

Diabetes in dogs

Diabetes mellitus is a disease in which the [beta cells](#) of the [endocrine pancreas](#) either stop producing insulin or can no longer produce it in enough quantity for the body's needs.

The condition is commonly divided into two types, depending on the origin of the condition: [Type 1 diabetes](#), sometimes called "juvenile diabetes", is caused by destruction of the beta cells of the [pancreas](#). The condition is also referred to as insulin-dependent diabetes, meaning [exogenous](#) insulin injections must replace the insulin the pancreas is no longer capable of producing for the body's needs.

Dogs have insulin-dependent, or Type 1, diabetes; research finds no Type 2 diabetes in dogs.

Because of this, there is no possibility the permanently damaged pancreatic beta cells could re-activate to engender a remission as may be possible with some [feline diabetes](#) cases, where the primary type of diabetes is Type 2. There is another less common form of diabetes, [diabetes insipidus](#), which is a condition of insufficient [antidiuretic hormone](#) or resistance to it.

The condition is treatable and need not shorten the animal's life span or interfere with quality of life. If left untreated, the condition can lead to cataracts, increasing weakness in the legs (neuropathy), [malnutrition](#), [ketoacidosis](#), [dehydration](#), and death.

- Diabetes mainly affects middle-age and older dogs, but there are juvenile cases. The typical [canine](#) diabetes patient is middle-age, female, and [overweight](#) at diagnosis.

-The number of dogs diagnosed with diabetes mellitus has increased three-fold in thirty years. In survival rates from almost the same time, only 50% survived the first 60 days after diagnosis and went on to be successfully treated at home. Currently, diabetic dogs receiving treatment have the same expected lifespan as non-diabetic dogs of the same age and gender

Classification and causes

At present, there is no international standard classification of diabetes in dogs. Commonly used terms are:

- Insulin deficiency diabetes or primary diabetes, which refers to the destruction of the beta cells of the pancreas and their inability to produce insulin.
- [Insulin resistance](#) diabetes or secondary diabetes, which describes the resistance to insulin caused by other medical conditions or by hormonal drugs.

While the occurrence of beta cell destruction is known, all of the processes behind it are not. Canine primary diabetes mirrors Type 1 human diabetes in the inability to produce insulin and the need for exogenous replacement of it, but the target of canine diabetes autoantibodies has yet to be identified.

-Studies have furnished evidence that canine diabetes has a seasonal connection not unlike its human Type 1 diabetes counterpart, and a "lifestyle" factor, with pancreatitis being a clear cause. This evidence suggests that the disease in dogs has some environmental and dietary factors involved.

Secondary diabetes may be caused by use of steroid medications, the hormones of [estrus](#), [acromegaly](#), ([spaying](#) can resolve the diabetes), pregnancy, or other medical conditions such as [Cushing's disease](#). In such cases, it may be possible to treat the primary medical problem and revert the animal to non-diabetic status.

- Returning to non-diabetic status depends on the amount of damage the pancreatic insulin-producing beta cells have sustained.

It is possible for acute pancreatitis to cause a temporary, or transient diabetes, most likely due to damage to the endocrine portion's beta cells.

Insulin resistance that can follow a pancreatitis attack may last for some time thereafter. Pancreatitis can damage the endocrine pancreas to the point where the diabetes is permanent

Genetic susceptibility of certain breeds]

This list of risk factors for canine diabetes is taken from the genetic breed study that was published in 2007. Their "neutral risk" category should be interpreted as insufficient evidence that the dog breed genetically shows a high, moderate, or a low risk for the disease. All risk information is based only on discovered genetic factors.

Pathogenesis

The body uses [glucose](#) for energy. Without insulin, glucose is unable to enter the cells where it will be used for this and other [anabolic](#) ("building up") purposes, such as the synthesis of glycogen, proteins, and fatty acids. Insulin is also an active preventor of the breakdown or [catabolism](#) of glycogen and fat. The absence of sufficient insulin causes this breaking-down process to be accelerated; it is the mechanism behind metabolizing fat instead of glucose and the appearance of ketones.

Since the glucose that normally enters the cells is unable to do so without insulin, it begins to build up in the blood where it can be seen as hyperglycemia or high blood glucose levels. The [tubules](#) of the kidneys are normally able to re-absorb glucose, but they are unable to handle and process the amount of glucose they are being presented with. At this point, which is called the renal threshold, the excess glucose spills into the urine ([glycosuria](#)), where it can be seen in urine glucose testing. It is the [polyuria](#), or over-frequent urination, which causes [polydipsia](#), or excessive water consumption, through an [osmotic process](#). Even though there is an overabundance of glucose, the lack of insulin does not allow it to enter the cells. As a result, they are not able to receive nourishment from their normal glucose source. The body begins using fat for this purpose, causing weight loss; the process is similar to that of [starvation](#)

Symptoms

This dog has complete cataracts; the clouding of its eyes can be easily seen. Depending on the condition of the eyes and the overall health of the dog, it is often possible to have them surgically removed, restoring sight.

Generally there is a gradual onset of the disease over a few weeks, and it may escape unnoticed for a while. The main [symptoms](#) are:

excessive water consumption— [polydipsia](#)

- frequent and/or excessive urination—[polyuria](#)—possible house "accidents"
- greater than average appetite—[polyphagia](#)—with either weight loss or maintenance of current weight
- cloudy eyes—[Cataracts](#)

It is possible that the illness may not be noticed until the dog has symptoms of [ketosis](#) or [ketoacidosis](#). When newly diagnosed, about 40% of dogs have elevated ketone levels; some are in diabetic ketoacidosis when first treated for diabetes.

Management

Early diagnosis and interventional treatment can mean reduced incidence of complications such as [cataracts](#) and [neuropathy](#)

Since dogs are insulin dependent, oral drugs are not effective for them. They must be placed on insulin replacement therapy.

-Approved [oral diabetes drugs](#) can be helpful to sufferers of [Type 2 diabetes](#) because they work in one of three ways: by inducing the pancreas to produce more insulin,

-by allowing the body to more effectively use the insulin it produces,

-or by slowing the [glucose absorption](#) rate from the [GI tract](#).

Unapproved [so-called "natural" remedies](#) make similar claims for their products. All of this is based on the premise of having an [endocrine pancreas](#) with beta cells capable of producing insulin.

-Those with [Type 1](#), or insulin-dependent diabetes, have beta cells which are permanently damaged, thus unable to produce insulin. This is the reason nothing other than [insulin replacement therapy](#) can be considered real and effective treatment. Canine diabetes means insulin dependency; insulin therapy must be continued for life.

The goal is to regulate the pet's blood glucose using insulin and some probable diet and daily routine changes. The process may take a few weeks or many months. It is basically the same as in Type 1 diabetic humans.

-The aim is to keep the blood glucose values in an acceptable range. The commonly recommended dosing method is by "starting low and going slow" as indicated for people with diabetes. Typical starting insulin doses are from 0.25 IU/kg (2.2 lb) to 0.50 IU/kg (2.2 lb) of body weight.

During the initial process of regulation and periodically thereafter, the effectiveness of the insulin dose at controlling blood glucose needs to be evaluated.

-This is done by a series of blood glucose tests called a curve. Blood samples are taken and tested at intervals of one to two hours over a 12- or 24-hour period. The results are generally transferred into graph form for easier interpretation. They are compared against the feeding and insulin injection times for judgment. The curve provides information regarding the action of the insulin in the animal. It is used to

determine insulin dose adjustments, determine lowest and highest blood glucose levels, discover insulin duration and, in the case of continued hyperglycemia, whether the cause is insufficient insulin dose or [Somogyi rebound](#), where blood glucose levels initially reach hypoglycemic levels and are brought to hyperglycemic ones by the body's [counterregulatory hormones](#). Curves also provide evidence of insulin resistance which may be caused by medications other than insulin or by disorders other than diabetes which further testing can help identify.

Other diagnostic tests to determine the level of diabetic control are [fructosamine](#) and glycosylated hemoglobin (GHb) blood tests which can be useful especially if stress may be a factor. While anxiety or stress may influence the results of blood or urine glucose tests, both of these tests measure glycated proteins, which are not affected by them.

Fructosamine testing provides information about blood glucose control for an approximate 2- to 4-week period, while GHb tests measure a 2- to 4-month period. Each of these tests has its own limitations and drawbacks and neither are intended to be replacements for blood glucose testing and curves, but are to be used to supplement the information gained from them. While HbA1c tests are a common diagnostic for diabetes in humans, there are no standards of measurement for use of the test in animals. This means the information from them may not be reliable.

The diabetic pet is considered regulated when its blood glucose levels remain within an acceptable range on a regular basis. Acceptable levels for dogs are between 5 and 10 mmol/L or 90 to 180 mg/dL. The range is wider for diabetic animals than non-diabetics, because insulin injections cannot replicate the accuracy of a working pancreas.

Insulin therapy

The general form of this treatment is an intermediate-acting basal insulin with a regimen of food and insulin every 12 hours, with the insulin injection following the meal. The most commonly used intermediate-acting insulins are [NPH](#), also referred to as isophane, or Caninsulin, also known as Vetsulin, a porcine Lente insulin. While the normal diabetes routine is timed feedings with insulin shots following the meals, dogs unwilling to adhere to this pattern can still attain satisfactory regulation. Most dogs do not require [basal/bolus](#) insulin injections; treatment protocol regarding consistency in the diet's calories and composition along with the established feeding and injection times is generally a suitable match for the chosen intermediate-acting insulin.

Diet

Most of the commercially available prescription diabetes foods are high in fiber, complex carbohydrates, and have proven therapeutic results. Of primary concern is getting or keeping the animal eating, as use of the prescribed amount of insulin is dependent on eating full meals. When no meal is eaten, there is still a need for a [basal](#) dosage of insulin, which supplies the body's needs without taking food into consideration. Eating a partial meal means a reduction in insulin dose.

-It is possible to regulate diabetes without any diet change. If the animal will not eat a prescribed diet, it is not in the dog's best interest to insist on it; the amount of additional insulin required because a non-prescription diet is being fed is generally between 2–4%.

-Semi moist foods should be avoided as they tend to contain a lot of sugars. Since dogs with diabetes are prone to pancreatitis and [hyperlipidemia](#), feeding a low-fat food may help limit or avoid these complications.

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Glucometers and urine test strips

The use of an inexpensive [glucometer](#) and blood glucose testing at home can help avoid dangerous insulin overdoses and can provide a better picture of how well the condition is managed.

Ketodiastix color chart for interpreting test results. This test measures **both ketones and glucose** in urine.

Using only one blood glucose reading as the reason for an insulin dose increase is to be avoided; while the results may be higher than desired, further information, such as the lowest blood glucose reading or nadir, should be available to prevent possible hypoglycemia.

[Urine strips](#) are not recommended to be used as the sole factor for insulin adjustments as they are not accurate enough. Urine glucose testing strips have a negative result until the [renal threshold](#) of 10 mmol/L or 180 mg/dL is [reached or exceeded](#) for a period of time. The range of negative reading values is quite wide-covering normal or close to normal blood glucose values with no danger of hypoglycemia ([euglycemia](#)) to low blood glucose values ([hypoglycemia](#)) where treatment would be necessary.

- Because urine is normally retained in the bladder for a number of hours, the results of urine testing are not an accurate measurement of the levels of glucose in the bloodstream at the time of testing.

Glucometers made for humans are generally accurate using canine and feline blood except when reading lower ranges of blood glucose (<80 mg/dL), (<4.44 mmol/L). It is at this point where the size difference in human vs animal red blood cells can create inaccurate readings.

Treatment complications

Hypoglycemia

Hypoglycemia, or low blood glucose, can happen even with care, since insulin requirements can change without warning. Some common reasons for hypoglycemia include increased or unplanned exercise, illness, or medication interactions, where another medication [potentiates](#) the effects of the insulin. [Vomiting](#) and [diarrhea](#) episodes can bring on a hypoglycemia reaction, due to dehydration or simply a case of too much insulin and not enough properly digested food

Symptoms of hypoglycemia need to be taken serious hypoglycemia can be fatal, it is better to treat a suspected incident than to fail to respond quickly to the signs of actual hypoglycemia.

"Hypoglycemia is deadly; hyperglycemia is not. Owners must clearly understand that too much insulin can kill,

Symptoms

Some common symptoms are:

- depression or lethargy
- confusion or dizziness
- trembling
- weakness
- ataxia (loss of coordination or balance)
- loss of excretory or bladder control (sudden house accident)
- vomiting, and then loss of consciousness and possible seizures
- Successful home treatment of a hypoglycemia event depends on being able to recognize the symptoms early and responding quickly with treatment.
- Trying to make a seizing or unconscious animal swallow can cause choking on the food or liquid. There is also a chance that the materials could be [aspirated](#)
- Seizures or loss of consciousness because of low blood glucose levels are medical emergencies.

Treatment

Food should be offered at the first signs of possible hypoglycemia. If the animal refuses it, a sugar solution ([corn syrup](#), [honey](#), [pancake syrup](#),) should be poured on the finger and rubbed on its gums or under the tongue ([sublingually](#)). The solution must be applied this way to prevent possible aspiration of it.

- Intervet suggests one tablespoon of a sugar solution rubbed onto the gums, regardless of the size of the dog.

-Another hypoglycemia formula is 1 gram of glucose for every kilogram (2.2 lb) of the animal's body weight. Since sugar acts quickly, a response should be seen within a minute or two.

Honey, syrup, or sugar, as [simple carbohydrates](#), act rapidly and will make the blood glucose rise, but the rise will not last very long, as they are broken down quickly by the body.

- Feeding something containing [complex carbohydrates](#) when the pet is able to eat will make sure another hypoglycemia event does not overtake the rapid rise in blood glucose levels from the sugar solution.

- Complex carbohydrates take longer to be broken down by the body, so they do not raise blood glucose levels until some time after being eaten.

-A small meal should be fed and the animal taken for medical evaluation to determine if further treatment is needed. Treatment of a serious hypoglycemia episode is similar to that of diabetic humans: using [glucose or glucagon infusions](#), depending on severity