accurately predict how hot environments will affect insulin requirements in the field. Insulin itself may denature if exposed to high temperatures (>30°C). As previously discussed, careful consideration needs to be taken with medication storage in hot environments. For expeditions that require repeated bouts of exercise, it is also important to recognize that glycogen resynthesis is impaired in hot environments.[82]

Recommendation. There are insufficient data to describe the effect that heat exposure has on diabetes management (no recommendation).

Heat illness

During exercise, cutaneous vascular flow and sweating increase to release excess endogenous heat and maintain core body temperature. Individuals with type 1 diabetes may have impaired sweating during high-intensity exercise.[7,83,84] Both type 1 and 2 diabetes may result in impaired exertional heat loss in hot environments.[6,7,84] It is theorized that those with diabetes have a blunted sensitivity to elevated ambient temperatures and an inadequate cutaneous vascular perfusion or sweat production response. Age, long-term hyperglycemia, and neuropathy further impair blood flow to the skin, putting individuals with diabetes at higher risk of heat illness.[85,86] The ADA recommends that older adults with diabetes avoid exercising outdoors on very hot and/or humid days.[16] For relatively young adults, close blood glucose monitoring for hyperglycemia is important during heat exposure to avoid exacerbating potential existing impairments in the body's cooling mechanisms.

Recommendation. Wilderness athletes with diabetes are at increased risk for heat illness (**Evidence grade:** 1C).

MONITORING AND TREATMENT

Glucose monitoring

Prior recommendations on athletic participation for individuals with diabetes have provided reasonable suggestions for blood glucose monitoring and involvement.[16,53] Ideally, pre-exercise blood glucose monitoring should be performed 2 to 3 times at 30 min intervals to determine a blood glucose trend; during exercise, every 30 min; and after exercise, every 2 to 4 h owing to potential delayed hypoglycemia.[53] It has been suggested that the ideal blood glucose level for exercise is between 130 and 180 $mg \cdot dL^{-1}$,[16,26,53] though it is preferable to have individualized targets based on an athlete's personal history. Because such time-intensive glucose monitoring is difficult in the wilderness, it is prudent for an individual to establish trends in insulin and carbohydrate requirements during exercise and in similar environmental conditions prior to the expedition. Patients with well-established exercise insulin requirements may check blood glucose prior to exercise and every few hours during prolonged periods of exertion. Continuous glucose monitors (CGM), which will be discussed separately, may be a useful adjunctive tool for close monitoring of blood glucose during wilderness activities, though robust clinical data are lacking.

Recommendation. In insulin-dependent diabetes, blood glucose should be monitored before, during, and after intense and/or prolonged exercise (**Evidence grade:** 1B).

Carbohydrate intake

The goal of euglycemia for health and performance in individuals with diabetes requires managing both carbohydrate intake and insulin treatment. Increased carbohydrate intake and/or reduction in insulin dose is typically required to reach the goal of euglycemia during exercise. Past studies suggest 10 to 15 g of carbohydrate is needed to prevent hypoglycemia for low- to moderate-intensity aerobic activity lasting 30 to 60 min.[87] A similar amount of activity following an insulin bolus may require 30 to 60 g of carbohydrate to maintain euglycemia.[88] A composite of specific guidelines for carbohydrate intake from several organizations are shown in Table 3.[16,53,87] Specifically regarding travel in the wilderness, frequent snacks are recommended to maintain energy needs for prolonged physical activity, and we generally recommend increased carbohydrate intake to help mitigate the risk of altitude illness.

Recommendation. Those planning protocols for glucose monitoring and carbohydrate intake in exercise should understand how to adjust carbohydrate intake based on blood glucose and exercise. This plan should be individualized based on patients' medical and exercise history and the environmental stressors to which they are exposed (**Evidence grade:**1B).

Hydration

Adequate hydration is important before, during, and after exercise. Hyperglycemia may predispose to dehydration and electrolyte (potassium, magnesium, phosphorous) loss through osmotic diuresis. In general, wilderness athletes are able to participate safely if they drink "according to thirst,"[89,90] but people with diabetes should hydrate more frequently, especially in the setting of hyperglycemia, ketosis, and illness related to environmental stressors (eg,