Dog Genome May Shed Light On Human Disease

By Tom Harrison

Scientists have succeeded in sequencing the dog genome, an accomplishment that could lead to

better health for humans as well as canines. An international team of researchers have published their detailed analysis in the journal Nature.

"Of the more than 5,500 mammals living today, dogs are arguably the most remarkable," says senior author Eric Lander, PhD, director of the Broad Institute at of MIT and Harvard. He is a professor of biology at MIT and systems biology at Harvard Medical School, as well as a member of the Whitehead Institute for Biomedical Research.

"The incredible physical and behavioral diversity of dogs −− from Chihuahuas to Great Danes −− is encoded in their genomes. It can uniquely help us understand embryonic development, neurobiology, human disease and the basis of evolution," Dr. Lander notes.

Powerful Tool

"When compared with the genomes of human and other important organisms, the dog genome provides a powerful tool for identifying genetic factors that contribute to human health and disease," says Francis S. Collins, MD, PhD, director of the National Human Genome Research Institute (NHGRI), which supported the research.

"This milestone is especially gratifying because it will also directly benefit veterinary researchers' efforts to better understand and treat diseases afflicting our loyal canine companions," Dr. Collins adds.

Humans domesticated the dog, Canis familiaris, from gray wolves as long as 100,000 years ago. As a result of selective breeding over the past few centuries, modern dog breeds present a model of diversity. From six−pound Chihuahuas to 120−pound Great Danes, from high−energy Jack Russell Terriers to mild−mannered basset hounds, and from Shetland sheepdogs with their herding instincts to pointers inclined to point, humans have bred dogs for desirable physical and behavioral traits.

Such breeding practices preserve preferred traits of one generation in the next, but they also predispose many dog breeds to genetic disorders, including heart disease, cancer, blindness, cataracts, epilepsy, hip dysplasia and deafness.

The research group found that while different breeds show amazing physical diversity, they often share large segments of their DNA, likely reflecting their recent shared origin. As a result, genetic tools being developed at the Broad Institute and NHGRI for any one breed of dog are likely to be useful in genetic experiments in nearly any breed.

Evolutionary Tree

While dogs occupy a special place in human hearts, they also sit at a key branch point, relative to humans, in the evolutionary tree. It was already known that humans share more of their ancestral DNA with dogs than with mice. The availability of the dog genome sequence has allowed researchers to

describe a common set of genetic elements −− representing about 5 percent of the human genome −− that are preferentially preserved among human, dog and mouse.

Rather than being evenly distributed, some of these elements are crowded around just a small fraction of the genes in the genome. Future studies of these clusters may give scientists the critical insight needed to unravel how genomes work.

Elaine A. Ostrander, PhD, chief of NHGRI's Cancer Genetics Branch, is a co−author of the Nature paper, along with postdoctoral research fellows, Heidi G. Parker and Nate B. Sutter. In addition, Dr. Ostrander is the lead author of the white paper that sets forth the biomedical rationale for sequencing the dog genome.

Dr. Ostrander's laboratory maps genes responsible for susceptibility to cancer −− including breast and prostate cancers −− in canines and humans.

"The leading causes of death in dogs are a variety of cancers, and many of them are very similar biologically to human cancers." says Dr. Ostrander. "Using the dog genome sequence in combination with the human genome sequence will help researchers to narrow their search for many more of the genetic contributors underlying cancer and other major diseases."

Genetic Compass

Efforts to create the genetic tools needed for mapping disease genes in dogs have gained momentum over the last 15 years, and already include a partial survey of the poodle genome. More than two years ago, Kerstin Lindblad−Toh, PhD, co−director of the genome sequencing and analysis program at the Broad Institute, and colleagues embarked on a two−part project to assemble a complete map of the dog genome.

First, they acquired high−quality DNA sequence covering nearly 99 percent of the dog genome from a female boxer named Tasha. The boxer was chosen as a representative of the average purebred dog to

produce what has become a reference sequence for the dog−genome community.

Using the sequence information as a genetic "compass," they navigated the genomes of 10 different dog breeds and other related canine species, including the gray wolf and the coyote.

The researchers identified roughly 2.5 million single nucleotide polymorphisms, or SNPs, sprinkled throughout the dog genome. SNPs are variations in the DNA code, some of which contribute to diseases or the overall health of a dog.

SNPs also can be used to create a set of coordinates with which to survey genetic changes, both within and across dog breeds. These efforts revealed that individual breeds have maintained a large amount of genetic variability, despite their long history of restrictive breeding.

In practical terms, this means that future efforts to locate disease genes in dogs can be much narrower in scope than comparable human studies, requiring a smaller number of genetic markers and DNA samples collected from the blood or cheek from only a few hundred dogs.

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Lyme Disease in Dogs

By Niall Kennedy

It is hard to get an early diagnosis of lyme disease in your own dog. The first sign of lyme disease in humans is a rash, well; animals do not develop this rash. Lyme disease is also not one of the first illnesses that the veterinarian looks for when you take your dog in for a visit. Many other common illnesses can produce some of the same symptoms, so it can be hard to detect.

Lyme disease does affect each dog different as it does with humans. Many dogs that are affected with lyme disease seem to be in pain and many stop eating. They may even run very high fevers. Lyme disease affects the entire body and some dogs may become lame and then even if untreated the lameness can disappear but can reappear later on. Your dog may not even show any signs of an illness for a long period of time and in fact have lyme disease, and then the symptoms can show up a year later.

Diagnosis of lyme disease can be done with a blood test. But, if your dog has had the illness for a long time even confirming that it is, in fact lyme disease can be hard to prove. In many cases, the antibodies that are present when a dog has lyme disease may have already disappeared or have not been created yet.

So, of course, the best way to go to ensure that your dog does not contract lyme disease is in the

prevention. Always groom your dog after they have been outdoors in and around where ticks live, high grass, thick brush, or even in the woods.

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