



managing insulin doses, with options for dose adjustments and supplementation that do not require separate injections. Limitations include need for greater patient involvement, lack of a long-acting pool, and pump failure. Newly diagnosed T1DM should be managed for a period of time (at least 6 to 12 months) with intermittently injected insulin before transition to a pump is considered. During the transition from intermittent insulin injections to CSII in a patient with well-controlled blood glucose levels ($\text{HbA}_{1c} \leq 7.0\%$), the total daily insulin dose typically is decreased by 10% to 20% initially.

Many CSII patients require a slightly higher basal infusion rate in the early morning hours to accommodate the *dawn phenomenon*, a period of decreased insulin sensitivity secondary to circadian changes in secretion of insulin counter-regulatory hormones such as growth hormone. Adjustments in the basal rate may also be needed at other times of day because of changes in insulin sensitivity that may occur (e.g., after exercise). Premeal insulin boluses are calculated to include a correction dose if needed, based on the premeal blood glucose level, plus a meal coverage dose calculated from the patient's predetermined individual carbohydrate/insulin ratio. It often is most effective for a patient to be seen in a specialty setting during transition to CSII, so that an experienced educator (often a specially trained RN) can assist with needed patient education. Devices are available that provide continuous glucose monitoring (CGM), either as a separate device or integrated with an insulin pump. Because of concern about their consistent accuracy, insulin infusion rates are not adjusted automatically in response to the measured glucose levels by current devices; rather, patient intervention is required to make changes.

Intensive insulin therapy is not appropriate for all T1DM patients. Some patients are unwilling or unable to manage the required frequent glucose monitoring, diet adherence, and multiple insulin boluses. In other patients, the tight blood glucose control and low HbA_{1c} targets that are the goals of intensive insulin therapy may not be feasible. For example, there may be an increased risk of hypoglycemia because of autonomic neuropathy and inability to sense hypoglycemia, or gastrointestinal neuropathy may cause gastroparesis resulting in unpredictable variations in nutrient digestion and absorption. Under such circumstances, simpler approaches to insulin therapy and blood glucose management, previously termed *conventional insulin therapy*, may be appropriate. Such a regimen may be based, for example, on two injections per day of intermediate-acting insulin with or without short- or rapid-acting insulin. As one example, a *split-mixed regimen* uses NPH/regular or NPH/lispro (or aspart or glulisine) formulations twice daily. Initially, two thirds of the estimated total daily dose is given before breakfast and one third before dinner; at each of these times, two thirds of the insulin is given as NPH and one third as regular or a rapid-acting insulin. The amount of each insulin type at each of the injection times is then adjusted according to measured blood glucose levels, with the expectation that the peak of the morning NPH will cover lunch, the rapid-acting insulins will cover the other meals, and the NPH will otherwise ensure adequate basal blood glucose control. Two daily injections are made possible by mixing the intermediate- and rapid-acting insulins in a single syringe. Premixed insulin

preparations, such as 70% NPH plus 30% rapid-acting insulin or 50% NPH plus 50% regular insulin, also are available for injection with syringes or with preloaded insulin pens. Premixed insulins provide greater ease of use but are less likely to achieve good glycemic control.

Hypoglycemia Management

Irrespective of the specific treatment regimen, patients with T1DM need to learn how to manage hypoglycemia. Patients usually experience adrenergic symptoms (e.g., sweating, anxiety, tremulousness) as blood glucose levels decrease below the normal range (<50 to 70 mg/dL). If glucose levels decrease markedly enough, patients may experience central nervous system (CNS) symptoms ranging from difficulty thinking clearly to confusion, obtundation, and loss of consciousness. If low blood glucose is confirmed (e.g., <70 mg/dL), 10 to 15 g of rapidly absorbed carbohydrate should be ingested. For a glucose level lower than 50 mg/dL, 20 to 30 g of carbohydrate is advisable. This can be provided as orange juice or crackers, or patients can carry glucose tablets or squeeze tubes of glucose solution (obtainable over-the-counter from pharmacies) for use in treating hypoglycemia. The blood glucose level should be retested after 15 minutes, and the treatment should be repeated as needed until hypoglycemia is resolved. An alternative is to inject glucagon. For patients who have a history of hypoglycemia severe enough (including loss of consciousness) to require assistance from others, it often is helpful for a family member to be trained in glucagon injection. With severe hypoglycemia, there is a risk of injury, such as from a fall or automobile accident, as well as neurologic damage if hypoglycemia is sustained.

Nutritional Management

Appropriate nutritional management is an essential component of an effective T1DM treatment program. This ideally should be individualized to the patient's lifestyle, exercise regimen, eating habits, culture, and financial resources. Many expert panel recommendations allow individualized decisions regarding the relative amounts of carbohydrate, fat, and protein consumed within a general set of guidelines. For example, the American Diabetes Association (ADA) recommends the following:

- Fat intake, less than 7% of total calories with minimal amounts of trans-fats
- Total cholesterol intake, less than 200 mg/day
- Dietary protein intake, 15% to 20% of total calories in the absence of renal failure
- Fiber intake, at least 14 g per 1000 total calories
- Reduced sodium intake (1500 mg/day), especially in the context of even mild hypertension.

Patients should work with a medical professional who is trained in diabetes care to establish nutritional goals.

Most diets focus on measuring and controlling the amounts rather than the sources of carbohydrates. Patients can be taught to estimate the grams of carbohydrate in a meal (*carbohydrate counting*) as a means of ensuring that a consistent amount of carbohydrate is ingested. Alternatively, they can use carbohydrate