



Brookville Road Animal Hospital

8049 Brookville Road, Indianapolis, IN 46239

phone: (317) 353-6143

Home Care Instructions

Things to Remember:

- Also, allow free access to water at all times, as she will continue to have excessive thirst, until we have her well-regulated.
- Store the insulin in the refrigerator, and protect from light.
- Mix the insulin gently by rolling between hands, and inverting repeatedly, for 30 seconds.
- Administer at a 45 degree angle
- Remember, it is more dangerous to have LOW blood sugar, than to have high blood sugar. If she is acting ill, and you **KNOW** she hasn't eaten at all over a 12 hour period, SKIP that insulin dose. If she doesn't eat prior to her next scheduled insulin injection, skip that as well, and bring her in **right away**. Review attached information for signs of LOW blood sugar (confusion, staggering, collapse, seizure). (Depending on how she responds, we may make changes later, and administer a partial dose if she doesn't eat, but for now, follow these instructions.)

Follow-up:

- Schedule recheck exam in 21 days with your doctor. Offer food, and administer insulin as you normally would that morning – it will not affect this blood test (fructosamine.) This will give us an idea of her average blood regulation, over the past 3 weeks. Your doctor will also examine, and she will be weighed to monitor for gain/loss.
- If she is not feeling well, has a decreased appetite, vomiting, diarrhea, or extreme lethargy, please schedule a recheck appointment sooner.
- Monitor her thirst and urination and appetite, as we will use these to help find the right dose for her as well.
- Please review the attached information regarding diabetes.
- If you have any questions, please feel free to contact your doctor or a technician.

Additional Instructions/Comments:

- Problems like dental disease can make it difficult to regulate diabetics, so we recommend having her teeth cleaned sometime in the next few months, especially if we have difficulty getting her regulated (finding the right dose).

- Diabetics are more prone to infections, especially urinary tract infections, so bring her in right away if she is acting ill.
- Insulin, and all syringes require a prescription. We will give you a prescription or call this in to your preferred pharmacy.
- To dispose of syringes, a home “sharps” container can be used. We may have samples available, or these can be ordered on-line. You can also place them in a used plastic laundry detergent (liquid) container, and close tightly with the lid. This can then be disposed with your regular trash.

THE PET HEALTH LIBRARY

By Wendy C. Brooks, DVM, DipABVP

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Diet for the Diabetic Dog

A lot of information has recently been published about high protein diets in managing diabetes mellitus in cats. It may be tempting to try to apply similar rules to dogs but, in fact, an entirely different approach is needed. Canine diabetes mellitus is more like Type I or insulin-dependent diabetes in humans, while feline diabetes is more like Type II. What this means is that the canine pancreas is not producing any insulin at all while the feline pancreas isn't producing enough. The dietary approaches are very different.

Fiber

Classically, high fiber diets have been recommended for the management of canine diabetes mellitus. More recent scrutiny of fiber has led to conflicting results. In many cases, addition of insoluble (non-digestible) fibers to the diet helped glycemic control, meaning that blood sugars were more stable throughout the day.

Fiber blunts the increase in blood sugar levels that occur after eating, delays the emptying of food from the stomach, and slows the digestion of carbohydrates (glucose sources). All this means that blood sugar levels are inclined not to jump as high after eating compared to those of patients fed low fiber diets.

If the diabetic dog is overweight - and many are - fiber also helps the patient feel full after eating, thus encouraging weight loss. This may not be so desirable in a diabetic dog that is underweight, and many are.

High Digestibility Diets: Probably not the Best Thing

There are numerous diets on the market designed for dogs with “sensitive stomachs.” These foods typically are designed for easy digestion and absorption. While this is helpful to dogs with digestive issues, easy digestion and absorption amounts to higher blood glucose levels after eating. This is probably not the best thing for a diabetic dog.

Low Fat

A common issue that accompanies diabetes mellitus is elevated triglycerides (fats) in the bloodstream. In humans, this is the doorway to vascular disease, cholesterol deposits, heart disease and stroke. Dogs do not generally have to contend with these issues but the elevated fat levels in the blood can lead to pancreatitis, which is a serious disease. Many nutritionists recommend that metabolizable energy of a diet not exceed 30% fat, but this information is not readily available on a pet food label. Protein recommendations should be 18-25% in the diet on a dry matter basis.

To calculate the percentage of protein in a diet on a dry matter basis, look for the crude protein and the moisture content amounts in the guaranteed analysis on the food label. Multiply the moisture content by the crude protein and subtract that number from the crude protein. (Example: a food is 20% crude protein and 10% moisture. Multiply $20 \times 0.10 = 2$. Subtract 2 from 20. The answer is 18% protein on a dry matter basis.) If the food is dry, there is typically so little moisture content that the numbers off the label approximate the dry matter percentages. If the food is canned, though, the food might be 80% water and calculation becomes more important.

Other Concepts

As long as the diet is consistent, it is generally possible to work with it in achieving diabetic regulation. Here are some additional tips:

- If the dog has an additional medical problem that requires a specific diet in its management, then this trumps the suggestions for diabetic management.
- As long as a reputable food that has passed AAFCO feeding trials is being fed, it should not be necessary to add nutritional supplements.
- Soft-moist foods typically use sugary preservatives and should be avoided. Canned and dry foods are equally acceptable.
- Ideally, a brand of food with a "fixed formula" is preferred to one with an "open formula." Foods with an open formula stick to their prioritized ingredient list on the label and to the guaranteed analysis minimums and maximums, but the exact ingredient amounts are not fixed. A fixed formula food uses specific amounts of each ingredient every time in every lot. In general, non-prescription diets are open formula diets.

Your veterinarian can help you choose the most appropriate food for your diabetic dog.

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THE PET HEALTH LIBRARY

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Insulin Administration in Dogs

Vetsulin is once again available in the U.S., as of mid-April, 2013. It had been unavailable in the U.S. since 2009 due to manufacturing issues.

Insulin is the injectable medication you use to control your diabetic dog's blood sugar. When insulin therapy is started, the optimal dose for your pet is unknown and will have to be determined by trial and error. Most dogs will need insulin injections twice a day, though occasionally a patient is found where a single dose is long acting and once-a-day insulin works out. A dose will be selected based on what research has shown to be a good starting point, and after a couple of weeks your dog will return for a glucose curve where blood sugar levels will be mapped out over the course of a 10 to 24 hour period. The curve will show if the insulin is lasting long enough and if the dose should be raised, lowered, or kept the same. Alternatively, you can learn how to monitor your dog's blood glucose levels yourself but if you are a beginner you may want to master giving the injections before moving on to taking blood samples.

There are two commonly used insulins for dogs: Vetsulin®, which is of pork origin (pork and dog insulin are molecularly identical so essentially Vetsulin is canine insulin) and Humulin N, which is human insulin (produced through genetic engineering technology). There are other types of insulins but as these are rarely used in dogs, probably will not come up except for special circumstances so they are omitted from this discussion.

Vetsulin is available through your veterinarian's office or through veterinary pharmacies while Humulin N is available through any regular pharmacy.

BE SURE YOU UNDERSTAND HOW MUCH INSULIN YOU ARE SUPPOSED TO GIVE YOUR PET.

DO NOT ADJUST YOUR PET'S INSULIN DOSE WITHOUT VETERINARY GUIDANCE.

Storing Insulin

The bottle you are currently using need not be refrigerated although if you have a supply of insulin bottles, it is probably best to refrigerate the bottles that are not in use.

- Do not use insulin that is past its expiration date. In fact, it is a good idea to change to a fresh bottle every 6 to 8 weeks.
- Do not use insulin that has been frozen. Insulin is not normally frozen but accidents happen, especially in smaller refrigerators.
- Do not expose insulin to direct light or heat.

The Syringes

Human and veterinary insulins are made at different concentrations and thus each requires its own type of syringes for proper dosing. Insulin syringes are extremely small in diameter so that injection will not be painful. It is a rare patient that objects to insulin shots per se, but some dogs resent being held still. It is crucial that the injection goes into the dog rather than into the fur so let your veterinarian know if you would like a small spot shaved to facilitate the injection.

- Vetsulin is available at 40 units of insulin per cc and requires U-40 syringes.
- Humulin N is available at 100 units of insulin per cc and requires U-100 syringes.

Always be sure you have the correct syringes for your insulin.

Used syringes should be placed inside a thick plastic container, such as a liquid laundry detergent bottle

or similar receptacle. If the needle is enclosed in such a container, the entire container can be closed up and disposed of in the regular trash at home. Specific containers can be purchased for needle disposal or the used syringes can be returned to the veterinary hospital for disposal if you prefer.

How to Give the Injections

First, feed your dog. The blood sugar of a dog that has not eaten a normal meal but receives insulin may drop to a dangerously low level. If your dog is not eating, this could indicate a need for a checkup with your veterinarian. After your dog has eaten, you are ready to give the injection.

Before drawing up the insulin in a syringe, roll the bottle back and forth in your palms so that the white material in the bottom is mixed in to the rest of the solution. Do not shake the bottle as the insulin molecule can be damaged.



Insulin is drawn into the syringe after holding the bottle upside down. Photo by Teri Ann Oursler, DVM



Tent the pet's skin before injecting the insulin. Photo by Teri Ann Oursler, DVM

When drawing up the insulin, always hold the bottle vertically to avoid unnecessary bubbles in the syringe. Since insulin is being given under the skin, bubbles are not an enormous problem as it would be with an intravenous injection but we still want to minimize bubbles. If you get bubbles in the syringe, flick the syringe with your fingers until the bubbles rise to the top and then simply push the air out of the syringe with the plunger.

After you have the insulin dose ready in the syringe, it is time to get your dog. Be sure you can trust your dog to hold reasonably still for the shot. Most dogs do not require a second person to hold them still but some dogs are rambunctious and a helper is necessary. If you have such a pet but no helper, consider tying a short leash around a piece of furniture. (Use a slip knot in case of a choking emergency.) Some dogs are uncooperative and require a muzzle.

Lift up a fold of skin, ideally along the side of the body. This will create a small space for the needle. Insert the needle into this space and inject the insulin. Withdraw the syringe and needle when you are

finished.

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Monitoring Glucose Regulation

Monitoring is crucial to determining your pet's proper insulin dose. Much monitoring can be done at home and it is possible to save a great deal of money by doing so; however, some tests simply must be done at the veterinarian's office. We will now review important parameters that you must keep an eye on if diabetic regulation is to be achieved long term. Consider keeping a notebook or spreadsheet with weekly, if not daily, notations regarding some of these parameters; the more information you have when it is time to see the vet, the better.

Download a printable PDF file of a [monitoring diary](#).

Clinical Improvement

The hallmark signs of diabetes mellitus are excessive water consumption, excessive urination, excessive hunger and weight loss. It is not necessary to measure your pet's water consumption as the fluid requirement will change with exercise level, environmental temperature, and other factors. Still, make a mental note about whether your pet's appetite, thirst, and urine production are "normal," increased or decreased. If you are keeping a notebook, consider making a daily notation in this regard. It is subjective somewhat but good to note.

Your pet's body weight is less subjective. If your pet is small enough, consider weighing your pet every couple of weeks. As your pet comes into regulation, weight will be gained. A well-regulated pet will maintain body weight. Keep body weights recorded in your notebook.

Ketones

Food provides our bodies with fuel. Most of our tissues can burn stored fat, though our brains require glucose. In normal life, there is plenty of fat and plenty of glucose to run our metabolism but in times of starvation problems start: we deplete stored glucose and must make it and we burn fat more desperately.

Ketones are a by-product of intense fat burning. The brain is able to use ketones as an alternative to glucose which is a good thing. The problem is that intense ketone production leads to metabolic pH changes leading to acidic blood and dangerous electrolyte imbalances.

When diabetes mellitus is complicated by infection or other problem, ketoacidosis can result. This is a serious complication that can lead to expensive hospitalization and even death. It is helpful to monitor your pet's urine for the presence of ketones.

Ketostix are urine dipsticks when indicate the presence of ketones in urine. Only a drop of urine is needed. Dip the dipstick in the urine and look for a color change. A color guide is on the dipstick bottle. This need not be done every day if the pet seems to be doing well but when it is done record the results in the monitoring notebook if you have one.

Occasional ketones are not an alarming finding in a diabetic pet but if ketones are found in urine three days in a row or if the patient showing ketones seems ill (poor appetite, vomiting etc.) then the pet should see the vet right away. In such a situation, diabetic ketoacidosis is likely occurring and serious treatment is likely needed.

Ketostix can be purchased at any drugstore.

(For more information on diabetic ketoacidosis [click here](#))

Collecting your Pet's Urine

Cats

For cats, a piece of cellophane can be placed over the litter box and some urine will be caught there even if the cat digs. Only a drop of urine is needed for the test so even if the cellophane is wrinkled up, hopefully a drop can still be obtained. Alternatively a very small amount of litter can be placed in the box. The cat will still understand what she is supposed to do but not all the urine will be absorbed by the litter.

It is not necessary or particularly even desirable to monitor urine glucose with dipsticks. The contents of the urinary bladder represent several hours of urine production, thus making interpretation of urine glucose challenging. In the past urine glucose monitoring has been recommended and certainly there is nothing wrong with collecting more information but it can be confusing to decipher and should be considered optional.

Glucose Monitoring

Fructosamine Level (my preferred method for cats)

Measuring fructosamine is a helpful way to help monitor glucose control and, if for whatever reason, it is not possible to run glucose curves this would be the next best thing. Blood glucose fluctuations leave a metabolic mark that lasts a week or two. Measuring fructosamine gives a sense of the average blood glucose over the previous couple of weeks. Control is designated excellent, good, fair, poor, or prolonged hypoglycemia. Because the fructosamine is looking at averages, it will not distinguish excellent control from wide swings of high to low glucose readings. Still, even with this limitation, fructosamine is good to include in periodic monitoring tests.

To do a Curve in the Animal Hospital

- Ideally you will bring your pet in with an empty stomach, her regular food, and her insulin and syringes.
- The veterinary staff will run a pre-insulin glucose level.
- After this is drawn, they will observe how you draw up and administer the insulin confirming that you are doing it correctly.
- The pet is then left with the food for the day and the veterinary staff will check blood glucose levels every 2 hours.
- Pick up your pet and receive new dosing instructions at the end of the day.

Other Tests

Your pet will still need regular veterinary checkups, typically every six months after regulation has been achieved. Obviously, if she seems sick or if the symptoms of diabetes seem to return, then she needs to be checked right away.

Urine Culture

It is largely inevitable that sugar will spill into your pet's urine, possibly even for a short time daily. Sugar in urine is highly encouraging to bacteria, and urinary tract infections are common in diabetic pets. Often symptoms are difficult to discern at home so periodically performing urine cultures is a good practice in ruling out latent infection.

See more information on [urinary tract infection](#).

A basic blood panel and urinalysis should also be expected when the pet returns for regular check up and evaluation.

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THE PET HEALTH LIBRARY

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The Hard to Regulate Diabetic Cat

The goal in long-term management of diabetes mellitus in cats is the alleviation of unpleasant clinical signs (constant thirst, weight loss, etc.) and prevention of dangerous secondary conditions (infections, **ketoacidosis**, etc.). To accomplish this, blood sugar levels should be regulated between 250 mg/dl and 80 mg/dl. This is not as good as the body's natural regulation, but it is a fair and achievable goal in most cases.

Some cats just seem completely unaffected by even high doses of insulin, and it is important to have a step-by-step plan to rule out causes of insulin resistance so that regulation can be achieved.

Insulin resistance is defined as requiring more than 1 unit of insulin per pound of body weight for regulation

or

All sugar levels for the day >300 gm/dl despite 6 - 8 units per dose of insulin.

Step One: Rule Out Insulin Administration Related Factors



This may seem basic but it is important not to skip the basics. Confirm that the amount of insulin being drawn into the insulin syringe is correct, that the injection technique is correct and that the patient is actually receiving the injection. Rule out any snacking or changes in the patient's feeding schedule. Be sure the bottle of insulin is not expired and that it has been properly stored.

Review insulin storage and handling. [click here](#).

Also important is making sure the diet is appropriate. Soft-moist foods are often preserved with sugars. Extra treats may be interfering with regulation. Ideally a low carbohydrate diet should be fed.

Step Two: Determine for sure that the Patient is Insulin Resistant

A glucose curve is needed to distinguish the following three phenomena.

Somogyi Overswing

In the case of Somogyi Overswing, the insulin dose is too high and drives the blood sugar low for part of the day. When the blood sugar is low, other hormones such as cortisone or adrenalin are released to raise blood sugar. These hormones can have a prolonged effect (many hours) thus creating hyperglycemia (high blood sugar). If the patient's high blood sugar has been caused by a Somogyi overswing, a lower dose should be used and a new curve performed in a week or two.

Rapid Insulin Metabolism

In this case, the insulin simply isn't lasting long enough to create sustained normal blood sugar levels. If the curve shows that the insulin effect is wearing off too soon, twice a day administration of the insulin may solve this problem or a longer acting insulin may be needed.

True Insulin Resistance

Here no significant drop in blood sugar level (levels stay greater than 300 mg/dl) is seen in response to the insulin dose used. Usually there is a history of prior increases in insulin dose all met with minimal response.

We shall continue assuming that the patient has true insulin resistance on the glucose curve.

Step Three: Are there Medications being used that could Elevate Blood Sugars?

The obvious medication would be a member of the cortisone (corticosteroid) family. This might be a pill, a shot, an asthma inhaler, or even a topical ointment, spray or ear cleaner. Always keep your veterinarian informed about products you are using.

Progestins (female hormones) were previously used frequently for behavior problems as well as skin diseases in cats. These medications were famous for inducing and promoting diabetes mellitus. If the cat is licking a hormone-containing topical medication from the owner's skin, this is also important to report.

Step Four: Rule Out Infection

Diabetic animals are at risk for developing bladder infections because they have so much sugar in their urine. Stress of any kind will contribute to high blood sugar, and infection would lead to stress. A urine culture should be done to rule out bladder infection plus the teeth and skin should be inspected for infection. If infection per se is not found, the patient should be screened for other chronic illnesses that might constitute a stress. A basic blood panel would be a logical starting point.

If infection or other stress is allowed to go unchecked, ketoacidosis, an especially life-threatening complication of diabetes mellitus, can develop.

Do not allow the pet's teeth to become a source of infection; have your veterinarian clean the teeth annually.

Step Five: Control Obesity

Insulin response is typically blunted in obese patients. If obesity is an issue, it should be addressed. A formal weight loss program using measured amounts of a therapeutic diet and regular weigh-ins is necessary for success. Read general information about [weight loss](#) for pets.

If these steps do not reveal a relatively simple explanation for the poor insulin response, then it is time to seek more complicated causes.

This generally means an additional hormone imbalance.

Hyperadrenocorticism (Cushing's Disease)

[Cushing's disease](#) is relatively common in dogs but less so in cats. In short, this condition involves an excess in cortisone-type hormones either from over-production within the body or over-treatment with medication. Cortisone (more accurately referred to as cortisol) is secreted naturally in response to a fight or flight situation and prepares the body for exercise by mobilizing sugar stores. If sugar is mobilized into the blood stream in the absence of a fight or flight situation, diabetes mellitus can result. If the excess cortisone situation is resolved, it is possible that the diabetes will also resolve.

About 10% of dogs with Cushing's disease are also diabetic. About 80% of cats with Cushing's disease are also diabetic. Testing for Cushing's disease cannot proceed until some degree of diabetic control has been achieved and the patient is not ketoacidotic.

Hyperthyroidism

Thyroid hormone is another hormone that alters glucose metabolism in cats but not in dogs.

While [hyperthyroidism](#) is a common condition of older cats, less than 1% of hyperthyroid cats are also diabetic. Still, when a diabetic cat becomes hyperthyroid, control of the thyroid disease generally leads to better regulation of the diabetes.

Acromegaly

Acromegaly results from an over-secretion of the pituitary hormone known as growth hormone. This hormone normally is responsible for one's growth from infancy to adulthood. When adulthood is achieved, its secretion dramatically slows, bone growth plates close, and growth essentially stops. If for some reason, this hormone begins secreting again, growth resumes but not generally in normal proportions as the limb bones have closed their growth areas.

One of the effects of growth hormone is causing the body tissues to become resistant to insulin by interfering with tissue insulin receptors. Animals with acromegaly are frequently diabetic.

The prognosis and treatment for acromegaly is different between dogs and cats. Dogs generally develop acromegaly due to excess progesterone secretion (as would occur from an ovarian cyst). Canine patients

are thus usually older unspayed females and spaying may be curative depending on the remaining ability of the pancreas to secrete insulin.

The feline situation more closely approximates the human situation. Cats and people develop acromegaly when they develop a growth hormone secreting pituitary tumor. Over 90% of acromegalic cats are male (there is no sex predisposition in humans.)

The diagnosis of acromegaly can be difficult. Growth hormone can make soft tissue organs enlarge and cause characteristic proliferation of gum tissue in the mouth, but pituitary tumors require some kind of brain imaging (CT scan or MRI) for detection. In terms of blood testing, two values are helpful: a growth hormone level and an insulin growth factor-1 level. Growth hormone, unfortunately, is not secreted evenly throughout the day meaning there is overlap between what normal cats do and what acromegalic cats do.

Insulin Growth Factor-1, known as IGF-1 and previously known as somatomedin C, is produced by the liver in response to growth hormone and is responsible for many of the effects of growth hormone. IGF-1 can also be measured and may be a more helpful parameter since, unlike growth hormone, it is released in a more steady fashion. (Also, few laboratories run growth hormone levels so often only the IGF-1 value is available for interpretation.)

Treatment of feline acromegaly is difficult and may involve radiotherapy of the pituitary tumor causing the problem. Unfortunately, this condition seems to be more common than previously had been thought and research is ongoing.

Antibodies against Insulin

When a patient is treated with insulin from another species, the immune system recognizes the introduction of the foreign protein and generates antibodies. It was because of this phenomenon that most commercial insulin available is genetically engineered human insulin so that human diabetics no longer need to worry about making insulin antibodies.

But where does this leave dogs and cats? It leaves them making antibodies against human insulin, that's where.

One would think this would pose a big problem but in fact insulin antibodies are not always bad. Most of the time the antibodies simply interfere with removal of the insulin leading to a longer acting insulin than would be achieved with the same type of insulin made from the native species. For example, Humulin N (human insulin) will last longer in the dog than Canine Insulin N. This may be desirable depending on the patient; changing the species of origin of the insulin is one way to get the insulin to last a bit longer.

To become insulin resistant from antibodies, one must lose 70% or more of the insulin injection to antibody binding. This is unusual but possible and should not be forgotten as a possible cause of insulin resistance. Blood tests to measure insulin antibodies are available in some areas. Insulin can be switched to a species of origin more closely related to the species desired.

If a Cause Cannot be Found

If a cause cannot be found or if treatment for that cause is not practical or possible, the good news is that multiple high doses of insulin can generally overcome the resistance. Sometimes combinations of short and long-acting insulins are used together to achieve reasonable regulation. Some of the oral agents listed in the section on [controlling diabetes without insulin](#) may be helpful.

Difficult cases of getting diabetic cats under control is an area that not all veterinarians are comfortable performing. Discuss with your veterinarian whether referral to an internal medicine specialist would be best for you and your pet.

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