goselin, C., Letson, K., McGuinniss, K., Walters, A., & Fagan, J. M. (2011). Animal shelter funding. Rutgers University. https://rucore.libraries.rutgers.edu/rutgers-lib/38418/PDF/1/

Gunter, L. M., Barber, R. T, & Wynne, C. D. L. (2018). A canine identity crisis: Genetic breed heritage testing of shelter dogs. PLOS ONE, 13(8), e0202633. https://doi.org/10.1371/journal.pone.0202633

Gunter, L. M., Barber, R. T., & Wynne, C. D. L. (2016). What's in a name? Effect of breed perceptions and labeling on attractiveness, adoptions, and length of stay for pit-bull-type dogs. PLOS ONE, 11(3), e0146857. https://doi.org/10.1371/journal.pone.0146857

Gunter, L. M., Gilchrist, R. J., Blade, E. M., Reed, J. L., Isernia, L. T., Barber, R. T., Foster, A. M., Feuerbacher, E. N., & Wynne, C. D. (2022). Emergency fostering of dogs from animal shelters during the COVID-19 pandemic: Shelter practices, foster caregiver

engagement, and dog outcomes. Frontiers in Veterinary Science, 9, 862590. https://doi.org/10.3389/fvets.2022.862590

Hawes, S. M., Kerrigan, J. M., Hupe, T. M., & Morris, K. N. (2020). Factors informing the return of adopted dogs and cats to an animal shelter. Animals, 10(9), 1573. https://doi.org/10.3390/ani10091573

Holland, K. E. (2019). Acquiring a pet dog: A review of factors affecting the decision-making of prospective dog owners. Animals, 9(4), 124. https://doi.org/10.3390/ani9040124

Kogan, L. R., Ruch-Gallie, R., & Salman, M. D. (2000, August). Keeping Spot at home: An epidemiological approach to maintaining the human-animal bond through behavior education and obedience training [Conference presentation]. 9th International Symposium on Veterinary Epidemiology and Economics, Breckenridge, CO, United States.

Kwan, J. Y., & Bain, M. J. (2013). Owner attachment and problem behaviors related to relinquishment and training techniques of dogs. Journal of Applied Animal Welfare Science, 16(2), 168–183. https://doi.org/10.1080/10888705.2013.768923

Martinez, E., Cesário, C. S., Ferraz, F., Repolês, R., Silva, I. O., & Boere, V. (2022). Behavior of rural and urban free-ranging dogs in Viçosa, Minas Gerais, Brazil. Journal of Veterinary Behavior, 48, 68–73. https://doi.org/10.1016/j.jveb.2021.09.004

Mason, T. (2024). Kennels full at Aurora Animal Shelter as more Colorado pet owners surrender dogs. MSN News. https://www.msn.com/en-us/news/us/kennels-full-at-aurora-animal-shelter-as-more-colorado-pet-owners-surrender-dogs/ar-AA1x6Pae

Menor-Campos, D. J., Molleda-Carbonell, J. M., & López-Rodríguez, R. (2011). Effects of exercise and human contact on animal welfare in a dog shelter. Veterinary Record, 169(15), 388. https://doi.org/10.1136/vr.d4757

Mineo, L. (2022, June 29). 'Shadow pandemic' of domestic violence. Harvard Gazette. https://news.harvard.edu/gazette/story/2022/06/shadow-pandemic-of-domestic-violence/

Mitchell, C. (2023, August 14). Animal overpopulation: Causes, effects and solutions. World Animal Foundation. https://worldanimalfoundation.org/advocate/companion-animals/params/post/1275970/animal-overpopulation-crisis

Morgan, L., Protopopova, A., Birkler, R. I. D., Itin-Shwartz, B., Sutton, G., Gamliel, A., Yakobson, B., & Raz, T. (2020). Human–dog relationships during the COVID-19 pandemic: Booming dog adoption during social isolation. Humanities & Social Sciences Communications, 7(1), 155. https://doi.org/10.1057/s41599-020-00649-x

New, J. C., Jr., Salman, M. D., King, M., Scarlett, J. M., Kass, P. H., & Hutchison, J. M. (2000). Characteristics of shelter-relinquished animals and their owners compared with animals and their owners in U.S. pet-owning households. Journal of Applied Animal Welfare Science, 3(3), 179–201.

Norris, M., & Hastings, R. (2023, February 15). Why economic hardship is keeping more animals in shelters. PBS NewsHour. https://www.pbs.org/newshour/nation/why-economic-hardship-is-keeping-more-animals-in-shelters

Notaro, S. J. (2011). Disposition of shelter companion animals from nonhuman animal control officers, citizen finders, and relinquished by caregivers. Journal of Applied Animal Welfare Science, 7(3), 181–188. https://doi.org/10.1207/s15327604jaws0703_4

Pasteur, K., Diana, A., Yatcilla, J. K., Barnard, S., & Croney, C. C. (2024). Access to veterinary care: Evaluating working definitions, barriers, and implications for animal welfare. Frontiers in Veterinary Science, 11, 1335410. https://doi.org/10.3389/fvets.2024.1335410

Patronek, G. J., & Crowe, A. (2018). Factors associated with high live release for dogs at a large, open-admission, municipal shelter. Animals, 8(4), 45. https://doi.org/10.3390/ani8040045

Patronek, G. J., Glickman, L. T., Beck, A. M., McCabe, G. P., & Ecker, C. (1996). Risk factors for relinquishment of dogs to an animal shelter. Journal of the American Veterinary Medical Association, 209(3), 572–581.

Powell, L., Lee, B., Reinhard, C. L., Morris, M., Satriale, D., Serpell, J., & Watson, B. (2022). Returning a shelter dog: The role of owner expectations and dog behavior. Animals, 12(9), 1053. https://doi.org/10.3390/ani12091053

Protopopova, A., Gilmour, A. J., Weiss, R. H., Shen, J. Y., & Wynne, C. D. L. (2012). The effects of social training and other factors on adoption success of shelter dogs. Applied

Animal Behaviour Science, 142(1–2), 61–68. https://doi.org/10.1016/j.applanim.2012.09.009

Protopopova, A., & Gunter, L. M. (2017). Adoption and relinquishment interventions at the animal shelter: A review. Animal Welfare, 26(1), 35–48.

Reese, L., & Li, X. (2021). Animal welfare deserts: Human and nonhuman animal inequities. Animals, 11(9), 2647. https://doi.org/10.3390/ani11092647

Rogelberg, S. G., Reeve, C. L., Spitzmüller, C., DiGiacomo, N., Clark, O. L., Teeter, L., Walker, A. G., Starling, P., & Carter, N. T. (2007). Impact of euthanasia rates, euthanasia practices, and human resource practices on employee turnover in animal shelters. Journal of the American Veterinary Medical Association, 230(5), 713–719. https://doi.org/10.2460/javma.230.5.713

Romaniuk, A. C., Diana, A., Barnard, S., Weller, J. E., Espinosa, U. B., Dangoudoubiyam, S., Shreyer, T., Arnott, G., & Croney, C. (2022). The effect of transportation on puppy welfare from commercial breeding kennels to a distributor. Animals, 12(23), 3379. https://doi.org/10.3390/ani12233379

Rose, D., McMillian, C., & Carter, O. (2021). Pet-friendly rental housing: Racial and spatial inequalities. Housing Policy Debate, 31(3–5), 584–603. https://doi.org/10.1080/10511482.2020.1860241

Rowan, A. N. (1992). Shelters and pet overpopulation: A statistical black hole. Anthrozoös, 5(3), 140–143. https://doi.org/10.2752/089279392787011430

Rowan, A. N., & Kartal, T. (2018). Dog population & dog sheltering trends in the United States of America. Animals, 8(5), 68. https://doi.org/10.3390/ani8050068

Shelter Animals Count. (2025). Adoption hours & policies pulse check report. Shelter Animals Count. https://www.shelteranimalscount.org/adoption-survey-report-2025

Shelter Animals Count. (2023). 2023 annual analysis. Shelter Animals Count. https://www.shelteranimalscount.org/wp-content/uploads/2024/01/Full-Year-2023-Report.pdf

Shelter Animals Count. (2023, January 5). Intake and Outcome Database (IOD). https://www.shelteranimalscount.org/intake-and-outcome-database-iod/

Shelter Animals Count. (n.d.). Animal welfare glossary. Retrieved January 10, 2025, from https://www.shelteranimalscount.org/glossary

Shelter Medicine Program, UW–Madison. (2025). Length of stay (LOS). University of Wisconsin–Madison, Shelter Medicine Program. https://sheltermedicine.wisc.edu/library/resources/length-of-stay-los

Shiverdecker, M. D., Schiml, P. A., & Hennessy, M. B. (2013). Human interaction moderates plasma cortisol and behavioral responses of dogs to shelter housing. Physiology & Behavior, 109, 75–79. https://doi.org/10.1016/j.physbeh.2012.12.002

Siettou, C., Fraser, I. M., & Fraser, R. W. (2014). Investigating some of the factors that influence "consumer" choice when adopting a shelter dog in the United Kingdom. Journal of

Applied Animal Welfare Science, 17(2), 136–147. https://doi.org/10.1080/10888705.2014.883924

Simmons, K. E., & Hoffman, C. L. (2016). Dogs on the move: Factors impacting animal shelter and rescue organizations' decisions to accept dogs from distant locations. Animals, 6(2), 11. https://doi.org/10.3390/ani6020011

Sleight, M., Nyerges, S., & McGinley, K. (2024, February 28). Animal abuse facts and statistics. USA Today. https://www.shelteranimalscount.org/animal-abuse-facts-and-statistics-2024/

Strong, E. (n.d.). Simple solutions for common behavior issues in shelters. IAABC Foundation Journal. https://journal.iaabcfoundation.org/common-behavior-issues-shelters/

Tails.com. (2023). Are small dog breeds really easier to care for? Tails.com Blog. https://tails.com/blog/small-breeds-care/tails

Tateo, A., Costa, L. N., & Padalino, B. (2022). The welfare of dogs and cats during transport in Europe: A literature review. Italian Journal of Animal Science, 21(1), 539–550. https://doi.org/10.1080/1828051X.2022.2043194

Teng, K. T.-y., Brodbelt, D. C., Pegram, C., Church, D. B., & O'Neill, D. G. (2022). Life tables of annual life expectancy and mortality for companion dogs in the United Kingdom. Scientific Reports, 12, 6410. https://doi.org/10.1038/s41598-022-10341-6

Turner, P., Berry, J., & Macdonald, S. (2012). Animal shelters and animal welfare: Raising the bar. Canadian Veterinary Journal, 53(8), 893-896. https://pubmed.ncbi.nlm.nih.gov/23372200

U.S. Bureau of Labor Statistics. (2025). Consumer Price Index for All Urban Consumers: All items less food and energy (CPI-U). https://data.bls.gov/timeseries/CUUR0000SA0L1E

U.S. Census Bureau. (n.d.). Population density map of ZIP Code Tabulation Area 06237. Retrieved January 10, 2025, from https://data.census.gov/map/860XX00US06237?q=population%20density&layer=VT_2022_860_Z2_PY_D1

USAFacts. (2023). What is the homeownership rate in the United States? USAFacts. https://usafacts.org/answers/what-is-the-homeownership-rate/country/united-states/

Verga, M., & Michelazzi, M. (2009). Companion animal welfare and possible implications on the human–pet relationship. Italian Journal of Animal Science, 8(Suppl. 1), 231–240. https://doi.org/10.4081/ijas.2009.s1.231

Weiss, E., Slater, M., & Lord, L. (2012). Frequency of lost dogs and cats in the United States and the methods used to locate them. Animals, 2(2), 301–315. https://doi.org/10.3390/ani2020301

Wisch, R. F. (2003). Detailed discussion of state dog impound laws. Animal Legal & Historical Center, Michigan State University College of Law. https://www.animallaw.info/article/detailed-discussion-state-dog-impound-laws

World Animal Foundation. (2025). Pet adoption statistics: Facts & figures on shelters, euthanasia, and ownership. World Animal Foundation. https://worldanimalfoundation.org/advocate/pet-adoption-statistics/

Why economic hardship is keeping more animals in shelters. (2023, February 15). PBS NewsHour. https://www.pbs.org/newshour/nation/why-economic-hardship-is-keeping-more-animals-in-shelters

Žák, J., Voslářová, E., Večerek, V., & Bedáňová, I. (2015). Sex, age and size as factors affecting the length of stay of dogs in Czech shelters. Acta Veterinaria Brno, 84(4), 407–413. https://doi.org/10.2754/avb201584040407