

Understanding complex inherited diseases in your dog

by [Casey Carl](#) on Oct. 8, 2014 in [All Things Dog](#)



When we look at the vast majority of genetic tests currently available for canine inherited diseases, we find a large number of diseases that can be predictably diagnosed with our current technology. For most of the available canine genetic tests, dog breeders understand that there are three commonly used designations applied to a dog for any given inherited disease; normal, carrier or affected. By knowing the way a disease is inherited ([recessive](#) vs [dominant](#) vs [X-linked](#)) and the number of copies of a mutation present in an individual, genetic testing laboratories like [Paw Print Genetics](#) can give predictable information about these diseases because they have a clear, 100% correlation between the cause and the illness.

Unfortunately for dog breeders, inheritance is not always as clear cut as a simple recessive or dominant pattern. In fact, the diseases with a clear-cut inheritance pattern likely only make up a small percentage of the diseases with inherited components. Some of the most frustrating diseases for dog breeders and geneticists are those which pose an increased risk by the combined effects of multiple genetic mutations and/or environmental conditions. In these multifactorial diseases, rather than a 100% correlation between a singular genetic mutation and disease, the overall risk is determined by adding together the individual risk contributions from any given genetic or environmental risk factor.

A good example of the variability in inherited disease risk can be seen with human breast cancer. On average, all women have about a 12% chance of developing breast cancer in their lifetime. However, the presence of mutations in one of two particular genes known as the *BRCA1* and *BRCA2* genes can significantly increase this risk to around 80% and 45%, respectively. A host of other factors can further increase risk; these risk factors include lack of exercise, poor diet, mutations in other genes, hormone replacement therapy, high alcohol intake, smoking, environmental chemicals and obesity. As you can see, despite

the large influence of the *BRCA1* and *BRCA2* gene mutations, no single risk factor can predict breast cancer in 100% of cases.

Humans are definitely not alone when it comes to the effects of multifactorial inherited diseases. Our clients at Paw Print Genetics frequently ask us about tests for many different multifactorial diseases in their dogs. Common examples include [hip dysplasia](#), [canine atopic dermatitis](#), [epilepsy](#), a variety of autoimmune diseases, cancer and [gastric dilatation-volvulus \(bloat\)](#). All of these diseases likely occur due to a combination of hereditary and environmental risk factors. Therefore, it is very unlikely that a single genetic mutation will ever be discovered for these conditions that can predict disease 100% of the time. However, one day as more genetic risk factors are discovered, laboratories will be able to develop testing panels that will allow for better estimations of risk for particular diseases. Advanced research in human inherited diseases has already allowed for these types of panels to be developed to predict risk of disease in people. For example, Ambry Genetics offers a panel known as [Breastnext](#) that tests for mutations in 17 genes associated with increased risk of breast cancer. After testing, statistical analysis can then provide a patient's overall risk of developing breast cancer.

At this point, veterinarians and canine geneticists can only dream of a day in which this type of panel testing could be done for hip dysplasia or other diseases. In theory however, with comprehensive disease risk information, preventative environmental changes, and selective breeding practices, the incidence of diseases like hip dysplasia could be drastically reduced in our canine friends.

Despite that over 180 mutations associated with canine traits and diseases are known, we are only scratching the surface of our ability to prevent unnecessary suffering in dogs due to inherited disease (over 5,400 disease causing mutations are known in humans). It is an exciting time of discovery in canine genetics. As we progress our understanding of the factors that contribute to diseases in dogs, we will make the lives of dogs and their relationship with those that love them longer and better than ever!

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Citations:

1. American Cancer Society (2014 Sept 25). *What are the risk factors for breast cancer?* Retrieved Oct. 2, 2014 from the American Cancer Society website: <http://www.cancer.org/cancer/breastcancer/detailedguide/breast-cancer-risk-factors>
2. American Cancer Society (2014 Oct 1). *Lifetime risk of developing or dying from cancer.* Retrieved Oct. 2, 2014 from the American Cancer Society website: <http://www.cancer.org/cancer/cancerbasics/lifetime-probability-of-developing-or-dying-from-cancer>