

Review of the Current State of Genetic Testing – An Introduction

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INTRODUCTION

Ongoing research and scientific discoveries have made huge advances in the field of canine genetics over the last two decades. We have literally gone from test breedings to determine a dog's genotype, to the initial mapping of the canine genome, to an ever-growing list of commercially available canine DNA tests. Ongoing scientific discoveries, new technical platforms, increased efficiencies, and decreasing costs are bound to continue this ever-changing landscape. However, with all the advances, one recurring theme has become abundantly clear: stakeholder knowledge and understanding of DNA, its uses, and the interpretation and application of DNA based tools has not kept up with the science. Stakeholders include veterinarians, registries, parent clubs, breeders, and the dog owning public at large. Each of these groups are desperate for clarification, education, and guidance. In many cases, DNA tests are the gold standard and can be an immensely powerful tool. Nevertheless, when misunderstood, misinterpreted, or misapplied, they can actually have a negative effect.

To maximize the potential benefits DNA can provide, we have to answer the call to provide clarification, education, and counseling on the use of the tools. This applies across the board whether the DNA is used for studbook integrity, in ongoing health research, for disease screening, diversity measurement, or simply trying to establish a dog's ancestry or heritage.

The American Kennel Club (AKC), the AKC Canine Health Foundation (AKCCHF), and the Orthopedic Foundation for Animals (OFA) have listened to the stakeholders, recognized the dilemma, and are motivated and well positioned to work together to produce materials that will maximize the use of DNA as a beneficial tool.

CURRENT-STATE ANALYSIS

Basic Canine DNA Uses

Currently, there are several primary uses for canine DNA samples: DNA profiling, DNA based ancestry testing, DNA based trait testing, DNA based disease testing, and DNA banking.

DNA profiling uses a standardized marker panel to establish unique dog identities. The markers can also be used to verify parentage and increase studbook integrity. Some panels such as the ISAG (International Society for Animal Genetics) panel are in the public domain. Others such as the panel used by the AKC are proprietary. As a result, panels are not interchangeable and for parentage verification, all dogs in question must be analyzed and reported using the same panel.

DNA based ancestry testing compares samples against a library of other samples to determine breed or even geographical ancestry. This is most commonly used by owners of mixed breed dogs who are curious what purebred background is a part of their dog's ancestry.

DNA based trait testing involves analysis of the dog's DNA for genes known to cause specific traits. The most common examples are tests for coat color, pattern, or type.

DNA based disease testing involves screening for genetic disease by collecting DNA samples and testing them for known disease causing mutations. As science and technology advance, the number of available tests has skyrocketed enabling breeders to make more informed breeding decisions. While some test results are easily interpreted and applied, many others, both current and future, require educational efforts to maximize understanding and the test's potential usefulness.

As new DNA based disease tests are announced with increasing regularity, it should be pointed out that no new tests can be developed without the underlying scientific research. Identifying disease causing genetic mutations requires DNA samples. At a minimum, samples are required from affected dogs. In addition, depending on the methodology of the research, samples may well be required from unaffected close relatives and other unaffected dogs to act as normal controls. Many research studies recruit samples as needed. However, a far more efficient approach is to establish banks representing a variety of both healthy and affected dogs from a variety of breeds that projects can draw from, thereby eliminating the time and effort involved in recruiting samples.

DNA Understanding

Educating stakeholders about DNA, its different uses, and applications, has been a challenge from day one.

For DNA profiling, many people do not understand how the profiles use a process of exclusion to verify parentage. Many people falsely assume DNA profiles are informative concerning trait genotypes. In addition, many people assume that the sample they provided for profiling purposes is sufficient for all other uses.

Issues regarding understanding and interpretation of DNA based disease tests are too numerous to fully itemize. Some of the more common issues resulting in misunderstood or misapplied results include direct tests versus linkage, confusion regarding mode of inheritance, monogenic versus polygenic traits, risk assessment tests, haplotype based tests, and the myriad of results reported from new microarray panel tests.

And, while seemingly the simplest DNA use, even DNA banking causes confusion. It's easy to confuse DNA stored in a centralized bank available to the research community at large versus the limited availability from an individual researcher's lab. Many owners fail to understand different sources of DNA (whole blood, buccal swabs, tissue), as well their DNA yield and quality. And, unfortunately many owners suffer from "Sample Fatigue" where they become resistant to frequent calls for DNA samples from multiple efforts that do not coordinate sample recruitment.

These are just a few examples. There are many more such fallacies and confusions, and they cross all stakeholder groups which include dog owners and breeders (both novice and experienced), as well as professionals within registries such as the AKC, and even the veterinary and research communities.

CALL TO ACTION

Universally, there is a request to create resources and educational materials to assist the various stakeholder groups in navigating DNA related complexities. Materials should not be expected to be breed specific guidelines or breeding recommendations, rather more general and educational in nature. Creating a better baseline of understanding about these underlying concerns will enable all stakeholders to better utilize and benefit from the various powerful DNA based tools.

Following this call to action, the AKC Canine Health Foundation approved a grant for a team of veterinarians and geneticists from the University of California Davis and Clemson University to develop these materials. The resulting document, *Review of the Current State of Genetic Testing – A Living Resource*, provides a baseline primer to genetics, addresses many of the questions that surround canine DNA testing, and can be updated as warranted. Sharing of the document is encouraged as we work to best utilize all the available tools to breed the healthiest dogs.