

# Treating neonatal and pediatric hypoglycemia

*A systematic approach to treating hypoglycemic puppies and kittens helps ensure successful outcomes.*



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**C**onsider this scenario: A 6-week-old Chihuahua presents with clinical signs of depression, stupor and muscle fasciculation. The veterinarian administers parenteral glucose, and the clinical signs resolve. The client is ecstatic, the veterinary team is fulfilled and, most importantly, the Pet is better.

As veterinary practitioners, we rarely deal with cases for which there is an immediate cure. Pediatric hypoglycemia affords us the opportunity to immediately help affected Pets, provided we approach treatment systematically and identify or rule out any underlying conditions. This article reviews current treatment modalities and includes an algorithm (*Figure 1*, page 35) to aid veterinarians in recognizing, treating and managing this potentially life-threatening, yet easily controlled, condition.

## Contributing factors

Hypoglycemia is defined as a blood glucose level below 50 to 60 mg/dl. Puppies exhibiting clinical signs usually have values less than 30 mg/dl.<sup>1</sup> The presence or

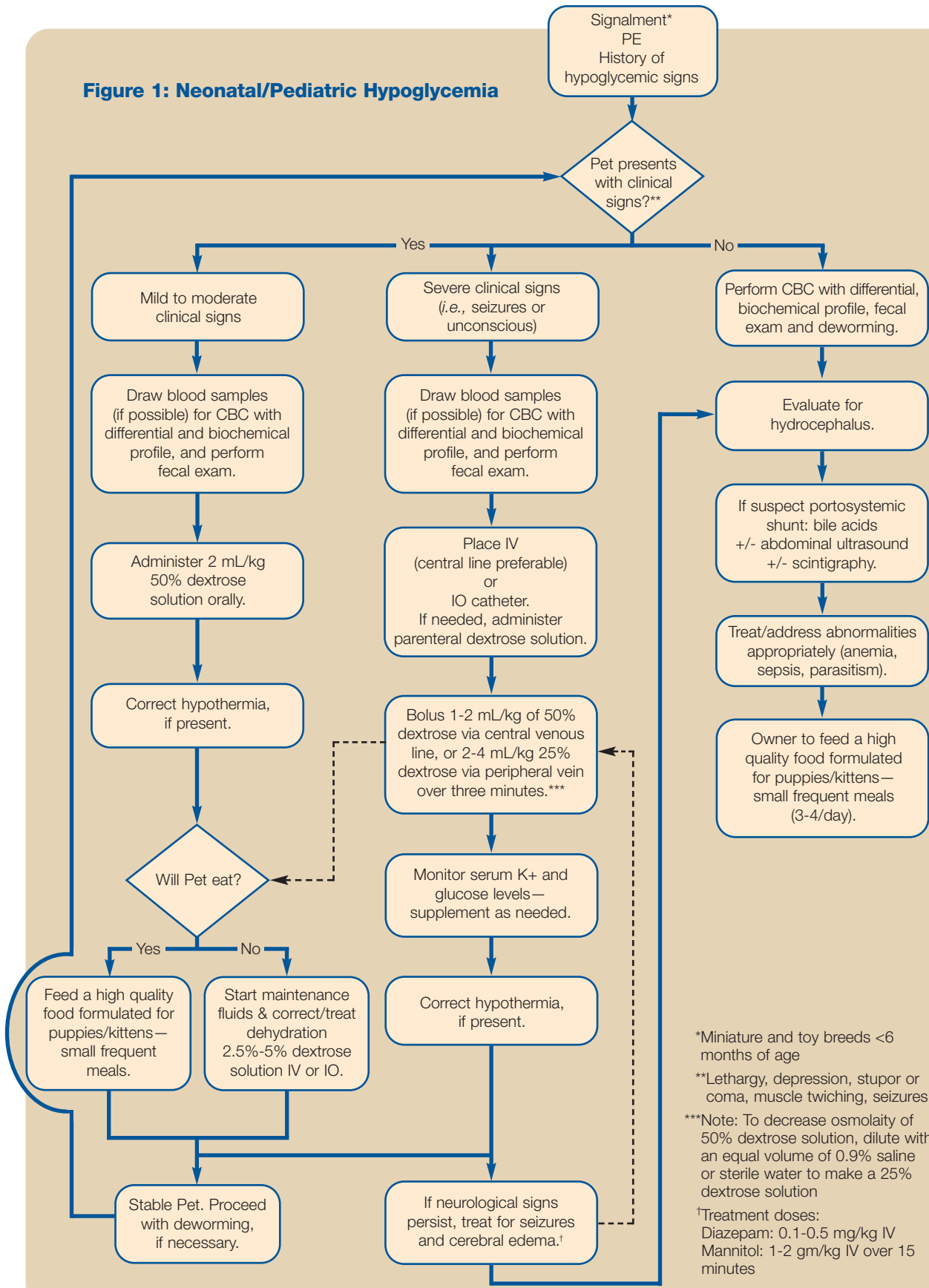
absence of clinical signs depends on the speed at which the blood glucose levels decreased and the Pet's ability to adapt to the lowered glucose concentrations. Clinical manifestations of lethargy, depression, stupor or coma, muscle twitching and seizures result from the brain's dependency on glucose oxidation for energy. Hypoglycemia is most common in puppies and kittens because they have insufficient muscle glycogen reserves and body fat to maintain blood glucose levels in the face of even short-term fasting or minor illnesses. As puppies and kittens age, they usually outgrow the tendency to develop low blood glucose.

The most commonly affected dogs are miniature and toy breeds, typically between 6 weeks and 6 months of age. In hypoglycemic toy breed dogs, resting serum glucose may be very low even if the Pet appears clinically normal. Fewer kittens present clinically; however, among those presented, the Persian breed is commonly represented.

Factors to consider when treating hypoglycemia include the following:

**1. Age and condition.** Determine whether

**Figure 1: Neonatal/Pediatric Hypoglycemia**



\*Miniature and toy breeds <6 months of age

\*\*Lethargy, depression, stupor or coma, muscle twitching, seizures

\*\*\*Note: To decrease osmolality of 50% dextrose solution, dilute with an equal volume of 0.9% saline or sterile water to make a 25% dextrose solution

†Treatment doses:  
Diazepam: 0.1-0.5 mg/kg IV  
Mannitol: 1-2 gm/kg IV over 15 minutes

the Pet is in good body condition. Check for dehydration, seizure activity, inability to eat, anemia and an enlarged abdomen.

**2. Nature of the episode.** Determine whether the episode is transient, persistent or recurrent.

**3. Pertinent history.** Find out whether there is a history of fasting, inadequate nutrition or evidence of disease.

**In neonatal Pets, hypoglycemia may result from nutritional stressors, such as inadequate nursing or starvation, or physiologic stressors, such as parasitism, diarrhea or sepsis.**

Pets that are anemic, with or without enlarged abdomens, may have heavy burdens of intestinal parasites such as hookworms, roundworms or both. A diseased state increases cellular utilization of glucose and may potentiate or exacerbate a hypoglycemic condition. Persistent or recurrent clinical episodes may indicate underlying disorders and necessitate specific testing.

### Neonatal care

In neonatal Pets, hypoglycemia is usually transient. It may result from nutritional stressors, such as inadequate nursing or starvation, or physiologic stressors, such as parasitism, diarrhea or sepsis. Educate clients about puppy or kitten feeding requirements, particularly if a Pet is an orphan, has many littermates or has a dam with agalactia. Neonates require feeding every three to four hours. If milk replacers are required, advise clients to use milk replacers formulated for puppies and kittens and be careful to ensure adequate water intake. Client education about managing the dam both before and

after birth is also helpful in reducing parasite burden during the neonatal period. A fecal exam and broad-spectrum deworming two weeks prior to expected whelping or queening is recommended, as is increasing the dam's caloric intake by approximately 30 percent during the last trimester.

### Treatment options

Mild to moderately affected hypoglycemic Pets respond rapidly to oral administration of a sugar solution. Clinical signs will commonly resolve after applying corn syrup or a 50 percent dextrose solution to the Pet's gums and buccal mucosa. Orally administer 2 mL/kg of a 50 percent dextrose solution once the Pet is able to swallow.<sup>2</sup> If the Pet is stable, normothermic and able to eat, feeding a high-quality food formulated for puppies and kittens, such as Hill's Prescription Diet p/d, should be part of the initial treatment or the only treatment required. Neonates less than 4 weeks old can be fed formula.

Feeding a sugar solution is contraindicated in seizing or unconscious Pets because of their inability to swallow and the potential for injury. After hypoglycemic Pets have been revived, feed them several small, high-protein meals of any growth formula or recovery diet throughout the next 24 hours. If the Pet refuses to eat, implement maintenance fluid therapy using 2.5 percent dextrose solution intravenously and repeat blood glucose evaluation. When the Pet is ready to leave the hospital, instruct the client that at-home care requires feeding the Pet at least three to four small meals daily for the next two to four weeks.

It is not uncommon for the hypoglycemic neonate to also be hypovolemic and hypothermic. Treatment should address each condition to ensure a complete

**Figure 2**

The jugular vein may be catheterized for intravenous fluids using a 24-ga over-the-needle catheter.

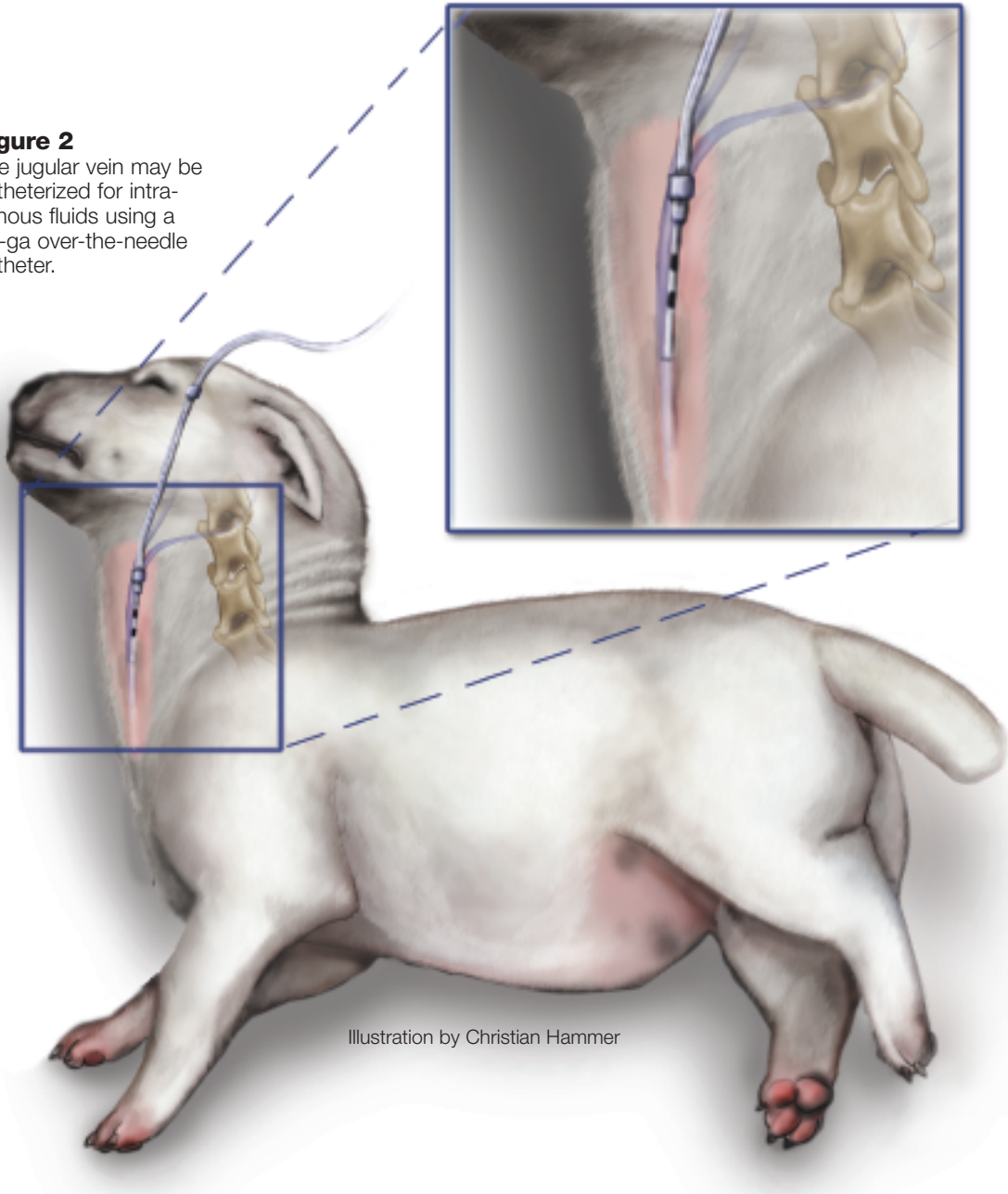


Illustration by Christian Hammer

recovery. A thorough physical examination, fecal examination and deworming should also be standard components of Pet care, but are especially important in hypoglycemic Pets

In juvenile Pets, hypoglycemia may also occur secondary to portosystemic shunts or other developmental anomalies such as hydrocephalus. If you suspect liver dys-

function, complete bile acid testing and consider abdominal ultrasound or scintigraphy to identify a specific abnormality. Surgical correction of a specific abnormality, such as a liver shunt, may help to prevent recurrence of hypoglycemia.

**Take action in serious cases**

Immediate treatment is indicated for Pets

presenting in a coma or with marked depression. Treat Pets with seizures as an emergency and administer diazepam, ipropofol or phenobarbital to control the seizure activity. (Avoid using diazepam if you suspect hepatic encephalopathy.) Always obtain blood samples for serum chemistry analyses (see *Diagnosing hypoglycemia*, page 24). Whenever possible, do this before initiating therapy.

An initial bolus of 1 to 2 mL/kg of 50 percent dextrose intravenously over one to three minutes is recommended.<sup>3</sup> Practitioners should reduce the osmolality of administered fluids by diluting the initial amount of the 50 percent dextrose solution with an equal volume of 0.9 percent saline or sterile water to make a 25 percent solution.<sup>4</sup> It is preferred to use a central vein when administering this solution because the increased osmolality upon extravasation can result in tissue edema and the development of thrombophlebitis. Placement of a jugular catheter is recommended. (See *Figure 2* on page 38 for an illustration of jugular catheter insertion.) In certain critical cases, it may be faster to administer the dextrose solution into a cephalic vein if the vein is large enough.

A continuous infusion of a 2.5 percent or 5 percent dextrose solution in a balanced electrolyte solution at a rate of 5 to 10 mL/kg/hr may also be indicated in severely affected Pets until they are able to eat and are rehydrated and normothermic. For best results, it is important to warm any fluids to near body temperature before administering them. Also, because glucose uptake is accompanied by the intracellular transport of potassium, monitor serum potassium levels and provide supplementation, if necessary. This is especially important in Pets that

are unable to eat. Electrocardiogram monitoring may be useful in identifying tachycardia and increased Q-T intervals, which may suggest a hypokalemic state.<sup>5</sup>

Venous access is often difficult in neonates, and a central vein may not be readily accessible. In such cases, fluids may be delivered intraosseously using a 22-ga spinal needle or an 18- or 20-ga hypodermic needle.<sup>2</sup> This method offers rapid and reliable systemic uptake. Substances infused into the marrow cavity reach the general circulation at rates similar to those injected into peripheral veins. The two most desirable sites for administration include:

1. The medial aspect of the proximal tibia distal to the tibial tuberosity
2. The trochanteric fossa of the proximal femur.

### Figure 3

The intraosseous route is the best method of fluid administration in small neonates. A 22-ga spinal needle or standard 18- to 20-ga needle placed intraosseously in the femoral cortex via the trochanteric fossa is an excellent way to administer fluids or blood. The site should be clipped, aseptically prepared and blocked. Rotate the needle back and forth as it is pushed in and firmly seated in the cortex.

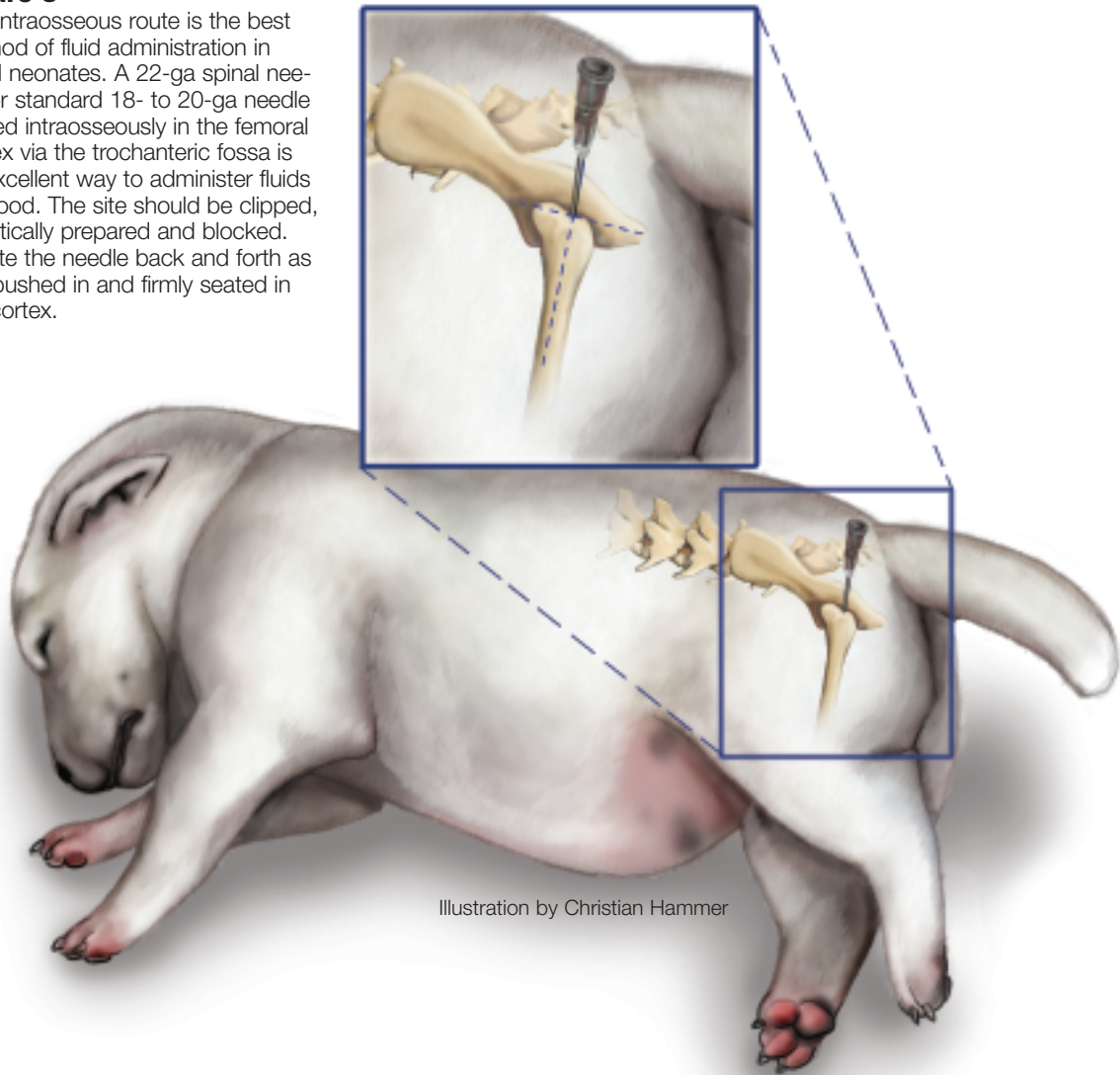


Illustration by Christian Hammer

The medial aspect of the proximal tibia is covered only with skin and subcutaneous tissue and thus is easily palpated and approached. The head of the humerus may also be used as an alternate catheter site.

Before inserting an intraosseous catheter, clip the overlying skin and aseptically prepare it. Local analgesia is necessary for conscious Pets. Make a 2- to 3-mm

skin incision and insert the needle at a 45- to 90-degree angle to the long axis of the bone (*Figure 3*). Advance the needle through the near cortex using a twisting motion. You will feel a change in resistance when the needle passes into the marrow cavity. Confirm the needle's position by aspiration and then secure it using a butterfly tape and anchoring skin sutures.

Immobilize the area with a bulky bandage.

Fluid rates should not exceed 10 mL/min. Gravity flow is adequate for Pets less than 16 pounds. Intraosseous fluid administration is contraindicated in cases of sepsis because of the potential for osteomyelitis development. Other possible

**Each case of neonatal hypoglycemia requires individualized treatment based on the severity and clinical signs present. Each case also requires that any underlying conditions be addressed.**

complications include fat embolism and damage to the growth plates.

Once the Pet is revived, offer a small meal of high-protein, high-complex-carbohydrate food. Continue to feed small meals throughout the day. If neurologic signs continue after treatment, implement the standard therapies for cerebral edema and seizure control.

Each case of neonatal hypoglycemia requires individualized treatment based on the severity and clinical signs present. Each case also requires that any underlying conditions be addressed. If the Pet is unable to eat, glucose is supplemented as described until the Pet can eat and maintain euglycemia. Educate clients about the nutritional management of Pets following resolution

of signs. Luckily, with this systematic treatment approach to hypoglycemia, Pets' prognosis is positive, especially in mild to moderate cases. 🐾

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## Tips for recognizing good performance

Simply telling team members they've done a great job increases the likelihood they'll keep performing at top level. Here are some other ideas for acknowledging good performance.

- Buy team members a cup of coffee.
- Write personal memos to team members, and put a copy of the memo in their personnel files.
- Ask for team members' advice about hospital-related matters.
- Make a ridiculous plaque and conduct a silly presentation during a team meeting.