

# Diabetes Educational Toolkit



Sponsored by  **Boehringer  
Ingelheim**



### Diabetes Educational Toolkit

Diabetes mellitus has become an increasingly common endocrine condition in cats. Management and treatment of feline diabetes is often perceived as a very complicated process as each cat needs an individualized plan, which includes frequent reassessment and adjustments to treatment as needed.

#### Instructions for Use

This educational toolkit is intended to be an implementation tool for veterinary professionals to access and gather information quickly. It is not intended to provide a complete review of the scientific data for feline diabetes. In order to gather a deeper understanding of feline diabetes, there are excellent resources for further reading linked in the left sidebar of the digital toolkit. We recommend that you familiarize yourself with these resources prior to using this toolkit.

To use the online toolkit, click the tabs at the top in the blue navigation bar to access each page and read more information about each area including diagnosis, treatment, remission strategy, troubleshooting, frequently asked questions (FAQs), and client resources. Each page also has an associated printable PDF that you can use in your practice. This document is a compilation of all of those pages.

#### Acknowledgments

The AAFP would like to thank **Boehringer Ingelheim** for their educational grant to develop this toolkit, and for their commitment to help the veterinary community improve the lives of cats. We also would like to thank our independent panel for their hard work in developing this educational toolkit content – Audrey Cook, BVM&S, MSc VetEd, DACVIM-SAIM, DECVIM-CA; Kelly St. Denis, MSc, DVM, DABVP (Feline); Sonnya Dennis, DVM, DABVP (Canine/Feline); and Elaine Wexler-Mitchell, DVM, DABVP (Feline), Chair.



#### Acronym Glossary

<b>BCS</b>	Body Condition Score	<b>PD</b>	Polydipsia
<b>BG</b>	Blood Glucose	<b>PP</b>	Polyphagia
<b>CBC</b>	Complete Blood Count	<b>PU</b>	Polyuria
<b>DKA</b>	Diabetic Ketoacidosis	<b>PZI</b>	Protamine Zinc Insulin
<b>DM</b>	Diabetes Mellitus	<b>RBC</b>	Red Blood Cell
<b>FeLV</b>	Feline Leukemia Virus	<b>T<sub>4</sub></b>	Thyroxine
<b>FIV</b>	Feline Immunodeficiency Virus	<b>U</b>	Units
<b>fPL</b>	Feline Pancreas-specific Lipase Test	<b>UA</b>	Urinalysis
<b>MCS</b>	Muscle Condition Score	<b>UPC</b>	Urine Protein Creatinine Ratio
<b>ME</b>	Metabolizable Energy	<b>UTI</b>	Urinary Tract Infection



### Diagnosis

Diabetes mellitus is not always a straightforward diagnosis. It requires a thorough assessment of clinical signs, individual history, and laboratory results. In the early stages of disease, cats may present with vague signs such as “seems a little off” or “less interactive lately.” Stress hyperglycemia can further complicate or delay diagnosis.

#### Client Concerns and History

- Weight loss (or owner's perception that a diet is *finally* working)
- Drinking more water
- Drinking from unusual places
- Begging for food/insatiable appetite
- Decreased ability to jump
- Lethargy
- Urine is sticky or difficult to clean
- More frequent urination, larger urine clumps, or urination out of the box

#### Supportive Clinical Findings

- Polyuria (PU), Polydipsia (PD), Polyphagia (PP)
- Weight loss
- Hyperglycemia and glucosuria; +/- ketonuria
- Plantigrade stance
- DM cats that are weak, depressed, anorexic, vomiting, collapsed, or moribund may have diabetic ketoacidosis (DKA) and require emergency care. (*Refer to ISFM Guidelines on Diabetes Mellitus, page 246*)

#### Diagnostics

- Minimum database: CBC, chemistry with electrolytes, Total T<sub>4</sub>, UA, FeLV/FIV Status
- Additional tests as appropriate to help confirm diagnosis: Fructosamine and fPL
- Additional tests as appropriate to fully assess the patient: blood pressure, UPC ratio, urine culture; also consider cobalamin and folate concentrations, thoracic radiographs, abdominal ultrasound

#### Complicated Diabetics

The following are comorbidities that may complicate diabetic regulation:

- Chronic Kidney Disease (CKD)
- Obesity
- Urinary Tract Infection (UTI)
- Dental disease
- Exposure to human hormone creams
- Conditions where steroids are a common component of management
- Acromegaly
- Hyperadrenocorticism

---

#### Diabetes Mellitus Diagnosis

A diagnosis of DM requires documentation of hyperglycemia (BG >250 mg/dl {13.8 mmol/L}) and concurrent glucosuria, plus one or more of the following pieces of supportive evidence:

- A history of PU/PD/PP and ketonuria
- An increased serum fructosamine concentration
- An increased glycated hemoglobin % (HgA1c)
- Documentation of hyperglycemia in the home environment (BG >250 mg/dl) 24 hours after a hospital visit
- Documentation of glucosuria in the home environment 24 hours after a hospital visit



### Treatment

Effective treatment is based on a combination of client goals, finances, implementation of the treatment plan, and the patient’s response. It is very important to establish goals with the owner at the initiation of treatment and to maintain a frequent, open dialogue.

#### Goals

- Regulate blood glucose
- Achieve stable, appropriate body weight - set and achieve a Body Condition Score (BCS) goal and maintain normal Muscle Condition Score (MCS)
- Reduce or eliminate clinical signs of hyperglycemia (e.g. PU/PD/PP)
- Avoid hypoglycemia
- Avoid complications associated with sustained hyperglycemia
- Achieve good quality of life (OSU has a tool called “How Do I Know When it’s Time?” See link in digital toolkit.)
- Avoid diabetic ketoacidosis
- Avoid peripheral neuropathy
- Achieve possible remission

#### Feeding Recommendations and Diet

- Maintain weight if good BCS
- Provide low carbohydrate diet
- Manage obesity
  - Loss of 0.5-2% of body weight per week (e.g. 0.3 lbs/0.137 kg per week for a 15 lb/6.8 kg cat)
  - Protein >5g/100 kcal, carbs 3g/100 kcal
  - Low carb diet <12% metabolizable energy (ME) fed to achieve target BCS
  - *Pet Nutrition Alliance Calculator Tool* (See link in digital toolkit)

#### Insulin Therapy

“There are many insulin formulations available worldwide, some specifically licensed in cats, which can be used to manage feline DM safely and effectively, especially when combined with an appropriate diet. The choice of insulin used by a clinician will depend on availability, familiarity, and the properties of the insulin itself. Additionally, in some countries, regulations may limit the first-line choice to certain veterinary registered products.” (*ISFM Guidelines on Diabetes Mellitus, page 239*)

Type	Formulation	Duration of Action	Starting Dose	Median Maintenance Dose
Lente (Vetsulin/Caninsulin)	U40	Medium-acting (8-10 hours)	0.25-0.5 U/kg q12h 0.11-0.23 U/lb q12h	0.5 U/kg q12h
Glargine (Lantus)	U100	Long-acting (12-24 hours)	0.25-0.5 U/kg q12h 0.11-0.23 U/lb q12h	2.5 U/cat q12h
PZI (Prozinc)	U40	Long-acting (13-24 hours)	0.2-0.7 U/kg q12h 0.1-0.3 U/lb q12h	0.6 U/kg q12h
Detemir (Levemir)	U100	Long-acting (12-24 hours)	0.25-0.5 U/kg q12h 0.11-0.23 U/lb q12h	1.75 U/cat q12h

*\*This table was created based on the ISFM Guidelines on Diabetes Mellitus.*

#### Initial Treatment

- Dosing initiated at 0.25-0.5 U/kg q12h (Most average cats are initiated on 1 U/cat q12 hrs. Round to the nearest half unit if more precision is required.)
- Schedule demonstration to teach proper insulin handling and administration.
- Recommend client daily treatment log listing dose, administration of feeding and insulin times, any observations, food and water intake, and urine output assessment. Discuss monitoring protocols.
- Hypoglycemia is unlikely if a cat is started in 1 U q12h and many practices do not hospitalize when starting insulin therapy.

*continued on next page*



### Treatment continued

#### Initial Treatment continued

- If hospitalization is decided upon: Day 1 begin with BG readings every 2 hrs unless BG below 150 mg/dl (8.3 mmol/L) then check hourly. *(Some examples for hospitalization might include: if the owner was not able to observe and monitor the cat during initial treatment, if the owner requires more in depth assistance during initial treatment, preference of the practitioner to observe the cat or check BG q2hrs after the first dose [hypoglycemia following a standard first dose of insulin is unlikely, however the first dose effect is somewhat unpredictable], or a cat with DKA.)*
- Identify and treat pain.

#### Monitoring Protocols

There are various ways to monitor a patient's response to insulin and determine dose adjustments. The method(s) used should be tailored to best meet the needs of both the cat and the owner.

##### *Intensive*

This protocol may be considered in a patient with a good likelihood of diabetic remission. The owner must be willing to monitor the cat closely and be able to follow directions.

- BG is checked at home three times a day
  - Before each insulin injection
  - 6-10 hours after the morning dose
  - Insulin dose is adjusted as necessary
    - Goal is to keep BG between 80 mg/dl (4.4 mmol/L) and 220 mg/dl (12.3 mmol/L)
    - Clear, written guidelines regarding dose adjustment must be provided to the owner
      - Adjustments are usually made in 0.5 U increments
      - Insulin dose should not be increased more frequently than q3 days
      - Insulin dose must be decreased if hypoglycemia is identified (*see References list – Roomp 2009*)

##### *Standard*

This protocol supports, but does not require, at-home BG monitoring and is a suitable choice for many diabetic cats, particularly those with comorbid conditions.

- Recheck examination in clinic 5-10 days after starting insulin
  - Patient weight checked and compared to expectations
  - Clinical signs (PU, PD, PP) and any other owner concerns are discussed
  - BG curve evaluated
    - Performed at home the day before examination (preferred), *or*
    - BG curve performed in the clinic (consider the impact of stress on these values)
  - Recheck diagnostics if previously abnormal as appropriate
  - Adjustments are usually made in 0.5 U increments
- Goals:
  - BG nadir >80 mg/dl (4.4 mmol/L)
  - BG peak <300 mg/dl (16.6 mmol/L)
  - BG <250 mg/dl (13.8 mmol/L) for most of the day without hypoglycemia
  - Avoid PU >50 mL/kg/day or approximately 8 oz for a 10# cat
  - Avoid PD >100 mL/kg/day or approximately 16 oz for a 10# cat
  - Patient examination + BG curve (home or clinic) q5-7 days until stable, then q3-6 months
  - Assessment of serum fructosamine may be useful if stress hyperglycemia is a concern, or if BG values do not correlate well with clinical signs, weight change, etc.

##### *Loose*

This protocol relies primarily on clinical signs (water intake, urination) and body weight to make insulin adjustments. This protocol may be a suitable choice if the owner's time or resources are limited. (*see References list – Restine 2019*)

- Attempt to keep BG below 350 mg/dl (19.5 mmol/L) if possible for most of the day
- Recheck examination and follow-up are still needed based on the individual cat



### Remission Strategy

Remission is the ideal goal, but not possible or appropriate for all patients. The ISFM Guidelines on Diabetes Mellitus state: “If negative glucosuria and/or euglycaemia are maintained for 2–4 weeks without insulin, the cat has likely achieved remission.”

- Need to establish goals with owner based on each client’s circumstances
- Insulin administration with the goal to keep BG <220 mg/dl (12.3 mmol/L)
- More likely achieved with intensive regulation utilizing insulins shown to have a longer duration of action in the cat (i.e., detemir, glargine, PZI)

#### Home BG Monitoring

- Adjust dose based on pre-insulin and nadir values

#### Dietary Recommendations

- Restricted carb diet <3g/100 kcal
- Carbs <12% of ME
- Regularly monitoring weight and BCS

#### Management of Obesity

- Target loss of 0.5-2% of body weight per week

#### Mitigation of Insulin Resistance

- Management of other diseases (i.e., endocrinopathies, dental disease, UTI, pancreatitis, etc.)
- Withdrawal of corticosteroids and progestins
- Management of obesity (see above)

#### In the Clinic

- If remission seems likely, more frequent clinic appointments may be necessary

#### Remission Frequently Asked Questions

See Remission FAQs for answers to questions such as, “Is it worthwhile to try for remission?” “What is the chance a patient will go into remission?” “Which patient is most likely to go into remission?” and “What else should I consider about remission?”





### Troubleshooting

Treating diabetic cats is not always straightforward and can be affected by a variety of factors.

#### Uncontrolled Blood Sugar

- Review home care, administration, and daily treatment logs
- Review insulin handling: storage; gentle handling of large, fragile protein structure; and drawing up product correctly (i.e., inversion of vial, ensure not drawing up air)
- Ensure correct measurement of required dosage: review technique, observe client drawing up insulin
- Ensure correct syringes being used: U-40 for 40 U/ml and U-100 for 100 U/ml insulins
- Ensure correct technique for subcutaneous administration: review with client, observe client administering insulin
- Ensure diet recommendations are being followed

#### Infection

- Appropriate diagnostic testing for infections should be pursued:
  - Urinalysis
  - Urine culture/sensitivity
  - *Note: inactive sediment in urinalysis with dilute urine does not rule out a UTI*
- Appropriate treatment of concurrent infections:
  - Treatment of urinary tract infection based on urine culture and sensitivity testing
  - Treatment of skin infection
  - Treatment of parasites

#### Dental Disease

- It may not be possible to achieve diabetic regulation until concurrent dental disease is treated.
- Management of concurrent dental disease should not be delayed as this may impact insulin responsiveness.
- Appropriate care for dental disease should be pursued:
  - General anesthesia
  - Dental radiographs
  - Surgical extraction of diseased teeth
  - Scaling and polishing of healthy teeth

#### Acromegaly/Hypersomatotropism

Pituitary tumor with excessive production and secretion of growth hormone

- Effects: Insulin resistant DM secondary to excess growth hormone, anabolic effects of excessive IGF-1, space occupying effect of pituitary macroadenoma
- Physical changes: weight gain, a broadened face, enlarged feet, protrusion of mandible, increased interdental spacing, organomegaly, poor coat
- Test: Serum IGF-1 concentration > 1000 ng/mL supports this diagnosis. Note: IGF-1 results may be unreliable in untreated diabetics; testing after 6 weeks of exogenous insulin is recommended. (*see References list – Niessen 2007*)
- Cats with hypersomatotropism will require insulin dosages in excessively high ranges (2-70 U daily)

#### Hypoglycemia

- Potentially higher risk in tightly controlled patients
- May be associated with the onset of remission
- Signs include lethargy, ataxia, dilated pupils
- Treat with corn syrup, over the counter glucose gels/paste, or sugar water with care to avoid aspiration. Attempt to apply any treatments to the gums
- Emergency veterinary visit (requires an informed client)
- Withhold insulin until hyperglycemic again and restart with lowered dose
- Confirm there has not been overdosing or double dosing

*continued on next page*



### Troubleshooting continued

#### Somogyi Effect

- Rebound hyperglycemia as a counter regulatory response to low blood sugar
- Mediated by effects of adrenaline, cortisol, growth hormone, and glucagon
- Observed as a BG <70 mg/dL (3.8 mmol/L), followed by a steep rise exceeding 400 mg/dl (22 mmol/L)
- Documented cases are rare but if suspicions are present, 18 to 24 hour BG curves may be needed to identify

#### Switching Insulin

- No wash out period required
- Start at the newly diagnosed patient dose (0.25-0.5 U/kg q12h based on lean body weight)
- Switching insulin should be considered only if duration of effect is an issue or after other troubleshooting has failed to determine a cause for uncontrolled blood sugars

#### Stress (Excitement) Hyperglycemia

- A particular issue in feline patients
- Blood glucose (BG) values of 144-360 mg/dL (8-20 mmol/L) may be falsely elevated due to stress
- Acute mobilization of glucose
  - BG may exceed the renal threshold (approximately 260 mg/dl [14-16 mmol/L] and result in glucosuria)

---

#### How to differentiate from true DM

- Urinalysis - there is risk of false positive due to stress glucosuria
- Home urine testing for glucose or have owner bring in urine sample from home
- Home BG testing
- Repeat testing in clinic (with pre-visit sedation, using Feline-Friendly Handling, and pre-visit analgesics where pain may be causing stress)
- Measurement of serum fructosamine
- Plasma beta-hydroxybutyrate (>0.22-0.58 mmol/L)

---

#### Client Factors to Consider

- Understanding of treatment, administration/home monitoring, clinical signs, and when to call immediately
- Compliance and follow-through at home and with routine appointments
- Daily routine and household factors (travel, work/social schedules, other household pets and humans, stress of client and cat)
- Multi-cat households where it might be difficult to measure food/water intake and urine output
- Finances and resources





### Veterinary Professionals FAQ

Diabetic cats are challenging to diagnose, treat, and monitor, so here is some additional information to help with individual regulation. There are also many misconceptions about treatments and responses when dealing with feline diabetes mellitus.

#### Remission Questions:

- **What factors have been shown to consistently impact the chance of remission?**

Study Overview: Gostelow R, Forcada Y, Graves T, et al. Systematic review of feline diabetic remission: separating fact from opinion. *Vet J* 2014;202(2):208-221

Twenty-two studies were included in the review, assessing influence of pharmaceutical intervention (n = 14) and diet (n = 4), as well as diagnostic tests (n = 9) and feline patient characteristics (n = 5) as predictors of remission. The current level of evidence was found to be moderate to poor.

No single factor predicts remission, and successful remission has been documented with a variety of insulin types and protocols.

Dietary carbohydrate reduction might be beneficial, but requires further study.

Factors associated with remission resemble those in human medicine and support the hypothesis that reversal of glucotoxicity is a major underlying mechanism for feline diabetic remission.

- **What is the chance that a patient will go into remission?**

Remission is not possible with all cats. Key contributors include:

- Cats that achieve tight regulations of their blood sugar will be more likely to experience remission
- Early initiation of dietary and insulin therapy are the first steps to regulation
- Remission can be achieved in cats that have developed diabetes as a result of exogenous steroid use
- Remission can occur months (and sometimes more than a year) after initiation of therapy
- Diabetes can be transient if caused by acute pancreatitis

See Remission page in the toolkit for more information.

- **Which patient is most likely to achieve remission?**

Patients that:

- Have shorter duration of the disease
- Achieve prompt glycemic control
- Have lower BG at diagnosis
- Have a lack of diabetic neuropathy
- Have a lack of concurrent diseases (with the exception of pancreatitis)

- **What else should I consider about remission?**

- Tight glycemic control increases risk of hypoglycemia
- At least 25% of cats that achieve remission subsequently resume insulin dependence
- Even cats that are in remission may fail a glucose tolerance test: once a diabetic, always a diabetic, always at risk for recurrent insulin dependence
- Frequency of routine veterinary visits and testing based on the individual cat and situation

#### What are Risk Factors for DM?

- Obesity has been directly related to insulin resistance in cats and humans
- Sex: 60-70% of diabetic cats are neutered males
- Age: 20-30% of cats are diagnosed between ages 7-10, 55-65% diagnosed older than 10 years of age
- Diet: high carbohydrate diets (the use of dry food as a risk factor has been challenged)
- Breed/Genetics: Burmese, in Australia and UK, but not North America
- Concurrent Disease: pancreatic disease, hyperthyroidism, renal disease, neoplasia, acromegaly, hyperadrenocorticism, and infection
- Corticosteroid use

*continued on next page*



### Veterinary Professionals FAQ *continued*

#### What is the Best Way to Monitor Blood Sugar?

- Ear vein or foot pad sample (A client video can be found in the digital diabetes toolkit)
- Protocol: spot checks versus blood glucose curves, which depends on patient and client
- Accuracy can be obtained through the AlphaTRAK® monitor
- Human glucometers generally read lower by 18-36 mg/dL (1-2mmol/L) than analyzers validated for veterinary use in cats and dogs
- RBC's use glucose and can falsely lower the reading in whole blood samples not immediately tested or serum samples not separated from clot
- Free Style Libre monitor may be considered for continuous monitoring (alternative to BG monitoring) (*see References list – Accuracy of a Flash Glucose Monitoring System in Diabetic Dogs, 2016*)

See the Monitoring Protocols page in the toolkit for more information.

#### Is Anesthesia Safe in Diabetic Patients?

- Anesthesia can be performed safely in diabetics, regardless of whether the disease is controlled
  - Blood sugar monitoring should continue throughout the anesthetic and peri-anesthetic periods (There is no consensus on frequency of monitoring during anesthesia. Some recommend monitoring q30 minutes or more when needed, and others make a determination of monitoring frequency, and insulin doses for the day of surgery, based on each cat)
  - Complete fasting may not be ideal. A small meal with 1/2 insulin dosage in the morning prior to surgery may benefit the patient
  - A small amount of food (1-2 tsp canned slurry) should be considered post-operatively as soon as the patient is sternal and able to voluntarily consume food
  - Uncontrolled diabetes or increased age should not be considered a reason to avoid dental care under anesthesia
- Diabetic conditions that should be treated and resolved prior to anesthesia include:
  - Hypoglycemia
  - Hyperosmolar diabetic crisis (extremely rare)
  - DKA
- Anesthesia may be required to treat
  - Urgent conditions: trauma (i.e., hit by car, bite wounds, fractures, etc.), intestinal obstruction, obstipation, urinary tract blockage
  - Non-urgent conditions which are interfering with diabetic control (i.e., dental disease, urinary tract disease, infected masses, etc.)

#### What Will Happen if the Diabetic Patient is Not Treated?

- Insulin and dietary management are the ideal methods of controlling diabetes. There is a small population of cats that can have relatively normal quality of life without glycemic control or with only dietary management using low carbohydrate diets.
- Treatment is recommended, but in cases where the owner is unwilling or unable to treat the patient, it is not unreasonable to see how the patient does with diet alone (in order to minimize clinical signs such as PU, PD, PP and stabilize weight) or to consider oral hypoglycemic agents.
- If quality of life is poor without treatment, humane euthanasia should be considered. (OSU has a tool called "How Do I Know When it's Time?" See link in digital toolkit.)

#### What if a Diabetic Cat's Condition was Triggered by Corticosteroids and Ongoing Use is Required?

- Some cats have concurrent medical conditions that require treatment with corticosteroids.
- Treatment with steroids may complicate diabetic control.
- If there is no suitable alternative, steroid treatment can continue during diabetic management.
- Budesonide is not necessarily a better alternative to prednisolone in diabetic patients.
- Consider using immunomodulating therapies other than corticosteroids.



### Veterinary Professionals FAQ *continued*

#### **What if the Diabetic Patient is Unwilling to Eat the Recommended Diet?**

- Consider kitten food since it tends to be higher in protein and lower in carbohydrates compared to adult maintenance diets.
- Consider all or mostly canned foods since they tend to be higher in protein and lower in carbohydrates.
- For extremely picky eaters, you will have to troubleshoot why they are picky eaters and then try to find a suitable balanced diet. Review Diagnostics page for more information.

#### **Can Oral Hypoglycemic Agents be Used Instead of Insulin?**

Right now, glipizide and glyburide are used for treatment of non-insulin dependent diabetes in humans (Type II). The complete mode of action is not 100% clear. Effects of these drugs include:

- Stimulating beta cells to produce insulin
- Potential enhancement of insulin receptor activity
- Potential reduction in basal hepatic glucose production

Type II diabetic cats have exhausted beta cells from glucose toxicity. Cats on glipizide may go in to remission, but most will need exogenous insulin in order to maintain wellbeing and avoid ketosis. Oral hypoglycemics should not be considered a first line treatment above insulin and diet.

#### **What if the Blood Glucose Values are Inconsistent?**

Most cats do not have reliable blood glucose curves and values can vary substantially from day to day. Veterinary professionals need to determine if other factors are causing the inconsistency such as comorbidities, PU/PD/PP, weight loss, or client compliance issues with consistency.



### Client Resources

#### Responses to common cat caregiver questions

##### *What if I miss an injection?*

Missing an injection is not dangerous if it does not happen often, but it is never recommended to miss more than 24 hours of insulin at a time.

##### *What if I cannot give the injection at the proper time?*

If you cannot give the injection within 2 hrs of the regularly scheduled time, it is all right to skip that dose, assuming this does not happen frequently. If you anticipate this happening, or it starts to happen often, contact your veterinarian to discuss different options for your cat.

##### *What if I am not sure I gave the full injection?*

If you are not sure that you have given an injection properly, it is better to miss an injection than to give more which could cause an accidental overdose.

##### *What if I gave too much insulin?*

Monitor for signs of hypoglycemia (low blood sugar) which include extreme lethargy (weakness or lack of energy), muscle twitches or trembling, loss of appetite, or unusual behavior. Offer food throughout the day and call your veterinarian immediately. Your veterinarian will consider and discuss monitoring your cat in the clinic if you are unable to observe your cat for at least 8 hours.

##### *What will happen if I don't treat the diabetes?*

Most cats require diet and insulin for proper management of diabetes mellitus as well as managing hyperglycemia (high blood sugar), monitoring electrolytes, and pain relief. When diabetes goes untreated, you may notice increased signs and symptoms (some listed below), which can progress leading to pain, nerve damage, muscle weakness, other diseases or conditions, or even death. Some of these signs and symptoms include:

- Weight loss
- Drinking more water
- Drinking from unusual places
- Begging for food
- Decreased ability to jump
- Walking on heels instead of toes
- Lethargy
- Urine is sticky or hard to clean
- More frequent urination or urination outside of the litter box

##### *What is hyperglycemia?*

Hyperglycemia means your cat has higher than average blood sugar levels.

##### *Can I go on vacation and leave my cat alone?*

Unfortunately, no. A cat that is receiving diabetes treatment needs to be monitored. A reliable pet sitter or boarding facility capable of monitoring and giving injections is needed. Your cat cannot miss consecutive days of treatment.

##### *What if the blood glucose values are inconsistent?*

Most cats do not have reliable blood glucose curves and values can vary substantially. You will need to speak with your veterinarian to determine if other factors are causing the inconsistency such as comorbidities (other diseases or conditions), weight loss, or other factors. Your veterinarian may recommend coming in for an examination. They will also ask you to measure your cat's recent water intake and bring your daily treatment log (listing dose, blood glucose curves, administration of feeding and insulin times, any observations, food and water intake, and urine output assessment).



### Client Resources *continued*

#### **Responses to common cat caregiver questions *continued***

##### ***How does diabetes affect my cat's lifespan?***

Many diabetic cats live happy and normal lives. A cat's lifespan is affected by stability of glycemic control and management of concurrent disease. Each cat is different and your veterinarian will work with you on an individualized health care plan for your cat.

##### ***Are there treatments other than insulin?***

Oral hypoglycemic agents can be used but they do not reliably control diabetes in cats and they carry risk of side effects.

##### ***What if my cat needs steroid treatment along with his diabetes treatment?***

Treating with corticosteroids may be required to manage concurrent disease and this can complicate glycemic control. Glycemic control and good quality of life are possible. You and your veterinarian will discuss an individualized health care plan for your cat.

##### ***How do I dispose of insulin needles?***

Needles need to be disposed of properly. Your veterinary practice or local pharmacy can provide resources for proper handling and disposal of needles based on local regulations.

##### ***What if my cat won't eat a special diet?***

There is evidence that higher protein, low carbohydrate diets improve diabetic control, and there are a variety of veterinary diets, kitten foods, and other commercial foods that can be used. You and your veterinarian will discuss an individualized nutrition plan for your cat.

##### ***Is it safe for my cat to go under anesthesia or have dentistry with diabetes mellitus?***

With appropriate anesthesia protocols and monitoring, these procedures are safe and recommended when needed.



### References

**The references below are listed by year starting with the most current.**

- Restine LM, Norsworthy GD, Kass P. Loose-control of diabetes mellitus with protamine zinc insulin in cats: 185 cases (2005–2015). *The Canadian Veterinary Journal* 2019; 60: 399–404.
- American College of Veterinary Internal Medicine. Fact Sheet: Diabetes Mellitus. [https://www.acvim.org/Portals/0/PDF/Animal%20Owner%20Fact%20Sheets/SAIM/SAIM\\_DiabetesMellitus.pdf](https://www.acvim.org/Portals/0/PDF/Animal%20Owner%20Fact%20Sheets/SAIM/SAIM_DiabetesMellitus.pdf) (accessed March 15, 2019)
- Behrend E, Holford A, Lathan P, et al. 2018 AAHA Diabetes Management Guidelines for Dogs and Cats. *J Am Anim Hosp Assoc* 2018; 54: 1–21.
- Gottlieb S, Rand J. Managing feline diabetes: current perspectives. *Vet Med (Auckl)* 2018; 9: 33–42.
- Öhlund M, Egenvall A, Fall T, et al. Environmental Risk Factors for Diabetes Mellitus in Cats. *J Vet Intern Med* 2017; 31: 29–35.
- Lewitt MS, Strage E, Church D. An individual approach to feline diabetes care: a case report and literature review. *Acta Vet Scand* 2016; 58: 63.
- Roomp K, Rand J. Rebound hyperglycaemia in diabetic cats. *J Feline Med Surg* 2016; 18: 587–596.
- Corradini S, Pilosio B, Dondi F, et al. Accuracy of a Flash Glucose Monitoring System in Diabetic Dogs. *J Vet Intern Med* 2016; 30: 983–988.
- Gilor C, Niessen SJM, Furrow E, et al. What's in a Name? Classification of Diabetes Mellitus in Veterinary Medicine and Why It Matters. *J Vet Intern Med* 2016; 30: 927–940.
- Sparkes AH, Caney S, Chalhoub S, et al. ISFM Consensus Guidelines on the Diagnosis and Management of Feline Chronic Kidney Disease. *J Feline Med Surg* 2016; 18: 219–239.
- Gottlieb S, Rand JS, Marshall R, et al. Glycemic status and predictors of relapse for diabetic cats in remission. *J Vet Intern Med* 2015; 29: 184–192.
- Norsworthy GD, Wexler-Mitchell E. Management of diabetic cats in primary care practices: ABVP roundtable report. *J Feline Med Surg* 2015; 17 (11): 967–969.
- Hoelmkjaer KM, Spodsberg EM, Bjornvad CR. Insulin detemir treatment in diabetic cats in a practice setting. *J Feline Med Surg* 2015; 17: 144–151.
- Gostelow R, Forcada Y, Graves T, et al. Systematic review of feline diabetic remission: separating fact from opinion. *Vet J* 2014; 202: 208–221.
- Bloom CA, Rand J. Feline diabetes mellitus: clinical use of long-acting glargine and detemir. *J Feline Med Surg* 2014; 16: 205–215.
- Nack R, DeClue AE. In cats with newly diagnosed diabetes mellitus, use of a near-euglycemic management paradigm improves remission rate over a traditional paradigm. *Vet Q* 2014; 34: 132–136.
- Palm CA, Feldman EC. Oral hypoglycemics in cats with diabetes mellitus. *Vet Clin North Am Small Anim Pract* 2013; 43: 407–415.
- Farrow HA, Rand JS, Morton JM, et al. Effect of dietary carbohydrate, fat, and protein on postprandial glycemia and energy intake in cats. *J Vet Intern Med* 2013; 27: 1121–1135.
- Callegari C, Mercuriali E, Hafner M, et al. Survival time and prognostic factors in cats with newly diagnosed diabetes mellitus: 114 cases (2000–2009). *J Am Vet Med Assoc* 2013; 243: 91–95.
- Rand JS. Pathogenesis of feline diabetes. *Vet Clin North Am Small Anim Pract* 2013; 43: 221–231.
- Zoran DL, Rand JS. The role of diet in the prevention and management of feline diabetes. *Vet Clin North Am Small Anim Pract* 2013; 43: 233–243.
- Reusch C, Padrucci I. New incretin hormonal therapies in humans relevant to diabetic cats. *Vet Clin North Am Small Anim Pract* 2013; 43: 417–433.
- Roomp K and Rand JS. Management of diabetic cats with long-acting insulin. *Vet Clin North Am Small Anim Pract* 2013; 43: 251–266.





### References continued

- Rand JS. Diabetic ketoacidosis and hyperosmolar hyperglycemic state in cats. *Vet Clin North Am Small Anim Pract* 2013; 43: 367–379.
- Roomp K, Rand J. Evaluation of detemir in diabetic cats managed with a protocol for intensive blood glucose control. *J Feline Med Surg* 2012; 14: 566–572.
- Scott-Moncrieff JCR, Moore GE, Coe J, et al. Characteristics of commercially manufactured and compounded protamine zinc insulin. *J Am Vet Med Assoc* 2012; 240: 600–605.
- Maggiore AD, Nelson RW, Dennis J, et al. Efficacy of protamine zinc recombinant human insulin for controlling hyperglycemia in dogs with diabetes mellitus. *J Vet Intern Med* 2012; 26: 109–115.
- Dietiker-Moretti S, Müller C, Sieber-Ruckstuhl N, et al. Comparison of a continuous glucose monitoring system with a portable blood glucose meter to determine insulin dose in cats with diabetes mellitus. *J Vet Intern Med* 2011; 25: 1084–1088.
- Scott-Moncrieff JC. Insulin resistance in cats. *Vet Clin North Am Small Anim Pract* 2010; 40: 241–257.
- Niessen SJ, Powney S, Guitian J, et al. Evaluation of a quality-of-life tool for cats with diabetes mellitus. *J Vet Intern Med* 2010; 24: 1098–1105.
- Zeugswetter FK, Rebuzzi L, Karlovits S. Alternative sampling site for blood glucose testing in cats: giving the ears a rest. *J Feline Med Surg* 2010; 12: 710–713.
- Gilor C, Graves TK. Synthetic insulin analogs and their use in dogs and cats. *Vet Clin North Am Small Anim Pract* 2010; 40: 297–307.
- Marshall RD, Rand JS, Morton JM. Treatment of newly diagnosed diabetic cats with glargine insulin improves glycaemic control and results in higher probability of remission than protamine zinc and lente insulins. *J Feline Med Surg* 2009; 11: 683–691.
- Roomp K, Rand J. Intensive blood glucose control is safe and effective in diabetic cats using home monitoring and treatment with glargine. *J Feline Med Surg* 2009; 11: 668–682.
- Nelson RW, Henley K, Cole C, et al. Field safety and efficacy of protamine zinc recombinant human insulin for treatment of diabetes mellitus in cats. *J Vet Intern Med* 2009; 23: 787–793.
- Slingerland LI, Fazilova VV, Plantinga EA, et al. Indoor confinement and physical inactivity rather than the proportion of dry food are risk factors in the development of feline type 2 diabetes mellitus. *Vet J* 2009; 179: 247–253.
- Norsworthy G, Lynn R, Cole C. Preliminary study of protamine zinc recombinant insulin for the treatment of diabetes mellitus in cats. *Vet Ther* 2009; 10: 24–28.
- Hall TD, Mahony O, Rozanski EA, et al. Effects of diet on glucose control in cats with diabetes mellitus treated with twice daily insulin glargine. *J Feline Med Surg* 2009; 11: 125–130.
- Forcada Y, German AJ, Noble PJM, et al. Determination of serum fPLI concentrations in cats with diabetes mellitus. *J Feline Med Surg* 2008; 10: 480–487.
- Marshall RD, Rand JS, Morton JM. Glargine and protamine zinc insulin have a longer duration of action and result in lower mean daily glucose concentrations than lente insulin in healthy cats. *J Vet Pharmacol Ther* 2008; 31: 205–212.
- Link KR, Rand JS. Changes in blood glucose concentration are associated with relatively rapid changes in circulating fructosamine concentrations in cats. *J Feline Med Surg* 2008; 10: 583–592.
- Niessen SJM, Petrie G, Guadiano F, et al. Feline Acromegaly: An underdiagnosed endocrinopathy? *J Vet Intern Med* 2007; 21(5): 899–905.

Additional references on feline diabetes can be found in the ISFM Guidelines on Diabetes Mellitus.

# Feline Diabetes



Download in  
easy-to-print  
brochure formats at  
[www.catvets.com/  
client-brochures](http://www.catvets.com/client-brochures)



You are an important member of your cat's healthcare team.  
You are instrumental in helping with the success of  
treatments and improved healthcare for your cat.

Sponsored by  **Boehringer  
Ingelheim**

# Feline Diabetes



## INTRODUCTION

Feline diabetes, known as diabetes mellitus, has become an increasingly common condition in cats. It often occurs in cats that are overweight and/or older. As in humans, cats have a pancreas that should produce insulin to regulate the sugar in their bodies from their diet. Diabetes occurs when a cat's body is not able to properly balance out the sugar (glucose) in their bloodstream.

If your veterinarian diagnoses your cat with diabetes, you will need to work together to create a plan to manage this disease. You are an integral part in the treatment for your cat. When diabetes goes untreated, you may notice increased signs and symptoms, which can progress leading to pain, nerve damage, muscle weakness, other diseases or conditions, and even death.

## RISK FACTORS

Cats that are at a higher risk for developing diabetes are male, neutered, over seven years of age, and overweight or obese. If your cat has been diagnosed with one of the following diseases, they are also at a higher risk for developing diabetes: pancreatic disease, hyperthyroidism, renal disease, neoplasia, acromegaly, hyperadrenocorticism, and/or infection, or if your cat is being treated with a class of drugs called corticosteroids.

## DIAGNOSIS

Feline diabetes is not always simple to diagnosis. Your veterinarian will need to conduct a thorough examination of your cat, obtain an individual medical history, and perform laboratory tests. In the early stages of diabetes, you may notice that your cat "seems a little off" or "less interactive."

### Clinical Signs

If you observe any of the following behaviors or problems in your cat, contact your veterinarian because the information may alert them to the possibility your cat has diabetes.

- Weight loss
- Drinking more water
- Drinking from unusual places
- Begging for food/insatiable appetite
- Decreased ability to jump
- Walking on heels instead of toes (known as "plantigrade" stance)
- Lethargy
- Urine is sticky or difficult to clean
- More frequent urination or urination outside of litter box



### Testing

Your veterinarian will need to conduct blood and urine tests to properly identify whether your cat has diabetes and rule out other diseases or conditions.

## TREATMENT

Once your veterinarian has diagnosed your cat with diabetes, you will work together to create a monitoring and treatment plan. There are different options to treat diabetes, and many cats have other diseases or conditions that may complicate treatment. It is important to find the best plan for you and your cat. It is crucial to be honest with your veterinarian about your goals, time, ability to monitor and treat, and potential limitations, as well as to maintain a frequent, open dialogue.

## Goals of Treatment

- Potential remission is the goal, but is not possible for all cats
- Blood glucose regulation and stabilization
- Stable, appropriate body weight
- Reduction of clinical signs
- Good quality of life
- Avoidance of hypoglycemia (low blood sugar), hyperglycemia (high blood sugar), ketoacidosis (cell starvation where fat breaks down to provide energy), or neuropathy (pain or damage to nerves)



## TREATMENT OPTIONS

If your cat is diagnosed with diabetes mellitus, you can increase your ability to successfully manage your cat's needs by having regular communication with your veterinary team. Most cats require a specific diet and insulin for proper management of diabetes.

### Feeding Recommendations and Diet

To help keep the diabetes under control and to prevent further damage, your cat needs to maintain a healthy weight. As with humans, a healthy diet and active lifestyle can make your cat's treatment more effective and improve quality of life. Your veterinarian will determine your cat's ideal weight, and help find a low carb diet to help your cat achieve and maintain that weight. For best results at home, use a pediatric scale for the most accurate weight.

### Insulin Therapy

Many insulin formulations are available that can be combined with an appropriate diet. Insulin is delivered by injection and your veterinarian can teach you how to successfully test glucose levels and administer injections to your cat. Most cats require twice daily injections. Many caregivers of cats with diabetes find that with practice they are able to administer the insulin to their cats quite easily.

### Initial Treatment

Once you and your veterinarian choose a treatment plan, you will learn how to monitor your cat and administer medications appropriately. Be sure to ask for a demonstration from the veterinary practice how to test glucose levels, handle insulin, and administer it to your cat. If you keep a daily treatment log including the dose, administration time, observations, food and water intake, and urine output, fine-tuning your cat's treatment will be easier. In some cases, hospitalization may be needed at the beginning of treatment. Your veterinarian may also identify and treat any pain your cat may be experiencing.

## MONITORING

An important part of the treatment plan is monitoring your cat's response to the insulin and making adjustments as needed. There are three different monitoring protocols – intensive, standard, and loose. You and your veterinarian will determine the method that works best for you and your cat.

Many diabetic cats can live happy and normal lives. To help your cat live a long life, maintain recommended checkups, work to keep their blood sugar level stable, strive to maintain a healthy body weight, and manage other diseases.

Remember, you play a key role in your cat's diabetes treatment plan, so be sure you are open and honest with your veterinarian about your ability to monitor and provide insulin therapy. Each cat is different and your veterinarian will work with you on an individualized healthcare plan for you and your cat.



For more information on feline diabetes, visit [www.catfriendly.com/diabetes](http://www.catfriendly.com/diabetes).

This brochure was developed from the 2019 AAFP Diabetes Educational Toolkit. © Copyright 2019 AAFP. All rights reserved.