

Update: Fanconi Syndrome Linkage Test

Prepared by the Health and Research Committee and approved by the BHE Board of Directors in 2011

The most common inherited lethal disease in Basenjis is Fanconi Syndrome, a kidney defect that does not become apparent until the dog is old enough to have had offspring. In 2007, researchers developed a test to help breeders identify which dogs are likely to develop or pass on this defect. The test utilizes linkage analysis which, although it does not identify the actual gene that produces Fanconi Syndrome, has a high degree of accuracy.

Click on these questions to learn more and the BCOA's recommendations:

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What is a linkage test?

The gene causing Fanconi Syndrome has not yet been discovered, although researchers have identified three markers on basenji DNA that are near the Fanconi gene and are inherited along with the gene. The linkage test looks for these markers, and is considered an interim step until the Fanconi gene is discovered and a direct test for the gene is developed. The linkage test assists breeders in reducing the risk of producing Fanconi affected puppies now while research continues to search for the actual Fanconi gene.

The Fanconi research is being performed at the University of Missouri, Department of Veterinary Pathobiology, in the Small Animal Molecular Genetics laboratory of Dr. Gary Johnson, DVM, PhD. Dr. Johnson's research is funded, in part, by the Basenji Health Endowment, Inc. and the Basenji Club of America, Inc. Additional funding has come from the AKC Canine Health Foundation, Basenji clubs in other countries, and the University of Missouri. A portion of the fees from Fanconi testing also supports the research.

Since the linkage test was first offered to the public in July 2007, over 4060 Basenjis have been tested. Approximately 50% of the dogs have tested as "Probably Clear/Normal," approximately 40% as "Probably Carrier," approximately 3% as "Probably Affected," and approximately 6% as "Indeterminate Between Normal and Carrier (Indeterminate)."

Note that these test results do not represent the prevalence of Fanconi Syndrome in the breed as a whole; there are a number of pre-testing selection factors. For example, a clinically affected (sick) dog is unlikely to be tested, as its status is obvious.

The BCOA Health & Research Committee has examined the few reported cases in which test results were inconsistent, and found that there had been a human error, such as a mistake in parentage or in handling the samples. Upon re-testing, these errors have been corrected.

As of June 2011, we have 1193 second generation tests, in which a dog and both of its parents have been tested. Of these, there has not been a single case in which the results of the offspring are inconsistent with their parentage. **The OFA keeps data on these test results which are updated daily at this LINK.**

In addition, there have been 3 cases to date (May 9, 2011), well less than 0.1% (1 in 1000), where a tested dog has been reported as clinically affected, yet did not have a verified Fanconi Linkage Test result showing that it was Probably Affected. Two of these tested as Probably Carrier while one tested as Probably Clear/Normal, even with repeated tests from new samples. The cause is not yet known.

The linkage test is only 3.5 years old, and Fanconi Syndrome is usually diagnosed in basenjis between 3 and 7.5 years of age. It is possible that, as our dogs age, more inconsistent results may appear once dogs previously tested as not being Probably Affected begin showing clinical signs of Fanconi Syndrome. However, over 40% of the dogs tested to date were whelped in 2004 or earlier, and are old enough to be fairly certain of their Fanconi status, suggesting that such instances will continue to be rare.

The recommendation of the Health & Research Committee is that until we have a direct test for the actual Fanconi gene itself, owners continue to strip test their dogs.

In addition, we strongly encourage everyone to enroll their Basenji in the **Canine Phenome Project** and to periodically update the information on their dogs' health when/if any changes occur.

Over the past several years the lab at the University of Missouri has tweaked the analysis process several times. Unless it is of such significance as to dictate that results need to be reevaluated, these subtle changes are not reported to the Health Committee. Recently, one such change made it easier to distinguish which of two graphical chart peaks was more significant. Sometimes the peaks were so similar in height that it affected the determination of a result. This change made it possible that about 10% of dogs that had previously been classed as Indeterminate could now be called Probably Carrier or Probably Clear/Normal.

Who should test and why?

Responsible breeders test all potential breeding stock before breeding decisions are made and will share the results and implications with puppy buyers. It is not a requirement that all non-breeding pet basenjis

are tested but owners should want to know their Fanconi status as part of a general veterinary health program. The test can reveal the potential for disease before the onset of symptoms. Early detection and treatment may extend and improve the quality of an affected dog's life. Owners should contact their breeder for this information and/or are encouraged to test their own dogs. The test is especially important in situations where the breeder or pedigree of the dog is not known.

How do I test my Basenji?

The Fanconi DNA Linkage test is available through the Orthopedic Foundation for Animals (OFA).

Blood samples are no longer required to submit DNA, rather a cheek swabbing is spread on special sample collection paper by the owner. The cheek swab collection procedure allows for testing at any age, decreases the possibility of human specimen handling error, yields enough DNA for over 30 tests, and samples can easily be sent internationally. The collection procedure is safe, non-invasive, and can be done at home by the owner; no veterinary appointment is necessary. **Complete instructions on how to order the test can be found [here](#).** Select "Fanconi Test" from the menu. The fee is \$65.00, payable online via credit card, and includes the test kit, laboratory processing, and registration on the OFA database. Samples are sent to the University of Missouri, College of Veterinary Medicine for processing in the Small Animal Molecular Genetics Lab. Results will be sent to the OFA; the OFA will issue a report to the owner and add the results to the public database.

In addition, we strongly encourage everyone to enroll their Basenji in the **Canine Phenome Project**. The Canine Phenome Project is intended to complement the Canine Genome Project. The goal is to describe the dog as a species in all of its variability and to understand the factors, both genetic and non-genetic, that contribute to this variability. The Project began with the Basenji. As more and more basenjies are enrolled, there is an increasing wealth of information that will be useful for understanding many characteristics of our breed. **Please [click here](#)** to learn more about this project and enroll your dog today.

Can frozen semen be tested for Fanconi?

We recommend you wait until you are seriously planning to use the frozen semen, as the direct test may then be available. The lab at the University of Missouri can extract DNA from semen, but they need to use two straws, and they may still not get usable DNA. **[Click here to download handling instructions](#)**

Alternatively, a breeder could use untested frozen semen from a deceased sire, provided the bitch has tested Probably Clear/Normal. Keep in mind that if the semen donor was affected, all puppies would be expected to be Carriers. (See below.)

What do the test results mean?

Each individual Basenji is genetically either **Clear, Carrier, or Affected** for Fanconi Syndrome. Because we are using a linked marker test (see above) that does not identify the precise gene responsible, test results are always modified as "Probably." When a direct test identifying the actual Fanconi gene is developed and implemented, results will no longer be labeled "Probably."

Probably Clear/Normal: This status indicates that the dog probably does not have the Fanconi gene, and will not get sick. Because we are still working with a marker test, not a direct test, you should periodically strip test your dog's urine. It is very unlikely your dog will ever spill sugar, but if this were to happen, contact **Dr. Johnson's lab email** or phone 573-884-3712 immediately. In addition, it would be helpful if you would also contact a BCOA Health and Research Committee member so we can track these anomalies. Anomalous results like this greatly help in identifying the actual Fanconi gene.

Probably Carrier: This status indicates the dog has only one copy of the Fanconi gene, and will not get sick, as two copies are required for the illness. This dog can, however, produce the disease if bred to another Probably Carrier, or to a Probably Affected. Do strip test your Probably Carrier once a month, watching for an anomalous result. As with the Probably Clear/Normal dog, it is unlikely your dog will spill sugar, but if this were to happen, contact **Dr Johnson's Lab email** or phone 573-884-3712 immediately. In addition, it would be helpful if you would also contact a BCOA Health and Research Committee member so we can track these anomalies. Anomalous results like this greatly help in identifying the actual Fanconi gene.

Probably Affected: This result does not mean the dog is sick at this time. However, dogs with a "Probably Affected" test result are at a high risk of developing Fanconi Syndrome at some point in their lives; owners need to be especially vigilant, watching for the first signs of the disease. The earlier the disease is caught and treated, the easier it is to manage and the better the prognosis for a long healthy life.

If your dog is Probably Affected, have your vet do a venous blood gas test as soon as possible, as this test can indicate the onset of the disease before glucose is found in the urine. If the venous blood gas test is **Abnormal, begin Fanconi Protocol treatment.**

If the venous blood gas test is Normal, plan to **strip test your dog's urine** for glucose and ketones every two weeks and recheck the venous blood gas every six months. Giving a daily nutritional supplement and using filtered water (Fanconi is a kidney disease) are also recommended. Print out the latest **Fanconi Protocol** information and take it to your veterinarian so that he/she is prepared long before the information is actually needed. Many dogs with the disease have lived long good lives with treatment. Furthermore, there have been a few cases of dogs that have tested "Probably Affected" but never become symptomatic for the disease. Download **the Fanconi Syndrome Protocol.**

You might want to join a Fanconi support group for owners of affected dogs such as:

fanconidogs-subscribe@yahogroups.com

<http://www.basenjicompanions.org/health/fanconi/index.html>

<http://www.basenjiforums.com./index.php>

Under this subhead are two threads; one is for Fanconi information which is open to the public, the other is a closed/private support group for owners of Fanconi affected dogs. Contact admin@basenjiforums.com for access.

Indeterminate Between Normal and Carrier: In approximately 6% of the samples submitted, the marker test is unable to determine the Fanconi status between Probably Clear/Normal and Probably Carrier. A dog with this result should be considered a Carrier until the more precise test for the Fanconi gene is available to make a definitive determination.

Should I spay or neuter my dog based on the results?

Spaying or neutering will neither alter nor affect the Fanconi status of your dog. If you are not planning to breed your dog, you may want to consider spaying/neutering as you would for any loved companion in your home.

Once a dog has been tested, does it need to be re-tested?

Genetically a Basenji is either Clear, Carrier, or Affected and that will never change during a dog's lifetime. At this time, we do not recommend re-testing previously tested dogs unless there is an anomalous result that should be investigated. In light of recent information that a very few dogs previously tested as "Probably Carriers" or "Probably Clear/Normal" are now showing clinical signs of Fanconi Syndrome, we do recommend that all owners do periodic **strip testing of the dog's urine**. However, when the actual Fanconi gene is identified, and a direct test developed, the BCOA and Health Committee will make further recommendations.

What does the Fanconi test status mean to breeding decisions?

Our goal as responsible stewards of the basenji breed is to eliminate Fanconi Syndrome as an inherited disease without losing valuable genetic diversity. Breedings that have the potential to produce Fanconi affected offspring are strongly discouraged. Before any breeding takes place, ideally both parents should be tested, and one parent should have tested Probably Clear/Normal. When using frozen semen from a deceased, untested sire, the dam should have tested Probably Clear/Normal.

The results of the Fanconi linkage test backs up the genetic assumption that the Fanconi gene is a simple recessive inheritance. Statistically, there are expected results from the various possible matings; but since

this is based on statistics, the actual number of pups with the expected results will vary within an individual litter. As an example:

When a Probably Clear/Normal is bred to a Probably Clear/Normal, 100% of the offspring are expected to be Probably Clear/Normal. Any other result should immediately be reported to **Dr. Johnson's lab email** or phone 573-884-3712 .

When a Probably Clear/Normal is bred to a Probably Carrier, the offspring may include Probably Clear/Normal, Probably Carrier, and/or Indeterminates. Probably Affected or clinically affected dogs should not result, and should immediately be reported to **Dr. Johnson's lab email** or phone 573-884-3712.

When a Probably Clear/Normal is bred to a Probably Affected, 100% of the offspring are expected to be Probably Carriers. Any other result should immediately be reported to **Dr. Johnson's lab email** or phone 573-884-3712. NOTE: *The effect of pregnancy and whelping on a Probably Affected bitch's kidneys is not currently known. However, the possibility of adverse health effects on the dam should be considered when deciding to use a Probably Affected bitch.*

When a Probably Carrier is bred to a Probably Carrier, the expected offspring may include Probably Carriers, Probably Clear/Normals, Probably Affecteds, and/or Indeterminates. **This breeding is not recommended.**

When a Probably Carrier is bred to a Probably Affected, the expected offspring may include Probably Carriers and/or Probably Affecteds. Probably Clear/Normal dogs should not result, and should immediately be reported to **Dr. Johnson's lab email** or phone 573-884-3712. **This breeding is not recommended.**

When a Probably Affected is bred to a Probably Affected, 100% of the offspring are expected to be Probably Affecteds. Any other result should immediately be reported to **Dr. Johnsons' lab email** or phone 573-884-3712. **This breeding is not recommended.**

NOTE: An **Indeterminate** result on the Fanconi Linkage test means it is not clear whether the individual dog is best characterized as a Probably Carrier or Probably Clear/Normal. For breeding decisions, an Indeterminate test result should always be considered as a Probably Carrier status, and it is recommended that Indeterminates be bred only to Probably Clear/Normals.

What should I do if I get an unanticipated or anomalous Fanconi test result?

If the result does not fit within the range of results that can be expected from your dog's parentage, (see previous paragraph – *“What Does Fanconi Test Status Mean to Breeding Decisions”*) notify **Dr. Johnson's laboratory email** or phone 573-884-3712 and any member of the BCOA Health and Research Committee. An example of anomalous results would be when offspring are not within the genetic possibilities of the

breeding as listed above, such as Probably Carrier or Probably Affected offspring from two Probably Clear/Normal parents, or Probably Affected offspring from a Probably Clear/Normal and a Probably Carrier parent.

Another type of anomalous result would be a dog that tested Probably Clear/Normal or Probably Carrier but later becomes clinically affected, either sick, or spilling sugar in the urine strip test. Also of interest are dogs that test Probably Affected but live to an old age without becoming clinically ill.

It is NOT anomalous when 100% of a litter from a Probably Carrier and a Probably Clear/Normal are Probably Carriers or Indeterminates. Although the average percentage, over many breedings, is 50% Probably Carriers and 50% Probably Clear/Normals, an individual litter may include any percentage and combination of Probably Carriers, Probably Clear/Normals, and Indeterminates. The results are not, therefore, anomalous.

Self-reporting of anomalous results is extremely helpful in furthering our understanding of Fanconi Syndrome. Openness and cooperation are needed to eradicate this disease, and as a steward of the breed, you will be helping the fancy. [Email Dr. Johnson's Lab](mailto:Dr.Johnson@lab.com) or phone 573-884-3712 to self report anomalous results.

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