Holistic Health Care For Cavaliers

Part XIII

The Kidney – Function, Failure and Therapy Part One

By: Larry A. Bernstein, VMD

Last chapter, we examined the liver, one of the most intricate organs in the body, besides of course, the brain.

The Kidney

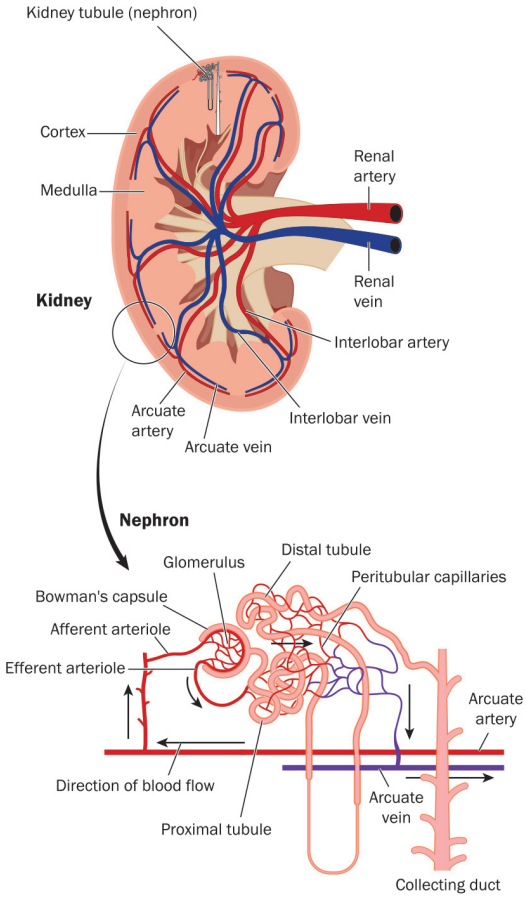
We see many cases of renal disease ("renal" is a medical term for the kidney) in veterinary practice, and in this chapter, we will be discussing:

1. The anatomical structure of the kidney
2. The functions of the kidney both on macroscopic and microscopic (physiologic) scales
3. Things that can go wrong with the kidney(s) from an acute and chronic standpoint
4. Things that can be done to AVOID kidney issues
5. Things we can do to treat kidney issues

Most everyone is aware that most mammals have two kidneys and they are the main organs responsible for excreting by-products of protein metabolism, especially nitrogen based compounds like creatinine and urea. They do this through the production of urine which is stored in the bladder and then voided. What many people do not realize is that these valuable organs are the water reclamation plants of the body. To understand this in more detail, we need to understand renal physiology, such as what urine is, how it is produced, and how many things can affect it.

The mammalian kidney is composed of an outer and inner portion, the renal pelvis and the renal cortex. And, while that's great to know, it really does not come into play that much except when we are dealing with kidney stones or "uroliths." Kidney stones are relatively rare in dogs and cats, whereas bladder stones can be very common. The renal pelvis, the outer meaty portion of the kidney, is composed of millions of individual process units called nephrons. So, to understand kidney function as it pertains to most aspects of kidney disease, we need to understand the nephron.

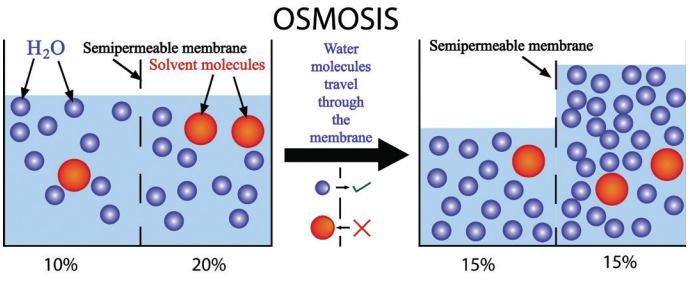
I like to think of the nephron as a microscopic water treatment plant. Dirty water (or plasma with toxic products whether administered or part of the normal components of metabolism) enters the nephron at the glomerulus, traverses multiple tubules and then empties into the collecting duct as urine. The urine is collected, flows down the ureter to the bladder and out the bladder via the urethra. There are many, many factors that come into play during the journey from the glomerulus to the collecting ducts and that will be our initial focus to better understand the physiology and importance of the nephron as the fundamental building block of the kidney.

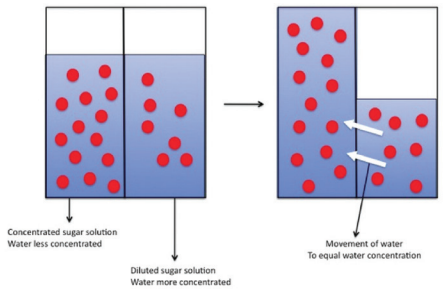


Before we can go any further, we also need to understand a process called osmosis. Osmosis is the tendency of two solutions, separated by a porous or permeable membrane, to want to equalize its concentration or specific gravity on either side of that barrier. The concept of specific gravity and osmosis is of critical importance to our discussion, if renal physiology and its

real life implications are to make any sense whatsoever.

Osmosis is the physical need for two solutions of different concentrations on opposite sides of a water permeable membrane to equalize their concentrations. This is why, if you put a potato in a bowl of salt or sugar water, it will start to shrivel up over time, because the salt or sugar concentration outside the potato is higher than the concentration inside the potato so some of the water leaves the potato to try to equalize the concentration because the salt (or sugar if a sugar solution is used) cannot penetrate that membrane.





Remember concentration is relative – it is a percentage and there is now less water in the potato because the salt concentration has increased in the potato. Since some of the water has moved out of the potato to the bowl, the salt concentration in the bowl is lower (same amount of salt but more water equals less concentration). This does not only have to be salt it can be anything that creates a differential in the concentration or specific gravity on the two sides of the membrane. This is a natural physical force, like gravity and is the basis of how the kidney functions. Really try to think of it as two sides with different pressure or volume or concentration trying to equalize. Two bodies of water that are connected try to reach the same level via water moving from one side to the other. Two rooms with different pressure try to equalize if you open the door between them. The same thing happens in nature within two tissues or two solutions with different concentrations that try to equalize. This same force (osmotic attraction or pressure) is why fluid stays in the blood. The proteins (albumin and globulin) in the blood have to create an osmotic pressure to "hold" liquid in the blood.

Fluid passes into the nephron at the glomerulus or the placenta like connection to the bloodstream at a concentration or specific gravity of 1.015 (for reference the specific gravity of pure water is 1.000). Since normal urine has a concentration of 1.020-1.060, you can see that something happens to pull water out of the tubules so it can be recycled into the body and at the same time, raise the concentration or specific gravity of the urine. Essentially, this is the main function of the nephron. There are many other functions related to electrolytes and blood pressure and acid base balance but for our purposes, this water recycling is the main issue. It takes fluid at the normal specific gravity of the body (1.015 or "filtration level") and does its best to reclaim as much water as possible. Since this is against the osmotic pressure, the nephron has to have energetic "pumps" to achieve this goal. It is active not passive.

When the nephron is not functioning properly, the urine does not get concentrated and passes out of the nephron at the filtration level (specific gravity 1.015) or close to it. There are even situations, such as diabetes, where there is so much sugar in the bloodstream (a blood glucose over 155) that some of that sugar spills into the nephron and acts as a water "magnet" to hold water in the tubule and this osmotic pull can be strong enough to draw from the body into the urine. In this kind of situation, even though the animal is drinking a lot and urinating a lot, it's actually dehydrating itself and that is why animals and people with highly elevated blood sugar often end up in the hospital from dehydration because the sugar in the renal tubules is actually pulling extra water through this process therefore dehydrating the patient. Since the tendency to balance fluid concentration through osmosis is the natural order of things, the nephron requires a complex energetic mechanism to overcome this tendency and concentrate the urine.

Now consider the fact that there are millions of nephrons in each kidney, like little water treatment and recycling plants, and you should be able to see why they play such an important role in the body. Not only are they reclaiming water but the water that is finally excreted as urine contains many toxins and metabolic by-products. They also serve to help maintain blood pressure and balance electrolytes like sodium, potassium, phosphorus, and chloride.

On a side note, and as an example, the white matter on top of bird droppings is actually composed of urine crystals. The bird's kidneys are so efficient that they pull almost all the water out of the nephron and the remaining urine is excreted as dry matter.

When an animal goes into "kidney failure" or "kidney compromise" a number of things can happen that interfere with this recycling process. The blood pressure may be too low because of heart disease, medication, dehydration from vomiting, or other reasons. This low blood pressure decreases the amount of fluid flowing into the nephron so kidney output is diminished. Let us say the blood pressure is fine and the inflow is normal but there is often a problem in the kidney itself. Nephritis (inflammation or infection of the kidney), cystic kidneys, renal amyloidosis (starch like deposits replacing kidney tissue), underdeveloped kidneys, fibrosis, medications, toxins, repeated incidents or insults, and even actual injuries can affect the number of functional nephrons and create a problem. We could spend an entire chapter reviewing any one of these issues, but the goal here is to give you an overview of how the kidneys work and how they fail.

Our second goal is to address some of the specific

problems, discuss some of the things we can do to avoid those problems, and introduce some of the things we can do to treat the kidney if issues do arise.

Obviously, if the blood pressure is too low (dehydration, loss of blood, shock, or low cardiac output), then there may not be enough fluid at the input end of the nephron. When this happens the kidney produces hormones that tell the heart to work harder or the capillaries to contract to try to raise the blood pressure, all in an effort to compensate and to increase production. In some cases, this can cause high blood pressure or blood pressure spikes.

For our purposes, the two primary by-products of protein metabolism are creatinine and blood urea nitrogen (BUN) and these are excreted, almost completely, in the urine. If the blood pressure is too low or the kidneys themselves are damaged or inefficient or there is too much being produced in the body for the kidney to handle, the level of these by-products rises in the blood and is often the main indication of renal compromise. This does not necessarily mean that the animal is in chronic kidney failure because this can happen in a dehydrated animal, perhaps a dog that has been vomiting and had diarrhea for the last day or two.

We have often seen animals that started out having a gastrointestinal "bug" develop severe kidney disease because they became dehydrated and developed what was, initially, a prerenal Azotemia. Azotemia is an old medical term for an increase in the creatinine and BUN and prerenal means the problem started because of an issue outside the kidney (like dehydration) rather than an immediate kidney issue. If left untreated the kidney gets damaged and can go into failure (or often recovers but has lost some of its reserve nephrons).

Another potential problem might be an overproduction of creatinine or nitrogen that makes up the BUN so that the kidneys cannot handle the load placed upon them. This is the rationale behind treating kidney issues with a low protein diet in chronic kidney animals so that, theoretically, the kidneys have to process less by-products. We will discuss this in more detail later but there is an entire group of veterinarians and nephrologists that think the damage done by too low of a protein diet can be more costly than a higher but complete or well-balanced protein diet.

Before we tackle problems of the kidney itself, there is also the possibility that there is some sort of blockage either via a tumor or a kidney stone or stone in the ureter that creates a back flow of urine and a back pressure forcing the shutdown of the kidney. This can be seen with bladder stones or urethral stones in a dog, but is much more common in a "blocked" cat with the inability to urinate because of sand or a plug at the penis so the bladder just fills up until the kidney shuts down. We do see this in male dogs also, but it is not as common.

There are many diseases of the kidney itself, as we previously alluded to which include, chronic strain through subclinical dehydration, infection (pyelonephritis), inflammation, cysts, scarring, poisoning, effects of renal toxic drugs, and trauma. Many drugs can be toxic to the kidneys and one must be especially careful with Ibuprofen (Advil) as I have seen complete kidney failure with a single dose. Ethylene glycol (antifreeze) is also very dangerous, as it sometimes leaks or is spilled and tastes sweet to an animal.

There are also a number of antibiotics (often the aminoglycosides like gentamicin) that can be extremely renal toxic so it is important to have a good idea of renal function and to maintain excellent hydration while on these types of antibiotics. Anesthesia can be hard on the kidneys because of the drug load plus the low blood pressure that usually comes with anesthesia, and we always recommend fluid therapy during and after any prolonged anesthesia, even with dentistry.

Unfortunately, (or fortunately depending on how you look at it) one does not see elevated creatinine or blood urea nitrogen (BUN) until over three quarters of kidney function is lost in the chronic case. That means that the kidney has a tremendous reserve and, by the time we are physically starting to see symptoms of chronic renal compromise, we are often in a very advanced state of pathology. I am not talking about a dog who has been throwing up for forty-eight hours and has not been on fluids, because that is more of an acute pre-renal situation that often responds quickly to fluid therapy or even appears to resolve on its own, although invisible damage can occur as we stated earlier. The acute situation can be absolutely life-threatening in its own right, but I am referring to an older dog whose appetite has been diminished, who is drinking loads of water, urinating large amounts frequently, and can even start having bad breath with a "urine like" smell. Once we reach that stage, we have already lost the functional value of at least one and a half of the kidneys.

Unlike the liver, kidneys do not regenerate. Kidneys can heal to some degree, they can become more efficient, and mildly damaged processing units (nephrons) can come online but the kidney does not generate new replacement nephrons. In humans, there are kidney transplants (done in animals but on a very limited basis) and there is dialysis. IV dialysis has not yet been effective in dogs and cats – there is a fragility to the red blood cells that makes them much more liable to rupture if taken out of the blood stream and run through tubes and a machine, plus there is the cost factor even if physically possible.

All of which brings us to the point of the first half of this chapter – what do we do to maintain kidney heath and how do we treat when things go wrong? I may have used this quote before, but it is worth repeating. In ancient China, a famous general, Sun Tzu, wrote a book called the *Art of War* and it is still the definitive work on battle tactics thousands of years later. To paraphrase, he said that the BEST way to win a battle was to NOT BE THERE. It makes sense and I use it in my medical practice. So the BEST way to treat kidney failure is to NOT GET IT. There are many things we can do to help treat these patients but there are also many things we can and should do to help keep the kidneys stay strong and functional and less vulnerable. This will be the subject of our next chapter.

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Part XIII

The Kidney – Function, Failure and Therapy Part Two

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In the previous chapter, we spent a great deal of time understanding how the kidney works to clean toxins from the bloodstream and to use the nephron unit to help maintain hydration in the body. We also discussed how some of these things can go awry. Finally, we discussed the inability of the kidney to regenerate and the fact that the functional equivalent of 1 and ½ of the kidney capacity has to be lost before we see overt kidney failure.

Signs of early Chronic Renal Disease (CRD) include:

1. Increased thirst
2. Increased urination
3. Decreased appetite
4. Intermittent vomiting
5. Possible anemia with a low reticulocyte count
6. Urine specific gravity at or near the filtration level of 1.015
7. Elevated creatinine, BUN, and phosphorus

Signs of late stage CRD include all of the above plus:

1. Possible smell of urine on the breath
2. Ulcers on the tongue
3. Vomit may contain blood
4. Appetite is minimal or non-existent
5. Creatinine, BUN, and phosphorus are very high plus potassium may be elevated
6. Non-regenerative anemia

As you can see, many of these signs are progressive and related to the inability of the patient to pass enough urine to excrete the toxic byproducts of metabolism (primarily BUN and creatinine). As these elevate in the system, they contribute to the nausea and ulceration of the gastrointestinal tract.

The anemia could be from blood loss (ulcers), but the primary reason for the anemia is the lack of the hormone erythropoietin. This hormone is produced by kidney cells similar to the way the pancreas has cells that secrete insulin. The erythropoietin (also known as EPO or Procrit) stimulates the bone marrow to make new red blood cells to replace those lost through normal attrition. Blood cells usually have a 3-4 month lifespan, so new ones are always being produced to replace the ones that get removed by the spleen at the end of their useful life. These young red blood cells are known as reticulocytes because they still have a fine reticulum of nuclear material visible for a few days after they leave the bone marrow. Mature red blood cells in most animals and in people do not have a nucleus. Since there is very little or no hormone to stimulate their production, the patient shows a slow, steady decline in the hematocrit (also called PCV for Packed Cell Volume) and a drop in the red cell count and hemoglobin count. Normal PCV in a healthy dog is about 44% and these CRF dogs have HCT's (hematocrits) in the 20–30% range. I deliberately have been changing the terms and abbreviations for PCV=HCT and CRD = an early stage of CRF in most cases because you might see any combination of them on medical records or lab reports. The reticulocyte count is also very low or zero and it is important to ask for this inexpensive test to be added in any anemic kidney animal. It is done on the same blood used for the regular blood count – CBC.

• Conventional Therapy

There are very few conventional treatments for CRD that have much effect. The standard therapy includes extra fluids via IV or subcutaneous administration, an H2 or H3 histamine blocker to decrease stomach acid production (e.g. Pepcid, Prilosec, or Tagamet), a low protein diet, and usually an antibiotic. If the phosphorus level is high, a phos binder like Aluminum Hydroxide is administered orally multiple times a day. After a few days, the creatinine and BUN will, hopefully, start to come down from their stratospheric levels and the animal either rebounds or the veterinarian recommends euthanasia. Fortunately, more owners are demanding, and more veterinarians are starting to accept, that fluids can be administered at home by the owner. This has extended

both the quality and quantity of life for many animals.

Remember all the tedious descriptions of osmosis, specific gravity, and nephrons earlier? This is where they come into play. Since there are not enough functional nephrons to concentrate the urine, it passes into the collection duct at the same level that it enters the nephron (1.015 or the filtration level). Thus, the more fluids that can move through the kidney (because of the additional fluid therapy), the more creatinine, BUN and phosphorus can be excreted in the urine.

• Fluid Therapy

Fluid therapy is the best tool we have for helping the animal survive. It is not difficult to do and can often buy us time for the other therapies to begin to help. We have started to promote the concept of preemptive fluid therapy in early stage renal disease. We have not talked about the urinalysis beyond the measurement of the specific gravity, but it can be a valuable monitor of kidney integrity by using a measurement of the urine micro proteins or micro albumin. These proteins are usually held inside the nephron and are only found in small levels in the urine. When the kidney is starting to fail and the integrity of the nephron wall is compromised, there is more leakage of these proteins into the urine and the levels are significantly higher. This is not a part of the standard urinalysis, but can be requested as an additional test, and we do this regularly in many of our middle age to senior dogs. It gives us an early indication and to paraphrase Sun Tzu again, "the best way to treat CRD is to not get it!" In these animals, we look at the diet, add in appropriate supplements, start homeopathic or acupuncture therapy, and often begin early fluid therapy.

• Why We Stress EARLY Fluid Therapy in Our Kidney Cases

We have been doing this in our holistic practice for many years and are seeing that these animals live longer, happier, and easier lives. Usually, these are cats that have elevated kidney toxin values like creatinine and BUN, often intermittent vomiting, a decreased appetite, dry stool, and increased thirst. When you perform the lab work you see that values are not "bad" - usually at the high end or just above normal. We are starting this more in dogs with increased urine micro proteins and other kidney indicators.

Most conventional veterinarians advocate fluid therapy for animals that are farther along into kidney failure as a final, life saving measure. We are finding that helping the owner start fluid therapy (at home) subcutaneously (under the skin) 1-2 times a week has a great number of benefits. Among these are:

1. The extra fluids help the kidneys, so they can work more efficiently, and they deteriorate more slowly giving us time to work on the root cause(s).

2. The owner also becomes more comfortable with the process and the patient more accepting of the procedure without it having the LIFE OR DEATH implications and stress at that time. This also means that if it is not a good day or experience, we can hold off once in a while without risking the animal. Thus, we can get into it slowly and more comfortably.

3. Elevated BUN and creatinine often create nausea and that has a negative effect on the appetite. So, when these animals are given supplemental fluids, their appetite is usually better. Plus, the animal drinks less and may have a better appetite overall since they are not filling up on water.

4. The animal almost ALWAYS feels better, eats better, and is stronger. This creates positive reinforcement for everyone.

Later, when and if the time comes that the fluid administration is essential for continued existence, as the kidney function gets really bad, it is much easier to manage more frequent fluid therapy, sometimes as much as twice a day in really advanced cases. We have seen animals with twice a day administrations survive with good quality of life for years. If we reach this stage, it seems to come much later, if ever, due to our having slowed the "normal" progression of the disease.

Natural Holistic Health Care has shifted to this approach in many of our cases and found it extremely encouraging. It is good to know if the animal is having a poor eating or vomiting day, the fear of dehydration and the devastating impact that dehydration can have on the remaining kidney function is much less since you know the animal is being hydrated.

Subcutaneous (under the skin) home fluid therapy is easy, and we have also discovered a great needle that really helps. The normal large bore (the size of the hole in the middle) needle is the 18 gauge (green) one in which the fluid flows quickly but the needle is pretty big. The 20 gauge needle (usually pink) is much smaller and easier, but the fluid rate is slower since the bore is smaller. We have found a 19 gauge THINWALL needle by Monoject (olive) that is sharp and small, but because it is thin walled, it has the same bore and flow rate of a standard 18 gauge needle.

Those of you who have borderline kidney CRD cats or dogs and a desire to help earlier rather than later, should look at this approach in conjunction with other holistic care.

• Diet and Nitrogen Load

One of the oldest and more entrenched philosophies in veterinary medicine is the idea that feeding an ultra-low protein diet is essential. The rationale behind this idea seems straightforward; less proteins and amino acids to break down equals less nitrogen and creatinine to be dealt with by the kidney. This fails to take into consideration the stress that a very low

protein diet places on the entire animal and more veterinarians and kidney specialists are starting to rethink this. In our practice,

we look to the quality of the protein rather than just the protein level itself. We feel that you can have a higher protein level if it is a "complete" protein and has all the essential amino acids in it. As an example, egg is an excellent example of a complete protein source. We rarely feed a commercial low protein diet in our renal cases, and would rather try to select easily digestible diets that contain as much of the essential amino acids as possible.

• Lowering Nitrogen Forming Bacteria

There is a probiotic on the market called Azodyl, and we have found this to be very helpful in a number of CRD and CRF cases. It is, essentially, a probiotic that lowers the nitrogen forming bacteria in the intestine. Less nitrogen means less work for the liver and the kidney. We have found it to be beneficial. However, it needs to be shipped on ice and stay refrigerated, the capsules are pretty large, and are best given on an empty stomach. Because of this, a number of clients have difficulty administering them on a regular basis.

• The Use of Supplements both Herbal and Glandular

There are number of Western herbs that we have found valuable in treating kidney cases. They both support the kidney and promote diuresis. These include dandelion root, parsley, and asparagus. We like to administer them twice a day or, if the patient is amenable, work them into their diet. There are also a number of Chinese herbs aimed at the kidney. We also use Standard Process Renal Support products on a regular basis.

• Problem with Phosphorus

As the kidneys fail, the phosphorus level starts to climb. Besides creating metabolic issues, elevated phosphorus can affect the appetite. Over the years, aluminum hydroxide (Di-Gel, ALternagel) has been administered orally 2-6 times a day, which helps coat the stomach and bind the phosphorus. Some of these products are now off the market or so vile (mint flavored, etc.) as to make them unpalatable, creating nausea, or a battle to administer. Many people have turned to the administration of aluminum hydroxide as a powder, and there have also been some veterinary products introduced recently as phosphorus binders. There is an excellent source of all things kidney related on the Internet called Tanya's Chronic Renal Failure (www.felinecrf.org) and many of the concepts here apply to dogs as well.

• Acupuncture and Homeopathy

Acupuncture and homeopathy have been valuable in the long term management of CRD and CRF patients. It is not feasible to discuss specific remedies beyond some of the more common ones we find valuable (this is NOT the place for you to experiment without professional guidance). We find many of these patients respond to Nux-vomica, Phosphoric acid, Phosphorus, and in extreme cases to Serum Anguillae (eel). We have also found that acupuncture, especially for bladder and kidney points can be powerful aids to stabilize these patients and even help them recover.

• Allopathic Drugs

As stated earlier, many practitioners will add in something to help limit the acid production in the stomach to help avoid ulcers forming. We usually will do this too. There has also been an increased interest in regular administration of the blood pressure medication benazepril to help control blood pressure fluctuations and also enhance renal blood flow (perfusion).

When anemia has become an issue, we will use Epogen (EPO) or Aricept (Darbopoetin) to help stimulate red blood cell production. EPO is more readily available and less expensive, but about one third of the patients develop an allergy to it after 6-9 months, whereas this is less of a problem with Darbopoetin. It is our experience, once you reach the anemia level that requires these meds, the 6-9 month time frame to develop an allergy may be less important from a practical standpoint. Survival times are usually limited due to other issues.

• In Conclusion

There are a multitude of things we can do to help treat and maintain the chronic renal patient and sometimes get them over the hump where their own kidneys kick back in and help. Fluid therapy, homeopathic remedies, diet, and supplemental therapy are all part of the strategy. However, we are finding that monitoring, early intervention, and fluid therapy gives us a much better chance of avoiding or, at least, delaying the slide from CRD to CRF – from disease to failure.

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