

Fanconi Renal Disease Management Protocol for Veterinarians

By Steve Gonto, M.M.Sc., Ph.D.

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Definition: Renal Fanconi Disease is a unique disorder distinct and unrelated to Fanconi Anemia. Renal Fanconi is a reabsorption failure in the nephrons, causing bicarbonate, proteins and amino acids, as well as sodium, potassium, calcium, phosphorus, and glucose, to be lost via urine excretion. The resultant solute diuresis can cause dehydration, electrolyte imbalances, vitamin and mineral deficiencies, and metabolic acidosis. Left uncorrected, these imbalances can result in multi-system failure and death. Renal Fanconi can be genetic in origin, as seen frequently in Basenjis, Norwegian Elkhounds, and “fancy silver” Cocker Spaniels. The gene can also be found more rarely in any mammal (including humans). Additionally, it can be induced or acquired, as has been the case with many different breeds of dogs, cats, and horses over the last few years. The AVMA speculates this is due to ingestion of tainted treats (primarily chicken or duck). Consult the AVMA website for updates.

<https://www.avma.org/News/Issues/recalls-alerts/Pages/Safety-Alert-on-Jerky-Treats-for-Pets.aspx>

Induced Fanconi and genetic Fanconi present with the same symptoms, and respond successfully to the same therapy. With genetic Fanconi, the disease is usually progressive but, with appropriate treatment, the statistics indicate a dog can live its normal life expectancy if its deficiencies and acidosis are addressed. With induced Fanconi we have found a number of dogs and cats, if supported through the life-threatening period of the event, can regain some, if not all, normal renal function; and many have weaned partially or fully off Protocol support within a year, based on improving follow-up lab studies.

Diagnosing Fanconi: In Basenjis, Norwegian Elkhounds, or “fancy silver” Cocker Spaniels, PU/PD with glucosuria, on **URINALYSIS**, in the absence of elevated blood glucose, is almost always Fanconi, unless proven otherwise. In approximately 3,000 canine cases, only twice to date was the glucosuria caused by another issue (one by a renal tumor, the other by insecticide toxicity). In other breeds of dog or in cats with these findings, ingestion of chicken jerky or dried breast treats should be investigated and discontinued if in use. Other possible causes of acquired or induced Fanconi include zinc toxicity, such as from constant licking of zinc-coated fence material, ingesting outdated tetracycline, or exposure to high levels of organophosphate insecticides. Fortunately, blood gas and chemistry results are essentially the same for genetic and acquired Fanconi, and both respond equally well to the same replacement Protocol management.

The absolute diagnostic and therapy-defining test is a **VENOUS BLOOD GAS**. No other test has been shown to provide the needed information to both diagnose and treat this disorder. Blood gas technique will be discussed later in this Protocol.

A Fanconi-afflicted patient, whether canine, feline, equine, human, or other mammal, will show a lowered HCO₃ value on their blood gas panel (normal HCO₃ being 24), and a negative base excess (normal being “0”), indicating bicarbonate loss.

Normal physiology is designed to compensate for acidosis in multiple ways in order to maintain a normal pH level, thus a normal pH is not indicative of the absence of Fanconi. In cases where your blood gas analyzer only provides a pH and p_vCO₂, you can go online and find many free Henderson-Hasselbalch calculators, which allow you to calculate an HCO₃ and base excess.

<http://www-users.med.cornell.edu/~spon/picu/calc/basecalc.htm>

Also indicated would be a **BLOOD CHEMISTRY** panel that includes calcium, potassium, phosphorus, BUN, and creatinine.

Fanconi pets diagnosed and treated early will usually have normal BUN and creatinine values. Those diagnosed later in their disease will show some azotemia, which may require modification of the Protocol to address both the Fanconi (failure to reabsorb solutes from the urine) and renal insufficiency (failure to lose toxic solutes in the urine), which are opposing clinical disorders.

For Basenjis, a genetic test is offered by the Missouri College of Veterinary Medicine, through the Orthopedic Foundation for Animals. Links to this test, as well as to other Fanconi-related topics, including this Protocol, can be found on the American Kennel Club Canine Health Foundation website at:

<http://www.akcchf.org>.

Even a negative genetic test in a Basenji is not 100% accurate, so any Basenji should still be watched for potential symptoms of Fanconi. A positive genetic test in a Basenji is reason to perform a baseline venous blood gas (never arterial), as we have found some dogs spilling bicarbonate at six months of age. This is far earlier than the earliest onset of glucosuria we have seen, which was at three years of age. Dogs testing positive for the Fanconi gene, but having a normal baseline blood gas, should be followed at home with monthly urine glucose/ketone test strips, and a blood gas and chemistry repeated immediately if urine glucose is detected. Ideally, annual venous blood gasses can be done as part of their routine health visit to detect possible bicarbonate loss even earlier.

Treatment Goals and Clinical Efficacy: Our therapy goal is to eliminate the metabolic acidosis by supplementing a replacement dose of bicarbonate, thus eliminating the metabolic workload of a respiratory compensation for metabolic acidosis. The pet will be using this supplementation to keep its pH normalized for as long as possible. We will also seek to normalize the pet's electrolyte, vitamin and protein levels by compensating for the losses. In short, we are replacing the losses to achieve a normal functional set of lab values, and in doing so we either arrest, or dramatically slow any further progression of the disease or disorder. One peer-reviewed article in the AVMA journal established that dogs treated with the Protocol lived essentially normal lifespans, with a high quality of life, whereas without treatment, dogs succumbed to Fanconi in approximately eighteen months after onset of symptoms.

<http://avmajournals.avma.org/doi/abs/10.2460/javma.2004.225.377>

Treatment Recommendations: A Basenji-size dog (approximately 30 lbs or 13.6 Kg), after diagnosing Fanconi via loss of bicarbonate on a venous blood gas panel, would **begin** with the following **EIGHT-STEP** regimen:

- 1. Three 10-grain sodium bicarbonate antacid tablets** (650 mg each) BID, given intact in a small food treat. (Recommended starting doses for other size pets are listed below). Soft cheese slices, xylitol-free* peanut butter rolled into balls, cream cheese, small quantities of cat food, or cooked meat are fine for pill-hiding. More pill-hiding ideas can be found at Basenji Companion's web page <http://basenjicompanions.org/2012/11/17/how-to-hide-that-yucky-pill/>

Pill Pockets brand pill-hiding treats, while useful in many situations, blocks bicarbonate absorption, and should **not** be used here. Below is a homemade pill-hiding formula that can be safely used with bicarbonate, and all Fanconi supplements. It is easily made, can be formed into small, easily swallowed balls around pills, and tends to be well accepted by canine patients.

HOMEMADE PILL-HIDING RECIPE

Two tablespoons all-purpose flour
One tablespoon milk
One tablespoon smooth xylitol-free* peanut butter

Mix together in glass or metal bowl and then finish by kneading like dough in your hands until evenly blended. This yummy mixture can be kept in a sealed container in the refrigerator to make small, pill-hiding balls.

* Peanut and other nut butters containing xylitol (a sugar alcohol used as a sweetener) can be extremely dangerous for dogs – even small amounts of xylitol can cause hypoglycemia, acute hepatic necrosis, and death. Make sure this additive is not in the nut butters used.

Recommended Sodium Bicarbonate Starting Dose - Canine and Feline
(Upon Venous Blood Gas confirmed Fanconi diagnosis)

PET BODY WEIGHT	STARTING DOSE OF SODIUM BICARBONATE
0-5 lbs (0-2.27 Kg)	— one 10-grain tablet (650 mg) P.O. BID
6-10 lbs (2.28-4.45 Kg)	— two 10-grain tablets (1300 mg) P.O. BID
11-35 lbs (5-15.91 Kg)	— three 10-grain tablets (1950 mg) P.O. BID
36-55 lbs (16.36-25 Kg)	— four 10-grain tablets (2600 mg) P.O. BID
56-90 lbs (25.45-40.9 Kg)	— five 10-grain tablets (3250 mg) P.O. BID
>91 lbs (>41.36 Kg)	— six 10-grain tablets (3900 mg) P.O. BID

Horses can be started on ten 10-grain tablets (6500 mg) P.O. BID (hidden in apple slices).

In dogs that are very athletic, or involved in activities such as lure coursing, an additional bicarbonate tablet can be given half-an-hour prior to the activity and another single tablet given immediately afterward, to help the body compensate for the additional CO₂ and lactic acid loads.

From this starting dose we will recheck a venous blood gas in approximately two weeks, aiming for a window between **six and eight hours after the last bicarbonate dose**, to avoid peaks and troughs. **We are aiming for our goal of a 20-22 mEq/L (same as mmol/L) reading on the HCO₃. You can titrate the sodium bicarbonate dose up or down to achieve this goal range, adding or subtracting one bicarbonate tablet BID, as needed. We try to keep all dosing BID to maintain stable blood levels of our supplements.**

Sodium bicarbonate is available over-the-counter (OTC) and best obtained in 1,000-count bottles, which are very low in cost. While I don't endorse any one brand, I have found Rugby brand to be very bioavailable and easily dissolved in canine GI tracts. Likewise, Lily and URL have been used with success in our patient population.

PLEASE NOTE: Citrates, such as UroCit-K, have been postulated in the literature as a treatment for metabolic acidosis. In many early trials we had zero success with these techniques. Only **sodium bicarbonate** worked effectively as a buffer to the metabolic acidosis of Fanconi.

Additional CRITICAL components of the Protocol is based on almost 30 years of experiencing all the **different permutations and losses that can occur with this disorder. Omission of any component can have unforeseen consequences.**

2. Any **complete canine or feline vitamin/mineral replacement** product given BID. Example, PET-TABS PLUS AF (Advanced Formula). (Previously PET-TABS PLUS.)
3. **One complete human vitamin WEEKLY** to cover for trace element losses we have seen in Fanconi dogs, but which are not included in most canine or feline formulas. Example, Centrum Complete or Flintstones Complete vitamins. The canine or feline multivitamin doses can be skipped on the day the **human** vitamin is given. The amino acid and complete vitamins can be given on the same day of the week for ease of compliance. Smaller dogs and cats can receive half of a tablet weekly, but larger dogs do **not** need more than the one tablet weekly.
4. Any **calcium/vitamin D/phosphorus replacement** product (usually sold for lactating females), BID. Example, PET-TABS CF (Calcium Formula). (Previously PET-CAL.) **This is given even if the measured blood labs show normal** calcium or phosphorus levels, since we know these are lost in Fanconi, and the measured levels are due to sequestration out of bone and tissue. We only withhold this supplement in cases of renal insufficiency, where phosphorus levels tend to rise. Smaller dogs and cats can get a half-dose BID. Larger dogs do **not** need more than the one tab BID.
5. **One tablet or teaspoon of human complete body building amino acid** formulation **WEEKLY**. Example, **Amino Fuel 1000** (formerly Amino Fuel) by Twinlab.
6. **Fresh water** should always be available. Filtered water is best. Any “in date” refrigerator filter, tap-end filter, such as Brita, PUR or Culligan is fine, as are filter pitchers, also by Brita, PUR and others.
7. Unless the dog shows azotemia, a good quality, **higher protein dog food** is optimal to address the protein losses inherent with Fanconi. Usually something in the 21-28% crude protein level for dry is optimal. Examples include Wellness, Natural Balance, Merrick, etc. Avoid foods higher than 28% in Basenjis, as BUN/creatinine elevations have been noted just from feeding these ultra high protein foods. In addition to this dry food, please add at least a can a week of wet meat-based food, to add additional long-chain amino acids and phosphorus. Again, many good quality foods are available, or cooked meat may be used, as well.
8. In cases of hypokalemia (about 30% of Fanconi dogs), if the potassium level is only slightly low, often the supplementation of the multivitamins will correct the issue. If hypokalemia persists on the follow-up lab work, then **potassium supplementation** may be needed. OTC potassium gluconate tablets, which are safe and inexpensive, often suffice for increasing levels to normal. In the USA, OTC potassium gluconate tablets containing 99 mg of potassium (regardless of the potency listed on the front of the bottle) may be used. (Always check the back ingredient list.) Starting dose would be one tablet BID, and can be increased to three BID as needed to restore normal blood potassium levels. If the OTC preparation does not bring the levels up sufficiently, then prescription Tumil K (2 mEq/tab) or UroCit-K, (5 mEq/tab) sustained release tablet (do **not** cut these), can be used. Some dogs have taken up to three UroCit-K BID to achieve normokalemia.

By following these eight simple steps, we have achieved remarkable success in the long term, healthy maintenance of pets with this previously fatal illness.

After initial blood work and starting on the Protocol, a repeat venous blood gas and blood chemistry panel is recommended at two weeks for dogs with severe symptoms, or eight to ten weeks for dogs whose

symptoms are minor. Again, wait six to eight hours after the last bicarbonate dose to draw the venous blood gas for accuracy. No fasting is needed for any Fanconi follow-ups.

Once stable, many dogs and cats get blood work repeated only during their six-month health checkups, or as symptoms dictate. A pet whose blood work is returned to relatively normal should have no issues until reaching the renal insufficiency inherent with old age, and that is dealt with exactly as with the renal insufficiency Protocol addendum below.

Renal Insufficiency Hybrid Protocol: Dogs or cats with elevated BUN/creatinine levels should remain on the standard, eight-step Protocol, outlined above, with the following modifications;

1. Due to decreased renal flow or urine concentration, pets often have a decreasing loss of bicarbonate, so a reduction of their bicarbonate dose, based on the measured venous blood gas HCO₃ level may be indicated to keep them in the 20-22 range.
2. Due to increasing phosphorus levels, we stop the calcium/phosphorus supplement in these pets.
3. Lower protein and restricted phosphorus foods may be indicated, but only in cases of extremely elevated BUN and creatinine levels do we find it necessary to use the more poorly tolerated full renal diets and highly protein restricted prescription diets to achieve control of these values.

Instead, we have found the lower protein levels (approximately 17-18% crude protein) in some senior weight loss or sedentary diets are sufficiently low in protein to level out or reverse mild azotemia. Ongoing medical research has shown it is much more important to limit phosphorus intake.

<https://web.archive.org/web/20031011083832/http://nss.vet.ohio-state.edu/DDT/new%20pages/nut&kidn.htm>

<http://www.ncbi.nlm.nih.gov/pubmed/1476305>

<http://dogaware.com/files/bovee.pdf>

http://web.archive.org/web/20030625214300/http://www.vetdiet.com/en/produkte/popups_h/054_klinstud.html

http://web.archive.org/web/20040205075757/http://www.cm-d.com/buckeye/tech_manual/8_28.html

A good, lower protein and lower phosphorus diet may include using fillers such as orzo, or Israeli couscous (also called pearl couscous; larger than standard couscous), or cooked, diced potatoes, mixed with cooked carrots, green beans, peas (frozen bags work great, because they have virtually no salt), and adding small amounts of either cooked ground pork or dark meat chicken (both contain low amounts of phosphorus). These can be added over low phosphorus dry kibble or even fed as a diet alone, without the kibble, in cases of severely elevated BUN and creatinine.

HERE IS ONE POPULAR RECIPE

INGREDIENTS

1 pound boneless, skinless chicken thighs or 1 pound of pork
1 pound orzo
1 pound frozen disc-cut carrots

1 pound frozen green beans

DIRECTIONS

1. Boil the chicken in water to cover for 30 minutes. If you're using pork, chop, pan fry, and set aside. (Both dark meat chicken and pork are lower in phosphorus than white meat chicken or beef.)
2. Strain the chicken, **reserving the liquid**, and set the chicken aside to cool.
3. Bring the reserved liquid to a boil, add the orzo, and cook according to package directions, about 11 minutes. Drain the orzo and place in a large bowl. (Using the cooking liquid adds flavor your dog will love!)
4. Cook the carrots and green beans and when cool, chop and add to the orzo.
6. Chop the chicken into small pieces and mix with the orzo and vegetables and you're done.

You can separate this mix into multiple smaller storage containers and freeze. Keep a few in the refrigerator, where they keep for three or four days. Simply warm the homemade food in the microwave before feeding – be careful it's not too hot! This can be fed as a primary diet or can be mixed with lower protein kibble for crunch (good for dental health), in dogs with milder cases of renal impairment.

4. All vitamin doses, such as the daily canine or feline vitamin/mineral administration, as well as the weekly higher potency human vitamin dose, can be cut in half in these dogs and cats (half a tab BID for most dogs, a quarter tablet BID for smaller dogs and cats).
5. Amino Acids weekly remain the same and may even be increased to twice a week if any loss of muscle tone or mass is seen.
6. In cases of high or worsening BUN/creatinine levels, a full renal diet may be needed. In serious cases some dogs have needed IV fluid diuresis, and others have been maintained on Sub-Q fluids at home. Some pets have stabilized after single IV diuresis treatments, others need monthly maintenance treatments.

Other Medical Issues to Note in Fanconi Dogs: Many Fanconi dogs show extremely high liver enzyme levels. **Alk phos, SGOT, cholesterol, SGPT and triglycerides** should be followed, but even in cases, for instance, where alk phos was noted at over 900, in only a few cases was liver disease ever seen, and in those cases, it was cancer each time. These elevations have not been noted as significant in feline patients.

T4 Levels: It is worth doing a thyroid check on these dogs, as many Basenjis are hypothyroid, but please wait to do your T4 level until after the acid/base balance has been restored, as uncontrolled Fanconi can lead to inaccurate false positives for thyroid disease.

Surgical Management in these dogs and cats is unchanged from an unaffected pet, except their emergence from general anesthesia may be prolonged, and hypoxia and hypercarbia can both create a severe stress on the kidney, worsening their Fanconi. Thus, I recommend allowing the dog or cat to wake up on some supplemental oxygen and not extubating the patient until it has strong breathing patterns to avoid hypercarbia from hypoventilation. With prolonged (>48 hour) NPO situations, the addition of IV sodium bicarbonate to maintenance IV fluids should be considered to prevent recurrence of acidosis from bicarbonate loss. Sodium Bicarbonate 8.4% (1 mEq/ml of bicarbonate) can be added to IV fluid and infused at 2 to 5 mEq per Kg of body weight over 4 to 8 hours to address acidosis.

Medical Management of Fanconi pets, once controlled, is the same as any other pet. There are no medical or pharmacological considerations.

UTI Prevention: Many Fanconi dogs have benefitted from the addition of a human cranberry extract capsule (O.T.C. product, administered daily, as it acidifies the urine, which is overly alkaline due to the lost bicarbonate load.) This has been a great adjunct in preventing UTIs, in dogs with this chronic problem, and may be considered in all Fanconi dogs as an additional therapy.

UTI Treatment: While best practice in medicine is to only prescribe antibiotics when a bacterial infection has been confirmed, this does not apply in cases of Fanconi, where a thickened and trebeculated bladder wall, as well as thickened renal parenchymal tissue can lead to loculated (walled-off) micro-infections. These pinhead-size infections have been documented on MRI of Fanconi dogs' kidneys, but are nearly impossible to document in the standard office setting. Since these micro-infection sites are walled off they may shed no casts or cells to be seen on urinalysis, and even a C/S may come out negative, even though the pet is symptomatic for UTI (urgency, increased thirst, pain, frequency of urination, leaking at night). Thus, best practice in a Fanconi dog is to treat anything that symptomatically is a UTI as if it **is** one. Employ whatever broad-spectrum antibiotic you would usually use to treat a UTI, for a seven- to ten-day run. If there is an infection present, it should resolve starting, on average, in 48 hours. If it does not resolve, then it is time to use other diagnostics to check for tumors, etc. If it resolves and returns after the antibiotics are completed, then we know it was an infection and needs another run of a different class of antibiotics due to incomplete kill of the organism.

Note that dogs leaking urine should first be treated for potential UTI, but if leaking persists, treatment with a single dose of Phenylpropanolamine (PPM) an hour before bed has helped many dogs (and owners) sleep through the night without accidents.

GME-Granulomatous Meningio Encephalitis: This is a multi-site spinal cord and/or brain tumor we have seen in some cases of Fanconi. It may or may not be related. This disease can manifest in many ways, but the visual cortex is one site often affected, thus visual/musculo-skeletal weakness or pain can be early indicators. CT scan with contrast can illuminate the tumors, although newer diagnostic techniques exist. Treatment with prednisone has slowed the progress of this fast-growing lesion, but if GME is suspected, please contact a veterinary neurologist, as new and better treatment options may be available.

Other Seizure Activity: Since azotemia, uremia, dehydration, metabolic acidosis, and electrolyte disturbances can all contribute to seizure activity in dogs, we have encountered both isolated event, as well as epileptic lifetime seizure activity in our Fanconi patient population. Our observation is that while phenobarbital has been a proven and inexpensive treatment modality, it is both sedating and, over time, hepatotoxic. Potassium Bromide has been used with less effect, in some dogs. Our observations indicate that the administration of OTC B6 (pyridoxine) given 100mg BID (Only B6, **not** a B complex vitamin) can increase the circulating GABA in the brain and thus increase the seizure threshold.

B6, in combination with newer anti-seizure medications, such as Zonisamide (dosed 5mg/kg BID), is more effective, non-sedating, and has not revealed any hepatotoxic effects. It has been considered safe for cats as well, but with less apparent efficacy. As of this publication, other new medications are available; Felbamate and Levetiracetam (Keppra), both non-sedating, and even Gabapentine are being used successfully for treating seizures. Always consult with a veterinary neurologist, however, as new and effective anti-seizure medicines are being added to the list frequently.

Venous Blood Gas Technique: Since venous blood gas analysis is crucial to diagnosing and treating this disorder, I want to refresh all clinicians on some basic technique facts.

1. Always use a specific dry lithium heparin syringe or one that has had a drop of heparin pulled in, swished about and squirted back out. (Heparin “wash” technique.)
2. After drawing venous blood (never arterial) into the syringe, expel all air, roll syringe barrel in your hands for ten seconds to mix in the heparin, then run the sample in the machine or cap it airtight.
3. Normal venous values should be pvO₂ of about 30-55, normal pvCO₂ of 45, normal HCO₃ of 24, and base excess of “0.”

If your sample cannot go directly from dog to machine, then cap the barrel airtight, place it inside a Ziploc-type bag, and immerse the bag in a cup of freezing ice water and ice. This should keep the sample viable and accurate for up to 35-40 minutes.

Additional Links: Some veterinarians feel more comfortable having a sample blood sent to **PennGen Laboratories** at the University Of Pennsylvania School Of Veterinary Medicine to confirm the specific amino acid losses in their patients. If you choose to do this, but already have a dog with bicarbonate losses seen on a venous blood gas, please **DO NOT** delay onset of treatment pending the PennGen test. These additional weeks of delay can result in additional, and permanent, renal impairment.

<http://research.vet.upenn.edu/InstructionsforSampleSubmission/tabid/554/Default.aspx>

There is an online owner support group for those treating **any** Fanconi pet. A lot of good information, help, and support are available through its approximately 250 members with Fanconi dogs of many breeds. You may wish to provide the link to your patients’ owners: Fanconidogs-owner@yahoo.com.

Basenji Companions has several articles on Fanconi Syndrome, which would apply to all pets:

<http://basenjicompanions.org/category/health-and-safety/fanconi-syndrome/>

The Basenji Club of America has information in their section on Basenji health:

https://www.basenji.org/joomla/index.php?option=com_content&view=category&layout=blog&id=166&Itemid=292#FanconiSyndrome

Since nutrition is critical in managing Fanconi, here are three superb sites that review pet food quality

<http://www.dogfoodscoop.com/>

<http://www.dogfoodadvisor.com/> (also includes information on pet food recalls)

<http://www.dogfoodanalysis.com/what-is-the-best-food-for-my-dog.html>

Assistance Policy: Please be aware that specific treatment advice and suggestions can only be offered directly to veterinary doctors and their staffs. Dr. Gonto cannot offer any medical information directly to owners and has no wish to come between any owner and veterinarian. Dr. Gonto is exclusively a free-information resource to the veterinary community, sharing the information gleaned from observing thousands of cases over almost three decades.

The prior Protocol is available on multiple websites and has been veterinarian-translated into many languages including Japanese, German, and Russian. I freely welcome the translation of this new Protocol in any language needed, so long as it is accurate and complete in the new language.

Contact Information: Dr. Gonto is always available to assist with a Fanconi case, on a voluntary basis, and is best reached via email at Outdoc@aol.com.

In a **dire** emergency, he can be reached via phone, between 6-8 p.m. EST, at (912) 598-5067

IMPORTANT NOTICE: This Protocol card is intended **ONLY** as a tool for qualified veterinarians to use as an aid in diagnosing and treating Fanconi. It is shared with owners and breeders only for the purpose of providing it to their veterinary professional. In **NO CASE** should anyone attempt to diagnose or treat Fanconi on his own, without the specific guidance of a veterinarian. Fanconi is a potentially fatal illness and should be treated as such by a qualified veterinarian only. Any attempt by an untrained individual to treat his dog using the outlined therapies here can result in catastrophic results for the pet. Also, please note: your vet may choose not to use any or all of the recommendations herein, as he is most familiar with your pet's unique medical needs and situation.

Legal Disclaimer: The author assumes no liability for the results or issues resulting from the use of any of the recommendations made in this Protocol. No medical or treatment advice is being offered directly to owner or breeders. No expectation of performance, nor guaranteed result or outcome is either promised or implied. The information here represents both the current best practices in veterinary medicine, combined with the author's accumulated data, based on years of experience assisting veterinarians with Fanconi cases, accumulating input from various veterinary and human specialists, as well as working with his own Fanconi dogs. A great deal of knowledge has been obtained based on the lab work and clinical feedback from many veterinarians treating pets using the Protocol recommendations worldwide for almost three decades. The information here is shared freely in all cases, and is provided on a totally voluntary basis as an aid and informational resource to veterinarians, who are expected to make their own calculations, use their own clinical knowledge and judgment, as well as obtaining their own findings in treating their Fanconi patients.

Acknowledgements: I wish to recognize with limitless gratitude the patience of my wonderful, multi-talented wife in supporting and participating in the untold hours spent helping owners and veterinarians over the last three decades. As many who have called my contact number (our home phone) at all hours of the day and night can attest, she has become quite the expert at Fanconi management in her own right, and I have received many compliments over the years about her caring advice, so freely offered.

I must also recognize my lovely daughter, who missed many hours of quality "dad time" as I would be glued to the phone (or later the computer) assisting on Fanconi cases from all over the globe, seven days a week, and at some very odd hours (in our time zone, anyway). I must admit, however, that her exposure to my work with Fanconi was at least partially responsible for sparking her interest in science and medicine. One example was her ability to care for our non-Fanconi Basenji, who did suffer from severe epilepsy. One morning when she was no more than ten years old, she greeted us with, "Good morning ... oh, by the way, Topper had a seizure last night. I made sure he was safe, and his airway was clear. Once it passed I let him go outside, then sent him back to bed. I didn't think it was worth waking you up for just that." She continues to amaze us with her skill and prowess as she works treating autistic children.

I wish to also recognize Betsy Polglase, a pillar in the Basenji community, with great appreciation for her time, writing expertise, sharp eye and bright mind, and decades-long friendship, in helping make the Protocol a useful tool from the very beginning, with her generously volunteered, and most expert editing. Betsy was founder and President of Basenji Companions, a wonderful, international support and friendship group for pet Basenji owners. Using that forum, she also started compiling Fanconi Protocol survival data, not only on Basenjies, but open to owners of all afflicted pets. Mrs. Polglase was also a founder and past president of the Bay State Basenji Club, and over the years was involved in obedience, agility work, as well as Basenji rescue and adoption. Her commitment to this breed and to pet health in general has been clearly demonstrated by her incredible effort in helping monitor and support Fanconi pet owners online, as well as her great effort in helping make the various iterations of this Protocol a much more readable and useful aid for veterinarians to use worldwide.

My sincere gratitude also extends to Jackie Kuhwarth and Chey Miller for their countless hours fine-tuning this document, and helping update it multiple times, thus helping make it available to veterinarians and owners worldwide, in the most useful possible form. Their work with Basenji Rescue and Transport, as well as all the other incredible volunteers and officers of this amazing organization, richly deserve the recognition and admiration of all in the Basenji community for what they so selflessly do. They certainly have my wholehearted thanks and support.

None of this work would have been possible without the initial information and invaluable contributions of the late Dr. Kenneth Bovee of University of Pennsylvania School of Veterinary Medicine, and an early pioneer in defining Fanconi; Dr. Jeanne Barsanti of the University of Georgia School of Veterinary Medicine, whose guidance and assistance with "Cenji's" care and the early Fanconi research, helped put in place the final pieces in the "Fanconi puzzle"; and finally, Dr. Jerry Case, a superb veterinarian and great friend, who worked tirelessly to bring clinical reality to my theories and ideas. Though now in his retirement, his daughter, Dr. Carla Case McCorvey, continues to advance the work of veterinary care and helps me care for my current Fanconi fur kids, thus allowing me to further "polish" this Protocol to the benefit of all Fanconi patients.

Finally, I must recognize Cenji (Little Miss Satin Cenji), a calm, patient, and most long-suffering, but never fussing, gentle soul of a Basenji, for whom this Protocol was developed. Had she not been such a good sport and a fierce, but stoic fighter against Fanconi, this Protocol would never have come into being. Rarely has one dog's life touched so many pets and humans across the globe.

Feel free to copy, print, translate, share, upload, download or link to this Protocol. It may be added to any website, and translated into any language. The only request is that ALL the information contained herein is shared ACCURATELY and IN COMPLETE FORM, and is reproduced LEGIBLY.