

Diabetes Mellitus in Dogs

This handout provides general information about diabetes mellitus in dogs. For information about its treatment, see the fact sheets "Diabetes Mellitus – Principles of Treatment" and "Diabetes Mellitus – Insulin Treatment".

What is diabetes mellitus?

Diabetes mellitus is a disease of the pancreas. This is a small but vital organ located near the stomach. It has two significant populations of cells. One group of cells produces the enzymes necessary for proper digestion. The other group, called beta-cells, produces the hormone insulin. Insulin regulates the level of glucose in the bloodstream and controls the delivery of glucose to the tissues of the body. In simple terms, diabetes mellitus is caused the failure of the pancreas to regulate blood sugar.

The clinical signs seen in diabetes mellitus are related to the elevated concentrations of blood glucose and the inability of the body to use glucose as an energy source.

What are the clinical signs of diabetes and why do they occur?

The four main symptoms of uncomplicated diabetes mellitus are increased thirst, increased urination, weight loss and increased appetite.

Glucose is a vital substance that provides much of the energy needed by cells, and it must work *inside* the cells. Insulin attaches to 'receptors' on the surface of body cells and opens "pores" through the cell wall that allow glucose to leave the bloodstream and enter the cell's interior. Without an adequate amount of insulin to "open the door," glucose is unable to get into the cells, and accumulates in the blood, setting in motion a series of events that can ultimately prove fatal.

"When there isn't enough insulin, the cells of the body become starved for their primary source of energy."

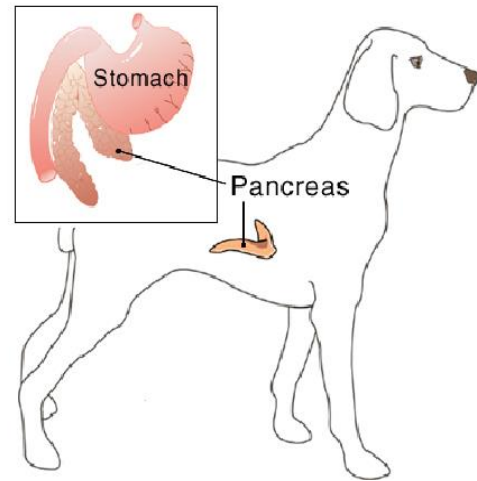
When there isn't enough insulin, the cells of the body become starved for their primary source of energy. In response to this apparent starvation, the body starts breaking down stores of fat and protein for energy, causing weight loss. The apparent starvation stimulates hunger and the dog eats more; thus, we have weight loss in a dog with a ravenous appetite. The body tries to eliminate the excess glucose by excreting it in the urine. Since glucose attracts water, it promotes loss of bodily fluids into the urine, resulting in the production of a large amount of urine. To avoid dehydration, the dog drinks more and more water.

Some people with diabetes take insulin shots, and others take oral medication. Is this true for dogs?

In humans, there are two types of diabetes mellitus. Both types are similar in that there is a failure to regulate blood sugar, but the basic mechanisms of disease differ somewhat between the two.

"Type I Diabetes Mellitus is the most common type of diabetes in dogs."

Type I Diabetes Mellitus (sometimes also called Insulin Dependent Diabetes Mellitus), results from total or near-complete destruction of the beta-cells in the pancreas. This is the most common type of diabetes in dogs. As the name implies, dogs with this type of diabetes require insulin injections to stabilize blood sugar.



Type II Diabetes Mellitus (sometimes called Non-insulin Dependent Diabetes Mellitus), is different because some insulin-producing cells remain. However, the amount of insulin produced is insufficient, there is a delayed response in secreting it, or the tissues of the dog's body are relatively resistant to it (also referred to as *insulin resistance*). Type II diabetes may occur in older obese dogs. People with this form may be treated with an oral drug that stimulates the remaining functional cells to produce or release insulin in an adequate amount to normalize blood sugar. Unfortunately, dogs tend not to respond well to these oral medications and usually need some insulin to control the disease.

How is diabetes mellitus diagnosed?

Diabetes mellitus is diagnosed by the presence of the typical clinical signs (excess thirst, excess urination, excess appetite, and weight loss), in addition the presence of a persistently high level of glucose in the blood stream, and the presence of glucose in the urine.

The normal level of glucose in the blood is 80–120 mg/dl (4.4–6.6 mmol/L). It may rise to 250–300 mg/dl (13.6–16.5 mmol/L) following a large or high-calorie meal. However, diabetes is the only common disease that will cause the blood glucose level to rise above 400 mg/dl (22 mmol/L). Some diabetic dogs will have a glucose level as high as 700–800 mg/dl (44 mmol/L), although most will be in the range of 400–600 mg/dl (22–33 mmol/L).

To conserve glucose within the body, the kidneys do not filter glucose out of the blood stream into the urine until an excessive level is reached. This means that dogs with a normal blood glucose level will not have glucose in the urine. Diabetic dogs, however, have excessive amounts of glucose in the blood, so it will be present in the urine. After the blood sugar reaches approx.. 10 mmol/L, the excess blood sugar is removed by the kidneys and enters the urine. This is why dogs and people with diabetes mellitus have sugar in their urine (called glucosuria) when their insulin is low.

How is diabetes mellitus treated in dogs? Is treatment expensive?



"Dogs with diabetes mellitus require...daily insulin injections...dietary change."

Dogs with diabetes mellitus require one or more daily insulin injections, and almost all require some sort of dietary change. In general, they must be fed the same food in the same amount on the same schedule every day. Although the dog can go a day or so without insulin and not have a crisis, this should not be a regular occurrence; treatment should be looked upon as part of the dog's daily routine. This means that you, as the dog's owner, must make both a financial commitment and a personal commitment to treat your dog. If you are out of town or go on vacation, your dog must receive proper treatment in your absence. Once your dog is well regulated, the treatment and maintenance costs are minimal. The special diet, insulin, and syringes are not expensive. However the financial commitment may be significant during the initial regulation process or if complications arise.

Initially, your dog may be hospitalized for a few days to deal with any immediate crisis and to begin the insulin regulation process. The "immediate crisis" is only great if your dog is so sick that it has quit eating and drinking for several days. Dogs in this state, called *diabetic ketoacidosis*, may require a several days of intensive care. Otherwise, the initial hospitalization may be only for a day or two while the dog's initial response to insulin injections is evaluated. At that point, your dog returns home for you to administer medication. At first, return visits are required every three to seven days to monitor progress. It may take a month or more to achieve good insulin regulation.

The financial commitment may again be significant if complications arise. Your veterinarian will work with you to try to achieve consistent regulation, but some dogs are difficult to keep regulated. It is important that you pay close attention to all instructions related to administration of medication, diet, and home monitoring. One serious complication that can arise is *hypoglycemia*, or low blood sugar, which can be fatal. This may occur due to inconsistencies in treatment.

What is the prognosis for a dog with diabetes mellitus?

Once the diabetes mellitus is properly regulated, the dog's prognosis is good as long as treatment and monitoring are consistent. Most dogs with controlled diabetes live a good quality of life with few symptoms of disease.



General monitoring recommendations (for stable diabetic):

- Spot blood glucose checks 1-2 times per day for first 2-3 days to be monitoring for

signs of hypoglycemia. If results are less than 10 mmol/L, call vet prior to any further insulin administration.

- Full 12 hour blood glucose curve approx. 7 days after insulin therapy begins. It is this curve that we use to determine the dog's response to insulin and whether dosing needs to be adjusted. Each time insulin dosing is changed, a curve is repeated about a week later to assess response to the new dose. Take first blood sugar reading just prior to regular morning feeding, then feed dog as usual in the morning and give insulin. Then take blood sugar reading every 2 hours throughout the day. The final reading should be at the time of evening insulin administration. It is important that these curve days are as representative of your pet's normal day as possible, so choose a quiet, routine day to do it.
- We recommend urine analysis and culture every 4 months to screen for infection
- We recommend full bloodwork every 6 months as a general health survey

*Do NOT give insulin in the following situations:

- pet doesn't eat at least 2/3 of meal
- any vomiting or diarrhea
- any listlessness or signs of low blood sugar (weakness, trembling, drooling, disorientation)

Check your pet's blood sugar immediately and call vet for further instruction.

In the short term (12-24 hours) it is much safer for blood sugar to be high than low, so it is safer to skip a dose of insulin if you have any concerns and contact the vet.

*If Blood sugar is low (<3mmol/L), give your dog something sweet such as honey or molasses in their mouth and call vet immediately for further assistance.

As mentioned, the vast majority of diabetic dogs develop type 1 diabetes as well and require insulin injections under the skin twice daily. Insulin must be *refrigerated* and *mixed gently* prior to administration. Different insulins have different types of syringes so it is essential to always confirm that the *correct syringe* is being used to avoid incorrect dosing (Caninsulin uses U-40 syringes). Insulin is to be given by injection under the skin (subcutaneous injection) exactly *12 hours apart*, with breakfast and dinner. It is essential to feed the dog *first* to ensure that they eat and do not vomit prior to receiving their injection, as if they do not eat enough or keep it down their blood sugar might already not be very high so insulin administration may drive it down dangerously low. Never let your dog run out of insulin. Caninsulin is only available through veterinary clinics. Always call ahead to re-order when the vial is getting low. Insulin has a *3 month shelf life* if kept in the fridge – at that point any unused insulin should be discarded and a new vial should be purchased.

As previously mentioned, insulin allows sugar to enter cells and tissues, which in turn *decreases* the amount of sugar left in the blood stream (*it lowers blood sugar*). Signs of dangerously low blood sugar include shaking, salivation, weakness, and even seizures. It is always safer (in the short term) for blood sugar to be high rather than low, therefore, it is better

to *skip a dose* of insulin if one is unsure. Reasons to skip an insulin dose include: noticing any of the aforementioned signs of hypoglycemia, cat not eating well, vomiting or profuse diarrhea, or listlessness. Skip the dose and call the vet for advice. If signs of hypoglycemia are noted, rub something sweet such as honey or corn syrup on the animal's gums and call the vet ASAP.

Close monitoring of diabetic patients is essential, as diabetes in pets often changes over time. Sometimes with insulin injections and weight loss the pancreas gets a rest and the beta cells start to produce more insulin again. We monitor pets via clinical signs at home, tracking their body weight, bloodwork, and urine analysis. *Blood sugar monitoring is essential*, as most pets need adjustments in their insulin doses from time to time. Many owners are able to do this at home via the dog's lip or foot pads and a hand-held glucometer. Human glucometers are often used, but can be slightly inaccurate. AlphaTrak glucometers are preferable, as they use very tiny blood samples and are calibrated specifically for pets, giving the most accurate results possible. *Never* adjust your pet's insulin dose without express instructions from your vet! If dosage adjustments are made, blood sugars should be monitored closely over the first 48 hours, and again 7-10 days later to assess response to the new dose. In situations where owners are unable to monitor blood sugars regularly at home, it is recommended that the dog come into clinic periodically for blood sugar curves (a full day of readings every 2 hours to track response to insulin) and fructosamine levels (a single blood test that gives us an average of how blood sugars have been at home over the past 4-6 weeks).

If diabetic patients are not well controlled and their blood sugar stays *high* for a prolonged period of time, they can go into a diabetic crisis called Diabetic Ketoacidosis, or DKA. This is a life threatening condition for which pets need immediate treatment. Symptoms include lethargy, loss of appetite, weight loss, and vomiting. Call your vet immediately if you note any of these signs.

Diabetic patients are also more vulnerable to infections, particularly bladder infections. Close monitoring of urination habits at home and regular urine analyses in hospital are important, as infections can fester and worsen if not treated promptly. Many diabetics will have "silent" urinary infections with no outward symptoms, making periodic urine assessment important.

Prognosis for diabetes is variable and depends greatly on the pet's age, response to insulin, and whether there is concurrent illness. "Simple" diabetics who are otherwise healthy can often do quite well if owners are diligent with care. It is, however, a long and potentially expensive road, so it is important to be realistic about treatment and whether this is something the family can commit to doing, either schedule-wise or financially. Speak to your veterinarian about any questions or concerns.