

Blood Glucose Management in the Clinical Setting

A normal blood glucose level is defined as 100 mg/dL or below while fasting and 140 mg/dL or below while non-fasting ([Gurung et al., 2020](#)). While 'normal' can vary with factors such as, but not limited to, age and comorbidities, normal measures throughout the day (fasting and non-fasting) should range between 60 mg/dL and 140 mg/dL ([Gurung et al., 2020](#)).

The below information summarizes hyperglycemia, hypoglycemia, DKA, and HHS prevention, recognition, confirmation, and management methods to prevent clinical complications.

HYPERGLYCEMIA

PREVENTION	INDICATIONS	TRIGGERS	TESTS AND MEASUREMENT	TREATMENT
<ul style="list-style-type: none"> Prevention of complications, including retinopathy, nephropathy, neuropathy: <ul style="list-style-type: none"> Refer patient to ophthalmologist for yearly eye exams. Monitor A1c levels every 3-6 months. Check urinary albumin levels annually. Conduct foot examinations during annual physicals. 	<ul style="list-style-type: none"> Polyuria Polydipsia Lethargic episodes Altered mental status Weight loss (Mouri et al., 2020) If symptoms remain without intervention, neurological problems may develop. 	<ul style="list-style-type: none"> Stress Overeating Incorrect or missed dose of insulin or other antihyperglycemic medication Overtreating an episode of hypoglycemia Illnesses such as common cold 	<ul style="list-style-type: none"> Monitor for cardiorespiratory status, mental status, and volume status (Mouri et al., 2020). Consider tests like serum electrolytes, urinalysis (UA), BUN and creatinine levels, and complete blood count. An arterial blood gas or venous blood gas test might be helpful in identifying decreased serum bicarbonate (Mouri et al., 2020). 	<ul style="list-style-type: none"> For type I: a variable exogenous insulin regimen with proper nutrition For type II: medications to assist with insulin resistance with improved diet and lifestyle

HYPOGLYCEMIA

PREVENTION	INDICATIONS	TRIGGERS	TESTS AND MEASUREMENT	TREATMENT
<ul style="list-style-type: none"> Monitor blood sugar. Do not skip or delay meals or snacks. Be diligent with taking medication in the correct doses and on time. Adjust medication and diet with increased physical activity. Eat prior to consuming alcohol. 	<ul style="list-style-type: none"> Feeling shaky, nervous, or anxious Sweating Fatigue Confusion Increased heart rate Nausea If hypoglycemia continues, the patient may suffer from lack of glucose to the brain which can lead to neurological effects (e.g., confusion, slurred speech) (ADA, 2020). 	<ul style="list-style-type: none"> Taking too much insulin or diabetic medication Not eating sufficiently Postponing of skipping meals and snacks Increased exercise or physical activity without eating more or adjusting medications Consumption of alcohol 	<ul style="list-style-type: none"> Mixed-meal tolerance test (MMTT) Continuous Glucose Monitoring (CGM) Blood sugar levels with glucose meter (blood glucose level below 4.0 mmol/L indicates hypoglycemia) 	<ul style="list-style-type: none"> A common treatment is the 15-15 rule, which involves consuming 15 grams of sugar and rechecking the patient's blood sugar after 15 minutes (ADA, 2020). If the blood sugar remains below 70 mg/dL, then another 15 grams of sugar should be consumed. The sugar can be: <ul style="list-style-type: none"> 4 oz of juice or regular soda (non-diet) 1 tablespoon of sugar, honey, or corn syrup Consuming too much for the purpose of raising the blood sugar can cause the blood sugar levels to spike too high quickly (ADA, 2020). Complex carbohydrates should not be consumed to raise blood sugar, as they can actually slow the absorption of glucose (ADA, 2020).

DIABETIC KETOACIDOSIS (DKA)

DKA involves pathologically high levels of ketone bodies found in the blood/serum and urine ([Ghimire et al., 2020](#)). DKA typically occurs in patients with diabetes and high blood sugar, most frequently associated with relative insulin deficiency ([Ghimire et al., 2020](#)).

PREVENTION	BASELINE	INDICATIONS	TRIGGERS	TESTS AND MEASUREMENT	TREATMENT
<ul style="list-style-type: none"> Monitor sugar levels, exercise, and be compliant with insulin treatment Identify effective stress coping mechanisms Maintain a balanced diet and stay hydrated. 	<ul style="list-style-type: none"> Normal: Blood ketone level of 0.6 mmol/L Increased risk for DKA: Blood ketone level of 0.6 to 1.5 mmol/L Higher risk for DKA (contact diabetes care team): Blood ketone level of 1.5 to 2.9 mmol/L Very high risk requiring immediate intervention: Blood ketone level of above 3.0 mmol/L 	<ul style="list-style-type: none"> Excessive thirst Frequent urination Nausea or vomiting Abdominal pain Weakness or fatigue Fruity scented breath (from ketone bodies) (Ghimire et al., 2020) 	<ul style="list-style-type: none"> Illness, due to the production of hormones like adrenaline and cortisol, which can counter the effects of insulin (Mayo Clinic, 2020) Missed insulin therapy or administering an inadequate or excessive amount of insulin can disrupt the body's homeostatic levels (Mayo Clinic, 2020) 	<ul style="list-style-type: none"> Urinalysis Electrocardiogram Blood electrolyte test Blood sugar test (above 250 mg/dL indicates a risk for DKA development) Ketone level (in serum and in urine UA) Blood acidity 	<ul style="list-style-type: none"> Initiate fluid replacement therapy to combat fluid loss from sweating and urination (Mayo Clinic, 2020). Initiate insulin therapy. Initiate electrolyte therapy to maintain essential organ function

HYPEROSMOLAR HYPERGLYCEMIC STATE (HHS)

HHS involves the experience of severe hyperglycemia and substantial dehydration, due to a decrease in net effective insulin available to the body ([Milanesi et al., 2018](#)).

PREVENTION	INDICATIONS	TRIGGERS	TESTS AND MEASUREMENT	TREATMENT
<ul style="list-style-type: none"> Recognize that infections are the most common precipitating factor for HHS, and therefore effective HHS prevention relies heavily on effective infection prevention. 	<ul style="list-style-type: none"> Blood glucose at or above 600 mg/dL and osmolality greater than 320 mOsm/L Altered consciousness and confusion Seizures 	<ul style="list-style-type: none"> Infection Medications that impair glucose tolerance, such as glucocorticoids, or medications that increase fluid loss (diuretics) Poor adherence to diabetes treatment 	<ul style="list-style-type: none"> Serum osmolality Serum electrolytes Blood urea nitrogen and creatinine Ketones Blood glucose level 	<ul style="list-style-type: none"> Administer intravenous 0.9% saline, typically at a rate of 15 to 20 mL/kg/hour, reassessed each hour after initiation. Thereafter, calculate corrected sodium. <ul style="list-style-type: none"> Readjust as necessary based on blood pressure, cardiac status, and fluid input/output ratio. Correct hypokalemia. Administer: <ul style="list-style-type: none"> 40 mEq/hour for serum potassium < 3.3 mEq/L 20 to 30 mEq/hour for serum potassium between 3.3 and 4.9 mEq/L Nothing for serum potassium ≥ 5 mEq/L. Administer intravenous insulin, typically at 0.1 unit/kg bolus followed by a 0.1 unit/kg/hour infusion after the first liter of saline administered. <ul style="list-style-type: none"> Add dextrose once glucose level reaches 250-300 mg/dL. Target plasma glucose is between 250-300 mg/dL. After emergency recovery, adjust to subcutaneous insulin.

In all cases, the care team should take time to understand the individual patient's circumstance, not solely for clinical intervention at the time of need, but to have a meaningful conversation with the patient after the emergency condition has been resolved and the patient has been stabilized. Understanding the patient's risk factors, concerns, and personal barriers can optimize the ongoing management of their condition and can prevent future adverse events.