2018 AAHA Diabetes Management Guidelines for Dogs and Cats*
2018 AAHA 犬猫糖尿病管理指南

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ABSTRACT 摘要

Diabetes mellitus (DM) is a common disease encountered in canine and feline medicine. The 2018 AAHA Diabetes Management Guidelines for Dogs and Cats revise and update earlier guidelines published in 2010. The 2018 guidelines retain much of the information in the earlier guidelines that continues to be applicable in clinical practice, along with new information that represents current expert opinion on controlling DM. An essential aspect of successful DM management is to ensure that the owner of a diabetic dog or cat is capable of administering insulin, recognizing the clinical signs of inadequately managed DM, and monitoring blood glucose levels at home, although this is ideal but not mandatory; all topics that are reviewed in the guidelines. Insulin therapy is the mainstay of treatment for clinical DM. The guidelines provide recommendations for using each insulin formulation currently available for use in dogs and cats, the choice of which is generally based on efficacy and duration of effect in the respective species. Also discussed are non-insulin therapeutic medications and dietary management. These treatment modalities, along with insulin therapy, give the practitioner an assortment of options for decreasing the clinical signs of DM while avoiding hypoglycemia, the two conditions that represent the definition of a controlled diabetic. The guidelines review identifying and monitoring patients at risk for developing DM, which are important for avoiding unnecessary insulin therapy in patients with transient hyperglycemia or mildly elevated blood glucose. (J Am Anim Hosp Assoc 2018; 54:1–21. DOI 10.5326/JAAHA-MS-6822)

糖尿病（DM）是犬猫内科中很常见的疾病。2018AAHA 犬猫糖尿病管理指南修订并更新了 2010 年发表的指南。2018 指南保留了很多上一版本中仍然非常实用的内容，同时增加了许多新内容，代表当前专家对糖尿病控制的意见。为实现成功管理糖尿病非常重要的一方面是确保糖尿病犬或猫主人能够注射胰岛素、能够识别糖尿病控制不良的临床症状以及能够在家监测血糖，但这只是理想状态不是强制性的；指南中会详细讨论所有方面。临床上治疗糖尿病的主要方式是胰岛素。根据现有的可用于犬猫的胰岛素制剂以及每种制剂的有效性和作用时长，指南分别提出了犬猫的胰岛素给药建议。指南还讨论了非胰岛素药物和饮食管理。这些治疗方式加上胰岛素为从业者提供各种各样的选择，帮助其减少糖尿病的临床症状同时避免低血糖，这两点如果做到了，就代表糖尿病得到控制。指南也回顾分析了如何识别并监测可能会发展成糖尿病的病患，这对那些一过性高血糖或轻度血糖升高的病患来说非常重要，可以避免不必要的胰岛素给予。

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ALP (alkaline phosphatase 碱性磷酸酶); BG (blood glucose 血糖); BGC (blood glucose curve 血糖曲线); BP (blood pressure 血压); CBC (complete blood count 全血细胞计数); DM (diabetes mellitus 糖尿病); HAC (hyperadrenocorticism 肾上腺皮质机能亢进); NPH (Neutral Protamine Hagedorn 中性鱼精蛋白胰岛素); PD (polydipsia 多饮);PP (polyphagia 多食); PU (polyuria 多尿); PZI (protamine zinc insulin 鱼精蛋白锌胰岛素); T4 (thyroxine 甲状腺素);U (units 单位); UG (urine glucose 尿糖); UPC (urine protein:creatinine ratio 尿蛋白肌酐比)

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These guidelines were prepared by a Task Force of experts convened by the American Animal Hospital Association. This documentis intended as a guideline only, not an AAHA standard of care. These guidelines and recommendations should not be construed as dictating an exclusive protocol, course of treatment, or procedure. Variations in practice may be warranted based on the needs of the individual patient, resources, and limitations unique to each individual practice setting. Evidence-based support for specific recommendations has been cited whenever possible and appropriate. Other recommendations are based on practical clinical experience and a consensus of expert opinion. Further research is needed to document some of these recommendations. Because each case is different, veterinarians must base their decisions on the best available scientific evidence in conjunction with their own knowledge and experience.
这份指南由美国动物医院联合会召集的专家组制定。这份文件仅作为指导，并不是 AAHA 的诊疗标准。文中的指导原则和建议不应直接拿来作为唯一的准则、治疗方法或程序。根据每个病患的实际需要、资源以及每家诊所的实际情况，实际操作可能需要做相应的改变。只要建议有相应的证据支持，本文都尽量援引。其他建议是基于临床实际经验和专家一致意见作出的。当然，文中一些建议还需要更多的研究来说明。因为每个病例都是不同的，兽医们必须结合最新科学证据和个人知识经验来做决定。

Note: When selecting products, veterinarians have a choice among those formulated for humans and those developed and approved by veterinary use. Manufacturers of

veterinary-specific products spend resources to have their products reviewed and approved by the FDA for canine or feline use. These products are specifically designed and formulated for dogs and cats and have benefits for their use; they are not human generic products. AAHA suggests that veterinary professionals make every effort to use veterinary FDA-approved products and base their inventory-purchasing decisions on what product is most beneficial to the patient.
注意：在选择产品时，兽医可以选择人用产品和兽用产品。兽用产品的制造商花费了大量资源来评估他们的产品并且通过 FDA 批准可以用于犬猫。这些产品是专门为犬猫设计制造的，对犬猫有很多益处；它们不是人药仿制品。AAHA 建议兽医专业人员尽可能的使用通过 FDA 认证的兽用产品，并且采购那些对病患最有益的产品。

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Introduction 简介

Diabetes mellitus (DM) is a treatable condition that requires a committed effort by veterinarian and client. Due to many factors that affect the diabetic state, a pet's changing condition, and variable response to therapy, management of DM is often complicated. Success requires understanding of current scientific evidence and sound clinical judgment. Each patient requires an individualized treatment plan, frequent reassessment, and modification of that plan based on the patient's response. This document provides current recommendations for the diagnosis, treatment, and management of DM in dogs and cats.
糖尿病（DM）是一种可治疗疾病，需要兽医和主人共同努力。因为很多因素都会影响糖尿病，宠物状况的改变以及他们对治疗有不同的反应，这些导致了糖尿病的管理经常十分复杂。成功治疗需要了解最新的科学证据以及很好的临床判读。每个病患都需要定制的治疗计划、经常的复查以及根据病患的反应作出相应的修改。本文提供了关于犬猫糖尿病最新的诊断、治疗和管理建议。

Previous AAHA DM guidelines published in 2010 are still applicable and provide useful background for the 2017 guidelines.[1] Readers will note that the 2017 guidelines use the same organizing framework as the 2010 guidelines. In some cases, essential content from the earlier guidelines has been retained verbatim. Practitioners will find several items or topics in the updated DM guidelines to be particularly relevant. These include:
2010 年发表的 AAHA 糖尿病指南仍然非常实用并且为 2017 版指南提供了十分有用的背景知识。读者将会发现 2017 版指南采用了与 2010 版指南相同的组织结构。在某些情况下，一些来自于 2010 版的重要内容都被一字不差的保留下来。从业者将会发现更新版糖尿病指南中的一些内容或主题更加贴合临床。这些包括：

- Quick-reference algorithms on responding to hypoglycemia,DM monitoring, and DM troubleshooting.
  针对低血糖、糖尿病监测和糖尿病问题解决的快速参考步骤
- New information on commercially available insulin formulations and recommendations for their use in dogs and cats.
  市场上现有胰岛素制剂的最新资讯以及它们在犬猫中的使用建议

- Recommendations for home monitoring of DM, a disease management approach that can contribute substantially to a favorable treatment response.
  糖尿病在家监测的建议，这种疾病管理方法可以极大的提高治疗效果。
- Information on non-insulin therapeutic agents and treatment modalities such as dietary management.
  关于非胰岛素药物治疗和其他治疗方式例如饮食管理的内容。
- The implications of identifying patients at risk for developing DM and how to monitor and treat them.
  如何识别糖尿病潜在风险病患以及如何监测和治疗他们。

Diabetes mellitus is a syndrome associated with protracted hyperglycemia due to loss or dysfunction of insulin secretion by pancreatic beta cells, diminished insulin sensitivity in tissues, or both. In the dog, beta-cell loss tends to be rapid and progressive, and is usually due to immune-mediated destruction, vacuolar degeneration, or pancreatitis.[2] Intact female dogs may be transiently or permanently diabetic due to the insulin-resistant effects of the diestrus phase. In the cat, loss or dysfunction of beta cells is the result of insulin resistance, islet amyloidosis, or chronic lymphoplasmacytic pancreatitis.[3] Studies have shown that diabetic cats have remission rates that have been reported to be variable (15 – 100%). Because remission can occur, cat owners may be advised that remission is a possibility when treated with combination of diet and insulin.[4,5]
糖尿病是一种与居高不下的高血糖有关的综合征，由于胰岛β细胞分泌的胰岛素不足或功能异常或两者同时存在，导致组织对胰岛素敏感性下降。在犬中，β细胞丢失通常是快速进行性发展，一般是由于免疫介导性破坏、空泡变性或胰腺炎。未绝育母犬由于间情期胰岛素抵抗的作用可能出现一过性或永久性糖尿病。在猫中，β细胞丢失或功能丧失是由于胰岛素抵抗、胰岛淀粉样变或慢性淋巴浆细胞性胰腺炎导致的。不同的研究表明，猫糖尿病的缓解率有所不同，从 15%到 100%不等。因为猫糖尿病可能会出现缓解，因此应建议猫主人同时进行饮食和胰岛素管理，这样是可能出现缓解的。

Risk factors for developing DM for both dogs and cats include insulin resistance caused by obesity, certain diseases (e.g., acromegaly and kidney disease in cats; hyperadrenocorticism [HAC], hyper- triglyceridemia, and hypothyroidism in dogs; dental disease, systemicinfection, pancreatitis, and pregnancy/diestrus in both dogs and cats), or medications (e.g., steroids, progestins, cyclosporine). Genetics is a suspected risk factor, and certain breeds of dogs (Australian terriers, beagles, Samoyeds, keeshonden) and cats (Burmese, especially in Australia and Europe) are more susceptible.[6,7] Researchers continue to rede fi ne and reclassify the different etiologies responsible for the development of DM in dogs and cats.[8] As different etiologies become better understood, treatment can be more speci fi cally tailored to the individual patient. Treatment that is more specific to the underlying etiology will presumably lead to better control of clinical signs of DM and possibly increase remission rates.
犬猫患糖尿病的风险因素包括肥胖、某些疾病（例如猫肢端肥大症和肾病；犬肾上腺机能亢进（HAC）、高甘油三酯血症和甲状腺机能减退；犬猫牙科疾病、全身性感染、胰腺炎和怀孕/发情间期）或药物（例如类固醇、孕激素、环孢素）引起的胰岛素抵抗。基因也是一个怀疑的风险因素，某些品种的犬（澳大利亚梗犬，比格，萨摩耶，荷兰卷尾狮毛狗）和猫（缅甸猫，尤其是在澳大利亚和欧洲的）更加易感。研究者持续在重新定义重新分类造成犬猫糖尿病不同的病因。随着我们对不同病因更加理解，可以针对每

个病患制定更加适合的治疗方式。更加针对潜在病因的治疗理论上来说会更好的控制糖尿病临床症状并且可能提高缓解率。

Regardless of the underlying etiology, classic clinical signs of polyuria (PU), polydipsia (PD), polyphagia (PP), and weight loss result from protracted hyperglycemia and glucosuria. Increased fat mobilization leads to hepatic lipidosis, hepatomegaly, hypercholesterolemia, hypertriglyceridemia, and increased catabolism. Eventually, if left untreated or inadequately controlled, ketonemia, ketonuria, and ketoacidosis develop and result in progressive compromise of the patient's health.
不管是何种潜在病因，持久的高血糖和糖尿会导致典型的临床症状，包括多饮多尿（PU/PD）、多食（PP）和体重减轻。脂肪转移增加导致肝脂质沉积、肝肿大、高胆固醇血症、高甘油三酯血症和分解代谢增加。如果不加控制或控制不足，最终会出现酮血症、酮尿和酮症酸中毒，并导致对病患健康造成进行性的损伤。

It is important to differentiate patients with clinical DM from those with transient hyperglycemia or mildly increased blood glucose (BG). The subgroup of patients with mildly elevated BG but without concurrent clinical signs associated with higher levels of hyperglycemia may require additional diagnostic and therapeutic measures but not insulin therapy. At this time, there is not a standard definition for subclinical DM in veterinary medicine or any validated testing to determine which patients are at risk for developing DM. In lieu of "subclinical DM," the Task Force has elected to use the more descriptive terminology "patients at risk of developing DM," or simply "at-risk patients" throughout the guidelines. As potential new etiologies emerge for overt or subclinical DM, they will be discussed in future guidelines or consensus statements.
临床上非常重要的一点是区分糖尿病病患和一过性高血糖或轻度血糖（BG）增高。血糖轻度升高但是没有更高水平的高血糖的临床并发症状的这些病患可能需要更多的诊断和治疗措施而不是胰岛素治疗。目前，兽医中没有关于亚临床糖尿病的标准定义或任何已证实的测试来判定哪些病患有患糖尿病的风险。在整篇指南中，专家组选择使用更加形象的术语"有糖尿病患病风险的病患"或简单点"有风险的病患"，来取代"亚临床糖尿病"。由于未来可能会发现显著或亚临床糖尿病的新病因，它们将在未来指南或共识文件中讨论。

Diagnosis and Assessment 诊断和评估

These guidelines describe different approaches to DM diagnosis and assessment depending on the level of hyperglycemia and the presence of clinical signs. For cats and dogs who present with clinical signs suggestive of DM, perform a physical exam and full laboratory evaluation (complete blood count [CBC]), chemistry with electrolytes, urine analysis with culture, urine protein:creatinine ratio (UPC), triglycerides, blood pressure (BP), and thyroxine (T4); to confirm the diagnosis as well as to rule out other diseases. Elevated BG can sometimes be identified on blood work in the absence of consistent clinical signs. In such cases, if stress hyperglycemia can be ruled out, the patient may be classified as at-risk for developing DM. Clinical signs of PU/PD do not develop until the BG concentration exceeds the renal tubular threshold for spillage of glucose into the urine.
这些指导原则根据不同程度的高血糖和存在的临床症状提供不同的方法来诊断和评估糖尿病。犬猫就诊时，如果临床症状提示糖尿病，应进行体格检查和犬猫的实验室评估（CBC）、生化加电解质、尿检和培养、尿蛋白肌酐比（UPC）、甘油三酯、血压（BP）

和甲状腺素（T4）；来确诊疾病以及排除其他疾病。在没有相关临床症状的情况下有时也可能会检测到血糖升高。在这种情况下，如果可以排除应激高血糖，这些病患可能会被分类为有糖尿病风险。直到血糖浓度超过了肾小管阈值，葡萄糖渗漏到尿液中才会出现多饮多尿的临床症状。

Glucosuria will typically develop when the BG concentration exceeds approximately 200 mg/dL in dogs and 250 – 300 mg/dL in cats.
糖尿通常出现在血糖浓度超过大约 200 mg/dL（犬）和 250-300 mg/dL（猫）时。

Clinical signs of DM will typically be present when there is persistent hyperglycemia and glucosuria. Clinical signs are usually absent with glucose levels ranging between the upper reference levels and the renal threshold values noted above. Blood glucose concentrations in these ranges may occur for a variety of reasons, including stress hyperglycemia in cats, corticosteroid administration, the presence of concurrent insulin-resistant disease (hyperadrenocorticism, obesity), or as part of the early stage of developing DM.
当存在持续性高血糖和糖尿时，糖尿病临床症状通常会出现。当血糖浓度在参考范围上限和肾阈值之间时，通常没有临床症状。血糖浓度出现在这些范围内可能有很多原因导致，包括猫应激高血糖、皮质类固醇给药、存在并发的胰岛素抵抗疾病（肾上腺皮质机能亢进，肥胖）或是糖尿病患病的早期阶段。

Dogs and cats in the early stages of nonclinical DM appear healthy, have a stable weight, and are usually identi fi ed as a result of routine laboratory evaluation. They do not have clinical signs of DM. Stress hyperglycemia needs to be ruled out, as well as correction of any insulin-resistant disorders and discontinuation of drugs asso- ciated with impaired insulin release or sensitivity. Reassessing BG or monitoring urine glucose (UG) levels once the patient is no longer stressed at home or measuring serum fructosamine concentrations may help differentiate between stress hyperglycemia and DM, and determine if further action should be taken.
犬猫处于糖尿病无临床症状的早期阶段时，看起来很健康，体重稳定，并且通常是因为常规化验而发现的。他们没有糖尿病的临床症状。需要排除应激高血糖以及纠正任何产生胰岛素抵抗的疾病，并且停用损伤胰岛素释放或敏感性的药物。当病患在家没有任何应激后复查血糖或监测尿糖（UG），或者检测血清果糖胺浓度可以会帮助区分应激高血糖和糖尿病，之后再决定是否需要进一步措施。

Clinical DM is diagnosed on the basis of persistent glucosuria, persistent hyperglycemia, and presence of characteristic clinical signs. Documentation of an elevated serum fructosamine concentration may be necessary to con fi rm the diagnosis in cats.[9] Fructosamine levels may be only mildly elevated with lower levels of persistent hyperglycemia, and should be interpreted as part of a complete evaluation.[9]
临床上诊断糖尿病需要依据持续性糖尿、持续性高血糖以及存在相应的临床证据这几点。猫糖尿病的确诊，可能还需要有血清果糖胺浓度的升高。如果是持续性低水平的高血糖，果糖胺可能只会轻度升高，应结合其他发现做全面评估。

Animals with clinical DM will present with PU, PD, PP, and weight loss. Some may present with lethargy, weakness, and poor body condition. Dogs may have cataracts, and cats may present with a complaint of impaired jumping and abnormal gait. Some patients will present

with systemic signs of illness due to diabetic ketosis/ ketoacidosis, such as anorexia, vomiting, dehydration, and depression.
动物患有糖尿病的临床表现有多饮多尿、多食和体重减轻。一些动物可能表现为倦怠、虚弱和体况不良。犬可能会有白内障，猫可能会发现跳跃功能受损和异常步态。一些病患会因糖尿病酮症/酮症酸中毒表现出全身性疾病症状，例如厌食、呕吐、脱水和沉郁。

The initial evaluation of the diabetic dog and cat should:
糖尿病犬猫应作的初始检查包括：

- Assess the overall health of the pet (history including diet and concurrent medications, and a complete physical exam).
  评估宠物的整体健康情况（病史，包括饮食和用药史，以及全面的体格检查）
- Identify any complications that may be associated with the disease (e.g., cataracts in dogs, peripheral neuropathy in cats).
  识别与糖尿病可能有关的所有并发症（例如犬白内障，猫外周神经疾病）
- Identify any concurrent problems often associated with the disease (e.g., urinary tract infections, pancreatitis).
  识别与糖尿病经常同时存在的问题（例如泌尿道感染，胰腺炎）
- Identify any conditions that may interfere with the patient's response to treatment (e.g., hyperthyroidism, renal disease, hyperadrenocorticism).
  识别任何可能干扰治疗效果的疾病（例如甲状腺机能亢进，肾病，肾上腺皮质机能亢进）。
- Evaluate for risk factors such as obesity, pancreatitis, insulin-resistant disease, diabetogenic medications, and diestrus in female dogs.
  评估风险因素，例如肥胖、胰腺炎、胰岛素抵抗性疾病、致糖尿病性药物和母犬发情间期。

Physical exam results of the diabetic cat or dog can be relatively normal early in the course of the disease. As the disease persists without treatment, the physical exam may reveal weight loss, dehydration, poor hair coat, abdominal pain if concurrent pancreatitis is present, or cataracts. Some cats with longstanding hyperglycemia can develop peripheral neuropathy, which manifests as a plantigrade stance. If ketosis is present, a sweet odor may be noticed on the breath of the pet.
在糖尿病早期，犬猫体格检查可能相对比较正常。在没有治疗的情况下，随着疾病的发展，体格检查可能表现出体重减轻、脱水、毛发变差、腹部疼痛（如果并发胰腺炎）或白内障。一些猫长期高血糖可能会出现外周神经疾病，表现为跖行姿。如果存在酮症，可能会闻到宠物呼吸有股甜味。

Laboratory evaluation includes a basic minimum database (CBC, chemistry with electrolytes, urine analysis with culture, tri- glycerides, UPC, BP, and T4 level in cats). Typical findings include hyperglycemia, glucosuria, and stress leukogram, as well as increased cholesterol and triglycerides. Dogs frequently show increased levels of alkaline phosphatase (ALP) and alanine aminotransferase. Cats, however, show more variability in the presence of a stress leukogram and elevated ALP. Elevated liver enzymes in a cat may warrant further evaluation for concurrent liver disease.[10] Pancreatitis is a common comorbidity and may need to be addressed.[10]

实验室评估应至少包括一些基础数据（CBC、生化电解质、尿检培养、甘油三酯、UPC、血压和猫的 T4）。典型发现包括高血糖、糖尿和应激白细胞象以及高胆固醇和甘油三酯。犬经常发现 ALP 和 ALT 升高。然而猫的应激白细胞象和 ALP 升高更多变。猫肝酶指标升高可能需要进一步检查是否有并发肝病。胰腺炎是常见的并发症，也需要相应的处理。

Cats and dogs with diabetic ketoacidosis may show very elevated BG concentrations, azotemia, and decreased total CO2 secondary to metabolic acidosis, osmotic diuresis, dehydration, and, in the case of profound hyperosmolarity, coma.
犬猫糖尿病酮症酸中毒可能出现非常高的血糖浓度、氮质血症和继发于代谢性酸中毒的总 CO2 减少、渗透性利尿、脱水以及在严重高渗透压的情况下昏迷。

Urinalysis will reveal the presence of glucose. It may also show presence of protein, ketones, bacteria, and/or casts. Because a urinary tract infection cannot be ruled out by the absence of an active urine sediment, a urine culture should always be performed in glucosuric animals, because infection is commonly present.
尿检会发现有葡萄糖。也可能会有蛋白质、酮体、细菌和/或管型。因为不能仅仅通过不存在活性尿沉渣就排除泌尿道感染，而且尿糖动物很常见感染，所以应进行尿液培养。

If thyroid disease is suspected in a dog, it is best to perform thyroid testing after DM is stabilized because of the likelihood of euthyroid sick syndrome. Cats over 7 yr of age with weight loss and PP should be tested for hyperthyroidism because DM and hyperthyroidism cause similar clinical signs and can occur concurrently.
如果怀疑犬还有甲状腺疾病，最好在糖尿病稳定后再检查甲状腺功能，因为可能会出现正常甲状腺功能病态综合征。猫大于 7 岁且有体重减轻和多饮多尿，还应检测甲状腺机能亢进，因为糖尿病和甲状腺机能亢进有同样的临床症状并且可能同时发病。

Treatment 治疗

The mainstay of treatment for clinical DM in dogs and cats is insulin along with dietary modifi cation. Goals include controlling BG below the renal threshold for as much of a 24 hr period as possible, which will improve clinical signs of DM, and avoiding clinically signi fi cant hypoglycemia.
现在犬猫糖尿病的主流治疗方法是胰岛素加上饮食调节。目标包括尽可能长时间的将血糖控制在肾阈值之下，这样可以改善糖尿病的临床症状同时避免出现严重的低血糖。

Treatment for Cats 猫的治疗

In cats, diabetic remission is a reasonable goal.[4] Successful management of DM in cats consists of minimal or no clinical signs, owner perception of good quality of life and favorable treatment response, avoidance or improvement of DM complications, (specifically, diabetic ketoacidosis and peripheral neuropathy), and avoidance of hypoglycemia. Predictors of diabetic remission in cats include achieving excellent glycemic control within 6 mo of diagnosis, using intensive home monitoring, discontinuation of insulin-antagonizing medications, and use of insulin glargine (Lantus) or detemir (Levemir) along with a low-carbohydrate diet.[4] A clinically sick, diabetic, ketotic cat should be hospitalized to initiate aggressive therapy. If 24 hr care is not feasible, the patient should be referred to an emergency or specialty hospital. Adjunct therapy for diabetic cats should include environmental enrichment using creative feeding tools such as food puzzles, particularly for

obese cats. Oral hypoglycemic drugs are neither recommended nor considered appropriate for long-term use. Their use is considered temporary and only if combined with dietary modi fication if the owner refuses insulin therapy or is considering euthanasia for the pet.
在猫中，糖尿病缓解是个合理的预期目标。猫糖尿病的成功管理包括最小化临床症、主人感到生活质量提高以及良好的治疗效果、未出现糖尿病并发症或并发症得到改善（尤其是糖尿病酮症酸中毒和外周神经疾病），以及未出现低血糖。猫糖尿病缓解的预测指标包括诊断后 6 个月内达到很好的血糖控制、使用强化的家庭检测、不再使用胰岛素拮抗药物以及使用甘精胰岛素（来得时）或地特（Levemir）加上低碳水化合物饮食。一只临床重病且有糖尿病和酮症的猫应立即住院开始激进的治疗。如果 24 小时护理后仍不稳定，应将病患转诊给一家急诊中心或专科医院。糖尿病猫辅助治疗应包括使用各种有趣的喂食工具例如食物魔方来丰富环境，尤其是肥胖猫。不推荐口服降糖药，而且降糖药也不适合长期使用。只能考虑暂时性的使用它们，或者主人拒绝使用胰岛素或者考虑安乐宠物时，才考虑将其与饮食调节结合起来。

The initial approach to management of the diabetic cat is to initiate insulin therapy with glargine (Lantus) or protamine zinc insulin (PZI; Prozinc) at a starting dose of 1 – 2 units (U) per cat q12 hr. The decision to monitor BG on the fi rst day of insulin treatment is at the discretion of the veterinarian. The goal of fi rst- day monitoring is solely to identify hypoglycemia. The insulin dose should not be increased based on first-day BG evaluation. If monitoring is elected, measure BG q 2 – 4 hr for cats on PZI and q 3 – 4 hr for those on glargine for 10 – 12 hr following insulin administration. Decrease the insulin dose by 50% if BG is <150 mg/dL any time during the day. Treat the diabetic cat as an outpatient after the fi rst day of monitoring, if elected, and plan to reevaluate in 7 – 14 days regardless of whether BG values are monitored on the fi rst day. Immediately re-evaluate if clinical signs suggest hypoglycemia or if lethargy, anorexia, or vomiting is noted. See Algorithm 2, “Moni- toring blood glucose levels in diabetic dogs and cats” and **Table 1**,“Insulin Products” for more information on monitoring and dosing.
猫糖尿病的起始治疗方法是使用甘精（来得时）或鱼精蛋白锌胰岛素（PZI；Prozinc），起始剂量 1-2 单位（U）每只猫，间隔 12 小时。胰岛素给药后第一天是否监测血糖由兽医自行决定。第一天监测的目的仅仅是确定是否出现低血糖。不应该根据第一天血糖的评估而增加胰岛素的剂量。如果选择监测，猫用 PZI 时每 2-4 小时测一次血糖，用甘精时每 3-4 小时测一次血糖，给药后连续监测 10-12 小时。如果血糖低于 150 mg/dL，不管在任何时候出现，降低胰岛素 50%。如果选择第一天就监测，第一天监测完就让猫咪回家治疗糖尿病，并且 7-14 天后，不管第一天有没有监测血糖，都要复诊再次评估。如果出现提示低血糖的临床症状或发现倦怠、厌食或呕吐，立即复诊。关于监测和剂量，更多信息见“糖尿病犬猫血糖监测”和表 1“胰岛素产品”。

表1

犬猫常用胰岛素产品

胰岛素产品	产品描述	品牌 (厂家)	FDA兽用批准情况	峰值（最低值）和作用时长	起始剂量	浓度	评论
Lente **(中效)**	猪胰岛素锌混悬液	Vetsulin （默沙东动保）	犬、猫	**猫** 最低值2-8小时 持续8-14小时 **犬** 最低值1-10小时 持续10-24小时	**猫** 0.25-0.5 U/kg q12hr(不要超过3U每只猫) **犬** 0.25-0.5 U/kg q12hr	40单位	常用于犬；用于犬猫的注射笔（0.5或1U的刻度）。**需要摇晃药瓶。** 注意：对犬，厂家建议的起始剂量是0.5U/kg q24hr
甘精 **(长效)**	重组DNA人胰岛素	来得时 （赛诺菲）	未批准	**猫** 最低值12-14小时 持续12-24小时 **犬** 最低值6-10小时 持续12-20小时	**猫** 如果血糖>360mg/dL 0.5U/kg q12hr；如果血糖<360mg/dL 0.25 U/kg q12hr **犬** 0.3 U/kg q12hr	100单位，300单位	常用于猫；仅使用100单位的（有300单位的）；犬潜在选项
PZI **(长效)**	重组DNA人胰岛素	Prozinc （勃林格殷格翰动保）	猫	**猫** 最低值5-7小时 持续8-24小时 **犬** 最低值8-12小时	**猫** 1-2 U每只猫 q12hr **犬** 0.25-0.5 U/kg q12hr	40单位	常用于猫；不常用于犬。一些临床医生认为犬起始剂量用0.25U/kg比较合适，0.5U/kg应留着给比较有挑战性的糖尿病使用
NPH **(中效)**	重组人胰岛素	诺和林 （诺和诺德） 优泌林	未批准	**犬** 最低值0.5-8.5小时 持续4-10小时	**犬** 0.25-0.5 U/kg q12hr	100单位	犬的选项；很少推荐用于猫，因为作用时间过短。大型犬考虑从剂量低值开始用，小型犬从剂量高值开始。
地特 **(长效)**	重组DNA人胰岛素	Levemir （诺和诺德）		**猫** 最低值12-14小时 持续12-24小时	**猫** 如果血糖>360mg/dL 0.5 U/kg q12hr；如果血糖<360mg/dL 0.25 U/kg q12hr **犬** 0.10 U/kg q12hr	100单位	对犬效果很强（需要注意）；用于犬和猫；适用于那些使用NPH和lente作用时间都过短的犬。

NPH，中性鱼精蛋白胰岛素；PZI，鱼精蛋白锌胰岛素

Treatment for Dogs 犬的治疗

Treatment of clinical DM in the dog always requires exogenous insulin therapy. U-40 pork lente (porcine insulin zinc suspension;Vetsulin) is the Task Force's first-choice recommendation for dogs using a starting dose of 0.25 U/kg q 12 hr, rounded to the nearest whole U. The duration of action is close to 12 hr in most dogs, and the amorphous component of the insulin helps to minimize post- prandial hyperglycemia. As with cats, a clinically sick, diabetic, ketotic dog should be admitted for 24 hr care for aggressive therapy of the ketosis and other underlying illnesses. A critical initial goal of treatment is avoidance of symptomatic hypoglycemia, which may occur if the insulin dose is increased too aggressively. Feed equal- sized meals twice daily at the time of each insulin injection. In contrast to cats, diabetic remission occurs only rarely in dogs with naturally acquired DM. Performing an ovariohysterectomy in intact diabetic dogs will support remission, regardless of the underlying cause of the diabetes.

临床上治疗犬糖尿病总是需要外源性胰岛素。U-40 猪 lente 胰岛素（猪源胰岛素锌混悬液；Vetsulin）是专家组推荐的犬首选胰岛素，起始剂量 0.25 U/kg, q12h，四舍五入。对大多数犬来说，作用持续时间接近 12 小时，而且胰岛素中的无形成分可以帮助最小化餐后高血糖。和猫一样，临床重病且有糖尿病和酮症的犬应立即住院监护针对酮症和其他潜在疾病进行激进的治疗。初始治疗的最重要目标是避免低血糖症状，当胰岛素剂量提高过快时可能出现。每天两次在注射胰岛素的时候饲喂等量食物。与猫不同的是，自然患病的糖尿病犬罕见缓解。不管糖尿病的潜在原因是什么，未绝育母犬患糖尿病时进行子宫卵巢摘除术都有助于缓解。

In dogs with subclinical DM, investigate and address causes of insulin resistance, including obesity, medications, hyperadrenocorticism and diestrus in intact females. Initiate dietary therapy to limit postprandial hyperglycemia (see "Dietary Therapy Goals and Management" for additional information.) Evaluate the dog closely for progression to clinical DM. Subclinical DM is not commonly identified in the dog. Most dogs in the early stages of naturally acquired diabetes (i.e., not induced by insulin resistance) quickly progress to clinical DM and should be managed using insulin.

犬处于亚临床糖尿病状态时，应调查引起胰岛素抵抗的原因并采取相应措施，包括肥胖、药物、肾上腺皮质机能亢进和未绝育母犬发情间期。开始饮食治疗来控制餐后高血糖（更多信息见"饮食治疗目标和管理"）。密切监测犬看其是否进一步发展成真正的糖尿病。亚临床糖尿病在犬中并不能经常发现。大多数处于天然获得性糖尿病（也就是不是胰岛素抵抗导致的）早期阶段的犬会快速发展成真正的糖尿病，应用胰岛素治疗。

Veterinarians use a variety of insulin products, but only two are presently approved by the FDA for use in dogs and cats. One of these is a porcine lente product (**porcine insulin zinc suspension, Vetsulin**) that is approved for both species. The other FDA-approved insulin, human recombinant **protamine zinc insulin or PZI (Prozinc) insulin**, is labeled as having an appropriate duration in cats, the only species for which it is approved. It is considered by clinicians as a long-acting insulin. Because of limited controlled comparative studies, most expert recommendations are based on a combination of clinical and anecdotal experience. The guidelines Task Force strives to make evidence-based recommendations when data are available. However, the ability to make specific recommendations based on differences and preferences between veterinary insulin products is limited. Members of the Task Force most commonly use porcine lente insulin (Vetsulin) in dogs and glargine (Lantus) in cats,

recognizing that other acceptable options used by many clinicians include Neutral Protamine Hagedorn (NPH;Humulin N, Novulin N) in dogs and PZI (Prozinc) in cats.
兽医使用各种各样的胰岛素产品，但是目前只有两种通过 FDA 批准可以用于犬猫。其一是猪 lente 胰岛素（猪源胰岛素锌混悬液，Vetsulin）批准用于犬和猫。另一获批的是人重组鱼精蛋白锌或 PZI（Prozinc）胰岛素，标签上说明在猫上有一定的持续作用时间，该胰岛素仅批准用于猫。临床医生认为它是一种长效胰岛素。由于控制对照试验有限，大多数专家建议都是基于临床和个人经验。指南专家组尽量根据现有的数据提出基于证据的建议。然而，根据不同的胰岛素产品特点以及不同兽医的偏好来制定出特定的建议十分困难。专家组成员给犬最常用的是猪 lente 胰岛素（Vetsulin），给猫最常用的是甘精（来得时），同时承认还有很多其他选项，很多临床医生在使用，包括中性鱼精蛋白胰岛素（NPH，优泌林 N，诺和林 N）用于犬，PZI（Prozinc）用于猫。

Although compounded insulin is available, its use is not recommended because of concerns about production methods, diluents, sterility, and insulin concentration consistency between lots. A study comparing commercially available insulin with its compounded counterparts showed that the manufactured insulin met all US Pharmacopeia requirements and only 1 of 12 compounders met US Pharmacopeia specifications at all time points. The variability between compounded insulins was also significant enough to have clinical consequences.[11] It is also not recommended to dilute insulin because dilution can produce unpredictable results, alter insulin efficacy, and result in bacterial contamination.[5,12]
虽然市面上有复合胰岛素，但是不建议使用，因为考虑到生产方法、稀释剂、无菌性和不同批次胰岛素浓度的一致性。一项研究对比商业化的胰岛素和其相应复合产品发现制造的胰岛素符合全部美国药典要求，而 12 种复合物中只有 1 种满足美国药典要求的所有项目。不同复合胰岛素之间的差异性足以导致显著的临床后果。同时也不建议稀释胰岛素，因为稀释后可能会造成无法预料的后果，改变胰岛素的效能，还可能会导致细菌污染。

Insulin Products (see Table 1) 胰岛素产品（见表 1）
1. Lente (U-40 porcine insulin zinc suspension; Vetsulin, Merck Animal Health) is an intermediate-acting insulin commonly used by the Task Force in dogs. It is FDA approved for use in dogs and cats. It has a close to 12 hr duration of action in most dogs and is useful for minimizing postprandial hyperglycemia.
Lente （U-40 猪胰岛素锌混悬液；Vetsulin，默沙东动保）是中效胰岛素，专家组常将其用于犬。它通过 FDA 批准可用于犬猫。大多数犬作用时间接近 12 小时，有助于最小化餐后高血糖。

2. Glargine (U-100 human recombinant; Lantus, Sanofi) is a longer-acting insulin commonly used by the Task Force in cats because it has an adequate duration of action in most diabetic cats. Several studies have demonstrated that glargine is effective for controlling blood sugar levels in diabetic cats and achieving high remission rates.[12] Glargine can also be used in dogs. It is a human analog insulin with modifications that provide variable solubility at different pHs. Glargine is soluble at a pH of 4.0, the pH at which it is supplied and stored, but in the neutral pH of the body’s blood or subcutaneous tissues it forms microprecipitates, facilitating slow absorption after injection. This results in rapid onset and long duration of action. Glargine is sometimes described as a “peakless” insulin, although peakless does not mean an absence of a nadir in cats but rather refers to glucose utilization rates.[4] In dogs, a fl

at blood glucose curve (BGC) may be seen, so glargine can be referred to as a peakless insulin in that species.[13]
甘精（U-100 人重组；来得时，Sanofi）是一种超长效胰岛素，专家组常用于猫，因为在大多数糖尿病患猫身上都有足够长的作用时间。一些研究表明甘精可以有效控制糖尿病猫的血糖并且有更高的缓解率。甘精也可以用于犬。它是一种人类似物经修饰后的产品，不同 pH 溶液中有不同的溶解性。当 pH 为 4.0 时，甘精可溶，并且是在此 pH 值下保存的，但是在机体血液或皮下组织的中性 pH 环境下，它会形成微沉淀，有利于胰岛素注射后缓慢吸收，这样带来起效快和作用时间长的好处。甘精有时被称为“无峰”胰岛素，虽然无峰并不意味着没有最低点，但是主要指葡萄糖利用率。在犬中可能看到平直的血糖曲线（BGC），因此对犬来说甘精可以称为无峰胰岛素。

3. PZI (U-40 human recombinant protamine zinc insulin; Pro-Zinc, Boehringer Ingelheim Animal Health) is considered by clinicians as a long-acting insulin, and is FDA approved for use in cats. In field studies in cats, mean time of the BG nadir was between 5 and 7 hr and the duration of action was 8 – 24 hr, which was deemed an appropriate duration of action by the FDA.[14] The results suggested that Prozinc should be administered twice daily in most diabetic cats to maintain control of glycemia.[14] This insulin is used in both cats and dogs, although it is less commonly used in dogs. Protamine zinc insulin can have a prolonged duration of action in dogs and may be tried on once-daily dosing schedule to minimize the chances of clinically significant hypoglycemia and/or the Somogyi phenomenon.
PZI（U-40 人重组鱼精蛋白锌胰岛素；Pro-Zinc，勃林格殷格翰动保），临床医生将其看作是长效胰岛素，FDA 批准用于猫。在猫的田野试验中，血糖最低值出现的平均时间是 5 和 7 小时，作用持续时间是 8-24 小时，被 FDA 认为是恰当的持续时间。研究结果表明大多数糖尿病猫 Prozinc 应一天两次给药来控制血糖。这种胰岛素可用于犬和猫，虽然在犬中很少使用。鱼精蛋白锌胰岛素在犬中可以有非常长的作用时间，可以尝试一天一次给药来减少出现显著低血糖和/或苏木杰现象的风险。

4. NPH (U-100 human recombinant; Neutral Protamine Hagedorn, Humulin N, Lilly or Novulin N, Novo Nordisk)is an intermediate-acting insulin that is used in dogs. The Task Force does not recommend use of this insulin in cats due to its short duration of action. The duration of action of NPH in dogs is often <12 hr. Some dogs can have postprandial hyperglycemia when treated with this insulin.[15] A combination form of NPH plus regular insulin (70 NPH/30 Regular) is available that may be suitable if the dog has an appropriate duration of action (8 – 12 hr) with an early nadir or postprandial BG spike. Some clinicians use this product in dogs who develop post- prandial hyperglycemia when being treated with NPH.
NPH（U-100 人重组；中性鱼精蛋白胰岛素，优泌林 N，礼来或诺和林 N，诺和诺德）是一种用于犬的中效胰岛素。专家组不建议在猫中使用这种胰岛素，因为它的作用时间很短。NPH 在犬中的作用时间经常小于 12 小时。一些犬使用这种胰岛素可能会出现餐后高血糖。现有一种 NPH 和常规胰岛素（70 NPH/30 常规）的复合制剂可能适合用于犬，只要作用时间恰当（8-12 小时）且最低点较早出现或餐后血糖升高就可以。一些临床医生在给犬使用 NPH 出现餐后高血糖时会使用这种复合制剂。

5. Detemir (U-100 human recombinant; Levemir, Novo Nordisk) is a long-acting insulin that can be used in both dogs and cats. Detemir is a human analog insulin engineered with modifications that allow it to bind albumin with high affinity in the subcutaneous and intravascular spaces, prolonging the insulin’s absorption.[4,16] This prolonged absorption gives

detemir a long and steady duration of action and less variability in biological activity.[4] Detemir has a very similar profile to glargine (Lantus) in cats in terms of BG control and remission rates.[12] However, cats receiving detemir require a lower median maximal dose than cats receiving glargine (1.75 U per cat for detemir versus 2.5 U per cat of glargine).[17] Dogs are very sensitive to the higher potency of this insulin and require lower starting doses (0.1 U/kg).[18] Particular caution must be used in small dogs because they are more likely to have more frequent hypoglycemic excursions.[18]
地特（U-100 人重组；Levemir，诺和诺德）是一种长效胰岛素，可以用于犬和猫。地特胰岛素是人胰岛素经过修饰而得到的类似物，在皮下和血管内跟白蛋白有很高的亲和力，进而可以延长胰岛素的吸收。这种超长缓慢吸收使得地特胰岛素有长且稳定的作用时间，以及较低的生物活性差异性。在控制血糖和缓解率方面，地特跟甘精（来得时）在猫上非常相似。然而，猫用地特时需要的平均最高剂量比甘精低（地特 1.75 U 每只猫，甘精 2.5 U 每只猫）。犬对这种高效胰岛素非常敏感，需要使用更低的起始剂量（0.1 U/kg）。尤其要注意小型犬，因为他们更容易频繁的出现低血糖。

Insulin dosages should be based on the patient's estimated ideal body weight. Judicious initial dosing is recommended because dietary change may alter food intake and affect the therapeutic response to insulin. Insulin dosages should not be increased more often than q 1–2 wk. The Task Force recognizes that clients are often cost-constrained. However, choosing a less efficacious insulin can result in higher total costs and careful monitoring. In addition, comparing per-U costs of insulin is more useful than comparing cost per vial. The cost per U of insulin gives a more accurate assessment of the overall cost of using the insulin versus cost per vial.
胰岛素剂量应根据病患预期理想体重选择。建议谨慎决定起始剂量，因为饮食变化可能会改变食物摄入并影响胰岛素的治疗效果。改变胰岛素剂量不应超过每 1-2 周一次的频率。专家组也知道顾客经常会纠结于费用，然而，选择一种低效胰岛素可能会导致更多花费并且需要更多监测。此外，对比每单位胰岛素的价格比每瓶价格更有用。计算每单位胰岛素价格比计算每瓶价格可以获得对全部费用更加精确的评估。

In the majority of feline diabetes cases, the Task Force recommends a starting dose of glargine (Lantus), q 12 hr based on the estimated ideal body weight of the cat and BG levels (0.5 U/kg q12 hr if BG > 360 mg/dL and 0.25 U/kg q 12 hr if BG <360 mg/dL). This equates to 1 U q 12 hr in the average cat. Even in a very large cat, the starting dose of insulin should not exceed 2 U per cat q 12 hr. Most cats are well regulated on insulin at an average dose of 0.5 U/kg q 12 hr, with a range of 0.2–0.8 U/kg. With PZI (Prozinc), a typical starting dose is 1–2 U per cat.
绝大部分猫糖尿病病例，专家组建议根据猫预期理想体重和血糖水平选择甘精（来得时）起始剂量（如果血糖>360 mg/dL，0.5 U/kg q12hr；如果血糖<360 mg/dL，0.25 U/kg q12hr）。这相当于猫平均是 1 U q 12 hr。即使是很大的猫，胰岛素剂量也不应超过 2 U 每只猫 q 12 hr。大部分猫可以维持的平均胰岛素剂量是 0.5 U/kg q 12 hr，范围 0.5 U/kg q 12 hr。使用 PZI（Prozinc）时，通常起始剂量是 1-2 U 每只猫。

In diabetic dogs, the Task Force recommends a starting dose of 0.25 U/kg of lente (Vetsulin) q 12 hr, rounded to the nearest whole U. Most dogs are well controlled on insulin at an average dose of 0.5 U/kg q 12 hr with a range of 0.2–1.0 U/kg.
糖尿病犬，专家组推荐的起始剂量是 Lente (Vetsulin) 0.25 U/kg q 12hr，四舍五入。大部

分犬可以很好的控制的平均胰岛素剂量是 0.5 U/kg q 12 hr，范围 0.2–1.0 U/kg。

See Table 1 for more detailed information on alternative dosing and insulin selections for both dogs and cats.
犬猫其他剂量和更多胰岛素用法见表 1.

It should be noted that product pharmacokinetics vary depending on insulin type, product formulation, and the individual patient's response. One should employ reasonable dosing flexibility based on individual patient response and the owner's compliance limitations. For example, a 12 ± 2-hour window on each side of the dosing interval and occasional missed doses are considered acceptable by most practitioners. Other insulin types and other therapeutics can be used in dogs and cats based on the patient's response to first-line insulin therapy and associated recommendations, as discussed in the "Monitoring" section of the guidelines.
应注意产品的药物动力学根据胰岛素类型、产品制剂和每个病患的反应会有所改变。兽医应根据每个病患的反应和主人的依从性灵活选择剂量。例如，12±2 小时的给药间隔和偶尔漏给药，对大部分医生来说都是可以接受的。根据一线胰岛素的治疗效果以及相关建议，其他胰岛素类型和其他治疗方法也可以用于犬猫，在指南"监测"部分有讨论。

Although none of the insulin products available for use in dogs and cats have canine- or feline-specific amino acid sequences, anti- insulin antibodies do not appear to cause a significant clinical problem.
虽然用于犬猫的所有胰岛素都没有特定的犬或猫氨基酸序列，抗胰岛素抗体似乎不会引起显著的临床问题。

Insulin manufacturers generally recommend discarding opened and used bottles of insulin after 4–6 wk or until the date of expiration listed by the manufacturer. However, if handled carefully and stored in the refrigerator, the Task Force is comfortable using insulins beyond the date of expiration (up to 3–6 mo) as long as they are not discolored, flocculent, or have any change in consistency. Insulin must be discarded if these changes occur. If a lack of BG regulation is noted 3–6 mo after using a specific bottle of insulin, it may be prudent to replace the bottle prior to increasing insulin dose.
胰岛素厂家一般建议胰岛素开封使用 4-6 周后扔掉或超过厂商标记的有效期后扔掉。然而，如果小心使用并且储存在冰箱里，专家组认为可以很放心的使用胰岛素超过有效期（高达 3-6 个月），只要胰岛素没有变色、没有沉淀物或质地没有改变。但是如果发生这些改变，必须丢弃胰岛素。如果在使用某瓶胰岛素 3-6 个月后发现无法控制血糖，更谨慎的做法可能是在提高胰岛素剂量之前先换瓶新的胰岛素。

Non-Insulin Therapeutic Agents (see Table 2)
非胰岛素治疗药物（见表 2）
1. **Sulfonylureas** such as glipizide promote insulin secretion from the pancreas and can be used in cats. Oral glipizide has been used successfully in cats with DM, with benefits being reported in approximately 40% of cats. Transdermal application is unreliable.[23] Adverse effects following oral administration include cholestasis, hypoglycemia, and vomiting. There is concern that glipizide may contribute to progression of DM and pancreatic amyloidosis.[23] The Task Force only recommends glipizide for use in cats with owners who refuse insulin

therapy, and only with concurrent dietary therapy. The initial dose is 2.5 mg/cat orally q 12 hr. The dose can be increased to 5 mg/cat q 12 hr if an inadequate response is seen after 2 wk. If no response is seen after 4 – 6 weeks, insulin therapy should be instituted.[23] If the cat appears to be clinically responsive, the trial can continue for 12 wk to assess response to therapy. Obtaining BGCs is important to confirm therapeutic response. To screen for liver toxicity, regular liver monitoring should be performed. Glipizide should not be used in dogs because they do not have any functional pancreatic beta cells due to the pathogenesis of canine DM.
磺脲类药物例如格列吡嗪促进胰腺分泌胰岛素，可以用于猫。口服格列吡嗪已成功用于猫糖尿病，对大约 40%的猫有益。皮内给药效果不理想。口服给药后的副作用包括胆汁淤积、低血糖和呕吐。使用格列吡嗪时，会担心它使糖尿病恶化并引起胰腺淀粉沉积。专家组仅在主人拒绝使用胰岛素的情况下推荐主人给猫用格列吡嗪，并且要同时进行饮食治疗。起始剂量是 2.5 mg 每只猫，口服 q 12hr。如果 2 周后效果不理想可以增加剂量至 5 mg/猫 q 12 hr。如果 4-6 周后仍无效果，应使用胰岛素治疗。如果猫临床上对治疗有反应，可以持续用药 12 周来评估动物对治疗的反应。监测血糖曲线对评估治疗效果非常重要。应定期监测肝功能筛查肝毒性。格列吡嗪不应用于犬，因为根据犬糖尿病的致病机理他们没有任何具有功能的胰岛β细胞。

2. a-glucosidase inhibitors such as acarbose are used to inhibit intestinal glucose absorption and reduce postprandial hyperglycemia. Acarbose has been used in cats along with insulin and a low-carbohydrate diet.[23] Acarbose can be used in dogs along with insulin therapy to help improve glycemic control and may decrease the dose of exogenous insulin administration. As a sole agent, acarbose is seldom if ever sufficient, especially in dogs. Advise owners that diarrhea is a possible side effect.[24]
α葡萄糖苷酶抑制剂例如阿卡波糖用来抑制肠道吸收葡萄糖，减少餐后高血糖。阿卡波糖已被用于同时进行胰岛素治疗和饲喂低碳水化合物的猫。阿卡波糖也可以用于进行胰岛素治疗的犬，来辅助控制血糖，可能可以降低外源性胰岛素的给药剂量。阿卡波糖作为单一药物治疗很少是足够的，尤其在犬中。告诉主人腹泻是可能的副作用。

3. Incretins such as GLP-1 (glucagon-like peptide 1) are metabolic or gastrointestinal hormones that can be used in dogs and cats. They can be used along with glargine (Lantus) insulin therapy and diet in cats to help achieve remission.[25]Incretins can help improve diabetic control in cats and dogs. In healthy animals and potentially diabetic cats, GLP-1 increases insulin secretion (in cats it also protects beta cells from oxidative and toxic injury and promotes expansion of the b-cell population) and functions to help delay gastric emptying and increase satiety. In dogs and cats, improved diabetic control is presumed to be via glucagon suppression.[26] Currently, although more research is needed, the most promising results have been reported in cats treated with exenatide ER (Bydureon) and in dogs with liraglutide (Victoza).[26,27]
肠促胰素例如 GLP-1（胰高血糖素样多肽 1）是代谢性或胃肠道激素，可以用于犬猫。他们可以和甘精（来得时）胰岛素以及饮食一起用于猫，以帮助达到缓解。肠促胰素有助于犬猫糖尿病的控制。在健康动物以及可能某些糖尿病猫中，GLP-1 可增加胰岛素的分泌（在猫中，它还可以保护β细胞免受氧化损伤和毒性损伤并促进β细胞的增殖），并且可以起到延迟胃排空和增加食欲的功能。目前，尽管需要更多研究，最具有前景的结果见于猫使用艾塞那肽（Bydureon）治疗和犬使用利拉鲁肽（Victoza）治疗的报告中。

表 2				
治疗犬猫糖尿病的非胰岛素治疗药物				
药物类别	举例	作用方式	与胰岛素联用	评论
磺脲类	格列吡嗪	刺激胰腺分泌胰岛素	否	仅在猫主人拒绝使用胰岛素时推荐使用，不可用于犬。
α葡萄糖苷酶抑制剂	阿卡波糖	抑制肠道吸收葡萄糖，减少餐后高血糖	是	可用于犬猫。当胰岛素峰值过快达到时有用（给药后 2 小时）
肠促胰素	胰高血糖素样多肽 1；艾塞那肽（Byetta）；缓释艾塞那肽（Bydureon）；利拉鲁肽（Victoza）	刺激胰腺分泌胰岛素，延迟胃排空，增加食欲，保护β细胞，促进β细胞增殖，抑制胰高血糖素	是	缓释艾塞那肽在猫中、利拉鲁肽在犬中有较好的效果。作用效果在大多数健康动物中可见，可能糖尿病猫也有效，但是典型糖尿病犬没有。

Dietary Therapy Goals and Management 饮食治疗目标和管理

The goals of dietary therapy are to optimize body weight with appropriate protein and carbohydrate levels, fat restriction, and calorie and portion control. Weight loss in obese patients and stopping DM- associated weight loss are treatment goals for diabetic canine and feline patients. The following approach is recommended for dietary management of DM:

饮食治疗的目标是通过恰当的蛋白质和碳水化合物含量、限制脂肪以及卡里路和饲喂量的控制达到最佳体重。肥胖动物减肥和阻止糖尿病造成的体重减轻是糖尿病犬猫的治疗目标。糖尿病的饮食管理推荐以下方法：

- The cat or dog’s daily caloric requirements, based on lean body mass, should be calculated.
  应根据去脂体重计算犬或猫的每日卡里路需求
- Body weight (using the same scale) and BCS should be obtained at least once or twice monthly and adjustments made in dietary intake to maintain optimal weight.
  应至少每月一次或两次记录体重（用同一个称）和 BCS，在据此调节饮食摄入量来维持最佳体重。
- A weight loss goal in obese cats is 0.5 – 2% reduction per wk and in dogs is 1 – 2% reduction per wk.
  肥胖猫的减肥计划是减 0.5-2%每周，犬是 1-2%每周。
- Managing protein and carbohydrate intake is recommended to minimize postprandial hyperglycemia.
  推荐管理蛋白质和碳水化合物的摄入，来最小化餐后高血糖。

Diabetic cats should be fed a high-protein diet (de fi ned as ≥40% protein metabolizable energy) to maximize metabolic rate, limit the risk of hepatic lipidosis during weight loss, improve satiety, and prevent lean muscle-mass loss.[28] This dietary regimen is necessary to prevent protein malnutrition and loss of lean body mass. High-protein diets typically provide the lowest amount of carboydrates without impacting palatability. The following dietary

principles for diabetic cats should also be considered:
糖尿病猫应饲喂高蛋白饮食（定义为≥40%的蛋白质代谢能）来最大化代谢率、在减重过程中降低脂肪肝的风险、提高食欲并预防肌肉量的丢失。饮食法则非常重要可以预防蛋白质营养不良和瘦体重的丢失。高蛋白饮食通常含有最少的碳水化合物，而且适口性不受影响。以下糖尿病猫饮食原则也应考虑：

- Protein normalizes fat metabolism and provides a consistent energy source.
  蛋白质正常化脂肪代谢，提供持续的能量来源。
- Arginine stimulates insulin secretion.
  精氨酸刺激胰岛素分泌。
- Carbohydrate intake should be limited because carbohydrates may contribute to hyperglycemia and glucose toxicity. The Task Force recommends a diet of approximately 12% ME, recognizing that there are a variety of expert opinions on this topic.[23,28]
  应限制碳水化合物的摄入，因为碳水化合物可能会导致高血糖和葡萄糖毒性。专家组推荐饮食中占比大约 12%代谢能，但是注意关于这一话题有专家们还有不同的意见。
- Diabetic cats have reported remission rates between 15 and 100% when given a combination of a high-protein/low-carbohydrate diet and insulin.[4,5] The highest remission rates occur when glargine (Lantus) and detemir (Levemir) insulin are used in newly diagnosed (glargine) diabetics or those within 6 mo of diagnosis (both insulin forms).[12]
  糖尿病猫饲喂高蛋白低碳水化合物饮食且使用胰岛素治疗时，根据报道，缓解率为15-100%。新诊断的糖尿病猫使用甘精（来得时）胰岛素或诊断后 6 个月内使用甘精或地特（Levemir）胰岛素时，有最高的缓解率。
- High-fiber diets are not typically recommended for cats with DM.
  糖尿病猫通常不推荐高纤维饮食。

Feeding portioned meals has several advantages for dietary management of diabetic cats:
分餐饲喂糖尿病猫进行饮食管理有一些好处：

- It is easier to monitor intake and appetite.
  更容易监测进食量和食欲
- Portion control is facilitated.
  分餐更好控制。
- Free-choice feeding is acceptable if a cat’s eating habits cannot be changed (the Task Force recommends that the daily ration be divided into multiple meals. The use of timed feeders may be helpful in this scenario).[28]
  如果猫进食习惯无法改变，也可以自由采食（专家组建议将每日饲喂量分成多次进食。在这种情况下使用定时喂食器可能有帮助）。
- Canned foods are preferred over dry foods. Canned foods provide:
  罐装湿粮比干粮更好。湿粮可以提供：
  - ✧ Lower carbohydrate levels. 更低的碳水化合物水平。
  - ✧ Ease of portion control. 更好控制少食多餐。
  - ✧ Lower caloric density; cats can eat a higher volume of canned food and obtain the same caloric intake as smaller volumes of dry food.
    能量密度更低；猫可以吃很多的湿粮，而且摄入的卡里路跟较少的干粮提供的是一样的。
  - ✧ Additional water intake. 摄入更多的水分

Dietary recommendations for both dogs and cats should be adjusted if concurrent diseases are present (e.g., chronic kidney disease, pancreatitis, intestinal disease). For dogs, a diet that will correct obesity, optimize body weight, and minimize postprandial hyperglycemia is recommended. Unlike cats, dogs are not at appreciable risk for the clinical complications of hepatic lipidosis. Dogs with DM can do well with any diet that is complete and balanced, is fed at consistent times in consistent amounts, and is palatable in order to achieve predictable and consistent intake.
如果犬猫存在并发疾病（例如慢性肾病，胰腺炎，肠道疾病），应作相应的饮食调节。对犬，推荐饲喂可纠正肥胖、最优化体重以及最小化餐后高血糖的饮食。与猫不同，犬相对没有多少并发脂肪肝的风险。糖尿病犬可以饲喂任何全面均衡的饮食，定时定量饲喂，并且饮食适口性要高来达到预期和持续进食。

For dogs, diets that contain increased quantities of soluble and insoluble fiber or that are designed for weight maintenance in diabetics or for weight loss in obese diabetics can:
对犬，含有更多可溶性和不可溶性纤维或为糖尿病维持体重设计或为糖尿病肥胖动物减重设计的饮食，可以

- Improve glycemic control by reducing postprandial hyperglycemia.
  通过减少餐后高血糖提高血糖控制。
- Restrict caloric intake in obese dogs undergoing weight reduction.
  限制肥胖犬的卡里路摄入，减肥。

Some clinicians recommend that owners supplement with canned pumpkin, green beans, or commercial fiber supplements containing psyllium or wheat dextrin. Additionally, regular and appropriate exercise should be considered an adjunct of any diet- based weight-loss program.
一些临床医生建议主人补充罐装南瓜、绿豆或含有车前草或麦糊精的商业化纤维补充物。另外，任何基于饮食的减重计划都应考虑定期合理的运动来辅助。

In underweight dogs, the principal goal of dietary therapy is to normalize body weight, increase muscle mass, and stabilize metabolism and insulin requirements. Underweight dogs should be fed a high-quality maintenance diet or a diabetic diet that has both soluble and insoluble fiber and is not designed for weight loss. The diet should be palatable in order to provide predictable caloric intake when fed at consistent times and in consistent amounts. Owners should include treats when calculating daily caloric intake.
体重过轻的犬，饮食治疗的主要目的是正常化体重，增加肌肉量以及稳定新陈代谢和胰岛素需求量。体重过轻的犬应饲喂高质量的维持日粮或含有可溶性和不可溶性纤维的糖尿病处方粮，并且这些粮都不应是减肥粮。饮食应具有一定的适口性达到预期进食量，并且应定时定量饲喂。计算每日摄入卡里路时，主人应将零食也计算在内。

Monitoring 监测

The overarching goal of monitoring diabetic cats and dogs is to control clinical signs of DM while avoiding hypoglycemia. Stated another way, the definition of a controlled diabetic is absence of clinical signs and hypoglycemia. Blood glucose levels do fluctuate and short periods of mild hyperglycemia are acceptable. The goal is not necessarily to normalize BG, but to keep the BG below the renal threshold (200 mg/dL in dogs and 250 – 300 mg/dL in

cats) and to avoid hypoglycemia. When BG is above the renal threshold, glucosuria occurs, resulting in PU/PD. None of the monitoring modalities are perfect, and they each have strengths and weaknesses. Although normalizing clinical signs (such as resolution of PU/PD/PP and achieving ideal body weight) supersedes all other monitoring indicators, every attempt should be made to also monitor BG in the diabetic patient. To illustrate, if a patient is consistently negative for glucosuria, without measuring BG it is impossible to determine if the individual is a "perfectly regulated" diabetic or hypoglycemic.
糖尿病犬猫监测的首要目标是控制糖尿病的临床症状同时避免低血糖。换句话说，糖尿病得到控制的意思是没有临床症状和低血糖。血糖水平确实会有波动，短时间的轻度高血糖是可以接受的。目标不是一定要让血糖完全正常，而是将血糖控制在肾阈值之下（犬 200 mg/dL，猫 250-300 mg/dL）以及避免低血糖。当血糖超过肾阈值时，会出现糖尿，导致多饮多尿。没有哪种监测方法是完美的，它们都有优点和缺点。虽然临床症状的消失（例如多饮多尿多食消失以及达到理想体重）比其他所有监测指标都要重要，也应尽最大努力去监测糖尿病病患的血糖。举例来说，如果一只病患持续尿糖阴性，不检测血糖，是无法判断动物是糖尿病"控制良好"还是低血糖。

Monitoring diabetic pets can be challenging. The algorithm in Figure 1 provides a quick reference for three types of DM patients — newly diagnosed, previously diagnosed, and previously diagnosed but currently unregulated. Monitoring options include performance of BGCs, monitoring UG, measuring fructosamine, and assessment of clinical signs and weight. Results from different monitoring approaches may conflict. In a review of 53 cases of canine DM, BG measurements and fructosamine concentrations were consistent with good glycemic control in only 60% of dogs judged to have good clinical control. Furthermore, although all monitoring parameters were signi fi cantly improved in dogs with good clinical control, considerable overlap existed between dogs with good and poor clinical responses.[29] In cats, no single monitoring parameter best correlates with the level of clinical control identified.[30]
监测糖尿病宠物可能会具有挑战。图 1 将糖尿病病患非常简洁的分为了 3 类——新诊断、已诊断和已诊断但目前未控制。监测选项包括测量血糖曲线、监测尿糖、监测果糖胺以及评估临床症状和体重。不同监测方法的结果可能会相互矛盾。在 53 个犬糖尿病病例回顾中，仅在 60%评判为临床控制良好的病例中，血糖值和果糖胺浓度符合血糖控制良好。而且，虽然临床控制良好的犬的所有检测指标都有显著的改善，但是临床控制得好和不好的犬之间还是有很多的交叉。在猫中，没有哪个监测指标可以最好的与临床控制水平相符。

In-Hospital Blood Glucose Curves 院内血糖曲线

Blood glucose curves serve two very useful purposes that other monitoring parameters do not. They identify clinically undetectable hypoglycemia so that the insulin dose can be decreased before clinical signs of hypoglycemia develop. Thus, a periodic BGC is recommended for seemingly well-controlled patients. More importantly, although other techniques and clinical signs may suggest control is lacking, multiple reasons for poor control exist, including too low and too high an insulin dose. The only way to know how to appropriately change an insulin dose is to perform a BGC.
血糖曲线有两个非常有用的作用，其他监测指标没有。它可以发现临床上无法发现的低血糖，因此可以在低血糖的临床症状出来之前就降低胰岛素的剂量。因此，对表面看起来控制良好的病患，建议定期监测血糖曲线。更重要的是，虽然其他的方法和临床症状可能提示控制不足，但是有太多原因会导致控制不足，包括胰岛素剂量过高和过低，知

道如何正确调节胰岛素剂量的唯一一种方法是测量血糖曲线。

There are several situations when a BGC should be performed:
(1) after the first dose of a new kind of insulin; (2) at 7 – 14 days after an insulin dose change; (3) at least q 3 mo even in well-controlled diabetics; (4) any time clinical signs recur in a controlled patient;and (5) when hypoglycemia is suspected.
在以下几种情况应监测血糖曲线：
（1）首次使用一种新的胰岛素之后；（2）胰岛素剂量改变 7-14 天后；（3）即使是控制良好的糖尿病，也要至少每 3 个月监测一次；（4）在控制下的病患，任何时候只要出现临床症状就需要监测；（5）当怀疑低血糖时。

To construct a BGC, BG is generally measured q 2 hr for one interval between injections (i.e., for 12 hr if insulin is administered twice daily and for 24 hr if insulin is given once daily). When using glargine (Lantus) in cats, BG should be monitored every 3 – 4 hr. However, when BG is <150 mg/dL in both cats and dogs during any curve, BG should be measured hourly.
为了获得血糖曲线，通常在两次胰岛素注射之间每 2 小时测量一次血糖（例如胰岛素一天两次的话监测 12 小时，一天一次的话监测 24 小时）。当猫使用甘精（来得时）时血糖应每 3-4 小时监测一次。然而，当曲线任一点犬猫血糖<150 mg/dL 时，应每小时测一次血糖。

The AlphaTrak 2 may be the most accurate BG meter (glucometer) for veterinary patients because it has been calibrated in dogs and cats.[31,32,33] Although human glucometers are readily accessible to pet owners, the Task Force does not recommend their use due to inaccuracies when reading canine and feline blood.
Alpha Trak 2 可能是犬猫最精确的血糖仪，因为是专门针对犬猫制造的。虽然宠主可以很容易买到人血糖仪，但是专家组不建议使用，因为他们在测量犬猫血糖时不准。

A normal insulin treatment and feeding schedule must be maintained as much as possible during the BGC. Unless patients eat their normal amount of the normal food at the normal time, a BGC should probably not be obtained. When first regulating a diabetic patient, assessment of owner technique is crucial. Therefore, it is ideal if the feeding and insulin injection are done in the hospital so the injection can be observed. Obtaining a fasting blood sample for BG measurement prior to insulin injection can also aid in appraisal of glycemic control. However, this may not be possible if normal feeding time occurs before a hospital opens or if a dog or cat will not eat in the hospital. If an owner’s technique is suspect, the injection time can be changed to occur in front of the veterinarian. Clearly, cooperation between client and veterinarian is necessary to optimize the information obtained with minimal disturbance to routine.
在监测血糖曲线时，应尽可能维持正常胰岛素治疗和饲喂计划。除非病患在正常时间吃了正常量的正常食物，否则不应该监测血糖曲线。当首次管理糖尿病病患时，评估主人技术十分重要。因此，最好在医院喂食注射胰岛素，这样注射可控。注射胰岛素之前测量空腹血糖值对评估血糖控制也有帮助。然而，当正常喂食时间在医院开门之前或者犬猫不愿意在医院进食，这一点就不可行。如果怀疑主人的技术，可以调整注射时间，在兽医上班的时候注射。很明显，顾客和兽医之间需要紧密合作来加强信息交流并避免打乱正常生活。

A BGC should establish duration of treatment effect and the lowest BG (i.e., the nadir). The ideal nadir is a BG of 80 – 150 mg/dL. The highest BG should be close to 200 mg/dL in dogs and 300 mg/dL in cats. In assessing a BGC, whether it is the first curve performed on a patient or the most recent of many, two basic questions need to be asked. First, has the insulin succeeded in lowering BG? And second, how long has the BG been controlled?By answering these questions, logical changes in dosing regimen can be made.
根据血糖曲线应判读出作用持续时间和最低血糖值（也就是最低值）。理想最低值血糖是 80 – 150 mg/dL。血糖最高值犬应接近 200 mg/dL，猫应接近 300 mg/dL。在评估血糖曲线时，不管是第一次曲线还是很多曲线的最近一条，需要问两个基础问题。第一，胰岛素成功降低血糖了吗？第二，血糖控制了多久？通过回答这些问题，才能做出合理的剂量调节。

The first aim in regulating a diabetic is to achieve an acceptable nadir. If an acceptable nadir is not achieved, the insulin dosage should be adjusted (see below). An acceptable nadir with good clinical control may not be obtained if the insulin used has a short duration of activity. Hypoglycemia must always be avoided. No matter what other BG concentrations are during the day, if BG is ever <80 mg/dL, the insulin dose must be reduced.
控制糖尿病的首要目的是达到可接受的最低值。如果未达到可接受的最低值，应调节胰岛素剂量（见下文）。如果使用的胰岛素的作用时间很短，可能无法达到可接受的最低值和良好的临床控制。总是要避免低血糖。只要血糖值有低于 80 mg/dL，不管其他值是多少，都要减少胰岛素剂量。

Once an acceptable nadir is achieved, duration of action, roughly defined as the amount of time BG is controlled, can be determined. Duration cannot be evaluated until the nadir is opti- mized. The BG should be controlled for as close to 24 hr per day as possible.
一旦得到可接受的最低值，作用持续时间，也就是大约血糖控制的时间，就可以判断出来。最低值优化后才可以评估作用持续时间。血糖控制的时间越长越好，应尽可能达到每天 24 小时都在控制下。

The Somogyi or overswing phenomenon, also called hypoglycemia- induced hyperglycemia, refers to hypoglycemia followed by marked hyperglycemia. It results from a physiological response when an insulin dose causes BG to be <60 mg/dL or when BG concentration decreases quickly. In either case, counter-regulatory hormones, which act to increase BG (e.g., cortisol, epinephrine, and glucagon), are released. Hyperglycemia usually occurs rapidly and can be followed by a period of insulin resistance. In cats, however, hypoglycemia does not always trigger a Somogyi phenomenon and resistance may not occur.[34] The same is likely true for dogs. If a Somogyi phenomenon is observed, insulin dosage must be decreased. Once the nadir is >80 mg/dL, counter-regulatory hormones will no longer interfere and the true duration of effect will become apparent.
苏木杰或过冲现象，也称为低血糖诱导的高血糖，低血糖后出现显著的高血糖。它是一种生理反应，当胰岛素引起血糖<60 mg/dL 或血糖浓度降低过快时出现。在上面两种情况下，反调节激素，也就是升血糖的激素（例如可的松、肾上腺素和胰高血糖素）会释放出来。高血糖通常会迅速出现，并伴随一段时间的胰岛素抵抗。然而在猫中，低血糖通常不会激发苏木杰现象，胰岛素抵抗也可能不会出现。犬可能也是这样。如果发现苏木杰现象，胰岛素剂量一定要减少。只要最低值>80 mg/dL，反调节激素就不会释放干扰，真实的作用时长就会很明显。

Glucose curves are not perfect and must always be interpreted in light of clinical signs. Blood glucose curves vary from day to day and can be affected by deviation from the patient's normal routine.[35,36]Stress hyperglycemia falsely elevates results. See the Online Resource Center at aaha.org/diabetes for examples of interpreting various glucose curves.
血糖曲线不是完美的，一定要结合临床症状进行判读。血糖曲线每天都不一样，由于病患不是处于正常的生活状态，也可能会受到影响。应激性高血糖会导致血糖值假性升高。如何判读不同血糖曲线的具体案例可以参考线上资源中心，网址 aaha.org/diabetes。

At-Home Blood Glucose Curves 在家血糖曲线

Obtaining a BGC at home is strongly recommended both for dog and cat owners, but even more so in the case of feline patients due to the chance of stress hyperglycemia in a hospital setting. For home BGC, capillary blood is suitable.[37] Commonly used sites of blood collection are the ear, gums, non‐weight bearing or accessory foot pads, or elbow callus. If using devices designed for pricking human fin- gertips, one with a variable needle depth should be chosen. A hypodermic needle can also be used, especially if the marginal ear vein is the site of blood collection.[38]
强烈建议犬猫主人在家监测血糖曲线，尤其是猫，因为猫在医院容易出现应激性高血糖。在家血糖曲线，可以使用毛细血管血液。经常用来采血的部位包括耳朵、牙龈、不承重的或副足垫，或肘部老茧处。如果使用人用扎手指的设备，应选择有不同长度针的产品。皮下注射器针头也可以使用，尤其是在耳缘静脉采血时。

Not all owners are suited to the task of obtaining a home BGC, something that takes time and patience to master. The most frequent problems encountered by owners are the need for more than one puncture to obtain a blood drop, obtaining a sufficient volume of blood, the need for assistance in restraining a pet, and the pet's resistance to obtaining a blood sample.[38] Curves can vary from day to day even when done at home and must always be interpreted in light of clinical signs.[39] Practice team members can refer to the Diabetes Management Guidelines Online Resource Center at aaha. org/diabetes for more detailed information and resources for pet owners on at-home monitoring utilizing BGCs.
不是所有主人都能胜任在家制作血糖曲线这一重任，这需要时间和耐心才能掌握。主人最经常遇到的问题是需要扎好几次才能采到足够的血、需要别人帮助保定宠物以及宠物拒绝采血。即使在家采血，曲线也可能每天都有变化，必须结合临床症状进行判读。更多详细信息和关于宠主在家监测血糖曲线的资料，可以参考糖尿病管理指南线上资源中心，网址 aaha. org/diabetes。

Urine Glucose Measurements 尿糖检测

Urine glucose measurements can be helpful, but it should be remembered that dipsticks have a relatively low accuracy in dogs, often underestimating UG.[40] Also, UG concentration is only a reflection of the average BG over the time interval the bladder was filling. Relying solely on UG measurements is not recommended.
检测尿糖会有帮助，但是应记住尿试纸条在犬中的准确性相对较低，经常低估尿糖。而且，尿糖只反映膀胱充盈时间段内的血糖平均值。仅依靠尿糖检测是不推荐的。

Regardless, UG concentration can aid in assessment of a patient when other data conflict. Also, regular determination of UG concentration (at least weekly) can help in assessment of

表3 尿糖判读		
尿糖结果	评论	建议措施
没有颜色改变 - 葡萄糖阴性	应该担心胰岛素剂量是不是太高	如果结果仍然阴性，降低胰岛素剂量并且2-3天后复查。 注意：在没有血糖曲线的情况下尿糖阴性有变成危险低血糖的潜在可能，应作相应的监测。
一级颜色改变 - 100mg/dL	理想状况，尿糖应在阴性和100mg/dL之间。	胰岛素剂量不变，但是需要每周监测。
二级和三级颜色改变- 250和500mg/dL	专家组认为在没有检测血糖的情况下这是最难评估的结果。	考虑是否有饮食改变或偏差（“隐瞒”）。如果什么都没发现，而且猫也没有表现任何临床症状，2-3天后复查。如果主人愿意，根据是否存在临床症状，同时再检测血糖是最理想的。然而，如果主人拒绝血检，此时考虑增加胰岛素剂量0.5U q12hr。
三级、四级和五级改变 - 1000-2000+mg/dL	猫此时应该有临床症状	增加胰岛素1U q12hr并在5-7天后复查。 注意：不建议连续增加胰岛素超过2或3次，因为可能会引起苏木杰现象或胰岛素抵抗。

ongoing DM control (see Table 3). Consistently negative UG readings may indicate that insulin dosages are excessive. However, a negative UG reading only means that BG was below the renal threshold (i.e., BG could have been 150 mg/dL or 40 mg/dL). The only way to know is to measure BG.[41] Lastly, especially for cats for whom stress hyperglycemia prevents obtaining an accurate BGC, UG measurements can be used to adjust the insulin dose. However, such an approach is a last resort because of the potential for causing hypoglycemia. Although far from ideal, there are scenarios where this is the most practical monitoring scheme. Table 3 lists the suggested protocol for using UG test strip readings in cats is based on the Task Force’s clinical experience.

无论如何，当其他数据有冲突的时候，尿糖浓度可以帮助评估病患情况。而且，定期监测尿糖浓度（至少每周一次）可以帮助评估糖尿病长期控制情况（见表 3）。尿糖持续阴性可能代表胰岛素剂量过多。然而，尿糖阴性仅代表血糖浓度低于肾阈值（也就是血糖可以是 150 mg/dL 或 40 mg/dL）。知道具体血糖值的唯一方法是测量血糖。最后，尤其是猫容易出现应激性高血糖而无法获得准确的血糖曲线，尿糖检测可以用来调节胰岛素剂量。然而，这种方法是最后的手段，因为可能会引起低血糖。虽然不是很理想，还是有一些情况这是最实用的监测方法。表 3 根据专家组的临床经验列出了判读尿糖试纸的原则。

Glycosylated Proteins 糖化蛋白

The glycosylated proteins include fructosamine and glycosylated hemoglobin (A1C). Fructosamine, the glycosylated protein used in veterinary medicine, is formed by

nonenzymatic, irreversible binding of glucose to serum proteins, mainly albumin.[42] Rate of formation is proportional to the average BG level, so the higher the mean BG concentration is over time, the greater the fructosamine concentration should be. Because fructosamine concentration is also affected by the half-life of albumin, it reflects glycemic control over the previous 1 – 2 wk. Unfortunately, well-controlled diabetics can have elevated fructosamine concentrations. Conversely, uncontrolled diabetic pets can have normal levels.[43] Fructosamine may be elevated in sick, hyperglycemic, but nondiabetic cats.[43] For these reasons, fructosamine trends are more useful than isolated values. Because fructosamine is typically not affected by stress, it can help to differentiate stress hyperglycemia from diabetes.
糖化蛋白包括果糖胺和糖化血红蛋白（A1C）。果糖胺，兽医使用的糖化蛋白，通过葡萄糖与血清蛋白质，主要是白蛋白，经非酶促的不可逆结合而形成。形成速率与平均血糖水平成正比，所以某段时间内平均血糖浓度越高，果糖胺浓度也越高。因为果糖胺浓度也受白蛋白的半衰期影像，它反映了过去 1-2 周的血糖水平。不幸的是，控制良好的糖尿病可能会出现果糖胺升高。相反，未控制的糖尿病宠物可能会有正常水平。生病有高血糖但是没有糖尿病的猫也可能出现果糖胺升高。由于这些原因，果糖胺变化趋势比单个值更有用。因为果糖胺一般不会受到应激影响，它可以帮助区分应激高血糖和糖尿病。

One of the best uses of fructosamine is to evaluate trends in glycemic control if measured at each recheck. Declining fructosamine values indicate a lowering in BG overall, whereas increasing values indicate the opposite. A fructosamine concentration below the reference range is highly suggestive of chronic hypoglycemia, in which case a BGC should be performed. Additionally, this scenario may be an indicator that a feline patient may be nearing diabetic remission. Cats with hyperthyroidism or conditions that cause hypoalbuminemia, increased protein turnover rates, or hypoglobulinemia may have decreased fructosamine concentrations. Corrections can be performed by the laboratory performing the analysis.
果糖胺的最佳使用方法是每次复诊时都检测来评估血糖控制的趋势。果糖胺值下降表明血糖整体的降低，而值升高表明相反的变化。果糖胺浓度低于参考范围高度提示慢性低血糖，在这种情况下应测量血糖曲线。此外，这种情况也可能提示猫病患正在接近糖尿病缓解。猫患有甲状腺机能亢进或其他疾病引起低白蛋白血症、蛋白质代谢率增加或低球蛋白血症可能会有低果糖胺浓度。检测实验室可以对此进行纠正。

Commercial testing of canine and feline A1C is available. This glycated hemoglobin is commonly used to monitor diabetes in humans. More studies are needed to assess clinical use in pets.
现在已经有商业化检测犬猫 A1C 的方法。这种糖化血红蛋白经常用于检测人的糖尿病。需要更多的研究来评估它在宠物临床中的使用。

Home Monitoring 家庭监测

Observation of clinical signs is crucial to effective monitoring of DM. Owners should be encouraged to keep a daily log of appetite, observation of thirst (i.e., increased or normal), and insulin dose administered. Where DM monitoring is concerned, clinical signs supersede all else. When the patient has no clinical signs and the body weight is steady or increasing, DM is likely well controlled. In cats, one of the parameters considered to be the most useful and practical indicator of clinical DM control is the amount of water consumed over 24 hr.[30]

Cat owners are often happy with the level of clinical DM control, despite not having laboratory evidence of tight glycemic control, emphasizing that the long- term goal of DM treatment is to normalize clinical signs.[30] However, because a placebo effect can occur, judging the adequacy of DM control should not rely solely on owner observations.
观察临床症状对有效监测糖尿病非常重要。应鼓励主人每日记录下食欲、渴感（例如增加或正常）和给予的胰岛素剂量。当关注糖尿病监测时，临床症状比其他所有都重要。当病患没有临床症状并且体重稳定或增加时，糖尿病可能处于良好控制。在猫，被认为反映糖尿病控制情况最有用实用的一个指标是 24 小时的饮水量。猫主人经常会满足于糖尿病临床上得到控制，即使没有实验室证据表明血糖得到很好控制，这强调了糖尿病治疗的长期目标是消灭临床症状。然而，因为可能会出现安慰剂效应，不应仅仅根据主人的观察来判断糖尿病的控制是否足够。

Monitoring on the Initial Day of Treatment
治疗第一天的监测

- Initiate insulin therapy.
  开始胰岛素治疗
- Measure fructosamine.
  检测果糖胺。
- Perform a BGC to ensure that hypoglycemia does not occur.
  监测血糖曲线确保没有出现低血糖。
- If BG is <150 mg/dL at any time:
  如果任一时间出现血糖<150 mg/dL：
  - ✧ Decrease dose by 10 – 50% in dogs.
    犬剂量降低 10 – 50%。
  - ✧ Decrease dose by 0.5 U in cats.
    猫剂量降低 0.5 U。
  - ✧ In both species, re-curve the next day and daily thereafter until a nadir >150 mg/dL is reached.
    犬猫，第二天及后面继续监测曲线，直到达到最低值>150 mg/dL。
- If BG is >150 mg/dL, discharge the patient and re-evaluate in 7 – 14 days (sooner if concerns for hypoglycemia arise). The insulin dose should not be increased on day 1 no matter how high BG may be.
  如果血糖>150 mg/dL，病患出院，然后 7-14 天后重新评估（如果担心出现低血糖可以早些）。第一天不管血糖值有多高都不应提高胰岛素剂量。

Monitoring Until Control Is Attained
持续监测直到达到控制

- In a new diabetic, have owner administer insulin in hospital to observe technique.
  新诊断的糖尿病，让主人在医院注射胰岛素，观察其是否正确掌握给药技术。
- BGC will need to be performed q 7 – 14 days until acceptable dose is found.
  需要每 7-14 天监测一次血糖曲线直到找到可接受剂量。
- Review owner log.
  查看主人日志。
- Perform a physical examination, including measurement of body weight.
  进行体格检查，包括称体重。
- Perform a BGC and measure fructosamine.

测量血糖曲线并检测果糖胺。

Ongoing Monitoring
持续监测

- Review owner log.
  查看主人日志。
- Perform a physical examination, including measurement of bodyweight.
  进行体格检查，包括称体重。
- Perform a BGC and measure fructosamine.
  测量血糖曲线并检测果糖胺。
- Semiannually, perform full laboratory work including urinalysis, urine culture, triglycerides, thyroid levels (cats), and BP.
  每半年，进行一次全面的实验室检查，包括尿检、尿液培养、甘油三酯、甲状腺水平（猫）和血压。
- Any time an insulin dose is changed, a BGC should be performed in 7 – 14 days.
  每次调节胰岛素剂量后，都应在 7-14 天后测量血糖曲线。
- Utilizing “spot checks” or isolated BG values by themselves is not recommended as a sole reason to increase an insulin dose, but can sometimes be used to decrease the dose (if verified).
  不推荐主人自己利用“随机测”或单独血糖值作为唯一依据来增加胰岛素剂量，但是有时可以用来降低剂量（在证实的情况下）。

Insulin Adjustments if the Nadir Is <80 mg/dL (see Figure 2)
如果最低值 <80 mg/dL 如何调节胰岛素（见图 2）

- If clinical signs of hypoglycemia are present, treat as necessary.
  如果存在低血糖的临床症状，需要时进行治疗。
- Once the BG becomes >250 mg/dL, reinitiate therapy.
  一旦血糖 >250 mg/dL，重新开始治疗。
  - ✧ Decrease the dose 10 – 25% in dogs depending on the BG level and if there are no clinical signs of hypoglycemia.
    根据血糖水平并且在没有低血糖的临床症状情况下，犬剂量降低 10 – 25%。
  - ✧ Decrease the dose 50% in dogs if there are clinical signs of hypoglycemia.
    如果有低血糖的临床症状，犬剂量降低 50%。
  - ✧ Decrease the dose 0.5 – 1 U in cats depending on BG and if there are clinical signs of hypoglycemia.
    根据血糖水平并且在没有低血糖的临床症状情况下，猫剂量降低 0.5-1 U。
  - ✧ A BGC should be obtained after the next dose to ensure hypoglycemia does not recur. If hypoglycemia recurs with the lower dose, continue to decrease dose and obtain a BGC until hypoglycemia is not seen. Obtain a BGC in 7 – 14 days.
    更改剂量后需要监测血糖曲线，确保不会出现低血糖。如果降低剂量后仍出现低血糖，继续减量并监测血糖曲线直到没有低血糖。在 7-14 天内监测血糖曲线。
- If BG never returns to >250 mg/dL, consider remission, especially in cats. Monitor for hyperglycemia recurrence, in which case reinitiate insulin therapy as for new patient.
  如果血糖一直没有回升至 >250 mg/dL，考虑出现缓解，尤其是猫。监测高血糖是否复发，如果复发，当作新病患重新开始胰岛素治疗。

Insulin Adjustments if the Nadir Is >150 mg/dL

如果最低值 >150 mg/dL 如何调节胰岛素

- If clinical signs are present:
  如果存在临床症状：
  - ✧ Increase the dose 10 – 25% in dogs depending on the size of the patient and the degree of hyperglycemia.
    根据犬体型大小和高血糖的程度，剂量提高 10-25%。
  - ✧ Increase the dose 0.5 – 1 U in cats depending on the size of the patient and the degree of hyperglycemia.
    根据猫体型大小和高血糖程度，剂量提高 0.5-1 U。
  - ✧ If giving insulin once daily, consider q 12 hr therapy.
    如果胰岛素是每天一次，考虑每天两次给药。
- If clinical signs are not reported:
  如果未见临床症状：
  - ✧ Consider stress hyperglycemia OR placebo effect.
    考虑应激性高血糖或安慰剂效应。
  - ✧ If weight is stable, leave dose unchanged and recheck in 1 – 3 mo.
    如果体重稳定，剂量维持不变，1-3 个月后复查。
  - ✧ If weight is decreasing, consider dose increase and recheck in 14 days.
    如果体重减轻，考虑增加剂量并在 14 天后复查。
- Consider the presence of insulin resistance if:
  如果出现以下情况，考虑存在胰岛素抵抗：
  - ✧ In dogs, insulin dose >1 U/kg/dose with no response or >1.5 U/kg fails to bring BG below 300 mg/dL.
    犬，当胰岛素剂量 >1 U/kg/次时无反应或 >1.5 U/kg 时仍无法将血糖降至 300 mg/dL。
  - ✧ In cats, insulin dose >5 U/dose.
    猫，胰岛素剂量>5 U/次时。

Insulin Adjustments if the Nadir Is 80 – 150 mg/dL

如果最低值是 80 – 150 mg/dL 如何调节胰岛素

- If clinical signs are controlled, no adjustment needed.
  如果临床症状得到控制，不需要调节。
- If clinical signs are not controlled, do not adjust the insulin dose. Consider the following possibilities:
  如果临床症状未得到控制，不要调节胰岛素剂量。考虑以下可能性：
  - ✧ BGC is not reflective of overall control; BGC varies day to day.
    血糖曲线未反映整体的控制；血糖曲线每天都不一样。
  - ✧ There is inappropriate insulin duration of action. If giving insulin once a day, consider q 12 hr therapy. If giving q 12 hr, may need to consider changing insulin.
    胰岛素作用时长不合适。如果胰岛素是每天一次，考虑每天两次。如果每天两次，可能需要考虑换胰岛素。
  - ✧ There is overlap of insulin action. If BG is still decreasing at end of day, the subsequent dose may cause hypoglycemia. May need to give a lower dose in the evening.
    胰岛素作用有重叠。如果在一天结束的时候血糖仍持续降低，下一次给药可能

会引起低血糖。傍晚的时候可能需要给一个较低的剂量。

- ✧ Presence of another disease is causing the clinical signs.
  存在其他疾病引起这些临床症状。

Ongoing Home Monitoring

持续家庭监测

- Log food and water intake and appetite daily.
  记录每日进食量和进水量以及食欲。
- Log insulin doses daily.
  记录每日胰岛素给药剂量。
- Note any signs suggestive of hypoglycemia; contact veterinarian if persistent.
  注意任何提示低血糖的症状；如果持续存在联系兽医。
- Periodically test urine; record glucose level and ketones. If ketones are present, contact veterinarian.
  定期检测尿液；记录葡萄糖水平和酮体。如果存在酮体，联系兽医。

Key Points about Monitoring

监测的关键点

- The hallmark of an appropriate DM-monitoring approach is to interpret all monitoring modalities in light of clinical signs.
  正确糖尿病监测方式的标志是结合临床症状综合判读所有监测方法。
- In cats and dogs, DM is probably well controlled if the pet is not showing signs of PU, PD, or PP and weight is stable.
  对犬猫来说，如果宠物没有多饮多尿多食的症状并且体重稳定，糖尿病可能就处于良好控制下。
- Senior cats and dogs of advanced age need to be closely monitored.
  老年犬猫需要更加密切的监测。
- Performing spot checks for BG is not a reliable monitoring modality; obtaining BGCs is a reliable monitoring strategy.
  随机测血糖不是一种可靠的监测方法；获得血糖曲线是一种可靠的监测策略。
- Obtaining BGCs at home is preferred to doing so in the clinic.
  血糖曲线在家测比在诊所测更好。
- It is important not to place undue importance on isolated hyperglycemic values without considering clinical signs and stress-related BG increases.
  非常重要的一点是不要过于重视单个高血糖值，而不考虑临床症状和应激有关的血糖升高。
- Monitoring BG is the only way to identify hypoglycemia.
  监测血糖是唯一一种发现低血糖的方法。
- If hypoglycemia exists in an insulin-treated patient, the insulin dose must be decreased, even in cases where one low value is obtained on an otherwise normal BGC.
  如果接受胰岛素治疗的病患出现低血糖，胰岛素剂量必须降低，即使血糖都正常就只有一个低值。
- In veterinary medicine, stringent BG control is not as critical as in human medicine, although senior cats and dogs should be monitored more closely than younger animals.
  在兽医中，严格的血糖控制不像人医那么重要，虽然老年犬猫要比年轻动物更密切的监测。

Troubleshooting 排疑解难

The uncontrolled diabetic is one with poor control of clinical signs. This may include hypo- and hyperglycemic pets, those with insulin resistance (decreased responsiveness to the insulin, defined by >1.5 U/kg per dose in dogs or >5U/dose in cats), or those with frequent increases or decreases in insulin doses. Any dog or cat with persistent clinical signs (PU/PD/PP) and unintended weight loss should be re-evaluated using the following protocol (see algorithm in **Figure 3**):

未控制糖尿病指临床症状控制不良。这可能包括低血糖和高血糖宠物，那些有胰岛素抵抗（对胰岛素反应降低，也就是犬每次剂量>1.5 U/kg 或猫每次剂量 >5U），或那些频繁加减胰岛素剂量的宠物。任何犬猫持续存在临床症状（多饮多尿多食）以及体重不理想时，应根据以下原则重新评估（见图 3）：

1. Rule out client and insulin-handling issues first. A common misconception is that a patient who does not respond to insulin has insulin resistance, but this is not necessarily true;other insulin-related factors should be considered.
   首先排除顾客和胰岛素操作问题。一个常见的误解是病患对胰岛素没有反应就有胰岛素抵抗，但是实际上这不一定就是正确的；还应考虑其他胰岛素相关因素。
   a. Observe client's administration and handling of insulin,including type of syringes used. Assess insulin product and replace if out of date or if the appearance of the insulin changes (i.e., becomes flocculent, discolored, or, in the case of glargine [Lantus] or detemir [Levemir], cloudy).
   观察顾客如何注射使用胰岛素，包括使用的注射器类型。评估胰岛素产品，如果过期或胰岛素外观改变就换新的（例如出现沉淀、变色，或者，像甘精[来得时]或地特[Levemir]变混浊）。

2. Review diet and weight-loss plan.
   回顾饮食和减重计划。

4. Rule out concurrent medications that could cause insulin resistance, such as glucocorticoids, cyclosporine, and progestins. Specifically ask owners about steroid-containing eye and ear drops and progestins that might be transferred from an owner via medicated cream used as hormone-replacement therapy in women.
   排除是否在使用可以引起胰岛素抵抗的药物，例如糖皮质激素、环孢素和孕激素。尤其要特别问主人是否使用含有激素的眼药水和滴耳液，以及女性使用孕激素药膏作为激素替代疗法时是否可能传到动物身上。
   a. If the concurrent medication can be discontinued, the patient should be reassessed 2 wk later. For example, if the patient is placed on a short course of steroid eye drops before or after cataract surgery, the insulin dose does not usually need to be changed despite a short period of increased clinical signs.
   如果可以停止使用那些药物，应在 2 周后重新评估病患。例如，如果动物在进行白内障手术之前或之后短期使用了激素眼药水，尽管出现了短期的临床症状，胰岛素剂量通常也不需要改变。
   b. If the comedication cannot be discontinued within 2 wk, the insulin dose may need to be increased. Consultation with or referral to a specialist may be helpful in these situations, particularly if the diabetic patient has a concurrent immune-mediated disease that is

being managed with glucocorticoids.
如果药物不能在 2 周内停用，胰岛素剂量可能需要增加。在这些情况下，向专家咨询或转诊给专家可能会有帮助，尤其是糖尿病病患并发免疫介导性疾病需要糖皮质激素治疗的时候。

4. If not already done, obtain a BGC to rule out hypoglycemia. At-home monitoring is preferred. If hypoglycemia is detected, the insulin dose needs to be decreased.
如果还没解决问题，测量血糖曲线排除低血糖。最好在家监测。如果发现低血糖，就需要降低胰岛素剂量。

5. Rule out concurrent disease.
排除并发疾病。
   a. Repeat a physical exam. Specifically, evaluate the teeth and gums for dental disease. Ovariohysterectomies must be performed in intact, diabetic female dogs and cats. Note that anesthesia is not contraindicated in otherwise healthy, stable, nonketoacidotic diabetic patients. See aaha.org/diabetes for sample protocols for managing diabetic patients under anesthesia.
   重复体格检查。特别要检查牙齿和牙龈排除牙科疾病。如果是未绝育的糖尿病母犬和母猫，一定要进行子宫卵巢摘除术。注意对健康稳定且无酮症酸中毒的糖尿病病患来说，麻醉并不是禁忌。关于麻醉下糖尿病病患的监护，详见 aaha.org/diabetes。
   b. Perform baseline laboratory testing (CBC, serum biochemistry with electrolytes, and urinalysis with culture both in dogs and cats; BP, UPC, and total T4 in cats), if not already completed recently.
   如果最近还未全面检查，进行基础实验室检查（犬猫 CBC、血清生化电解质和尿检并培养；猫血压、UPC 和总 T4）。
   c. Consider second-level diagnostics, such as abdominal and thoracic radiographs, abdominal ultrasound, species- specific pancreatic lipase immunoreactivity (specPLI), trypsin-like immunoreactivity (TLI), B12/folate, and symmetric dimethylarginine (SDMA) for International Renal Interest Society (IRIS) staging. These diagnostic tests, in conjunction with baseline diagnostics, will help identify many causes of insulin resistance, including renal disease, pancreatitis, urinary tract infection, and neoplasia. Acute and chronic pancreatitis can both destabilize a previously controlled patient and make it difficult to regulate a pet initially. Diagnosis is sometimes challenging, and requires a multifaceted approach because not all abnormalities will be present in a given patient. Evaluation of clinical signs in conjunction with clinicopathologic abnormalities, species-specific PLI, and abdominal ultrasound is critical. Pets with chronic pancreatitis may have variable insulin requirements that increase when the patient has a flare-up, and decrease with improvement. If insulin doses are increased, hypoglycemia can occur when insulin resistance resolves with improvement of the pancreatitis. Thus, conservative dose adjustments should be made, and home monitoring for hypoglycemia is ideal.[44]
   考虑下一级的诊断检查，例如腹片胸片、腹超、种属特异性胰脂肪酶免疫活性（specPLI）、胰蛋白酶样免疫活性（TLI）、B12/叶酸和对称性二甲基精氨酸（SDMA）国际肾病协会（IRIS）分级。这些诊断性试验，结合基础检查，将会帮助找出造成胰岛素抵抗的许多原因，包括肾病、胰腺炎、泌尿道感染和肿瘤。急性和慢性胰腺炎都可以导致先前控制良好的病患再次不稳定，使得管理病患变得很困难。诊断有时具有挑战性，需要多方面的检查，因为一个病患可能不会表现出所有的异常。将临

床症状和临床病理改变、种属特异性 PLI 和腹超结合起来评估非常重要。患有慢性胰腺炎的病患对胰岛素有不同的需求，当疾病发作时，需要较高的剂量，当改善时需要较低的剂量。当胰腺炎改善胰岛素抵抗消失时，如果提高胰岛素剂量，可能会出现低血糖。因此，应十分谨慎的调节胰岛素剂量，最好在家监测低血糖。

d. Consider speci fi c diagnostics for (HAC), acromegaly, and thyroid disease. Hyperadrenocorticism can cause insulin resistance in dogs and cats, and cause persistent PU/PD in diabetic dogs who otherwise appear to be well regulated. Both species may have alopecia and dermatologic disease, and fragile skin is a hallmark feature of HAC in cats. Note that ALP is often increased in diabetic dogs, so increased ALP alone does not suggest HAC. Generally, endocrine testing for HAC should not be performed before diabetic regulation has been attempted for approximately 1 mo, because unregulated diabetes can lead to false-positive results in dogs who do not have HAC. ACTH stimulation tests and low-dose dexamethasone suppression tests can be used for diagnosis in dogs. The ACTH stimulation test is more specific (fewer false positives) but less sensitive (more false negatives) than the low-dose dexamethasone suppression test.[45] The low-dose dexamethasone suppression test is preferred in cats, but requires a higher dose of dexamethasone than that used in dogs (0.1 mg/kg).[46]

考虑针对肾上腺皮质机能亢进（HAC）、肢端肥大症和甲状腺疾病的特异性诊断试验。肾上腺皮质机能亢进会引起犬猫胰岛素抵抗，引起糖尿病犬持续性多饮多尿而其他方面都控制得很好。犬猫都可能出现脱毛和皮肤病，脆皮症是猫 HAC 非常典型的特征。注意糖尿病犬的 ALP 经常会升高，所以单独 ALP 升高并不提示 HAC。一般说来，在糖尿病管理大约 1 个月之前都不应进行内分泌试验检测 HAC，因为未管理的糖尿病可能会使得没有 HAC 的犬出现假阳性结果。犬可以用 ACTH 刺激试验和低剂量地塞米松抑制试验来诊断。相较于低剂量地塞米松抑制试验，ACTH 刺激试验特异性较高（假阳性较少）但是敏感性较低（假阴性较多）。猫更偏向于进行低剂量地塞米松抑制试验，但是使用的地塞米松剂量比犬要高（0.1 mg/kg）。

Acromegaly is more common in diabetic cats than once believed, and may occur in up to 32% of diabetic cats.[47,48]Acromegalic cats are sometimes on high insulin doses, reported to be as high as 35 U q 12 hr.[47] They may lose weight initially, but gain weight (or maintain weight) later in the course of the disease despite inadequate regulation and severe PU/PD/PP. Owners may report recent onset of snoring. Physical examination may reveal a large head with prognathia inferior, cranial organomegaly, or stertorous respiration. Insulin-like growth factor 1 (IGF-1) concentration is most often used for acromegaly screening in the United States. Consider testing once a cat has had approximately 6 wk of exogenous insulin. Hyperthyroidism and hypothyroidism can both cause significant insulin resistance. Diagnosis of hyperthyroidism in cats is often possible with a total T4 at initial diagnosis of diabetes, but diagnosis of hypothyroidism in diabetic dogs can be challenging. Many euthyroid diabetic dogs will have a decreased total T4 concentration due to euthyroid sick syndrome, so a decreased total T4 alone cannot confi rm hypothyroidism. In most cases, testing for hypothyroidism should be delayed for a few weeks after the diagnosis of diabetes to decrease the effects of euthyroid sick syndrome. If there is clinical suspicion of hypothyroidism in a diabetic patient, a total T4, free T4 by equilibrium dialysis, and TSH (thyroid-stimulating hormone) should be evaluated concurrently.[49]

现在人们认为肢端肥大症在糖尿病猫中更加常见，可能发生在多达 32%的糖尿病患猫中。肢端肥大症的猫有时用非常高剂量的胰岛素，有报道高达 35U 一天两次。他

们可能开始体重减轻，但是随着疾病发展，尽管控制不足并有严重的多饮多尿多食，后期反而会增加体重（或维持体重）。主人可能会说最近开始打鼾。体格检查可能会发现头很大并且下颌前凸、前侧器官增大或呼吸鼾声。在美国最常用胰岛素样生长因子 1（IGF-1）浓度来筛查肢端肥大症。在猫接受了大约 6 周的外源性胰岛素治疗后建议进行检测。甲状腺机能亢进和甲状腺机能减退都可以导致显著的胰岛素抵抗。在糖尿病刚诊断的时候经常可以通过检测总 T4 诊断猫的甲亢，但是诊断糖尿病患犬的甲减具有很大的挑战性。很多甲状腺功能正常的糖尿患犬由于正常甲状腺功能病态综合征会出现 T4 浓度降低，因此单独总 T4 浓度降低无法确诊甲减。大多数情况下，糖尿病诊断出之后应推迟几周再检查甲减，排除正常甲状腺功能病态综合征。如果临床上怀疑糖尿病病患有甲减，应同时检测总 T4、平衡透析法游离 T4 和 TSH（促甲状腺激素）。

e. If the cause of insulin resistance is identified, the clinician should focus on resolving and treating that cause, then return to regulating the DM.
如果找到胰岛素抵抗的原因，临床医生应先专注于对因治疗，然后再回来管理糖尿病。

Common Concurrent Diseases Implicated in Insulin Resistance
与胰岛素抵抗有关的常见并发疾病

- Obesity (dogs, cats) 肥胖（犬、猫）
- Hypothyroidism (dogs) 甲减（犬）
- Hyperthyroidism (cats) 甲亢（猫）
- Dental disease (dogs, cats) 牙科疾病（犬、猫）
- Infection; for example, urinary tract infection (dogs, cats)
  感染，例如泌尿道感染（犬、猫）
- Hypertriglyceridemia (dogs, especially schnauzers)
  高甘油三酯血症（犬，尤其是雪纳瑞）
- Hyperadrenocorticism (dogs > cats)
  肾上腺皮质机能亢进（犬 > 猫）
- Kidney disease (cats > dogs) 肾病（猫 > 犬）
- Acromegaly (cats) 肢端肥大症（猫）
- Pancreatitis (dogs > cats) 胰腺炎（犬 > 猫）
- Pregnancy/diestrus (dogs, cats) 怀孕/发情间期（犬、猫）

6. If the patient has never been regulated and has only been administered one type of insulin thus far, consider switching insulin type. This may be attempted prior to item 5c, based on clinician preference.
如果病患一直管理得不好并且到目前为止只用一种类型的胰岛素，考虑换一种胰岛素。根据临床医生个人偏好，可以在进行 5c 前先尝试换胰岛素。
7. Finally, consult with a specialist if the patient cannot be regulated.
最后，如果仍然无法控制病患，咨询专家。

Recognizing and Managing the Patient at Risk for Diabetes Mellitus
识别并管理糖尿病潜在风险病患

Patients with clinical DM must be differentiated from those with mild-to-moderate increased BG without glucosuria or clinical signs. Although the latter group may be at risk for

developing clinical DM and may require additional diagnostic and therapeutic measures, they do not require insulin therapy. One well-recognized example is transient stress hyperglycemia in the cat. Stress hyperglycemia should be ruled out in patients presenting with mild hyperglycemia by rechecking BG, potentially in the home environment, or by measuring fructosamine concentration.
一定要区分临床糖尿病病患和那些只有血糖轻度到中度升高而没有糖尿或临床症状的病患。尽管后者有患临床糖尿病的风险并且可能需要更多的诊断和治疗措施，他们不需要胰岛素治疗。一个很容易识别的例子是猫的一过性应激高血糖。病患就诊发现轻度高血糖时应排除应激高血糖，可以复查血糖，可以的话最好在家里测，或者检测果糖胺浓度。

When evaluating patients at risk for DM, clinicians should obtain a thorough history to ensure that the patient is not receiving any medications such as glucocorticoids that can cause insulin resistance. At-risk patients should be carefully evaluated for any concurrent diseases or conditions that may result in insulin resistance, like obesity.[50,51] These include diestrus in intact female dogs as well as HAC. Chronic pancreatitis has also been implicated as a risk factor for DM in cats.[8,44]
评估糖尿病潜在风险病患时，临床医生应采集非常全面的病史，确保病患没有用任何能引起胰岛素抵抗的药物例如糖皮质激素。应仔细检查风险病患，看是否有任何可能会导致胰岛素抵抗的并发疾病或状态，例如肥胖，还包括未绝育母犬的发情间期以及 HAC。研究表明猫慢性胰腺炎也是糖尿病的风险因素。

For patients at risk for developing DM, steps should be taken to prevent the patient from becoming overtly diabetic. Avoid administering medications such as corticosteroids, cyclosporine, or progestins. Patients should be treated for concurrent disease such as obesity, HAC, and chronic pancreatitis. For dogs and cats, the next step is often dietary modification. The goals of dietary therapy include optimizing body weight, minimizing post- prandial hyperglycemia, and exercising control of calorie, protein, carbohydrate, and fat intake. The section on “Dietary Therapy Goals and Management” that appears earlier in these guidelines provides detailed recommendations for maintaining optimum bodyweight in at-risk dogs and cats and those with clinical DM.
针对有患糖尿病风险的病患，应采取一定步骤来预防病患发展成明显糖尿病。避免给予例如皮质类固醇、环孢素或孕激素类的药物。应治疗病患的并发疾病，例如肥胖、HAC 和慢性胰腺炎。对犬猫来说，下一步经常是饮食调节。饮食疗法的目标包括优化体重、最小化餐后高血糖以及控制卡里路、蛋白质、碳水化合物和脂肪的摄入。本文前面的“饮食治疗目标和管理”部分有关于风险犬猫和临床糖尿病犬猫维持最佳体重的详细建议。

Patients identified as having chronically mild-to-moderately increased BG without clinical DM should be monitored regularly. Ongoing monitoring of BG and urinalysis should be tailored to the needs of the patient. If overweight, this monitoring will determine if the hyperglycemia corrects as weight reduction is achieved. This is also essential to identify patients that do not respond to conservative therapy or who develop overt DM. Unfortunately, for patients at risk for DM who do not have a treatable underlying condition such as obesity or corticosteroid administration, there is not currently a known way to prevent DM.
确认有慢性轻度至中度血糖升高但无临床糖尿病对的病患，应对其进行定期监测。应根

据病患需要制定持续血糖监测和尿检计划。如果超重，通过监测可以确定随着体重减轻高血糖是否纠正。这也可以帮助识别对保守治疗无反应的病患或发展成明显糖尿病的病患。不幸的是，对那些没有可治疗潜在疾病的糖尿病高潜在风险病患，例如肥胖或使用皮质类固醇，目前没有一种已知的方法可以预防糖尿病。

Client Education 客户教育

The goal of client education is to give the pet owner a realistic idea of the commitment involved in managing their pet's DM, along with positive encouragement that successful disease management is possible but can take time to achieve. Owners need adequate access to trained veterinary support staff to answer questions and troubleshoot common problems. Client education should provide owners with written information on commonly asked questions, what to watch for at home, and how to respond to changes in the patient's condition. Veterinarians should direct owners to helpful web links, including aaha.org/diabetes. Veterinarians should stress the importance of appropriate nutrition and weight management.

客户教育的目的是让宠主了解现实，清楚明白管理他们宠物糖尿病将要承担的责任，同时积极鼓励他们是可以成功管理疾病的但是需要花一定的时间来实现。主人需要可以联系到有经验的兽医人员来回答问题并解决一些常见问题。客户教育应给主人提供打印资料，说明一些常见问题、在家需要注意的事项以及如何应对动物状况的改变。兽医还应指导主人去浏览一些有益的网站，包括 aaha.org/diabetes。兽医应强调合理营养和体重管理的重要性。

Key Points of Client Education
客户教育的关键点

Insulin Mechanism, Administration, Handling, and Storage
胰岛素作用机制、注射、操作和存储

- Explain how insulin works and its effects on BG.
  解释胰岛素是如何工作的以及它对血糖的作用。
- Instruct owners in the proper handling for the specific type of prescribed insulin.
  指导主人如何正确使用指定的特定类型的胰岛素。
  - ✧ When using Vetsulin, the vial should be shaken until a homogeneous, uniformly milky suspension is obtained (noted in the Vetsulin package insert).
    使用 Vetsulin 时，使用前应摇晃药瓶直到出现均一质地的牛奶样混悬液（备注在 Vetsulin 包装上）。
  - ✧ When using other insulins (glargine [Lantus], PZI [Prozinc], NPH [Novolin, Humulin]), roll but do not shake vial.
    当使用其他胰岛素（甘精[来得时]，PZI[Prozinc]，NPH[诺和林，优泌林]）时，滚动但是不要摇药瓶。
- Wipe vial stopper with alcohol prior to inserting syringe needle.
  在插入注射器针头之前用酒精擦拭瓶塞。
- Do not freeze insulin preparations.
  不要冷冻胰岛素制剂。
- Do not expose insulin to heat; avoid leaving in parked car or prolonged exposure to direct sunlight.
  不要将胰岛素暴露在热量之下；避免留在停着的车内或长时间直接暴露在阳光下。
- Recommend storage in refrigerator for consistency in environment.

推荐存储在冰箱里保持环境一致。

- If stored carefully, the Task Force is comfortable using insulins beyond the date of expiration as long as they are not discolored, fl occulent, or have any changes of consistency. However, the Task Force also recommends referral to package insert for instructions about shelf life after opening and discarding insulin if it becomes out of date.
  如果小心储存，专家组可以很放心的使用超过有效期的胰岛素，只要它们没有变色、沉淀或没有任何质地改变。然而，专家组也建议参考药品说明书的开封后有效期，如果过期了就扔掉。
- Recommend new vial if insulin changes in appearance.
  如果胰岛素外观改变建议换一瓶新的。
- For human diabetic patients, manufacturer recommendations are to maintain glargine for only 28 days and store at room temperature.
  对人糖尿病患者，厂家建议甘精胰岛素开封后仅用 28 天，室温储存。
- Discuss what to do if the patient does not eat a full meal or vomits before or after insulin administration.
  如果病患没有全部吃完食物或在胰岛素注射前或后呕吐，讨论该做什么。

Types of Syringes 注射器类型

- Always use a U-40 insulin syringe with U-40 insulin and a U-100 insulin syringe with U-100 insulin.
  40 单位的胰岛素使用 40 单位的注射器，100 单位的胰岛素使用 100 单位的注射器。
- 0.3 and 0.5 mL insulin syringes or insulin pens are best to facilitate accurate dosing, especially in cats and dogs getting <5 U per dose.[52] Clinicians should evaluate if the needles in the pens are long enough for their specific patients.
  0.3 和 0.5 mL 的胰岛素注射器或胰岛素笔最方便抽取准确剂量，尤其是猫还有每次给药低于 5U 的犬。临床医生应评估胰岛素笔中的针头对病患来说是否够长。
- Syringes are for single use.
  注射器只能一次性使用。
- Do not use “short” needles. A standard 29 g, half-inch length needle is recommended.
  不要使用“短”针。建议使用标准 29G 半英寸长的针头。

Troubleshooting and Follow-up Action 排疑解难和回访

- If the pet does not eat, contact the veterinarian. Ideally, instruct owners to measure BG at home. Consider administering half the usual dose of insulin and monitor for signs of hypo- or hyperglycemia or other systemic illness.
  如果宠物不吃，联系兽医。最好告诉主人自己在家测血糖。考虑注射正常剂量的一般，监测低血糖或高血糖或其他系统性疾病的症状。
- Help clients recognize the signs of low BG, such as lethargy, sleepiness, strange behavior, abnormal gait, weakness, tremors, and seizures, and know what to do if they occur
  帮助客户识别低血糖的症状，例如倦怠、嗜睡、行为奇怪、步态异常、虚弱、震颤和抽搐，同时告诉主人当这些出现时该做什么
  - ✧ If their pet is conscious, feed a high-carbohydrate meal (e.g., rice, bread, pasta, a regular diet with added corn syrup).
    如果宠物是有意识的，饲喂高碳水化合物食物（例如米饭、面包、意大利面、常规饮食加点玉米糖浆）。
  - ✧ If their pet is poorly responsive or has tremors, rub 1 – 2 teaspoons of corn syrup

onto gum tissue. Some experts use a dose of 0.125 mL/kg. Advise client of the risk of aspiration in an obtunded animal. Feed if there is a response within 5 min. Take the pet to a veterinarian.
如果宠物反应不佳或有震颤，涂 1-2 茶匙玉米糖浆到牙龈组织上。一些专家用的剂量是 0.125 mL/kg。提醒主人迟钝的动物有吸入风险。如果 5 分钟内有反应继续喂食。带宠物去看兽医。

- Home BG monitors should be veterinary-approved products calibrated for dogs and cats.
家庭血糖监测仪应是专为犬猫校正的兽用产品。
- Client is empowered to decrease or skip an insulin dose if hypoglycemia is noted, but should never increase the dose or frequency of insulin without clear instructions from the attending veterinarian.
如果发现低血糖，客户有权减少或跳过一次胰岛素给药，但绝不可在没有主治医生同意的情况下擅自增加剂量或频率。

Conclusion 总结

Management of DM requires the commitment and coordinated efforts of the veterinary healthcare team and the pet-owner client. For this reason, proactive client education is an essential component of a DM treatment plan. Client education includes instruction on insulin administration, signs of favorable clinical response or lack thereof, measuring BG levels, and the importance of non-insulin therapies, including dietary management.
管理糖尿病需要兽医团队和宠主共同的付出和协同努力。因此，糖尿病管理计划中必须要包括积极的客户教育。客户教育内容包括胰岛素给药指导、临床反应有无好转、测血糖和胰岛素治疗的重要性，包括饮食管理。

Diabetes mellitus has a multifactorial etiology, requiring practitioners to consider and assess the possible roles of the patient’s body condition score, diet, concurrent diseases, medications, neutering status, and genetic predisposition. When the relevant DM-causative factors have been identified, a well-defined, case-specific treatment plan can be developed with a reasonable expectation for control, and in the case of cats, a chance for remission.
糖尿病有很多方面的病因，需要从业者去考虑并评估病患体况评分、饮食、并发疾病、药物、绝育状态和基因倾向性可能起到的作用。当发现糖尿病病因后，可以制定一份详细的治疗计划，合理预估控制的情况，如果是猫，还有缓解的机会。

The distinction between clinical and subclinical DM and transient hyperglycemia is an important factor in the approach to treatment. Insulin therapy is reserved for patients with clinical DM. Patients at risk for developing DM should be managed using monitoring strategies and non-insulin modalities, with an emphasis on dietary management. Diagnosis of DM focuses on a combination of predisposing factors, characteristic clinical signs, and laboratory diagnostic values outside the reference ranges. These factors should be considered in their totality rather than as isolated indicators.
区分临床和亚临床糖尿病以及一过性高血糖是决定治疗方法的一个非常重要的因素。胰岛素治疗只适用于临床糖尿病病患。糖尿病潜在风险病患应采取监测策略和非胰岛素方法进行管理，重点放在饮食管理上。糖尿病的诊断应根据易发因素、典型临床症状和实验室检查值超出参考范围来综合判读。应综合考虑所有这些因素，而不是只看某些指标。

The mainstay of treatment for clinical DM in dogs and cats is insulin along with dietary

modification. Goals include controlling BG below the renal threshold for as much of a 24 hr period as possible, which will improve clinical signs of DM, and avoiding clinically significant hypoglycemia. There are many insulin formulations currently commercially available, two of which are approved for veterinary use: lente (Vetsulin) in dogs and cats and PZI (Prozinc) in cats. The choice of insulin is often based on duration of effect in the respective species. Dietary management is an essential cotherapy in clinical DM cases, although non-insulin medications may be useful adjuncts to insulin therapy.
犬猫临床糖尿病的主流治疗方式是胰岛素加上饮食调节。目标包括尽可能长时间的将血糖控制在肾阈值之下，这样可以改善糖尿病的临床症状，同时还要避免临床上表现出显著的低血糖。目前市面上有很多种胰岛素制剂，其中两种批准用于兽医：lente（Vetsulin）用于犬猫，PZI（Prozinc）用于猫。胰岛素的选择经常基于每种品种的作用时间。虽然非胰岛素药物可能对胰岛素治疗也有一定的辅助作用，饮食管理是临床糖尿病管理的一种非常重要的联合治疗方法。

The goal of DM monitoring is to confirm the absence of clinical signs and avoidance of hypoglycemia, the definition of a controlled diabetic. Monitoring of BG levels is best done by obtaining a BGC rather than by “spot-check” BG measurements. Diabetes mellitus is probably well controlled if the pet is not showing persistent signs of PU, PD, or PP and is not experiencing unintended weight loss.
糖尿病监测的目的是确认临床症状的消失以及避免低血糖，也就是已控制糖尿病的意思。最好通过测量血糖曲线而不是“随机测”血糖来检测血糖水平。如果病患不再持续表现多饮多尿多食的症状并且不再计划外丢失体重，很可能糖尿病已被很好控制住。

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