Sterilization Timing Effects on Lengths of Stay in Shelter Dogs and Cats with Positive Outcome

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ABSTRACT

In 2023, an estimated 6.5 million pets entered one of the thousands of animal welfare organizations across the United States. Currently, animal shelters are experiencing a capacity crisis as an additional 900,000 animals have entered shelters since 2021 and have remained in care. Previous studies have attributed longer lengths of stay to many factors about the animal and shelter, including abnormal or problem behaviors, medical conditions and treatment, and available resources. Understanding how the timing of an animal's sterilization surgery can affect its length of stay might aid in the development of evidence-based best practices regarding this procedure. The current study utilized records sourced by Shelter Animals Count, a nonprofit organization that maintains a centralized database of United States animal sheltering data, for the year 2023 to investigate what shelter and animal variables, including the timing of its sterilization surgery, affect dog and cat lengths of stay. Our analysis showed significant relationships between sterilization surgery timing and days in the shelter, such that adopted dogs and those that were transferred out for placement had the shortest lengths of stay when sterilized post-outcome, while adopted and transferred cats had the shortest lengths of stay when sterilized before their arrival to the shelter. Moreover, we uncovered relationships between an animal's length of stay and how it arrived at the shelter and the animal's

positive outcome as well as the region in which the shelter was located and the type of positive outcome it experienced. In all, we found associations between sterilization surgery and length of stay, in addition to impacts of intake type and geographic region, that suggest the timing of this procedure could impact animal welfare and organizational resources, and warrants further investigation.

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Table of Contents

1. Introduction

1.1 Current Statistics on Animal Sheltering

In most recent data from Shelter Animals Count, a nonprofit organization that maintains a centralized database of animal sheltering data for the United States, an estimated 6.5 million pets entered one of the thousands of animal shelters and rescues across the United States in 2023 (2023 Statistics, 2024). Of those animals, 3.3 million cats (51%) and 3.2 million dogs (49%) were represented. In comparison, in a 1973 survey of shelters, the Humane Society of the United States estimated that more than 20 million animals entered shelters and 13.5 million of those animals were ultimately euthanized – a rate of approximately 64 dogs and cats per 1000 people living in the US at the time of 1984 (Rowan & Kartal, 2018). Recent figures indicate 1.3 million pets are euthanized annually in US shelters (Haworth, 2019), an over 90% reduction in euthanasia compared to 1970 rates. More recently, Woodruff and Smith (2020) reported that nearly half of all dogs that entered shelters in the US were adopted, 18% were returned to their owners, 14% were transferred to other facilities for placement, 14% were euthanized, and 6% were lost in the shelter's care.

Nevertheless, these improvements in the fate of animals entering shelters are being met by a more sobering reality following the pandemic. For 2023, Shelter Animals Count reported an increase in non-live outcomes for cats, with a total of approximately 330,000 cats euthanized in US shelters. This represented an 8% increase, or 34,000 more cats euthanized when compared to 2022 (2023 Statistics, 2024). Unlike dogs, only 7% of cats entering shelters are reclaimed by their owners (Cotterell et al., 2024). Nevertheless, a total of 2.6 million cats were placed into homes in 2023 (2023 Statistics, 2024).

Similar data post-pandemic emerged for dogs. Of the 3.2 million dogs Shelter Animals Count estimated to have entered shelters, 360,000 of them were euthanized, a 24% (78,000 dogs) increase from 2022 and 64% (157,000 dogs) increase from 2021. However, 2.2 million dogs were adopted from shelters, an increase of 109,000 dogs when compared to 2022. Additionally, 1.5 million pets were transferred between sheltering organizations in 2023, marking a 4% decrease as compared to 2022. A capacity crisis is being faced by sheltering organizations, brought about by an additional 900,000 animals lingering in the care of animal shelters since 2023. This strain is more often felt by animal welfare facilities, as opposed to rescues (which are often foster-based and do not have physical locations), as shelters account for 85% of total animal intakes in the US.

1.2 History of Sterilization Surgeries

Since the 1970s, high volume large scale surgical interventions have become a significant tool in controlling the pet population in the United States (Haworth, 2019). Rates of intake and euthanasia declined drastically due to modifications in sterilization practices by private veterinarians, implementation of shelter sterilization policies, and the passage of ordinances that mandated differential licensing fees for altered and unaltered animals (Rowan & Kartal, 2018). The first clinic that specialized in high volume, low cost spay-and-neuter surgery opened in Los Angeles, California in 1969. However, private veterinary practices have offered the service since the 1930s and perform most surgical sterilization procedures in the US (Haworth, 2019). In Los Angeles, sterilization surgeries numbered an average of 10,000 surgeries from 1975 onwards, with approximately 80% of those surgeries performed by private practice veterinarians (Rowan & Kartal, 2018). According to dog licensing data from Los Angeles Animal

Services, in 1971 only 10.9% of dogs were sterilized compared to a few years later, when it was approximately 50%, and by 2018, nearly 100%.

After the implementation of high-volume large scale surgical intervention in the 1970s, there was a 25-40% decline in pet intake and euthanasia at animal shelters by 1994 (Zawistowski et al., 1998). In the 1980s, these decreases leveled off but were then followed by a slower but steady decline from the 1990s onwards (Rowan & Kartal, 2018). While there is no published estimate of how many sterilization surgeries are performed each year in the United States, a survey of 212 spay-neuter clinics showed that the subsidized clinics performed 1,217,240 surgeries in 2019, 1,059,388 in 2020, and 1,184,274 in 2021 (Guerios et al., 2022). When we consider the estimated 3,000 spay-neuter clinics across the United States performing these surgeries at a similar rate, it is likely that over 17 million sterilization procedures were performed in 2019.

Laws requiring the sterilization of certain dogs and cats have been shown to decrease animal intake in local shelters. The first mandatory sterilization ordinances in Santa Cruz County were implemented in 1994 (Winkleblack, 2011). Between 1995 and 2002, both dog and cat shelter intakes in Santa Cruz County declined by 8% and 14%, respectively. Cat euthanasia declined an average rate of 19%; however, dog euthanasia rose 4%. In a study by White and colleagues (2010), the authors found that the onset of a government-funded surgical sterilization program in New Hampshire shelters was followed by a significant decrease in cat intake and euthanasia at the state's shelters, although reductions in cat intake and euthanasia were already occurring prior to the program. In Austin, Texas, the authors found that a free spay-and-neuter program slowed the rate of increase for dog and cat intakes into the shelter and euthanasia within the

program's service area, as compared to areas not served by the program, which were defined as residents in differing zip codes. In a more recent study in Victoria, Australia, researchers identified that the implementation of a free sterilization program for cats decreased impoundments by 66%, euthanasia by 82%, and cat-related animal service calls by 36% in eight years. This saved the government AU$440,660 for an investment of AU$77,490 (Cotterell et al., 2024).

1.3 Public Opinions on Sterilization Surgeries

Public opinion on sterilization of animals has changed over the last several decades and are likely informed by many demographic factors. Glasser (2021) found that younger generations (Generation X and Millennials) have less knowledge about sterilization and more safety concerns about the procedure as compared to Baby Boomers. Specifically, Millennials are less likely to believe that sterilization is morally and socially positive. Individual geography can also inform a person's opinions on sterilization. Those living in rural areas are less likely to believe sterilization is cruel and support laws mandating sterilization but are also more likely to believe that animals should have a litter of offspring before sterilization occurs. Men and women tend to have different viewpoints as well. Women tend to support sterilization and surgical mandates. In a 2009 study in Auckland, New Zealand, 90.2% of women reported their pets were sterilized while only 80% of men had their pets altered (McKay et al., 2009). Sterilization is also viewed differently for dogs and cats, such that people are more likely to believe that sterilization for dogs is expensive and less likely to believe that the surgery is the "right thing to do" as compared to cats (Glasser, 2021). Nevertheless, cats are more likely

to be sterilized than dogs, with 91.7% of cats being sterilized and only 78.5% of dogs (McKay et al., 2009).

1.4 Sterilization Mandates

Many shelters and rescues require that pets undergo surgical sterilization prior to placement, and state legislations often mandate the procedure for adopted animals. A total of 32 states requires shelters and rescues to sterilize their animals before adoption (Hodges, 2010). Violations of these mandates often involve owners being fined from $20 to $500 with additional fees for repeated offenses, cost of prosecution, and enforcement and court costs. In some states, failure to comply with sterilization can be punishable with imprisonment and removal of the animal from the owner's care. Similar punishments can befall shelters that place unaltered animals. Fines can range from $50 to $500 per violation; and upon conviction of three or more offenses, shelters can have their operating license temporarily or permanently revoked. Interestingly, most laws mandating sterilization focus on shelter-adopted pets, and those that are rehomed privately or acquired from breeders do not face the same requirements.

1.5 Health Concerns Related to Pediatric Sterilization

Nevertheless, recent research has identified health concerns for dogs and cats that undergo spay and neuter procedures, particularly at young ages. Pediatric sterilization is defined as the ovariectomy, ovariohysterectomy, or castration of a dog or cat during the first six to 16 weeks of age (Oliveira-Martins et al., 2023). One of the most notable health ramifications of early sterilization is that when animals have not reached sexual maturity at the time of the procedure, it can limit the amount of testosterone and estrogen available during their muscle tissue and bone growth development (Vendramini et al., 2020).

Animals with lower levels of these hormones tend to burn fewer calories due to lower activity, which can be as great as 60% post-sterilization. This lower activity reduces the caloric needs of animals with cats requiring 24%, and dogs 30%, fewer calories (Linder & Mueller, 2014; Allaway et al., 2017). Nevertheless, appetite management often occurs with these hormones; and without them, dogs can have a 60% increase in appetite and cats, a 23% increase (Jeusette et al., 2004; Kanchuk et al., 2002; Kanchuck et al., 2003). Furthermore, there is a potential connection between early sterilization and immune function as indicated by increases in certain diseases, such as hypoadrenocorticism, autoimmune haemolytic anaemia, atopic dermatitis, hypothyroidism, inflammatory bowel disease, and thrombocytopenia (Vendramini et al., 2020).

Several studies over the past decade have evaluated sterilization's effects on the bodies and health of dogs. Recently, Hart and colleagues (2024) found that the incidence of joint disorders increases in mixed breed dogs that weighed 20 or more kilograms when they were sterilized before the age of one. Additionally, they found that certain breeds, along with the dog's sex, were associated with different outcomes, such that joint disorders and certain cancers were more prevalent in those who have been sterilized early. Canine pediatric sterilization has been associated with an increased rate of osteosarcoma in Rottweilers, cranial cruciate ligament ruptures in golden retrievers, and hip dysplasia and lymphoma in male golden retrievers (Howe, 2015). Additionally, Hart and Hart (2021) uncovered that German shorthaired and wirehaired pointers, mastiffs, Newfoundlands, Rhodesian ridgeback, and Siberian Huskies were more vulnerable to joint disorders and cancers when neutered early. Torres de la Riva and colleagues (2013) explored how neutering age affects golden retrievers, specifically, and found that when these dogs were

sterilized before 12 months of age, they were twice as likely to be diagnosed with hip dysplasia and significantly more likely to experience cranial cruciate ligament tear, while males were three times more likely to be diagnosed with lymphosarcoma, and females were four times more likely to have hemangiosarcoma. Furthermore, Howe (2015) found that female dogs spayed before three months of age were at a higher risk of developing urethral sphincter-mechanism incompetence, which can lead to urinary incontinence. It is worth noting these studies (Howe, 2015; Hart & Hart, 2021; and Torres de la Riva et al., 2013) have identified health-related associations with sterilization, not causation, as they were performed by reviewing medical records and the incidence of various conditions relative to dogs' sterilization status and age of sterilization (Bushby, 2020).

In their best practice guidelines regarding canine spay and neuter, Hart et al. (2024) offers recommendations for sterilization timing for 40 dog breeds based on their research on the procedure's health effects. For male dogs, they recommended that 25 breeds should have the procedure after six months of age. With eight breeds, owners were encouraged to wait until dogs were a year or older; six breeds were given a post-two-year neuter recommendation; and for one breed, Doberman Pinscher, Hart and colleagues suggested that males remain intact for the entirety of their lifespan. With female dogs, their guidelines suggested that 24 breeds should be spayed following six months of age. The authors recommended that the owners of nine breeds wait until their dogs were older than a year to spay; and with six breeds, Hart et al. (2024) recommended waiting until the dogs were two years or older. Their guidelines recommended that female Golden Retrievers should remain intact. The researchers emphasized an individualistic approach to sterilization decisions based on the complexity of their findings, which could affect

how sheltering organizations approach canine sterilization when unaltered purebred dogs enter their care.

Unlike data related to dogs, scientific evidence suggests that sterilization surgeries are safe for cats over the age of six weeks (Howe, 2015), but this approach is a more recent perspective. Previously, practitioners worried about the procedure's impact on feline behavior and orthopedic disorders, such as physeal fractures (Oliveria-Martins et al., 2023). A particular concern with male cats was that neutering prior to sexual maturity would result in the narrowing of the penile urethra, leading to an increased risk of urinary obstruction. However, a 1996 study by Root and colleagues found no differences in urethral diameter between cats neutered seven months old, seven weeks old, or left intact. Nevertheless, the authors did find a significant difference in the urethral diameter of female cats but suggested that this difference did not influence the function of the urethra. A remaining physical concern for animals following sterilization is maintaining a healthy weight so as to minimize weight-associated endocrine diseases and the potential for slipped capital physes in male cats (Howe, 2015). Some cats who have experienced pediatric sterilization have demonstrated behavioral differences as well, such that they are less hyperactive but have increased fearfulness than cats that experience the procedure later in life (Oliveria-Martins et al., 2023). Finally, some practitioners have questioned kittens undergoing anesthesia at a young age; however, with modern anesthetic techniques and agents, these procedures have been found to be safe for animals as young as six to eight weeks old (Kustritz, 2002).

1.6 Benefits of Pediatric Sterilization

Despite these concerns, pediatric sterilization is commonly performed in the United States. Supporters of pediatric sterilization suggest that these practices are based on overall animal health and longevity, not the impact of a select number of diseases that often disproportionately affect purebred dogs. In a recent examination of the medical records of over 70,000 patients at the University of Georgia, researchers found that the mean age of death for intact dogs was 7.9 years old, while the mean age of death for sterilized dogs was 9.4 years old (Hoffman et al., 2013), suggesting that sterilization had not impeded these dogs' longevity. Specifically, neutered male dogs had a 13.8% longer life expectancy, and spayed female dogs, a 26.3% increase as compared to dogs that were not sterilized. Additionally, pediatric sterilization is a relatively short, inexpensive procedure, with few operative complications (Polak, 2017). A retrospective study by Oliveira-Martins and colleagues (2023) was unable to identify significant relationships between a dog's age of sterilization and owner reports of obesity, behavioral changes, or urinary and joint diseases.

The benefits of feline pediatric sterilizations may outweigh the potential harm. Ovariohysterectomy in cats prevents conditions such as pyometra and ovarian cancer. Female cats who are sterilized at six to eight weeks of age have a substantial reduction in the risk of developing mammary neoplasia, such that those that were spayed before six months of age had a 91% reduction in disease incidence (Overley et al., 2005). Male cats that are neutered at a young age have decreased aggression and sexual behaviors that are considered problematic for owners, such as urine spraying (Oliveria-Martins et al., 2023).

Additionally, researchers have found that neutering male cats prevents testicular cancer, another benefit in electing to perform the procedure early (Bushby, 2021).

1.7 The COVID-19 Pandemic Effects on Veterinary Care

The aftermath of the COVID-19 pandemic threatens to reverse the progress made in companion animal welfare, especially with veterinary care. In March 2020, stay-at-home orders were issued in response to SARS-CoV-2, and many veterinary providers suspended nonessential services, such as routine sterilization surgeries (Guerios et al., 2022). Guerios and colleagues evaluated the pandemic's impact on the volume of sterilization procedures performed at spay-neuter clinics, utilizing data from 212 clinics. For the year 2021, they found a deficit of more than 2.7 million sterilization surgeries for dogs and cats compared to 2019 (the study's baseline year). In a discussion about the effects of the pandemic on veterinary care, Muzzatti and Grieve (2022) suggest that pets are likely waiting longer now to receive standard care, such as vaccines and sterilization. The number of admissions to veterinary clinics, both concurrently and over the course of a working day, decreased to allow for safe heath practices for staff, with a prioritization on stray or feral animals over well cared for pets (Muñoz & Hesterman, 2020).

1.8 Veterinary Costs and Shortage

Veterinary costs are a concern for owners and may influence their likelihood to seek veterinary care for their pets. In a 2021 National Public Radio interview, it was reported that American pet owners would spend over $30 billion on veterinary care (Garcia-Navarro & Leslie, 2021). According to the Bureau of Labor Statistics' Consumer Price Index (2023), the cost of veterinary services increased by over 10.6 percent from 2022 to 2023 with such rises attributed to overhead costs of clinic operations (i.e., rent,

utilities, property taxes, insurance, medical disposal fees, and building maintenance), inventory (i.e., medications, prescription diets, non-prescriptive diets, and other goods offered by the clinic), equipment (i.e., maintenance and purchasing of needed diagnostic equipment), and the salaries of clinic staff (Llera & Buzhardt, n.d.). Additionally, an increasing number of veterinary clinics are owned and operated by corporate entities, further contributing to the rising cost of pet health care (Garcia-Navarro & Leslie, 2021).

Contemporaneously, the United States is experiencing a veterinary shortage that is unlikely to subside in the near future. It is estimated that by 2030, the US will have a deficit of approximately 15,000 veterinarians relative to the number of companion animals (Adams, 2023). Of particular concern, animal shelters are struggling to retain their veterinarians on staff. In a survey performed by Best Friends Animal Society (2023), over half of shelter veterinarians surveyed indicated high levels of burnout and roughly 90% reported high compassion fatigue, suggesting a significant level of work-related distress for these individuals. The authors found that those that reported high burnout were also more likely to leave the field, which will impact staff turnover rates (Wolf & Gillespie, 2023).

It is likely that this veterinary shortage will further affect access to care. In a study by Kogut et al. (2024), 79% of veterinary clinics surveyed reported that clients are waiting longer than usual for care, and that delay was at least two months in over half of clinics surveyed. Longer wait times for owners needing veterinary services for their pets along with the rising cost of veterinary care could negatively affect animal shelters. Kogut and colleagues found that of the 140 animal shelters that responded to their survey, 91% reported having a backlog of animals needing veterinary care. These 140 shelters

reported a combined total of 18,648 animals waiting for surgery. These delays could potentially lengthen the amount of time animals reside in the shelter, which could have unfortunate consequences. In an older study by Clevenger and Kass (2003), researchers found that the longer a dog stays in the shelter, their likelihood of euthanasia increases. The authors posited that space limitations may explain this relationship.

1.9 Welfare Associated Concerns in Animal Sheltering

In addition to the increased risk of euthanasia associated with longer shelter stays, the animal shelter is a stressful environment for dogs and cats, negatively impacting their welfare. This is likely due to the excessive noise in kennels, a lack of routine and predictability, and social isolation (Gunter et al., 2022). In the shelter, cats struggle with lack of caretaker familiarity, stressors due to veterinary care and increased handling, disease transmission, unfamiliar conspecifics, and inadequacies in space and control (Vojtkovská et al., 2020). Animal shelters are typically designed for short term stays and are not comparable to a home environment.

For most animals, the introduction of the shelter's stressors is often accompanied by changes in their affective states, detrimentally impacting the animal's mental and physical health (Levy et al., 2020). Researchers have found that some animals refuse to eat or move in response to the environment, leading to weight loss. Tanaka and colleagues (2012) discovered that 82% of cats lost weight during their first week in the shelter's care, and 25% of the cats lost over 10% of their body weight while at the shelter. Furthermore, stressed animals are more likely to become ill and contract upper respiratory infections, which are common in the shelter (Levy et al., 2020). Tanaka and colleagues (2012) found that cats with high stress scores during their first week in shelter

care were five times more likely to develop upper respiratory infections than cats with low stress. During their stay at the shelter, 58% of cats developed an upper respiratory infection before leaving the facility.

Most cats' stress levels in the shelter begin to subside after spending two to five weeks in the environment; however, some cats are unable to adapt (Vojtkovská et al., 2020). In a study by Gouveia et al. (2011), researchers found that shelter cats with longer length of stays were less active and were more often involved in conflicts with conspecifics than cats with shorter length of stays, although this could be due to the increased observation time. Gouveia and colleagues observed that long-stay cats had reduced food and water intake, decreased litter box activity, inadequate coat care and engaged in overgrooming, performed less playful behaviors, were excessively vigilant, urine sprayed, hid more often, and displayed more agonistic behavior towards humans.

Long lengths of stay in the shelter negatively affects dogs' behavior. Wells and colleagues (2002) found that dogs that had resided in the shelter for over five years spent more time in the back of their kennels, likely making it more difficult for potential adopters to view these dogs. Protopopova et al. (2014) found that dogs that face away from the front of their kennels when people approach have longer lengths of stay in the shelter than dogs that did not engage in the behavior. Other dog behaviors, such as paw lifting, vocalizing, repetitive behaviors, circling, self-licking, panting, and the inability to rest, have also been associated with more days awaiting adoption in the animal shelter (Raudies et al., 2021).

1.10 Economic Effects of Prolonged Lengths of Stay

Along with the effects on animal welfare, prolonged length of stays can have drastic economic costs to animal sheltering organizations. In a study by Hawes et al. (2018), researchers found that the median cost of care for cats in an Austin animal shelter was approximately $12.26 a day. The median amount spent for cats who were in shelter care for zero to nine days was only $46.08, while cats who stayed 130-160 days cost the shelter an average median cost of $1,831.68. Dogs' median cost of shelter care was approximately $13.57 per day. Dogs who spent zero to nine days in the shelter had an average median cost of care of $56.49, while dogs sheltered for 140-149 days had an average median cost of care of $2,356.04. In a self-reported financial disclosure, the Dakin Humane Society in Springfield, Massachusetts, revealed that the average cost of care per animal had nearly doubled over the past decade. From 2015-2018, the cost was approximately $513 per animal; comparatively in 2024, the cost was $950 per animal. The shelter cited that increase was due to longer lengths of stay for animals and rising supply and care costs (Dakin Humane Society, 2024).

Longer stays and higher associated costs can negatively impact resource-limited shelters. Organizational budgets depend on the amount of money received from municipal contracts and private funding, which limits the resources and supplies available to shelters (Goselin et al., 2011). When animals reside longer in the shelter, the number of new animals admitted into the shelter's care is affected. While physical holding capacity for animals is one component in calculating a shelter's capacity for care, organizations also consider their optimal number of animals available for adoption as well as the staff's capacity for daily care and their ability to provide specialized care,

such as intake evaluations, behavioral evaluations, surgeries, and adoption procedures (Bootcamp, 2015). If lengths of stay can be shortened, shelters can conserve resources and lower animals' risks for behavioral and health problems as well as provide better conditions for both the animals and staff at these organizations.

1.11 Policies Lengthening the Stay of Shelter Animals

A variety of shelter policies and procedures can impact an animal's stay in the organization's care, such as stray hold policies, medical procedures, and adoption policies. Stray hold policies provide owners the opportunity to reclaim their pet if it has arrived at the shelter as a stray before the organization assumes ownership of the animal (Wisch & Dillingham, 2017). Most states require shelters to hold pets for three to five days; but in some jurisdictions these periods can last as long as 10 days. Despite the duration of these mandated periods, animals are typically reclaimed by their owners in one or two days. When California increased its mandatory holding period for stray pets in 2012, researchers found no increase in animal reclamation rates, but these longer holds increased demands for animal housing and care in shelters (Bootcamp, 2015). Shelters often place new animals in quarantine areas, away from other pets to limit the spread of diseases and monitor their health, further lengthening an animal's time in care. Shelters may also evaluate an animal's behavioral suitability for adoption or complete medical or surgical procedures that can add additional days to an animal's length of stay.

1.13 Surgical Sterilization Affecting the Length of Stay

The timing of an animal's surgical sterilization in the shelter may affect its length of stay. During the pandemic, Gunter and colleagues (2022) found that dogs that had already arrived at the shelter sterilized had the shortest length of stay. Puppies had the

shortest lengths of stay when altered after adoption; and conversely, had the longest lengths of stay when their sterilization procedure occurred during foster care. It is possible that the logistics of providing sterilization to dogs and puppies when living outside of the shelter might explain these longer stays in care. The researchers hypothesized that sending puppies to their adoptive homes before sterilization could minimize time spent in the organization's care and socialize them in the environment in which they would be living.

To avoid extending the animal's length of stay in the shelter, Levy and colleagues (2020) has suggested that sterilization surgeries must be appropriately timed. Historically, shelters postponed scheduling sterilization until the animal was adopted to avoid altering animals that may not be made available for adoption; however, this has been found to create a bottleneck and add unnecessary days to an animal's stay in the shelter. As such, it is vital to understand how the timing of sterilization surgery impacts the length of stay of dogs and cats in shelters. As previously discussed, longer lengths of stay can have unwanted effects on the individual animal's welfare and shelter's resources.

The purpose of this study is to investigate whether sterilization that has occurred prior to an animal's intake, during its time in the shelter, or after adoption is associated with the number of days it resides in care. We hypothesize that animals altered prior to admission or following adoption will have shorter lengths of stay than dogs and cats altered during their stay. Additionally, we will explore if variables about the shelter, including its location or type, and the animal, such as its intake type, sex, age, size, and positive outcome, are correlated with length of stay.

2. Methods and Materials

2.1 Dataset Acquisition

Shelter Animals Count (SAC), a nonprofit organization based in Atlanta, Georgia, maintains a centralized database of animal sheltering data and provided this dataset for analysis. Organizations utilizing PetPoint, a cloud-based data management system (24Pet Company, Rolling Meadows, IL), were selected for inclusion in this study. The number of shelters and rescues utilizing this software system in the United States is over 2,000 (Rowan & Kartal, 2018). Shelters included in this dataset are located in nearly all 50 states and Washington D.C., except Delaware, North Dakota, Utah, and Wyoming. This dataset represents records of dogs and cats residing at these shelters between January 1 and December 31, 2023.

2.2 Data Variables and Coding

The initial dataset included 708,508 animal records. These records include demographic information about the animal: its species, intake type into the shelter and its outcome, whether the animal was altered prior to shelter entry as well as its sex and size. Additionally, the type of sheltering organization and its location were included.
The variables and categorical levels of those variables are described in further detail:

Species includes dogs, cats, small mammals, livestock, reptiles, and birds.

Intake Types describes how the animal arrived at the animal shelter and includes owner/guardian surrender and return, seized custody, stray, and transport in. An *owner/guardian surrender* or *return* is defined as the relinquishment of a pet by its owner to the animal shelter. A variety of reasons may be provided by the owner at the time of relinquishment including having a lack of time to care for the pet, cost of care, the health

of the animal, family problems, moving, or behavioral concerns (Hawes et al., 2020). Typically, organizations classify a pet as a *return* on intake if the animal has been in the adopter's care for less than 30 days. A longer duration is typically categorized as "*owner/guardian surrender*." *Seized custody* is defined as when an animal welfare agent believes an animal is not receiving humane care and is removed from the owner's care after confirmation from a veterinarian that it is in the animal's best interest (Impound, Protective Custody, and Quarantine, 2024). *Stray* animals are either born in the community, abandoned, or lost without identification when brought into the shelter for rehoming (Stray Animal Care, 2023). *Transport in* is defined as an animal who has been admitted from another animal sheltering organization (Intake and Outcome Definitions, 2017). *Clinic* indicates the animals received medical services but was not in the care of the organization for the purpose of rehoming. An animal with *service in* as its intake type received other services, such as cremation.

Intake Subtype indicates a more specific intake type and includes agency assist/unspecified transport, 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 transport, 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. Descriptions of these subtypes are provided in Appendix 1.

Outcome Types describes the animal's outcome from the animal welfare organization and includes admin missing, adopted, clinic out, deceased, euthanized, return to owner, transfer out, no outcome, and incorrect data entry. *Admin missing* indicates that the organization lost the animal while in its care or the animal had an unknown outcome at the time of data collection. *Adopted* indicates the animal was placed with an owner that assumed all responsibility for their care (Intake and Outcome Definitions, 2017). *Deceased* occurs when an animal has died in care without humane euthanasia due to trauma, disease, or unknown causes. *Euthanized* is the humane euthanasia of an animal in the shelter's care that has been deemed unfit for placement due to being gravely ill, temperamentally unsound for placement, posing a threat or danger to the community, or overcrowding. *Return* indicates that an animal in care was reunited with its owner. An animal was categorized as *transfer out* when it was moved to another animal welfare agency for placement. *Clinic out* is the release of an owned animal that was in the shelter's care for medical services. *Service out* is associated with clinic out, indicating that an animal received service (i.e., vaccination clinics, trap-neuter-release). Animals with *no outcome* remained in the organization's care at the end of data collection.

Alteration Type describes the animal's spay-neuter status upon entry and includes altered after intake, unknown alteration status at intake, and altered before intake. *Altered after intake* describes animals that were intact at the time of admittance into the organization's care. *Unknown altered status* indicates that sheltering staff were unable to

determine if the animal was sterilized at the time of entry. Animals that were *altered before intake* were sterilized prior to entering the shelter's care.

Sex Type includes female, male, and unknown. *Unknown* describes animals whose sex was not identified or input into the animal's record.

Size Type includes small, medium, large, and extra-large.

Organization Type describes the animal welfare organization in which the animal resided. An organization may be categorized as an animal rescue with a government contract, animal shelter with a government contract, government animal services, rescue without a government contract, and shelter without a government contract. *Animal shelters* (animal shelters with and without government contracts) are physical sheltering locations that the public can visit and adopt pets. *Organizations with government contracts* (rescue and shelters) receive funding from municipalities to carry out animal care services but are not operated by a municipality (Goselin et al., 2011). *Animal rescues* typically do not have publicly accessible locations and utilize fostering programs to provide care for their animals. *Government animal services* are animal care services directly managed by the municipality.

US Region indicates the physical location of the animal welfare organization and includes 45 states and Washington D.C. For the purposes of our study, US states were grouped into regional categories as described by the United States Census Bureau (2021) with a further division of the South as reported by National Geographic (O'Connor, 2023). In total, the regions of *Northeast*, *Southeast*, *Midwest*, *Southwest*, and *West* were used.

Length of Stay (LOS) is the measure of time elapsed between the animal's intake and outcome from the shelter. LOS was calculated by subtracting the intake date from the outcome date. These values are described in days.

Age is calculated at time of intake. This value, described in months, was calculated by subtracting the estimated or provided birth date from the intake date at the shelter.

Spayed/Neutered indicates whether the animal was sterilized at the time of outcome. *Unknown* indicates that the shelter was uncertain of the sterilization status when the animal departed.

Sterilization Surgery Timing depicts when the animal's alteration occurred and was determined based on two alteration statuses: at the time of intake and when the animal left the shelter's care. *Before Intake* indicates that the animal received surgical sterilization before entering the shelter's care. *During Shelter Care* indicates that the animal was sterilized while under the care of the shelter and before an outcome was completed. *After Outcome* indicates that the animal was not sterilized before it left the shelter's care. As such, the animal remained intact at the time of its outcome with an assumption that the animal was sterilized either by its new owner (adoption) or animal welfare agency (transfer out).

2.3 Data Count and Exclusions

Records of animals other than dogs and cats are not included in this 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 for rehoming purposes were also removed. Animals with intake types (i.e., bite quarantine, euthanasia request,

quarantine, trapped/feral) remained in the data set if they had a live, non-owner-related outcome. Additionally, animal records with duplicated intake and outcome types (i.e., stray, owner/guardian surrender, seized custody) were excluded.

Considering our interest in the timing of sterilization surgeries and its impact on length of stay, animals with non-live outcomes (i.e., deceased, euthanized) or those that were returned to their owners were excluded from our analysis. Similarly, animals whose alteration statuses, sexes, and timing of sterilization surgeries were unknown or not clearly indicated in the dataset were removed. Data from animal rescues, as opposed to animal shelters, were also removed as they were not the focus of this study. Table 1 describes the animal records that were excluded from the analyzed dataset.

Table 1. Percentage of excluded data from initial dataset by category of exclusion

Variable	**Excluded Categories**	**Records excluded (*n*)**	**Excluded data (%)**
Intake Type	Clinic, Service In	15,527	5.0%
Animal Type	Agricultural, Amphibian, Aquatic, Barnyard, Livestock, Bird, Fowl, Equine, Exotic, Small Mammals, Wildlife, “Other”	24,429	7.9%
Outcome Type	Admin Missing, Clinic Out, No Outcome Listed, Service Out, Deceased, Euthanized, Incorrect Data Entry	181,362	58.8%
Alteration Status	Unknown, None Listed	41,555	13.4%
Organization Type	Animal Rescue with a Government Contract, Animal Rescue without Government Contract	24,963	8.1%

Sex	Unknown	31,418	10.2%
Spay/Neuter Timing	Unknown, Missing	18,501	6.0%

Note. Some records were excluded for multiple reasons (e.g., animal and organization types). As such, records that were excluded may be included more than once in this table. The final dataset included 400,108 animal records.

Table 2. Percentage of included data by variable and type

Included Variable Categories by Type	**Records included (*n*)**	**Included data (%)**
Intake Type		
Owner/Guardian Surrender/Return	135,453	33.9%
Seized/ Custody	26,425	6.6%
Stray	155,023	38.7%
Transport In	83,207	20.8%
Intake Subtype		
Agency Assist/Unspecified Transport	18,437	4.6%
Abandoned	8,797	2.2%
Animal Control/Law Enforcement Officer	34,669	8.7%
Abuse/Neglect	2,358	0.6%
Better Placement Options	3,190	0.8%
Boarding/ Temporarily Fostering	124	>0.1%
Born During Shelter Care	6,002	1.5%
Behavioral Concerns	1,720	0.4%
Bite Quarantine	261	0.1%
Breed Restrictions	1	>0.1%
Lifestyle Changes	1,230	0.3%
Coalition Transport	25,155	6.3%
Pet Care/Cost	136	>0.1%
Courtesy Hold	56	>0.1%

Deployment	9	>0.1%
Disaster/Emergency Response	439	0.1%
Does Not Want/Like	255	0.1%
Euthanasia Request	687	0.2%
Housing Concerns/Eviction	832	0.2%
Family Concerns	520	0.1%
Legal Proceedings/ Owner Arrested	988	0.2%
Pet Medical Concerns, Unspecified	1,485	0.4%
Allergies	21	>0.1%
Owner Medical Concerns, Unspecified	192	>0.1%
Out-of-State Transport	25,601	6.4%
Owner Died	224	0.1%
Protective Custody	312	0.1%
Public Drop-off	85,629	21.4%
Quarantine	32	>0.1%
Return	19,454	4.9%
Unspecified Stray	40,481	10.1%
Unspecified Surrender	108,071	27.0%
Too Many Animals	269	0.1%
Trapped/Feral	11,453	2.9%
Unrestrained	29	>0.1%
Unwanted Litter	846	0.2%
Unspecified Seizure	132	>0.1%
Animal Type		
Dog	177,059	44.3%
Cat	223,052	55.7%
Outcome Type		
Adopted	328,669	82.1%
Transfer Out	71,439	17.9%
Alteration Type		

Prealtered	107,661	26.9%
Intact	292,447	73.1%
Sex		
Male	200,786	50.2%
Female	199,322	49.8%
Size		
Small	218,116	54.5%
Medium	112,363	28.1%
Large	66,022	16.5%
Extra Large	3,607	0.9%
Sterilization Surgery Timing		
Before Intake	107,661	26.9%
During Shelter Care	242,537	60.6%
After Outcome	49,910	12.5%
Organization Type		
Animal Shelter with a Government Contract	210,759	52.7%
Government Animal Services	82,579	20.6%
Animal Shelter without Government Contract	106,770	26.7%
U.S. Region		
Northeast: Maine, New Hampshire, Massachusetts, Rhode Island, Vermont, New York, New Jersey, Connecticut, and Pennsylvania	19,239	4.8%
Southeast: Delaware, Maryland, Washington D.C., West Virginia, Virginia, Kentucky, North Carolina, South Carolina, Tennessee, Georgia, Alabama, Mississippi, Arkansas, Louisiana, and Florida	96,411	24.1%
Midwest: Ohio, Michigan, Wisconsin, Minnesota, North Dakota, South Dakota, Nebraska, Iowa, Kansas, Missouri, Illinois, and Indiana	133,193	33.3%
Southwest:Oklahoma, Texas, New Mexico, and Arizona	76,667	19.2%

West: Colorado, Utah, Wyoming, Montana, Idaho, Nevada, California, Oregon, Washington, Hawaii, and Alaska	74,598	18.6%

2.4 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 27).

The species of animal, its intake type, age (in months), sex, size, timing of sterilization surgery, length of stay (in days), and live outcome type were the final animal variables used in data analysis. Due to the number of intake subtype categories and their tangential relationship to our research questions, this variable was not included in our statistical analyses. Variables about the organization, such as the type and region of the United States that the shelter was located, were included.

To better understand the amount of time that animals resided in the shelter (length of stay) and its relationship with sterilization surgery timing, a generalized linear model was utilized. This count model included a negative binomial distribution with a log link function. In addition to sterilization timing, all other independent variables and one covariate, age, were entered in 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.

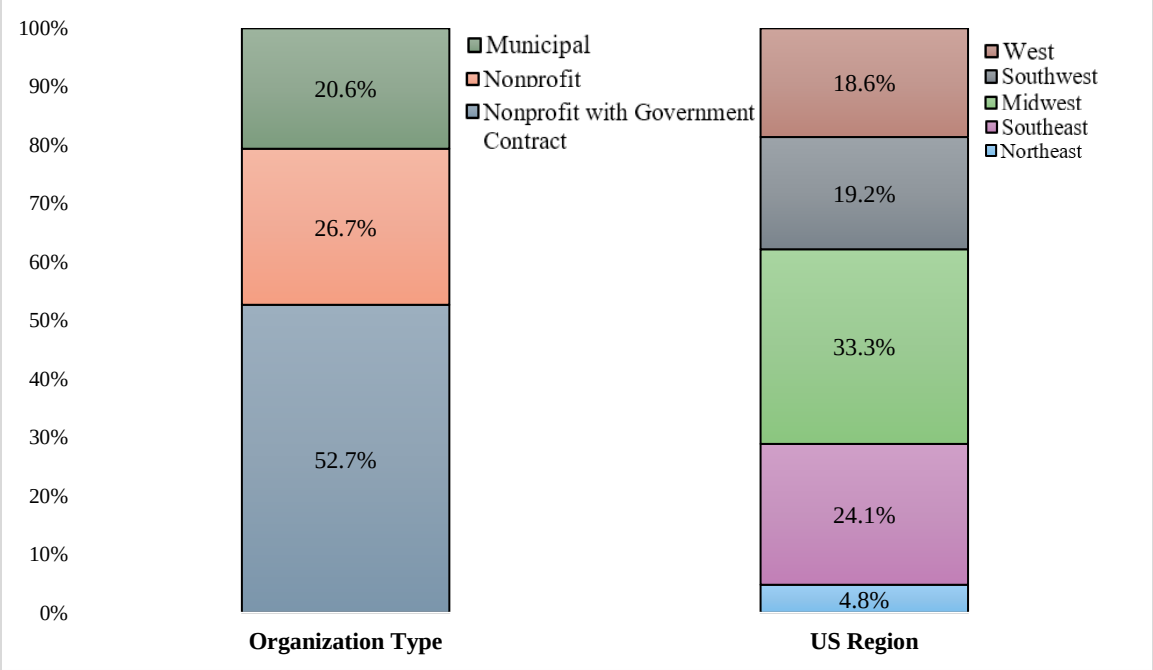
3. Results

3.1 Descriptive Statistics

Shelter Demographics

Animal records from nonprofit sheltering organizations with government contracts comprised the majority of records in our dataset, 52.7% (*n* = 210,759), with municipal shelters and nonprofits representing the remaining records (Figure 1). In terms of geographic location, most records were from animal shelters in the Midwest region of the United States (33.3%, *n* = 133,193), followed by the Southeast (24.1%, *n* = 96,411). Southwest (19.2%, *n* = 76,667) and West (18.6%, *n* = 74,598) regions were similarly represented with a small proportion of records (4.8%, *n* = 19,239) from shelters in the Northeast (Figure 1).

Figure 1. Proportions of organization types and US regions represented

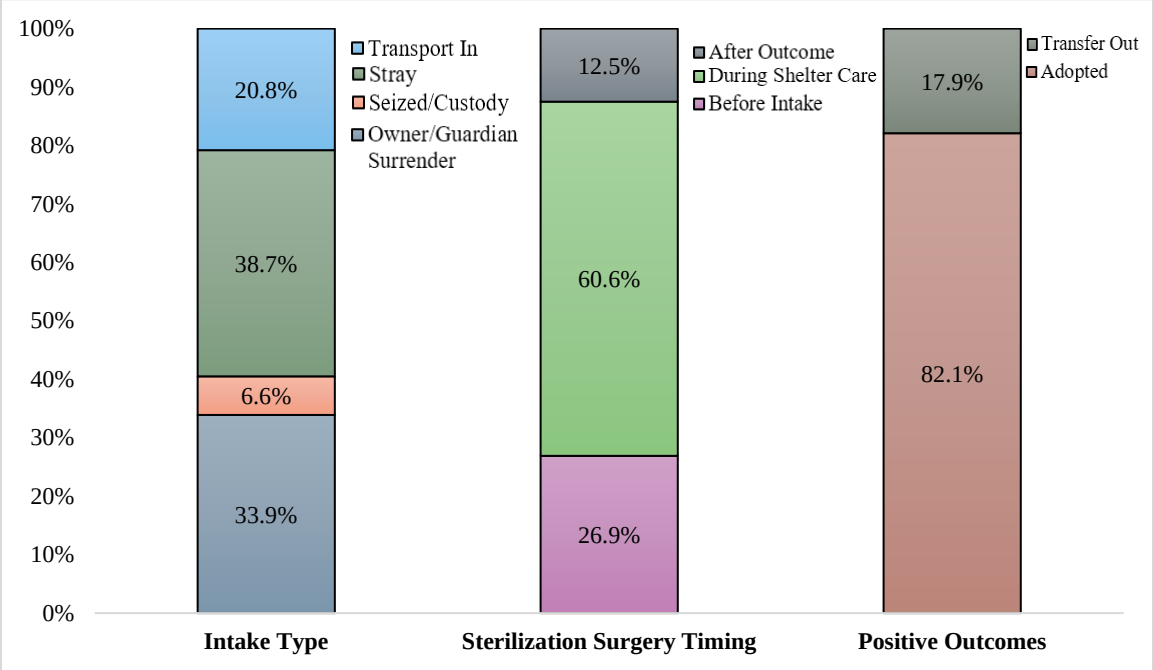


Animal Demographics

Cats were more represented in our dataset than dogs (55.7%, *n* = 223,052). Most animals entered the shelter as strays (38.7%, *n* = 155,023) followed by those that were surrendered by their owners (33.9%, *n* = 135,453). The remaining were transported in from other organizations (20.8%, *n* = 83,207) and a small proportion were brought to their shelters as part of seizure or custody cases (6.6%, *n* = 26,425) (Figure 2). The mean age of animals entering the shelter was 1.6 years old (*SD* = 27.88 months) with a median of 8 months old and a range of newborn (born in the care of the shelter) to 22.9 years old. Approximately half of all animals were male (50.2%, *n* = 200,786). When describing the size of the dogs and cats, animals were typically categorized as small (54.5%, *n* = 218,116), followed by medium (28.1%, *n* = 112,363) and large (16.5%, *n* = 66,022) with few animals described as extra-large (0.9%, *n* = 3,607).

Most often, animals were sterilized during their time in the animal shelter (60.6%, *n* = 242,537), with slightly over one-quarter (26.9%, *n* = 107,661) arriving already spayed or neutered, and 12.5% (*n* = 49,910) leaving the shelter's care unsterilized (Figure 2). Regarding the positive outcomes of animals in our dataset, 82.1% were adopted (*n* = 328,669), and 17.9% were transferred out of the facility for placement (*n* = 71,439) (Figure 2). The mean number of days animals spent in shelter's care was 28.4 days (*SD* = 34.2 days) with a minimum of exiting the same day as intake (0 days) and a maximum of 387 days. The median length of stay of the animals in our dataset was 16 days.

Figure 2. Proportions of animal intake types, sterilization surgery timing, and positive outcomes



3.2 Predictors of Length of Stay

A total of 400,108 animal records were used in our statistical analysis. We analyzed animals' length of stay using a generalized linear model to detect an effect of organization type, animal type, intake type, age (in months), sex, size, sterilization surgery timing, positive outcome, and US region and their interactions. The main effects of intake type, age, sex, and size and 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 3.

Table 3. Generalized linear model predicting animals' length of stay

Source	Wald Chi-Square	*df*	*p*
Intercept	12027.55	1	< 0.001

Intake Type	86.56	3	< 0.001
Positive Outcome	135.86	1	< 0.001
US Region	137.06	4	< 0.001
Sterilization Surgery Timing	58.68	2	< 0.001
Positive Outcome x Animal Type	14.05	1	< 0.001
Positive Outcome x Sterilization Surgery Timing	21.16	2	< 0.001
Animal Type x Sterilization Surgery Timing	65.94	2	< 0.001
Positive Outcome x Animal Type x Sterilization Surgery Timing	10.59	2	0.005
Positive Outcome x US Region	78.54	4	< 0.001
Intake Type x Positive Outcome	34.28	3	< 0.001

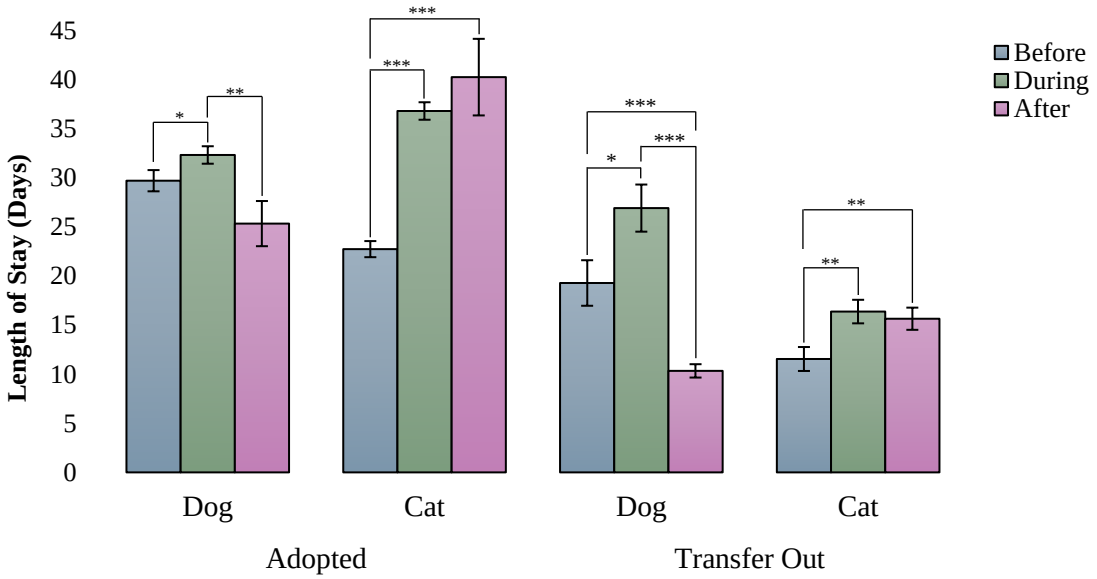
In describing our three-way interaction between animal type, sterilization timing, and positive outcome, our model predicted that the amount of time dogs and cats, which were adopted or transferred out, stayed in the animal shelter differed depending on when they were sterilized (Figure 3). For adopted dogs, we found that their lengths of stay were significantly shorter when they were sterilized following adoption as compared to being sterilized during their time in care (Difference: -6.99, *95% CI* [-11.74, -2.25], $p = 0.004$). Sterilization prior to entering the shelter was also associated with shorter lengths of stay for adopted dogs than sterilization that occurred at the shelter (Difference: -2.62, *95% CI* [-5.14, -0.09], $p = .042$). Adopted dogs had shorter lengths of stay, which were approaching significance, when altered after their time in care versus arriving already altered (Difference: -4.38, *95% CI* [-9.28, 0.53], $p = 0.081$).

In comparison, adopted cats experienced significantly longer lengths of stay when they were altered after adoption as compared to before (Difference: 17.52, *95% CI* [9.84, 25.21], $p < 0.001$). Additionally, we found no difference between these cats' time in the

shelter when they were sterilized after or during their shelter stay (Difference: 3.45, *95% CI* [-4.19, 11.09], $p = 0.376$). Adopted cats that arrived at the shelter altered had significantly shorter length of stays than those altered during care (Difference: -14.08, *95% CI* [-16.18, -11.98], $p < .0001$) or after adoption (Difference: -17.52, *95% CI* [-25.21, -9.84], $p < 0.001$).

Dogs that were transferred out of their shelters for placement had much shorter length of stays when they were sterilized after transfer as compared to arriving to the shelter spayed or neutered (Difference: -8.95, *95% CI* [-13.49, -4.40], $p < 0.001$) or being sterilized during their time in care (Difference: -16.58, *95% CI* [-21.10, -12.06], $p < 0.001$). Conversely, transferred dogs had the longest length of stays when altered during care (Difference: 7.64, *95% CI* [1.46, 13.81], $p = 0.015$). For transferred cats, being altered before intake resulted in the shortest length of stay as compared to during (Difference: -4.83, *95% CI* [-8.06, -1.61], $p = 0.006$) or after their time in care (Difference: -4.11, *95% CI* [-7.06, -1.15], $p = 0.003$). We found no difference between transferred cats that were altered during as compared to after their stay in the shelter (Difference: 0.73, *95% CI* [-2.12, 3.57], $p = 0.616$).

Figure 3. Estimated Marginal Means of Length of Stay (in days) for Dogs and Cats by Positive Outcome, and Sterilization Surgery Timing



*Note. *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.*

Table 4. Table of Significance of Estimated Marginal Means of Length of Stay (in days) for Dogs and Cats by Positive Outcome, and Sterilization Surgery Timing

Variable	*Mean*	*SE*	1	2
Adopted Dogs				
1. Altered After Outcome	25.34	2.30		
2. Altered Before Intake	29.71	1.08	0.081	
3. Altered During Care	32.33	0.89	0.004	0.042
Adopted Cats				
1. Altered After Outcome	40.26	3.87		
2. Altered Before Intake	22.74	0.82	<0.001	
3. Altered During Care	36.81	0.87	0.38	<0.001
Transferred Out Dog				

1.	Altered After Outcome	10.34	0.68		
2.	Altered Before Intake	19.29	2.32	<0.001	
3.	Altered During Care	26.92	2.43	<0.001	0.015
	Transferred Out Cats				
1.	Altered After Outcome	15.65	1.13		
2.	Altered Before Intake	11.55	1.22	0.006	
3.	Altered During Care	16.38	1.21	0.616	0.003

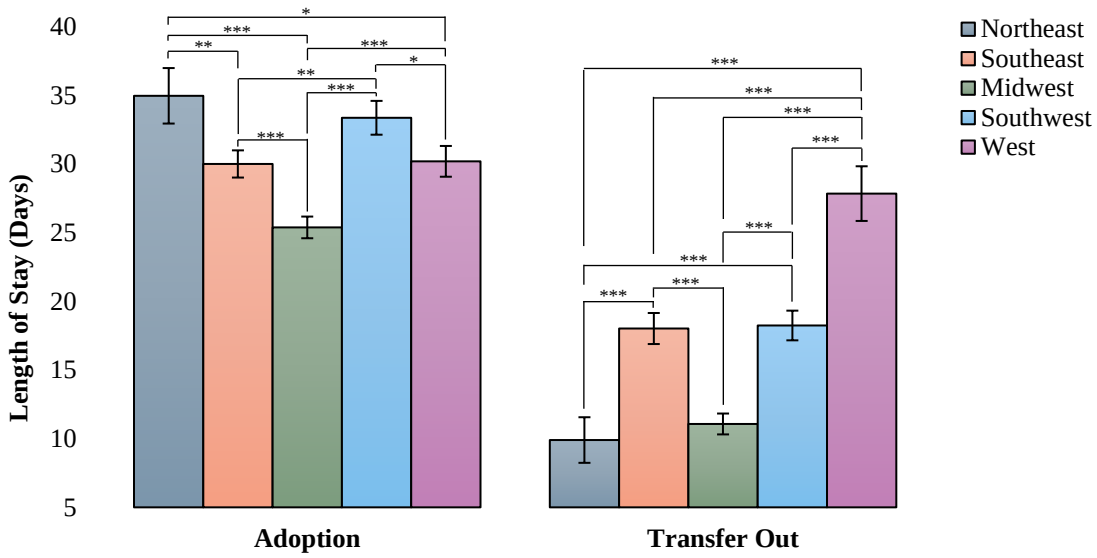
In describing our two-way interaction between positive outcomes from the shelter and the US region in which the shelter was located, our model predicted that animals' length of stay differed depending on the shelter's location and type of outcome (Figure 4). We found adopted animals' lengths of stay at Midwest shelters were significantly shorter than animals that were adopted from any other region ([NE] Difference: -9.57, *95% CI* [-13.36, -5.79], $p < 0.001$; [SE] Difference: -4.61, *95% CI* [-6.45, -2.78], $p < 0.001$; [SW] Difference: -7.97, *95% CI* [-10.25, -5.69], $p < 0.001$; [W] Difference: -4.80, *95% CI* [-6.88, -2.72], $p < 0.001$).

Conversely, adopted animals from Northeast shelters had significantly longer lengths of stay than those from Southeast (Difference: 4.96, *95% CI* [1.04, 8.88], $p = 0.013$), Midwest (Difference: 9.57, *95% CI* [5.79, 13.36], $p < 0.001$), and West (Difference: 4.77, *95% CI* [0.74, 8.80], $p = 0.020$) shelters; however, we found no difference in the lengths of stay between adopted animals in Northeast and Southwest shelters (Difference: 1.60, *95% CI* [-2.53, 5.73], $p = 0.447$). Adopted animals in Southeast shelters had significantly shorter lengths of stay than those in Southwest

shelters (Difference: -3.36, *95% CI* [-5.86, -0.86], $p = 0.009$), but no difference was found between animals' lengths of stay that were adopted from Southeast and West shelters (Difference: -0.19, *95% CI* [-2.51, 2.13], $p = 0.873$). Adopted animals in Southwest had significantly longer lengths of stay than those in West shelters (Difference: 3.17, *95% CI* [0.51, 5.83], $p = 0.020$).

The lengths of stay for animals transferred out of Northeast shelters was significantly shorter as compared to all other regions ([SE] Difference: -8.12, *95% CI* [-11.94, -4.30], $p < 0.001$; [SW] Difference: -8.35, *95% CI* [-12.12, -4.58], $p < 0.001$; [W] Difference: -17.94, *95% CI* [-22.76, -13.13], $p < 0.001$) except transferred animals from the Midwest (Difference: -1.17, *95% CI* [-4.60, 2.26], $p = 0.504$). We found that animals that were transferred out of Southeast shelters had longer lengths of stay than those animals at Midwest shelters (Difference: 6.95, *95% CI* [4.42, 9.48], $p < 0.001$) and shorter lengths of stay than transferred animals from West shelters (Difference: -9.82, *95% CI* [-13.82, -5.83], $p < 0.001$), but there was no difference between transferred animals at Southeast and Southwest shelter (Difference: -0.23, *95% CI* [-3.03, 2.58], $p = 0.873$). The length of stay of transferred animals at Midwest shelters was shorter than those animals at Southwest (Difference: -7.18, *95% CI* [-9.61, -4.74], $p < 0.001$) and West (Difference: -16.77, *95% CI* [-20.73, -12.81], $p < 0.001$) shelters. Animals that were transferred out of Southwest shelters for placement had shorter lengths of stay than those animals from shelters in the West (Difference: -9.60, *95% CI* [-13.65, -5.55], $p < 0.001$).

Figure 4. Estimated Marginal Means of Length of Stay (in days) by Positive Outcomes & US Region



Note. *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

Table 5. Table of Significance of Estimated Marginal Means of Length of Stay (in days) by Positive Outcomes & US Region

Variable	*Mean*	*SE*	1	2	3	4
Adopted Animals By Region						
1. Northeast	34.96	2.02				
2. Southeast	30.00	0.99	0.013			
3. Midwest	25.38	0.79	< 0.001	< 0.001		
4. Southwest	33.36	1.25	0.447	0.009	< 0.001	
5. West	30.19	1.12	0.020	0.873	< 0.001	0.020
Transferred Out Animals By Region						
1. Northeast	9.90	1.66				

2. Southeast	18.02	1.13	< 0.001			
3. Midwest	11.07	0.76	0.504	< 0.001		
4. Southwest	18.24	1.08	< 0.001	0.873	< 0.001	
5. West	27.84	1.99	< 0.001	< 0.001	< 0.001	< 0.001

In describing our two-way interaction between positive outcomes and intake type, our model predicted that the time animals resided in the shelter differed depending on how the animal arrived and their outcome type (Table 6). When animals were adopted, they had the longest length of stay when they arrived as part of a seizure or custody case as compared to animals that were surrendered by their owners (Difference: 10.98, *95% CI* [7.15, 14.80], $p < 0.001$) or a transported in from another organization (Difference: 11.37, *95% CI* [7.49, 15.26], $p < 0.001$). The length of stay for seized or custody animals was not significantly different than those that arrived as strays (Difference: 0.92, *95% CI* [-3.01, 4.85], $p = 0.647$). The lengths of stay of animals that were surrendered by their owners did not differ from animals that were transported into their facilities for placement (Difference: 0.40, *95% CI* [-1.34,2.13], $p = 0.654$).

When animals were transferred out of their shelter to another animal welfare organization for placement, animals that were seized or part of a custody case had the longest lengths of stay compared to all other intake types (Difference: 5.92; 6.85; 12.60, *95% CI* [0.81, 11.03; 1.97, 11.72; 7.48, 17.72], $p = 0.023$; $p = 0.006$; $p < 0.001$). In contrast, transported in animals that were then transferred out had the shortest length of stay (Difference: -6.68; -12.60; -5.75, *95% CI* [-9.33, -4.04; -17.72, -7.48; -7.95, -3.56], *p*

< 0.001; $p < 0.001$; $p < 0.001$). Animals that were surrendered by their owners and strays did not have differ in their lengths of stay when transfer out was their outcome (Difference: 0.93, *95% CI* [-1.45, 3.31], $p = 0.445$).

Table 6. Estimated Marginal Means of Animal Length of Stay (in days) by Positive Outcome Type and Intake Type

Positive Outcome	**Intake Type**	*Mean*	*SE*	95% Wald Confidence Interval	
				Lower	Upper
Adoption	Owner Surrender [a,b]	25.90	0.80	24.39	27.51
	Seized or Custody [a,c]	36.88	2.00	33.16	41.01
	Stray [b,d]	35.96	1.10	33.86	38.18
	Transport In [c,d]	25.51	0.90	23.80	27.33
Transfer Out	Owner Surrender [e, f]	16.92	1.17	14.78	19.36
	Seized or Custody [e,g,h]	22.83	2.55	18.35	28.41
	Stray [g,i]	15.99	0.84	14.43	17.72
	Transport In [f,h,i]	10.23	0.87	8.67	12.08

Note. Intake types with matching superscript letters have a significance value of $p < 0.05$.

Table 7. Table of Significance of Estimated Marginal Means of Animal Length of Stay (in days) by Positive Outcome Type and Intake Type

Variable	*Mean*	*SE*	1	2	3
Adopted Animals by Intake Type					
1. Owner Surrender	25.90	0.80			
2. Seized or Custody	36.88	2.00	< 0.001		
3. Stray	35.96	1.10	< 0.001	0.647	
4. Transport In	25.51	0.90	0.654	< 0.001	< 0.001

Transferred Out Animals By Intake Type

1.	Owner Surrender	16.92	1.17			
2.	Seized or Custody	22.83	2.55	0.023		
3.	Stray	15.99	0.84	0.445	0.006	
4.	Transport In	10.23	0.87	< 0.001	< 0.001	< 0.001

4. Discussion

4.1 General Overview

This study analyzed animal records from US animal shelters in order to gain a better understanding of how the timing of an animal's sterilization surgery among other factors, such as the shelter's organization type and location, in addition to how the animal arrived at the shelter, its sex, age, size, and type of positive outcome, affected its stay in the shelter. In our investigation, we found that both adopted and transferred out dogs had the shortest lengths of stay when they were sterilized after leaving the shelter as compared to during their time in care. For transferred dogs that were sterilized after, their length of stay was even shorter than those dogs that arrived at the shelter already spayed or neutered. Dogs experienced the longest lengths of stay when they were sterilized during their time in the shelter. Cats had the shortest lengths of stay when they arrived already spayed or neutered. We found no significant difference between adopted or transferred out cats' lengths of stay when altered during or after shelter care.

During our investigation, we also uncovered other combinations of factors that influenced shelter length of stay, such as the US region in which the shelter was located, how the animal arrived at the shelter, and its outcome. We found that adopted animals'

length of stay was shortest at Midwest shelters and longest at shelters in the Northeast and Southwest. For transferred out animals, their lengths of stay were shortest at Northeast shelters and longest at shelters located in the West. When understanding the influence of intake type, for adopted animals, their lengths of stay were longest in cases where the animal was a part of a seizure or custody case or a stray upon arrival. Animals that were transferred out experienced the longest lengths of stay when they were a part of a seizure or custody case and shortest when they were transported into the facility for placement.

4.2 Relationship Between Animal Type, Sterilization Surgery Timing, and Positive Outcome with Regards to Length of Stay

For dogs that were adopted or transferred out of their facilities, sterilizing after their outcome resulted in the shortest shelter lengths of stay, 25.34 days (*SE* 2.30) and 10.34 days (*SE* 0.68), respectively. This observed reduction in length of stay, as compared to dogs that were sterilized during their time in care, was nearly seven days for adopted dogs and over 16 days for dogs that were transferred to another facility for placement. These findings are both in contrast and correspondence with previous literature about the timing of spay-neuter surgeries for shelter dogs. In their study, Gunter and colleagues (2022) found that puppies, under eight weeks of age, had the shortest lengths of stay when altered after their outcome (*M* 25.67, *SD* 23.42) while dogs over eight weeks of age had longer lengths of stay when spayed or neutered following their shelter stay (*M* 60.04, *SD* 92.72), which was not as long as when they were altered during their time in foster care.

It is possible that the discrepancy in our findings may be related to our much larger dataset of 177,056 canine records, which only included dogs that had positive outcomes from their shelters, whereas Gunter and colleagues (2022) utilized a smaller sample of puppies and dogs (n = 2,225) that had both positive and negative outcomes from the participating shelters. Nevertheless, our dataset included 35,864 records of puppies that were under eight weeks of age. The average age of dogs in our dataset was 1.6 years old, with a median age of eight months. Taken together, our findings seem to suggest that sterilization can shorten the length of stay for young dogs in the shelter if it occurs after their shelter stay, as found by Gunter et al. (2022), but it can also lead to shorter stays for adult dogs that have positive outcomes from the animal shelter as well.

Both adopted dogs and cats that entered the animal shelter already altered had shorter lengths of stay, regardless of their positive outcome. It is likely that when animals arrive at the shelter sterilized, the time required for their medical procedures prior to adoption availability shortens, reducing their lengths of stay. Guerios and colleagues (2022) found that following the pandemic, there was a deficit of more than 2.7 million sterilization surgeries at U.S. veterinary clinics. Of 140 animal shelters surveyed by Kogut and colleagues (2024), 91% faced this backlog of procedures, with a total of 18,648 animals waiting for sterilization. In general, client wait times for veterinary services have been reported to be anywhere from two to six weeks (Muzzatti & Grieve, 2022) to over two months (Kogut et al., 2024). It is possible that the sterilization procedure itself (and recovery) as well as the time waiting to receive this veterinary care in the shelter contributed to the longer lengths of stays for dogs and cats that we observed in our study.

When examining adopted dogs' length of stay, being sterilized after placement was similar to arriving at the facility already spayed or neutered as these dogs also bypass the need for a medical procedure that may increase their time in care. Shelters are likely able to place unaltered animals into homes through the use of post-adoption spay/neuter contracts. With these contracts, owners receive a voucher to bring their newly adopted animal to an approved veterinarian who will perform the sterilization surgery. The participating veterinarian then returns the voucher to the shelter for reimbursement and verification that the animal was sterilized (Alexander & Shane, 1994).

Post-adoption sterilization contracts pose inherent risks if pets are not spayed or neutered after leaving the shelter. In their study of over 600 spay and neuter records of animals adopted from an animal control facility in East Baton Rouge, Louisiana during a three-year period, Alexander and Shane (1994) observed that only 41% of new owners complied with the shelter's post-adoption sterilization requirement, such that 53.8% of intact cats and 38.3% of intact dogs were sterilized following adoption. During their study, the authors found that the animal's age played a role in owner decision-making about post-adoption sterilization. Sixty-seven percent of adult cats were sterilized as compared to 47% of kittens. This trend was also observed in dogs: 40% of adult dogs were sterilized while 35% of puppies were spayed or neutered following adoption. Alexander and Shane (1994) also noted differences in likelihood to sterilize based on the sex of the animal. New owners more often sterilized their adopted female pets than those that were male. Finally, the researchers found that when a newly adopted animal was a purebred, new owners complied with their sterilization contract 31% of the time while 69% of owners with mixed breed animals sterilized their new dog or cat.

Despite these challenges, post-adoption sterilization can shorten lengths of stay for animals in shelters and possibly benefit their welfare. In an American Society for the Prevention of Cruelty interview with Dane County Humane Society in Madison, Wisconsin, shelter staff reported that allowing intact animals to go home prior to sterilization reduced their animals' length of stay, particularly for those that were young and recovering from illness (*They Did It: Decreased Length of Stay with Post-Adoption Spay/Neuter Contracts*, 2023). By placing unaltered animals, Dane County Humane Society found that the number of shelter animals in their care decreased. Since implementing post-adoption spay/neuter contracts in 2020, the shelter reports that fewer than 10 adopters have been non-compliant with their contracts, despite the shelter placing over 3,000 animals each year. While this evidence is anecdotal in nature, it is promising support for the use of post-adoption spay/neuter programs and associated vouchers.

As previously mentioned, adopted cats as well as those that are transferred out of their facilities for placement have shorter lengths of stay when sterilized prior to entering the shelter. Not only does being spayed or neutered likely reduce time in care by simply not needing the surgery prior to adoption (along with the associated wait times for those procedures), it is possible that altered cats' lengths of stay may be reduced by displaying more desirable behavior in the shelter. Previous research has suggested that feline spay-neuter surgeries are associated with positive changes in cat behavior, such as decreased hyperactivity as well as reductions in aggression and sexual behaviors, such as urine spraying (Oliveria-Martins et al., 2023). Additionally, in a 2002 study by Lepper and colleagues, the authors found that potential adopters preferred altered animals. In their research, they observed that intact females and males had odds ratios of being adopted of

1.00 and 1.17, respectively, while sterilized females and males had odds ratios of being adopted of 4.28 (females) and 6.68 (males).

We did not find the same positive effects on length of stay for cats sterilized post-placement as we did for dogs. Cats had the longest lengths of stay when sterilized following their adoption and lengths of stay that were comparable to being sterilized in care when transferred out for placement. It is possible that the behavior of intact cats in the shelter may have played a role in their longer lengths of stay. In a study of cats living in homes, Grigg and Kogan (2019) found that owners reported more problem behaviors with their intact cats as compared to those that were sterilized, especially with female intact cats. The researchers uncovered that owners of intact female cats reported twice as many problem behaviors, such as aggression, destructive behaviors, excessive vocalization and house soiling, as compared to owners of altered female cats.

Additionally, opportunities for intact cat housing are likely more limited in the animal shelter. For intact cats, especially males, single housing is often recommended due to the likelihood of increased aggression amongst these individuals when living together (Griffin, 2012). While female dogs may have estrous cycles, on average, twice a year (Weir et al., n.d.), cats may have up to five litters in a single year (Syufy, 2022), creating greater risk for breeding among unaltered cats, reducing the possibility of co-housing between intact male and female cats in the shelter. In a study by Suchak and Lamica (2018), the authors found that single-housed cats were typically viewable in their kennels by potential adopters 67% of the time while group-housed cats were able to be seen nearly all of the time (97%). Additionally, cats who are housed by themselves were found to be 3.2 times more likely to be moved to isolation than cats housed in group

settings, suggesting that such housing may be stressful for cats and lead to health issues that require treatment and time away from potential adopters.

4.3 Relationship Between US Region, Positive Outcome, and Length of Stay

For adopted animals, shelter lengths of stay varied considerably between regions, ranging from an average of 25 days in Midwest to 35 days at shelters in the Northeast. Many studies have reported that Northern and Eastern states simply do not have the number of shelter animals to meet the demand of potential adopters (Rowan & Kartal, 2018; Reese, 2024) with shelters in the Northeast region, in particular, having the fewest number of dogs entering their shelters (Woodruff & Smith, 2020). Behavior-related problems are one of the most cited reasons for animals, specifically dogs, to be surrendered by their owners to animal shelters. In one of the earliest studies describing shelter relinquishment, Salman and colleagues (2000) found that behavioral problems, specifically aggression towards people and other animals, was the most frequently given reason for the surrendering of dogs and the second most common reason for surrendering cats. More recently, Hawes and colleagues (2020) found that aggression was the most cited reason (38.2%) for a dog to be returned to the shelter.

Considering the difficulties owners face living with animals that have behavioral issues, it is reasonable that shelter animals with behavioral problems may have longer lengths of stay. Raudies and colleagues (2021) found that dogs who displayed a range of problematic behaviors, such as aggression and high arousal, were at a high risk of staying in the shelter for over a year, especially when coupled with other traits deemed less desirable by potential adopters (i.e., larger size, “dangerous” breed, and older age). It is possible that with less animals entering shelters in the Northeast, these organizations may

be more inclined and have the resources to place animals with behavioral issues, leading to the longer lengths of stay we observed for Northeast shelters in our study.

Previously, Woodruff and Smith (2020) reported that shelters in the Northeast are the most likely to transport in dogs from other animal welfare organizations. In our study, we observed that both Northeast and Midwest shelters had comparable proportions of transported in animals in their care (25%, 24.8%), relative to those that were surrendered by their owners, arrived as strays, or were part of a seizure or custody case, but these proportions were higher than those found at shelters in the Southeast (15.5%), Southwest (17.1%), and West (16.9%).

Additionally, Woodruff and Smith (2020) reported that Midwestern shelters have one of the lowest levels of dog intakes in the country. The researchers suggested that this could be due to stringent legislation regarding leash laws, sterilization requirements, education programs, pet ownership standards, and even differences in climates as colder regions are less sustainable for stray animal populations. In our study, Midwest had lower proportions of stray intake than any other region with 30.2% while Northeastern shelters had 35.6%, Southeastern 38.3%, Southwestern 43.3%, and Western 50.6%. In a study by Simmons and Hoffman (2016) about transport programs in U.S. animal shelters, they found that organizations in the Midwest were the most likely to decline certain breeds of dogs for transport into their shelters. In their study, shelters cited insurance restrictions, breed-specific legislation, overabundance of breeds locally, and concerns about potential behavioral issues as motivations for selection criteria. Considering these previous studies alongside our present findings, it is possible that overall length of stay of animals at Midwest shelters may be shorter due to the adoptability characteristics of animals

transported into their facilities, such as breed and behavior, that were not captured as variables in this study's dataset. Furthermore, length of stay is not necessarily related to euthanasia rates. Shelters may opt to euthanize animals deemed less desirable rather than utilize resources caring for and placing them. If this was the case with shelters in the Midwest, it might have contributed to the shorter lengths of stay we observed.

For animals that were transferred out, the region in which the shelter was located affected their length of stay, with shelters in the Northeast having the shortest lengths, while Western shelters had the longest. Previous studies have reported that shelters in the Northeast, followed by those in the West, are the least likely to transfer out a dog to another organization for placement, perhaps due to the relatively low numbers of dogs in these areas (Woodruff & Smith, 2020). It is possible that the longer lengths of stay we observed in the West may be related to shelters attempting to adopt out these dogs initially; but after being unsuccessful (e.g., due to medical or behavioral issues), transferring them to another animal welfare organization for placement. In their study of dog transfer programs amongst U.S. animal shelters and rescue groups, Simmons and Hoffman (2016) reported that 85% were motivated to utilize such programs because of the animal's likelihood of being euthanized. Furthermore, 95% of organizations rated the animal's bite history as an important factor when considering transfer. Though it is counter to the Association of Shelter Veterinarians guidelines to transport dogs or cats that pose a significant risk of aggression to people (Nolen, 2020), some shelters elect to transfer these animals to organizations that are better suited to meet the animals' needs.

4.4 Relationship Between Intake Type, Positive Outcome, and Length of Stay

Our data indicated that an animal's intake type affected its length of stay with animals having the longest lengths of stay when they were part of seizure or custody cases, particularly those that were transferred out. This is likely due to the laws and policies regarding animals whose owners are facing cruelty or neglect investigations (Wisch & Dillingham, 2017). Typically, these animals are held until the completion of the legal proceedings, which can extend to over a year (Berry et al., 2005), as the animal is considered the owner's property and is not eligible for placement in another home during this time (*Cost of Care Legislation,* n.d.). Additionally, it is possible that owners will appeal their cases, further lengthening the hold these animals experience, and communication difficulties between authorities can increase stays even longer (Berry et al., 2005).

It is worth noting that we observed that few animals enter the sheltering system due to seizure or custody cases as compared to strays and those that are surrendered by their owners. In our dataset of dogs and cats entering US animal shelters that had positive outcomes, seized or custody case animals only accounted for 6.6% of the animal records (n = 26,425). Previously, Shelter Animals Count reported that intake types other than those that were transported in, stray, and relinquished, accounted for 9% of all intakes in 2023, regardless of outcome (2023 Annual Analysis, 2024).

When animals were placed at their facilities, we did not find a significant difference between animals brought to the shelter as part of seizure or custody cases and those that arrived as strays, although both types had longer lengths of stay than those that were surrendered by their owners or transported in from another facility. It is possible

that the necessity of a stray hold could play a role in these longer lengths of stay as such holds can be from three to 10 days in duration (Wisch & Dillingham, 2017). Additionally, seized and custody case animals as well as strays are the most likely animals to need medical attention in the shelter, necessitating longer stays in care as they receive treatment (Berry et al., 2005; Janke et al., 2017).

While we did not find an interaction between animal and intake type and the type of positive outcome the animal experienced, adopted stray cats in our study had the longest lengths of stay compared to all other intake types with similar amounts of time in the shelter as seized and custody case cats. This may be related to the unconscious biases potential adopters have toward stray cats. In a study Dybdall and Strasser (2014), the authors reported that when potential adopters were presented with cats of varying intake types, they scored the biographies of cats more adoptable when they were described as owner surrendered versus stray.

4.5 Limitations

Regarding the limitations inherent in this study, our dataset spanned a single year (2023) and only animal shelters that used PetPoint during this year and submitted their data to Shelter Animals Count were included in our analysis. It is quite likely that the inclusion of more years of data would have increased our understanding of how our variables of interest, particularly the timing of spay-neuter surgery, was related to animals' length of stay. Furthermore, the COVID-19 pandemic saw a drastic increase in the demand for veterinary care for companion animals, exacerbating the already present shortage of veterinary practitioners (Schlemmer, 2022). As such, it is possible that the

2023 dataset utilized in our study acutely reflected this shortage, leading to differences we found in spay-neuter timing, that may not have been detected in previous years.

PetPoint is only one of several data management systems that is used in the companion animal welfare field. In a study by Vinic et al. (2019) of animal shelters located in Massachusetts, 47.2% of shelters used PetPoint followed by Chameleon (8.3%), ShelterPro (8.3%), iShelter (5.6%), and Sheltermanager (5.6%). Additionally, some organizations reported using paper documentation exclusively, or utilized commercially available software programs (e.g., Excel) or a custom software program.

Our dataset focused on dogs and cats that were either adopted from the animal shelter or transferred to another facility for placement. It is likely that the inclusion of animals that did not experience a live outcome, such as those that died in care or were returned to their owners, would have influenced our findings. Nevertheless, our primary research question involved the timing of spay-neuter surgery, and specifically after the animal had left the shelter. As such, unaltered animals that do not leave the shelter alive are not able to experience post-placement sterilization and were excluded from our dataset. Furthermore, our dataset did not follow animals after their outcome. As such, records designated as sterilized after outcome were unable to be verified as to whether the sterilization occurred. Additionally, a large variety of other companion animals are served by shelters that were not included in our dataset. The inclusion of these animal types, such as rabbits and horses, would have broadened the scope of our findings.

It is worth noting that a number of records had missing data specifically involving our primary research question, such as the animal's alteration status upon entry to the animal shelter, its sex, and the timing of their spay and neuter surgery following intake at

the shelter (if it occurred during this time). In total, over 90,000 records had at least one missing or unknown piece of data regarding these variables; and as such were removed from our dataset. Their inclusion would have increased our sample size and subsequent ability to detect main effects and interactions in our analysis. Furthermore, some categories within variables had small sample sizes, such as seized and custody case animals as well as animals from Northeast shelters. Having such limited representation within these variables led to greater variability as indicated in their larger standard errors. Moreover, it is likely that seizure and custody case policies and laws, which differ throughout the U.S., led to additional variability with this particular intake category.

As was previously mentioned, our study focused on animal shelters with physical locations. A majority of community intakes (85%) of companion animals occur through this type of animal welfare organization (2023 Statistics, 2024). Conversely, rescues are typically more specialized (i.e., breed specific, medical or behavioral needs) and are often foster-based, such that the animals do not reside in a shelter environment. Foster care reduces the stress of shelter animals (Gunter et al., 2019), often decreasing the need for an expedient adoption placement. As we were interested in the impact of spay-neuter surgery on the animal's time residing in the shelter, we elected to exclude rescues from our dataset, which limits our ability to relate this study's findings to these types of organizations.

Finally, we recognize that our dataset lacks specificity in some data categories. For example, it is unknowable whether sterilization procedures that occurred at the shelter were initiated after having an approved adopter or if animals were sterilized as standard shelter practice irrespective of an interested party. Without appreciating an

individual shelter's criteria for sterilization selection, it is possible that the timing of the procedure in the shelter could affect an animal's stay if it is viewable for adoption unaltered (Lepper et al., 2002). Additionally, already altered animals may arrive to the shelter more often with obedience training (Rohlf et al., 2010) or possess other desirable qualities (Oliveria-Martins et al., 2023) than animals that arrive unaltered; and as such, have a positive influence on these animals' lengths of stay in the shelter, regardless of spay-neuter status. Nevertheless, we would not expect such biases to disproportionately affect animals that were altered during their time in the shelter versus those that were altered post-outcome.

4.6 Future Directions

Concerning our primary research question, our findings along with those by Gunter et al. (2022) suggest that an animal's length of stay in the shelter may be influenced by the timing of their alteration. As both our study and Gunter et al. (2022) were correlational in their designs, an experimental study that randomizes the timing of an animal's sterilization surgery, at least for those that arrive unaltered, could better inform our understanding. Individuals could be matched across sterilization timings on animal factors known to impact length of stay, such phenotypic and behavioral characteristics, to allow for balanced proportions in each of the surgery groups and improve our causal inference abilities.

Nevertheless, present findings suggest that shelters may be able to reduce an animal's time in care by waiting to spay or neuter dogs after placement, whether that occurs in an adoptive home or in the care of a transfer partner. In describing current best practices for the sterilization of transferred animals, Doyle et al. (2020) suggest that

based on a multitude of factors, such as surgical capacity, length of stay, community need, and increased disease risk associated with longer stays at source shelters, sterilization should occur at destination shelters. For post-outcome sterilization of adopted animals to become a viable option for animal welfare organizations, much more research is needed on the practice of post-adoption spay/neuter contracts and adopter compliance. To this aim, exploration of public opinion could provide insight on the reservations that adopters have about spay and neuter. By understanding the efficacy of post-adoption sterilization programs, resource-limited animal shelters could be better informed about the costs of care for animals of various sterilization surgery timings and implement practices that are best-suited for their communities.

5. Conclusion

Many factors contribute to the amount of time animals spend in shelters. In this study, we investigated the timing of sterilization surgery and how it affected the lengths of stay of dogs and cats that had positive shelter outcomes. We found that dogs had the shortest stays when sterilized following placement. This is not the case for cats; they had the shortest lengths of stay when sterilized prior to intake. Furthermore, we found that a shelter's geographic location and the type of positive outcome the animal experienced influenced its length of stay with animals at Midwest shelters having the shortest stays, regardless of positive outcome type. Additionally, adopted animals from the Northeast averaged the longest lengths of stay, while transferred out animals in the West spent more time in the shelter than any other US region. Finally, our analysis revealed a relationship between intake type and positive outcome type with the animal's length of stay. Adopted animals that were surrendered by their previous owners or transported into their facilities

had shorter shelter stays while seized and custody case animals as well as strays faced longer lengths of stay. However, when animals were transferred out of their facilities for placement, transported in animals had the shortest stays while seized and custody case animals had the longest lengths of stay in the shelter.

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7. Appendices

7.1 Table 1. Intake Subtype Definitions

Agency assist/unspecified transport indicates a transport between animal sheltering organizations to relieve pressure from overcrowding or a transport that was not identified for any particular reason. *Abandoned* indicates an animal was intentionally left at a location permanently or temporarily, not the owner's residence for longer than 30minutes, without providing for the animal's care (618.02 Animal Abandonment, n.d.). *Animal Control/Law Enforcement Officer* indicates that an animal was brought into the animal sheltering organization by an animal control officer or other member of law enforcement (Intake Metrics, n.d.). *Abuse/Neglect* indicates that an animal was taken into the shelter's care due to an obvious case of animal abuse or animal neglect. When the animal was inputted into the shelter's system under *better placement options* it indicates that the animal was transported to a shelter that had more potential adopters for the specific needs of the animal. *Boarding/temporarily fostering* indicates that the animal was in shelter care for a relatively short period of time with the assumption that the owner would have custody returned to them. This program is utilized to minimize surrenders and assist families who are experiencing temporary inability to care for the pet (Safety Net Fostering, n.d.). *Born during shelter care* indicates that a shelter animal gave birth to the individual while in care of the animal sheltering organization. *Behavioral concerns* indicates that the animal was taken into the shelter due to behavioral problems, which can include aggression towards people, aggression towards animals, and separation anxiety. *Bite quarantine* occurs when an animal is put into the shelter's care to quarantine after either receiving or giving a bite, where the animal cannot escape, has no contact with

other animals or people, and can be observed by qualified professionals (Animal Bites, 2016). *Breed restrictions* are defined as rules or laws that regulate or ban certain dog breeds which are believed to be dangerous to humans and other animals (Breed-Specific Legislation, 2024). An animal under shelter care due to *lifestyle changes* indicates that when the animal was surrendered by previous owners, they cited changes to their routine and lifestyle as the main reason for the surrender. An animal that was surrendered into shelter care due to *pet care/cost* indicates that the previous owners cited the work to care for the pet or the cost of the care as the main reason for surrender. A *courtesy hold* indicates that an animal was adopted but remains at the shelter for a longer period of time before transitioning to the new home (Cohen et al., 2020). *Deployment* indicates that an animal was surrendered into shelter care because the owner was moving due to working for the military. *Disaster/emergency response* indicates that the animal was brought into the shelter due to a natural disaster or some other equivalent emergency. When an animal was surrendered with the tag *does not want/like* it indicates that the previous owner cited that they did not want or like the animal and that was the reason for the surrender. *Euthanasia request* indicates the animal was relinquished by the previous owners with the intention to have the animal euthanized (Intake Metrics, n.d.). *Housing concerns* indicates the animal was surrendered due to concerns the previous owner had regarding housing, which includes voluntarily moving, and eviction. *Family concerns* indicates that the reason for the animal entering shelter care was due to concerns the previous owner had about the human family members; this included a new baby. *Legal proceedings/owner arrested* indicated that an animal is in shelter care due to the owner going through court proceedings including trials, hearings, other public programs or

activities conducted by the Court or has been arrested (What is a court proceeding?, n.d.). *Pet medical concerns* indicates that the animal is in shelter care do to their medical history, which can include chronic concerns, emergencies, or acute illnesses. *Allergies* indicates that either the owner or pet has allergies that caused the animal to be surrendered. *Owner medical concerns* indicates that the animal entered shelter care due to illness or injury of the previous owner. *Out-of-State transport* indicates that the transport occurred across state lines. *Owner died* indicates that the previous owner passed away leading to the animal entering shelter care. *Protective custody* indicates that an animal is in shelter care due to a temporary or final protective order being granted by a judge (Ruth, 2022). *Public drop-off* indicates that an animal was brought in by a community member. *Quarantine* indicates that the animal entered shelter care to begin the process of physically being separated to monitor and control for the spread of infectious disease (Isolation vs. Quarantine in Animal Shelters, n.d.). *Rabies testing* indicates that the animal was brought to the shelter due to a potential rabies infection and needs testing. *Return* indicates that the shelters marked the animal as meeting their return policy, the range was from the same day as the adoption to months after the initial adoption. *Unspecified stray, unspecified surrender,* and *unspecified seizure* indicated that the shelter did not provide additional information on the animal past the intake type of stray, surrender and seizure. *Too many animals* indicates that the owner surrendered the animal due to the number of animals in their care. An animal marked as *trapped/feral* indicates the animal is a domestic animal that was not born in human custody and are adept at living outdoors that has been humanely trapped and brought into the shelter's care (Humane Animal Trapping, 2024; Langley, 2023). *Unwanted litter* indicated young

animal(s) had been surrendered to the shelter due to an unplanned pregnancy of the mother. *Unrestrained* indicated that the animal was not secured by a leash, carrier, or under the control of a responsible person (Restraint and the Law, n.d.).

7.2 Table 8. Table of Significance of Estimated Marginal Means of Animal Length of Stay (in days) by Animal Type and Region

Variable	Mean	SE	1	2	3	4
Dogs By Region						
1. Northeast	19.02	1.76				
2. Southeast	23.78	0.97	0.009			
3. Midwest	17.14	0.77	0.275	<0.001		
4. Southwest	25.23	1.03	<0.001	0.180	<0.001	
5. West	29.65	1.34	<0.001	<0.001	<0.001	<0.001
Cats By Region						
1. Northeast	18.19	1.64				
2. Southeast	22.73	0.93	0.009			
3. Midwest	16.39	0.67	0.275	<0.001		
4. Southwest	24.12	0.97	<0.001	0.180	<0.001	
5. West	28.35	1.28	<0.001	<0.001	<0.001	<0.001