

Diabetes Mellitus (Dogs)

ABOUT THE DIAGNOSIS

Cause: Diabetes mellitus (DM), generally just called diabetes or sometimes sugar diabetes, is a disease that affects dogs and cats, just as it affects people. Diabetes mellitus can be caused by a deficiency of insulin or abnormal use of insulin, either of which results in the inability of the body's tissues and organs to properly utilize glucose (a type of sugar). These result in the cells being starved for energy despite high blood glucose levels.

There are two types of DM. The first, also called insulin-dependent or type I DM, occurs when the body does not produce enough insulin. The second type is non-insulin-dependent DM or type II DM, which occurs when the body's ability to utilize the insulin it produces is abnormal; this type is important in cats and in people but is very rare in dogs. Almost all dogs with DM have insulin-dependent type I, in which the cells in the pancreas (an abdominal organ) that should produce insulin have failed. Unlike cats or people with type II DM that might go into a remission, DM in dogs almost always requires lifelong insulin treatment.

Diabetes mellitus is one of the most common endocrine (hormonal) disorders in dogs. Diabetes mellitus usually affects middle-aged to older dogs, and while any breed can be affected, it is more common in the keeshond, puli, miniature pinscher, Cairn terrier, poodle, dachshund, miniature schnauzer, and beagle breeds.

The cause for DM in dogs is rarely identified, although genetic factors and immune system destruction of the endocrine pancreatic cells likely play important roles. Other diseases, such as recurrent bouts of pancreatitis, infection, or cancer can occasionally precipitate DM. Some female dogs that have not been surgically neutered (spayed) can develop DM during pregnancy or due to hormones; this might resolve after a pregnant bitch gives birth or if she is spayed.

Most diabetic dogs initially have mild or moderate symptoms. The first evidence of disease is usually an increase in thirst and urination, with or without weight loss. At the far end of the spectrum, however, ketoacidosis is a very serious complication of DM and is considered a medical emergency. Uncontrolled, ketoacidosis produces diabetic coma and may be fatal. Animals with diabetic ketoacidosis are most often lethargic (sluggish), have little or no appetite, and generally seem profoundly ill; diagnostic testing by a veterinarian is necessary to identify ketoacidosis, and intensive care treatment is generally necessary for animals with diabetic ketoacidosis.

Other complications of DM may be the first reason for a veterinary visit. Diabetic animals are more prone to developing bacterial and fungal infections (opportunistic infections). Urinary tract infections are very common, as sugars present in the urine of diabetic patients can allow bacteria to multiply. Sometimes, the first sign of DM is a fairly sudden onset of blindness. Diabetic dogs are extremely prone to develop cataracts, which can come on seemingly overnight.

Diagnosis: Symptoms of DM can vary from patient to patient and are often common to several other diseases. The most common early signs of DM include an increase in thirst and urination, weight loss, and an increase in appetite. Later in the course of the disease, sluggishness and vomiting can be noted. Dogs can also develop poor vision and a white or cloudy discoloration of the eyes due to cataracts.

Your veterinarian will begin by asking you several questions to try to determine if DM, or another type of problem altogether, could be responsible for symptoms. You should provide whatever

information you have when you answer these questions, which often include: the type of symptoms observed, the length of time they have been occurring, effects on vital functions such as appetite and urine elimination, current diet, and any current medications or supplements you are giving your pet. There is no specific finding on physical examination that can confirm the diagnosis. If DM is suspected by your veterinarian, further testing will be recommended.

Routine blood and urine tests can help diagnose DM as well as rule out other possible medical problems that produce similar symptoms. A blood glucose level and urinalysis are the tests of choice. Finding persistently high levels of glucose in the blood (hyperglycemia) and urine (glucosuria) in a fasted (no intake of food for 8 or more hours) dog is typically diagnostic for DM. A complete blood count (CBC), biochemical profile, urine culture and sensitivity, imaging techniques (x-rays and ultrasound), and tests for other hormonal problems are also commonly performed to identify other concurrent illnesses and underlying diseases.

The diagnosis of DM, and its treatment, can be complex and challenging. No two individuals with this disease are alike. If there are questions, or simply for a second opinion, your veterinarian may refer you to a veterinary internal medicine specialist for a second opinion (directory: www.acvim.org or www.vetspecialists.com for North America; www.ecvim-ca.org for Europe).

LIVING WITH THE DIAGNOSIS

Diabetes mellitus is a serious and life-threatening disease if left untreated. On the other hand, most diabetic dogs that are diagnosed and treated properly can live a normal or near-normal life span with a good quality of life. Managing a diabetic animal requires a great commitment of time, education, observation, and follow-up care. There is also a financial commitment that comes with caring for a dog with DM.

Sticking with a routine is enormously important for management of DM. Ideally meals and insulin injections are given as close to the same time as possible each day, twice each day. A consistent amount of controlled exercise each day is ideal for dogs, provided this is tolerated by the dog and the level is tailored to remain comfortable for your pet and for you. As in diabetic people, a good daily routine of eating and exercising for diabetic pets will help prevent irregular fluctuations.

Many dog owners are anxious about the need to inject insulin. However, most dogs are not bothered by the injections in the least, and with a little practice, it is not difficult. You may know people that receive pills for treatment of DM; oral antidiabetic medications can help with type II DM, but since dogs almost always have type I DM, pills are not an option. Instead, insulin injections are required.

It is very important to become familiar with the proper handling, administration, and disposal of insulin. There are not only multiple types of insulin, but multiple types of insulin syringe - it is important that you know which type your dog receives, and you use the correct syringe. You will want to check each time you receive a refill that both the insulin, and the insulin syringes, are the correct type for your dog. If you have trouble using the syringe, or your vision makes it difficult to read the small numbers on the syringe used to treat a small dog, you can discuss the use of an "insulin pen". These devices allow you to "dial in" the dose needed rather than drawing it up out of a vial. You then deliver the dose to the pet by holding the pen against the skin and pushing a button.

Your veterinarian will be able to give you detailed instructions on how to store, handle, and administer insulin. Different types

of insulin have different handling instructions, but it is important that it be kept in a cool dry place (refrigerator is usually ideal). For most types of insulin, the bottle should be mixed carefully and thoroughly before drawing up the insulin dose by rolling the bottle gently in your hands until thorough mixing is achieved. On the other hand, one of the most common types of insulin used to treat dogs (e.g., Vetsulin, Caninsulin) must be shaken to form a milky suspension. After you give the insulin, the needle and syringe should be disposed of and not reused. You can collect them in a puncture-proof container (e.g., empty bleach jug) and bring it to your veterinarian for disposal according to state/provincial/local laws on medical waste.

You should discuss an ideal diet for your dog with your veterinarian and feed only the recommended foods. Some prescription pet diets are made especially for diabetic patients and should be used if your dog enjoys the taste of them because they can improve diabetic control. If your pet is unwilling to eat a prescription diet, contact your veterinarian prior to changing foods about other options. Portioned meal feeding has distinct advantages over free feeding (leaving food out all the time). Usually, two meals a day are fed, each one just before insulin administration. This can allow you to make sure your dog has an appetite, and to recognize when the appetite is suppressed. Always provide unlimited access to fresh clean water to drink. It is also important to talk to your veterinarian about any changes that should be made to your dog's medications if he/she is unwilling to eat or if digestive problems such as vomiting occur. In many cases, the insulin dose may be halved or skipped entirely if the dog misses one of the major meals to avoid causing a too low blood sugar.

During the first few months after an animal is diagnosed with DM, several trips to the veterinarian will be required for rechecks and tailoring of the treatment. In most situations, your dog will begin with a low dose of insulin that might need to be gradually increased by your veterinarian based on rechecks until diabetes is well-controlled. Often, your veterinarian will perform a "blood glucose curve" to make a graph of what happens to glucose levels during the day after insulin administration. Blood sugar levels are measured every hour or two for a 12- or 24-hour period 1 to 2 weeks after starting the insulin (the first recheck visit) and periodically thereafter to ensure that appropriate glucose levels are seen. This helps prevent giving too much insulin to your pet and causing dangerously low blood sugar levels, and it allows for fine-tuning of the insulin dose. It is common initially for blood glucose levels to be checked by your veterinarian every 1 to 2 weeks. To do this, your dog generally will have to stay in the hospital for the day in order to monitor blood glucose levels every few hours. Once the diabetes is well regulated, these visits will be less frequent, but some degree of monitoring is still required (a few times per year) since insulin requirements can change with time. Some dog owners choose to learn to measure blood glucose at home so that they can perform the curve themselves with less stress for the dog, then share the information with their veterinarian for interpretation. Occasionally, veterinarians might ask you to check urine ketones at home; if ketones are present, a trip to the veterinarian is warranted. It also is very important to carefully note any changes in your pet's weight, drinking, urination, and eating habits between appointments.

Once your pet has started insulin injections, monitoring for signs of low sugar levels (hypoglycemia) is also very important. As mentioned, too much insulin can cause blood sugar levels to go too low. Low sugar levels can cause disorientation, sluggishness, seizures, coma, and even death if prolonged. If you notice that your dog seems disorientated or weak but is still responsive, offer food immediately. If your dog is unconscious (cannot be awoken despite loud calling and shaking), apply a sugary solution like corn

syrup or maple syrup to the gums. In both of these cases, contact your veterinarian or local emergency veterinary hospital immediately.

TREATMENT

The goal of treating a diabetic animal is to minimize blood glucose fluctuations, eliminate the symptoms associated with high blood glucose levels (excessive drinking, urination, and appetite), and improve the quality of the pet's life.

Treatment of DM must be based on the individual patient, the severity of the symptoms, the underlying cause, and the secondary diseases that may be involved. In every patient, however, all concurrent or underlying diseases should be diagnosed and treated. Intact females (dogs that have not been altered/spayed) should be spayed. Hormonal changes that occur when animals are in heat can alter the effects of insulin and the body's use of glucose.

Patients with severe symptoms of DM or ketoacidosis will likely need to be hospitalized initially while intravenous (IV) fluids are given to correct dehydration, electrolyte, and acid-base abnormalities and medications including insulin are initiated. Ketoacidosis and severe symptoms (such as loss of appetite, vomiting, and collapse) is a very serious combination that carries a guarded prognosis; one third of patients do not survive even with intensive care.

Luckily, most dogs with DM can be treated with insulin at home and are likely to do well provided that you are able and willing to invest the time and effort required to manage the disease. Very likely, you will be injecting a small volume of insulin just under the skin twice daily at mealtime. The insulin types vary in strength and length (duration) of effect. Your veterinarian will recommend the most appropriate insulin for your animal. Comparison of the insulin types you are most likely to use are given below.

Insulin Type	Syringe Type	Veterinary Product	Comments
Lente (e.g., Vetsulin)	U-40	yes	The preferred insulin for dogs
NPH	U-100	no	Commonly used for dogs
Glargine	U-100	no	Uncommonly used in dogs
PZI	U-40	yes	Rarely used in dogs
Detemir	U-100	no	Rarely used in dogs

A diet and weight management program is essential to proper treatment of DM. Diets that are high in simple carbohydrates (sugars), which can cause a spike in blood sugar levels, are avoided. Diets containing complex carbohydrates (starches) that are broken down and used by the body more slowly are preferable, in moderation. Fiber is an important ingredient in diabetic diets since it slows the absorption of carbohydrates in the body and can decrease hunger sensations for those animals that are overweight. There are several different commercial prescription diets available that can meet the needs of all diabetic patients, whether weight loss, maintenance, or gain is the goal.

Cataracts (cloudy eyes with poor vision to blindness) that develop in dogs as a result of DM are permanent and will not resolve once the DM is regulated. Unfortunately, cataract formation is extremely common even in dogs receiving insulin. Fortunately, this does not have to have a negative impact on quality of life. Most dogs adapt very well to poor eyesight, but sight can be restored through cataract removal surgery. This type of surgery is generally performed by a veterinary ophthalmologist (see www.acvo.com for a listing of veterinarians specialized exclusively in eye problems of animals) once the blood sugar levels have been regulated.

DOs

- Realize that DM is a very treatable disease but that the proper management of a diabetic animal requires significant commitment of time, finances, and attention.
- Realize that serious and life-threatening complications can arise, especially if DM is left untreated or is treated inappropriately.
- Offer food immediately if you notice that your diabetic dog who is receiving insulin seems disoriented but is still alert and responsive. If your diabetic dog who is receiving insulin appears unconscious, apply a sugary solution like corn syrup or maple syrup to the gums. In either of these cases, contact your veterinarian or local emergency veterinary hospital immediately.
- Keep all recommended follow-up appointments with your veterinarian since they are essential in keeping your pet's blood sugar levels well regulated.
- Have your veterinarian or veterinary technician show you how to give all medications and demonstrate the correct method for insulin handling, administration, and disposal.
- Double check the insulin and syringe type each time you get a refill.
- Ask your veterinarian how long you can use the same bottle of insulin. For small dogs, there may be leftover insulin in the bottle at the time it reaches its expiration and should be discarded.
- Handle and use insulin as directed
 - Wipe the stopper of the insulin vial with alcohol then let it dry before use
 - Either roll or shake the insulin to create a suspension (depending on insulin type)
 - Keep the insulin cool and dry (refrigerator is ideal); never freeze, and never allow it to sit in the sun or in a hot car
 - Check that the insulin is not discolored and does not contain "chunks" after rolling/shaking that might indicate it has been contaminated and needs to be replaced.
- Handle and give all medications exactly as directed by your veterinarian. If you feel your pet is having side effects from any medications or you are finding it very difficult to medicate your animal, contact your veterinarian for advice before discontinuing the treatment.
- Ask what you should do if your dog skips a meal. You may be instructed to give a half dose of insulin with one skipped meal,

but if your dog doesn't want the next meal either, a trip in for evaluation is likely necessary.

- Ask your veterinarian questions about information you do not understand.
- Ask if home glucose monitoring would be helpful for your dog.
- Understand that in some dogs, DM can be difficult to treat, and a second opinion from a veterinary internal medicine specialist may be helpful. You can discuss this with your veterinarian and a list of these specialists is available at www.acvim.org or www.vetspecialists.com for North America; www.ecvim-ca.org for Europe.

DON'Ts

- Do not postpone a visit to your veterinarian if you observe any symptoms of illness or of DM since early diagnosis and treatment can aid in preventing serious and life-threatening complications of the disease and improving the quality of your pet's life. The initial screening may only require a physical exam and routine blood and urine tests.
- Do not increase the insulin dose without discussion first with your veterinarian as this could cause dangerously low blood sugar levels.
- Do not give any medications that are not prescribed by your veterinarian for the specific animal in question.
- Do not stop any medications if your animal is feeling better without consulting with your veterinarian first.
- Do not assume that all sources of information are accurate or complete (i.e., internet sites, outdated pamphlets or books, pet store workers, friends, etc.). Ask your veterinarian for recommended sources of information.
- If you are giving insulin injections at home, do not reuse or dispose of needles or syringes in the trash. Rather, collect them in a puncture-proof container (e.g., empty bleach jug) and bring it to your veterinarian for disposal.

WHEN TO CALL YOUR VETERINARIAN

- If your pet's symptoms change, worsen, or any new problems arise.
- If you are unable to give medications as prescribed or if you require a prescription refill.

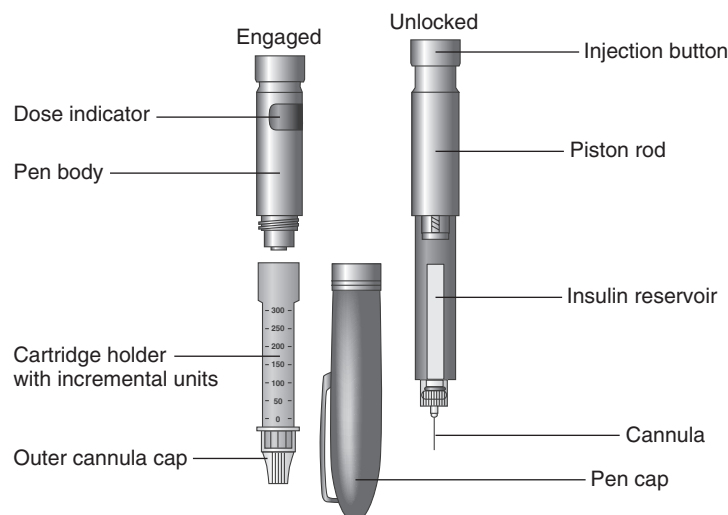


Diagram of typical insulin pen components. (Adapted from Gesenhues S, Ziesché R (eds): Praxisleitfaden Allgemeinmedizin. Berlin: Urban & Fischer, Elsevier, 2010. Fig 17-3.)

- When you have any questions or concerns related to your pet's continual treatment plan or current status.

SIGNS TO WATCH FOR

Symptoms that could indicate poor diabetic control or an additional medical problem, meaning a recheck visit to the veterinarian should be made promptly:

- Watch for general signs of illness, which can include changes in appetite, weight loss, decrease in activity, sluggishness, dull or poorly kept coat, and changes in behavior such as hiding and aggressiveness.
- Watch for signs of recurrent or persistent DM, which can include an increase in thirst (Are you filling up the water bowls more often? Is your animal drinking water from taps, bathtubs, fountains, etc.?) and urination (Is your animal asking to go outside more frequently or having accidents in the house?), vomiting, weakness, changes in vision and appearance of the eyes.

ROUTINE FOLLOW-UP

- As insulin requirements of a diabetic dog can change over time, it is very important to keep all recommended follow-up appointments and lab tests with your veterinarian in order to monitor blood sugar levels, document and treat any new problems that may arise, and make any needed medication adjustments.

Other information that may be useful: "How-To" Client Education Sheets:

- How to Administer and Handle Insulin
- How to Monitor Blood Glucose Levels at Home

Practice Stamp or Name & Address

Also available in Spanish.