Selecting Quality **Service Dogs**

Part 1: Morphological and Health Considerations

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Service dogs include dogs for mobility, vision, hearing, developmental disabilities, diabetic alert, seizure alert, and psychiatric support. They are trained to "provide work or perform tasks related to an individual's disability." When accompanied by a service dog, the individual with a disability is afforded some public access protections (Parenti, Foreman, Meade, & Wirth, 2013).

Current demand for service dogs outweighs supply (M. Winkle, Crowe, & Hendrix, 2012), and average wait times of up to three years for a well-trained dog are not uncommon. Service dogs are generally trained for a minimum of 18 months, and training can cost anywhere from $10,000 to $20,000 (Allen & Blascovich, 1996). According to some estimates, only 50% of dogs entering training progress to the level of service dog (Batt, Batt, Baguley, & McGreevy, 2008), increasing the cost of training and limiting the number of available dogs. Hereditary diseases and behavioral problems are the most common reasons for a dog to be released from a training program (Wahl, Herbst, Clark, Tsai, & Murphy, 2008).

Targeted selection and breeding of physically and behaviorally healthy dogs would allow organizations to allocate their resources more efficiently, reduce training costs, and increase the supply of service dogs to those in need. Service dog training programs nationwide can benefit from selecting and breeding dogs based on characteristics relevant to their service dog specialty.

This is the first of three articles on the selection and breeding of dogs for service work. The current article addresses morphological and health considerations; the remaining articles will focus on behavior and temperament characteristics and research in the field of service dog training.

Several breeds of dog have many of the necessary morphological (the form and structure of an organism) traits and general behavioral tendencies suitable for assistance work. Table 1 shows the common breeds and their general characteristics. Retriever breeds are often selected for mobility assistance because of their consistent temperament, trainability, and their predilection to retrieve objects (Burghardt, 2003; Weiss & Greenberg, 1997; Ostrander, et al., 2006). Although the information in this series may be applicable to any breed or mixed breed, it will focus on the most commonly used breeds for service dog work: Labrador Retrievers, Golden Retrievers, German Shepherd Dogs, Saint Bernards, Collies, and Cocker Spaniels.

Knowledge of the genetic control of morphology and disorders is imperative when breeding and selecting dogs for service dog work. This article is not exhaustive; it serves to illustrate the substantial risks in spreading genetic disorders through uninformed breeding practices. Service dog providers interested in breeding should acquire supplementary information regarding ethical guidelines and genetics.

Morphological Considerations

Morphological variation observed across dog breeds is greater than in any other mammalian species (Ostrander, et al., 2006). Dog breeds vary in ear length and carriage, head shape, coat color and texture, and of course, body size and shape. Of these, size and strength are of particular importance when selecting a dog for specific tasks. For example, a dog used for mobility assistance should be a large, strong dog to endure the weight of his handler and to provide balance. Alternatively, a dog used to assist an individual with a hearing impairment may not need to be large or strong; in fact, hearing dogs are often smaller breeds (M. Y. Winkle, Wilder, & Jackson, 2014).

Polygenic Traits

About 500 genetic diseases have been identified in purebred dogs, and it is presumed that every dog is a carrier for several defective genes. In the simplest terms, for most genes there are two versions (alleles) that are inherited. If those differ in form, one will have a greater influence (termed *dominance*) on the observed trait, and the other will have less influence (termed *recessive*). An example of dominance is the gene that controls coat color. Black is the dominant form of the gene and in the absence of a single dominant black gene, red (or tan) coat color can be expressed and is the recessive condition. However,

Breed	Bred for	Group	Height	Weight	Temperament
Golden Retriever	Retrieve game	Sporting group	20-24 in	55-75 lbs	Intelligent, eager to please, active, energetic, friendly
Labrador Retriever	Retrieve fishing nets and game	Sporting group	21.5-24.5 in	55-75 lbs	Gentle, intelligent, family friendly, aptitude to please, stable temperament, outgoing, devoted
German Shepherd Dog	Herding livestock	Herding group	22-26 in	75-95 lbs	Dependable, loving family companion, approachable, direct and fearless, strong, energetic, fun-loving, loyal.
Saint Bernard	Guard dog, avalanche rescue	Working group	25.5-27.5 in	130-180 lbs	Gentle, dignified, powerful
Collie	Drover dog	Herding group	22-26 in	50-75 lbs	Active, elegant, graceful, loyal, affectionate
Cocker Spaniel	Hunting dog	Sporting group	13.5-15.5 in	15-30 lbs	Merry, well-balanced, active

Table 1. Characteristics of some of the most commonly used breeds for service work. Information taken from the American Kennel Club (www.akc.org).

other modifying genes can impact the expression of coat color, such as the modifying dilution gene that leads to the expression of black coat color as grey. It is this *polygenic* nature of traits that breeders must understand, because unobserved genetic traits that exist in the otherwise "ideal" dog may come to light with some breeding practices. Most aspects of a dog's phenotype, including height, gait, and appearance, are controlled by polygenic traits. Because multiple (and often undiscovered) genes are involved, these traits are difficult to predict and control through breeding. Although polygenic traits are complex, the ability of careful selective breeding practices to alter characteristics, such as hip dysplasia and other physical features, demonstrates that some control over polygenic traits is possible.

Health Characteristics

A service dog must be physically healthy to provide effective and long-term assistance. Health disorders are a source of expense to service dog training organizations and clients, and they can reduce the working life of a service dog. Each breed of dog has its own particular

health concerns. Among the common breeds, more than 40 inherited disorders have been documented (Ostrander, et al., 2006). Table 2 lists common disorders, brief descriptions of the disorders, and the breeds at risk.

Cancers
The rate of cancer reported in dogs is the similar to that in humans: 1 in 3. As with other disorders, cancer affects different breeds at various rates. For example, Golden Retrievers have almost double the rate of cancer of all other dogs. Cancers are produced by the combination of complex genetic mutations and environmental influences; however, most cancer in dogs is considered *sporadic*, or has no identifiable cause. The onset of cancer is typically later in life, making screening prior to breeding difficult (Hovan). For example, lymphoma, one of the most frequently diagnosed cancers in Golden Retrievers, has an average age of diagnosis of 5 to 9 years (Rassnick, 2008). This late onset, paired with the complexity of inheritance, makes it impossible to know in advance whether a dog will or will not develop cancer. Even so, breeders often recommend raising puppies

Common Disorder	Description	Breeds Affected
Hip Dysplasia	A condition in which the hip joint develops incorrectly and can lead to inflammation. Growth rate and weight are important factors.	Large breeds — Golden Retrievers, Labrador Retrievers, and Saint Bernards
Elbow Dysplasia	Abnormal development of the elbow joint that can lead to inflammation. Growth rate and weight are important factors.	Large breeds; more prevalent in males than females
Congenital Heart Disease	A variety of cardiac malformations of the heart or its vessels from birth.	More common in purebreds than in mixed breeds — German Shepherd Dogs, Saint Bernard, Golden Retrievers, and Labrador Retrievers
Progressive Retinal Atrophy (PRA)	Deterioration of the retina, leads to blindness.	Most breeds
Pigmentary Uveitis	Inflammatory disease of the eye; often leads to glaucoma.	Golden Retrievers especially prone
Chronis Superficial Keratitis (CSK)	Aka *pannus*; inflammatory corneal disease.	Large breeds — Primarily German Shepherd Dogs
Cataracts	Clouding of the eye's lens, causing impaired vision.	Not breed specific; can affect any breed
Narcolepsy	Neurological disorder that results in excessive sleepiness, cataplexy, and sleep attacks.	Labrador Retriever
Centronuclear myopathy	A rare, but serious disorder involving muscle atrophy.	Labrador Retrievers
Epilepsy	A neurological disorder.	Not breed specific
Degenerative Myelopathy	A progressive neurodegenerative disease; leads to paralysis.	German Shepherd Dogs

Table 2. Common genetic disorders and the breeds affected.

to grow slowly, keep them lean, and avoid exposing them to certain environmental toxins as preventative measures (Hovan).

Degenerative joint disease

Degenerative joint diseases, such as *hip dysplasia*, are common orthopedic diseases of large breed dogs, such as German Shepherd Dogs, Saint Bernards, Golden Retrievers, and Labrador Retrievers. In dogs with hip dysplasia, the components of the hip joint do not fit together correctly, resulting in joint *laxity* (looseness). The abnormal hip results in damage to the cartilage, inflammation, bone spurs, and pain. Symptoms include gait abnormalities and reluctance to move. Development of hip dysplasia in a working dog reduces the dog's ability to engage in active behaviors related to service work, due to resulting pain affecting the dog's motivation to work. Pain may also affect the human-dog relationship and even lead to aggression.

Elbow dysplasia leads to decreased range of motion in the elbow joint, abnormal gait, and pain which can appear as early as 5 months of age. Like hip dysplasia, it begins with abnormal formation of the joint. Breeds most commonly affected by elbow dysplasia are the Rottweiler, Bernese Mountain Dog, Labrador/Golden Retriever, and the German Shepherd Dog (Kirberger & Fourie, 1998). As with hip dysplasia, elbow dysplasia can drastically reduce the working life of service dogs.

Hip and elbow dysplasia are polygenic diseases that are partially inherited. Environmental factors such as caloric intake, level of exercise, weight gain, and even weather seem to have an effect on the expression of hip dysplasia (Smith et al., 2001). Several studies have found that lower caloric intake is associated with a decreased prevalence of hip and elbow dysplasia; however it is unclear whether it is lower weight or a reduction in rate of growth that is responsible for this association (Kealy et al., 2000).

Congenital heart disease (CHD)

Congenital heart disease refers to a variety of cardiac malformations of the heart or its vessels at birth. Clinical signs of CHD include enlargement of the heart, cardiac arrhythmias, and murmurs. Symptoms may include coughing and exercise intolerance. Tragically, in some cases, the first clinical sign is sudden death. Certain congenital heart defects are surgically correctable, but many severe forms of CHD lead to death due to congestive heart failure. Service dogs with CHD will be unable to endure the physical stress of working, and will thus need to retire at an earlier age, if they can work at all.

Approximately 1% of dogs presented to veterinary clinics show some form of congenital heart defect (Patterson, 1989). One study of 976 dogs presented to a cardiology referral center found that 22% were diagnosed with CHD. Labrador Retrievers, Golden Retrievers, and German Shepherd Dogs were found among the top seven breeds at highest risk (Oliveira et al., 2011). The most common CHDs in dogs include pulmonic stenosis and subaortic stenosis. Congenital heart disease is more common in purebreds than in mixed breeds and each breed appears to be predisposed to specific types of CHD. For example, Golden Retrievers and German Shepherd Dogs have been found to be at a high risk for congenital aortic stenosis. Subaortic stenosis is especially prevalent in Golden Retrievers (Patterson, 1989). German Shepherd Dogs are predisposed to mitral valve dysplasia and Labrador Retrievers to tricuspid valve dysplasia (Famula, Siemens, Davidson, & Packard, 2002). Non-congenital, or acquired, heart defects also occur and, although there may be a genetic component to these disorders, environment is believed to play a bigger role.

Eye diseases

Eye diseases, common in many breeds of dog, threaten the working life of a service dog. They can cause pain, discomfort, and blindness. Although greater than 50% of all eye diseases in dogs have a genetic basis (Davidson, 2009), environmental factors such as trauma or nutritional deficiencies are known to play a role in their development.

Progressive retinal atrophy (PRA) or other PRA-like conditions have been described in more than 100 breeds of dog (Padgett, 1998) and are a leading cause of blindness. Labrador Retrievers are prone to *progressive rod-cone degeneration* (PRCD), the most frequently diagnosed form of PRA (Lin, Gould, Petersen-Jones, & Sargan, 2002). Some clinical signs are common to all cases of PRA, but may differ in onset and rate of progression. Most forms of PRA cause night blindness before a gradual loss of daytime vision occurs, ultimately resulting in complete blindness. In some cases, progressive blindness may not be apparent until the dog is no longer able to navigate. There is no known cure for PRA; however, early treatment has been reported to delay symptom progression.

Pigmentary uveitis is an inflammatory disease of the inner chamber of the eye. This disease is frequently observed in Golden Retrievers 4 years of age or older with an estimated prevalence of 25 to 33% (Golden Retriever Club of America, 2014). In animals affected, the development of secondary glaucoma can be as high as 46% (Townsend, 2008). Glaucoma develops relatively quickly (about five months) after initial presentation of pigmentary uveitis. The etiology of this disorder is poorly understood; however, the lack of demonstrable environmental causes and its prevalence is certain breeds have given support to genetic factors as a primary influence.

Chronic superficial keratitis (CSK), or *pannus*, is found primarily in German Shepherd Dogs, but it also occurs in other large breeds. It is a progressive inflammatory disease that affects the surface of the eye and typically affects both eyes simultaneously. Affected dogs show symptoms between 3 and 5 years of age (Rafie & Mousavi, 2008). The etiology of CSK is not known, but several factors have been hypothesized to play a role. The condition may be immune mediated, and seems to be heritable, due to apparent breed predilection. In addition, ultraviolet light has been shown to aggravate the condition. Treatment includes lifelong medication, but there is no cure, and some patients may lose vision completely (Allgoewer & Hoecht, 2010).

Cataracts are an eye disease characterized by any opacity or cloudiness of the lens or its capsule. Cataracts have been reported in over 100 breeds of dog (Padgett, 1998),

and they are one of the most frequent intraocular diseases and cause of blindness in dogs. One study reported a prevalence rate of cataracts in dogs of 2.42% during 1994 to 2003 (Gelatt & MacKay, 2005). Inherited cataracts can affect one or both eyes and usually develop after 4 years of age. Contributing environmental factors may include dietary deficiencies of certain amino acids in neonates, diabetes mellitus, and certain toxins and medications. Dogs with high visual demands, such as working dogs, may be more adversely affected than dogs with less visual stress. The only available treatment is surgery.

Neurological and muscular disorders
Several neurological and muscular disorders occur in dogs, most of which will eliminate a dog from service dog work. These disorders result in either muscular instability and/or loss of muscular control.

Narcolepsy is a neurological disorder that results in excessive daytime sleepiness, sleep attacks, lethargy, or brief periods of collapse and unconsciousness (cataplexy). Bouts of extreme lethargy and/or cataplexy typically last from a few seconds up to 20 minutes and resolve spontaneously. Narcolepsy typically develops under 6 months of age. Inheritance has been confirmed in a few breeds, including the Labrador Retriever (McDonnell, 2013). There is no cure for this condition, but it can often be managed with medications.

Centronuclear myopathy or "Labrador muscular myopathy" is a disorder most common in Labrador Retrievers; however, it is rare. From 2010 to 2012, only 12 out of 7,426 Labrador Retrievers were found to be affected (<1%) and 267 were carriers (3.6%) based on genetic testing (Maurer et al., 2012). Although rare, its effects are serious. This disease involves muscular atrophy and results in an awkward gait, decreased exercise tolerance, and generalized muscle weakness. Clinical symptoms begin at a young age – from 2 weeks to 1 month – and include weight loss and absence of tendon reflexes. At 2 to 5 months, most symptoms are apparent and a diagnosis can be made. Some affected dogs may suffer from respiratory disease due to atrophy of muscles involved in breathing. This disorder is an autosomal recessive mutation, making awareness of this disorder essential for ethical breeding practices (Veterinary Genetic Services, 2014).

Epilepsy is a chronic brain disorder that is characterized by repeated seizures that occur over the span of weeks or months. The incidence of epilepsy in the general dog population is estimated at between 0.5% and 5.7%; however, the prevalence may be as high as 14% in some breeds of dog (Wiersma-Aylward, 2010). About 3% of epilepsy cases are inherited and typically become apparent at around 1 to 3 years of age (O'Brien, 2003).

Breeds in which the condition is inherited include Beagles, Dachshunds, Keeshonden, German Shepherd Dogs, Belgian Tervurens, and others. Breeds with a high incidence, but in which inheritance has not yet been established, include Cocker Spaniels, Collies, Golden Retrievers, Labrador Retrievers, Irish Setters, Poodles, Saint Bernards, and Wire Fox Terriers. Medical treatment has varying degrees of success. The risks of a service dog with epilepsy are obvious, and the presence of this disorder almost certainly eliminates a dog as a potential service dog or service dog breeder.

Degenerative myelopathy (DM) is a progressive neurodegenerative disease that causes loss of proprioceptive or sensory function. This disorder is present in over 115 breeds, but is most prevalent in German Shepherd Dogs. One study reported an overall prevalence estimate of 0.19% from 1990 to 1999. The prevalence during the same time period was 2% for German Shepherd Dogs (Coates & Wininger, 2010). As the disease progresses, it leads to ataxia (inability to coordinate muscle movements) and weakness of the pelvic limbs. The typical onset is late – after 7 years of age. A dog diagnosed with DM typically will become paraplegic within 6 months to a year after diagnosis. It is an autosomal recessive mutation, which, like centronuclear myopathy, makes it imperative to avoid breeding two carriers of the mutation.

The second article in this series will discuss behavioral and temperamental considerations when selecting and breeding for service dog work. We will discuss current research in the area, testing strategies, and how genetics and environment may influence behavioral expression. The third article will integrate current knowledge in the field and recommend some best practices for dog selection and screening.

Disclaimer: The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the National Institute for Occupational Safety and Health, the Centers for Disease Control and Prevention, or the U.S. Department of Health and Human Services.

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