Fanconi Disease Management Protocol for Veterinarians

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RECENT FINDINGS REGARDING GLUCOSE LOSS IN FANCONI SYNDROME
We have recently observed through EARLY "baseline blood gasses" on genetically "positive" tested dogs, that bicarbonate loss can happen YEARS before glucose loss. In short, glucose loss was never seen earlier than three years of age, and we assumed **GENETIC** Fanconi did not onset earlier, either. This proved to be **WRONG**. While some dogs do spill bicarbonate and, indeed, NEVER spill glucose, it doesn't matter, as we now know glucose is a LATE disease indicator, NOT an early catch device by any means. We have seen significant bicarbonate loss in dogs as young as six months old. Treating early, and correcting the acid base imbalance, at least in the few cases thus caught this early, have so far resulted in incredible disease stability and no loss of glucose ever being seen in several of these dogs. As with ANY disease, the earlier caught the better the results.

GENERAL GUIDELINES FOR BASENIS LABELED "AFFLICTED" ON THE FANCONI GENETIC TEST
A venous blood gas should be done immediately upon getting that news, regardless of the Basenji's age. If the venous blood gas shows the dog losing bicarbonate (minus Base Excess (B.E.)), and/or has a low HCO3 level (bicarbonate), then treatment should begin right away. If the venous blood gas is normal (Base Excess of about "0", and an HCO3 of 23 or 24), I would recommend doing a repeat Venous Blood Gas every four months (three times a year), as well as urine strip testing every week or two, so as to try not to miss anything … until such time as the Fanconi gene actually activates.

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 certain “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 their normal life expectancy if their 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, or 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 a Basenji, Norwegian Elkhound or “fancy silver” Cocker Spaniels, PU/PD with glucosuria, on **URINALYSIS**, in the absence of elevate blood glucose, is almost always Fanconi, unless proven otherwise. In approximately 3000 canine cases, only twice, to date, was the glucosuria caused by another issue (one a renal tumor, another was insecticide toxicity). In other breeds of dog, or in cats, with these findings, ingestion of chicken “jerky” or 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, be they canine, feline, equine, human or any 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, and thus a normal pH is not indicative of the absence of Fanconi. In cases where your blood gas analyzer only provides a pH and pvCO2, 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 which includes calcium, potassium, phosphorus, BUN, and creatinine.

Fanconi pets diagnosed and treated early will usually have normal BUN and Creatinine values; whereas 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 via 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 their 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 (Appx 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** regiment;

1. Three – ten-grain SODIUM BICARBONATE ANTACID TABLETS (650 mg each) BID, given intact in a small food treat. (Recommended starting doses for other size pets is listed below). Soft cheese slices, peanut butter rolled into balls, cream cheese, small quantities of cat food or cooked meat are all fine for pill-hiding. More pill-hiding ideas from the Fanconidogs' support group can be found at:
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)----------1 ten grain tablet (650 mg) P.O. BID

6-10 lbs (2.28-4.45 Kg)----------2 ten grain tablets (1300 mg) P.O. BID

11-35 lbs (5-15.91 Kg)----------3 ten grain tablets (1950 mg) P.O. BID

36-55 lbs (16.36-25 Kg)----------4 ten grain tablets (2600 mg) P.O. BID

56-90 lbs (25.45-40.9 Kg)----------5 ten grain tablets (3250 mg) P.O. BID

>91 lbs (>41.36 Kg)----------6 ten grain tablets (3900 mg) P.O. BID

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

In dogs who 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 afterwards, 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" of 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 and keep all dosing BID to maintain stable blood levels of our supplements.**

Sodium bicarbonate is OTC and best obtained in 1000-count bottles, which are very low in cost. While I don't "endorse" brands, we have found RUGBY 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 a are 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 AF (Advanced Formula). This was previously Pet Tabs Plus.

3. 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.

4. One tablet or teaspoon of human "complete body building **amino acid**" formulation WEEKLY. Example, Amino 1000 (formerly Amino Fuel) by Twinlabs.

5. 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.

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."

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. 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 contain 99mg 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" Protocol, listed 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 foods may be indicated, but rarely do we need to use the more poorly tolerated "full renal diets" (such as Hills K/D, or Purina NF). Instead, we have found the lower protein levels (approximately 17-18% crude protein) in some senior, weight loss or sedentary diets is sufficiently low in protein to level out or reverse the azotemia. The protein load in these foods can be cut even further by the use of "fillers" such as cooked rice, and cooked carrots and peas added to the diet.

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. Some dogs have needed IV fluid diuresis, in serious cases 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 unafflicted 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 they have 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 UTI's, 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, such as Felbamate, 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 Ziplock-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 is 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@yahoogroups.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 which 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 their 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 their own, without the specific guidance of their veterinarian. Fanconi is a potentially fatal illness and should be treated as so, by a qualified veterinarian only. Any attempt by an untrained individual to treat their dog using the outlined therapies here can result in catastrophic results for their pet. Also, please note your vet may choose not to use any or all of the recommendations herein, as they are most familiar with your pets 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 authors 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 decade's 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 Basenjis, 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's 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.

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 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. Even 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.