Diabetes - High Blood Sugar

Adult Office-Hours Version

DEFINITION

- Patient with known diabetes mellitus
- Has a high blood sugar (hyperglycemia), defined as a blood glucose > 200 mg/dl (11 mmol/l)
- Has symptoms of high blood sugar
- Has questions regarding high blood sugar

SYMPTOMS of High Blood Sugar (Hyperglycemia) include:

- Mild hyperglycemia: Most often patient will have no symptoms.
- Moderate hyperglycemia: polyuria, polydipsia, fatigue, blurred vision.
- Severe hyperglycemia: confusion and coma.
- Diabetic ketoacidosis (DKA): fruity odor on breath, vomiting, rapid breathing, weakness, confusion, and coma.

TRIAGE ASSESSMENT QUESTIONS FOR DIABETES - HIGH BLOOD SUGAR

Call EMS 911 Now

Unconscious or difficult to awaken
R/O: diabetic ketoacidosis (DKA), severe hyperglycemia, profound hypoglycemia

Acting confused (e.g., disoriented, slurred speech)
R/O: DKA, severe hyperglycemia, hypoglycemia

Very weak (can’t stand)
R/O: DKA, severe hyperglycemia, hypoglycemia

Sounds like a life-threatening emergency to the triager

Go to ED Now

Vomiting and signs of dehydration (e.g., very dry mouth, lightheaded, etc.)
Reason: may need IV hydration, possible DKA

Blood glucose > 240 mg/dl (13 mmol/l) and rapid breathing
R/O: DKA

Go to ED Now (or to Office with PCP Approval)

Blood glucose > 500 mg/dl (27.5 mmol/l)

Blood glucose > 240 mg/dl (13 mmol/l) AND urine ketones moderate-large (or more than 1+)
R/O: DKA

Blood glucose > 240 mg/dl (13 mmol/l) AND vomiting AND unable to check urine ketones
R/O: DKA

Vomiting lasting > 4 hours
R/O: DKA, dehydration
Patient sounds very sick or weak to the triager
*Reason: severe acute illness or serious complication suspected*

**Go to Office Now**

Fever > 100.5° F (38.1° C)
*Reason: diabetics are immuno-compromised, consider possibility of bacterial infection*

**Call Transferred to PCP Now**

Caller has URGENT medication or insulin pump question and triager unable to answer question

**Discuss with PCP and Callback by Nurse within 1 Hour**

Blood glucose > 400 mg/dl (22 mmol/l)
*Reason: significant hyperglycemia*

Blood glucose > 300 mg/dl (16.5 mmol/l) AND two or more times in a row
*Reason: obtain PCP input regarding medication adjustment and diet*

Urine ketones moderate - large
*Reason: obtain PCP input regarding medication adjustment and diet*

**See Today in Office**

New-onset diabetes suspected (e.g., frequent urination, weak, weight loss)

Symptoms of high blood sugar (e.g., frequent urination, weak, weight loss) and not able to test blood glucose

Patient wants to be seen

**Discuss with PCP and Callback by Nurse Today**

Caller has NON-URGENT medication question about med that PCP prescribed and triager unable to answer question

**Home Care**

Blood glucose > 240 mg/dl (13 mmol/l)
*Reason: hyperglycemia*

Blood glucose 60-240 mg/dl (3.5 -13 mmol/l)

Sick-day rules for diabetes mellitus, questions about

**HOME CARE ADVICE**

**Treating High Blood Sugar (Hyperglycemia)**

1.] **General:**
- *Definition of hyperglycemia:* Fasting blood glucose more than 140 mg/dL (7.5 mmol/l) or random blood glucose more than 200 mg/dL (11 mmol/l).
- *Symptoms of mild hyperglycemia:* frequent urination, increased thirst, fatigue, blurred vision.
- *Symptoms of severe hyperglycemia:* weakness, progressing to confusion and coma.
2. **Treatment - Liquids:**
   - Drink at least one glass (8 oz or 240 ml) of water per hour for the next 4 hours. (Reason: adequate hydration will reduce hyperglycemia).
   - Generally, you should try to drink 6-8 glasses of water each day.

3. **Treatment - Insulin:**
   - Continue to take your insulin, as prescribed by your doctor.
   - *Sliding Scale Insulin:* IF your doctor has given you instructions to take extra rapid-acting (e.g., lispro, aspart) or short acting (regular) insulin when your blood sugar is high, give yourself the insulin dose your doctor has recommended.

4. **Treatment - Diabetes Medications:** Continue taking your diabetes pills.

5. **Measure and Record Your Blood Glucose:**
   - Every day you should measure your blood glucose before breakfast and before going to bed.
   - Record the results and show them to your doctor at your next office visit.

6. **Daily Blood Glucose Goals:**
   - You and your doctor should decide on what your blood glucose goals should be. Typical goals for many people who perform daily finger-stick blood testing at home are:
     - *Pre-prandial* (before meal): 70-130 mg/dL (3.9-7.2 mmol/l)
     - *Post-prandial* (2-3 hours after a meal): Less than 180 mg/dL (10 mmol/l)

7. **Daily Blood Glucose Goals - Gestational Diabetes in Pregnancy** (Diabetes that Started in Pregnancy):
   - You and your doctor should decide on what your blood glucose goals should be. Typical goals for most pregnant women who perform daily finger-stick blood testing at home are as shown below.
     - *Pre-prandial* (before meal): less than 95 mg/dL (5.3 mmol/l)
     - *Post-prandial* (2-3 hours after a meal): Less than 120 mg/dL (6.7 mmol/l)

8. **Daily Blood Glucose Goals - Type 1 or 2 Diabetes in Pregnancy** (Diabetes that Started before Pregnancy):
   - You and your doctor should decide on what your blood glucose goals should be. Typical goals for most pregnant women who perform daily finger-stick blood testing at home are as shown below.
     - *Pre-prandial* (before meal): 60 - 99 mg/dL (3.3 - 5.4 mmol/l)
     - *Peak post-prandial* (after a meal): 100 - 129 (5.4 - 7.1)
     - *A1C* level less than 6.0%

9. **Expected Course.** You should call back in 3-5 days if:
   - Your blood sugar continues to get above 240 mg/dL (13 mmol/l).
   - Your blood sugar continues to be higher than your daily glucose goals (set by you and your doctor).
   - It has been longer than 6 months since you had an Hemoglobin A1C test.

10. **Call Back If:**
    - Blood glucose more than 300 mg/dL (16.5 mmol/l), 2 or more times in a row.
    - Urine ketones become moderate or large.
    - Vomiting lasting more than 4 hours or unable to drink any liquids.
    - Rapid breathing occurs.
    - You become worse.

**Sick Day Rules for Diabetics Who Use Insulin**
1. **General:**
   - **Do not stop taking your insulin.** During illness the blood sugar often rises.
   - **Check your blood glucose every 3-4 hours.** Write down the results.
   - **Check for ketones in your urine every 3-4 hours.** Ketones can be a sign of dehydration or poorly controlled diabetes.
   - **Drink liquids.** It is important to prevent dehydration. Drink small amounts frequently.
   - **Avoid hypoglycemia.** If your appetite is bad, you are not eating solid food, and your blood glucose is less than 200 mg/dl (11 mmol/l), then you should be drinking sugar-containing liquids. Examples are soda, clear juices, sports drinks.

2. **Insulin - Do Not Stop Taking It:**
   - If you are supposed to be using insulin, do not stop taking it.
   - The reason is that during an illness you may need even more insulin than usual.

3. **Insulin - Supplemental Insulin for Hyperglycemia:**
   - **Note to Triager:** Supplemental rapid-acting (e.g., lispro, aspart) or short-acting (regular) insulin is sometimes needed in addition to usual insulin doses for treating hyperglycemia. Most patients should already have been given "sick day rules" education by their doctor and instructions on when to use supplemental insulin. **The triage nurse must discuss all insulin dosing with the doctor before giving recommendations to the patient.** In most cases it is best if the doctor talks directly with the patient.
   - **Total Daily Dose (TDD):** The total daily dose is calculated by adding up all insulin administered during a usual day.
   - **Typical Sick-Day Insulin Supplementation - Urine ketones negative or trace:** If glucose is 80-240 mg/dl (4.5-13 mmol/l), give usual dose. If glucose is 250-400 mg/dl (14-22 mmol/l), supplemental insulin dosage is 10% of TDD. If glucose is over 400 mg/dl (22 mol/l), supplemental insulin dosage is 20% of TDD.
   - **Typical Sick-Day Insulin Supplementation - Urine ketones moderate:** If glucose is 80-240 mg/dl (4.5-13 mmol/l), give usual dose. If glucose is 250-400 mg/dl (14-22 mmol/l), supplemental insulin dosage is 20% of TDD. If glucose is over 400 mg/dl (22 mol/l), supplemental insulin dosage is 20% of TDD.

4. **Insulin - Decreased Insulin for Hypoglycemia:**
   - **Note to Triager:** Decreased insulin dosing is sometimes needed in patients with a blood glucose less than 80 mg/dl (4.5 mmol/l), especially if there is decreased oral intake. **The triage nurse must discuss all insulin dosing with the doctor before giving recommendations to the patient.** In most cases it is best if the doctor talks directly with the patient.
   - **Typical Sick-Day Insulin Reduction - for blood glucose less than 80 mg/dl (4.5 mmol/l) and there is decreased oral intake:** Do not give rapid-acting (e.g., lispro, aspart) or short-acting (regular) insulin. Reduce intermediate acting insulin (e.g., NPH, lente, 70/30) by 20%.

5. **Diet:**
   - **Appetite OK, minimal nausea:** Continue your normal diabetic meal plan. Avoid spicy or greasy foods.
   - **Appetite fair, moderate nausea:** Eat a bland diet. Try small amounts of food 6-8 times a day. Take 1/2 to 1 cup of food or liquids every 1-2 hours.
   - **Appetite poor, severe nausea, can't eat solid food:** Drink plenty of liquids. Try to drink 4-8 oz (120-240 ml) per hour. If glucose more than 240 mg/dl (13 mmol/l), drink sugar-free liquids (e.g., water, broth). If glucose less than 200 mg/dl (11 mmol/l), drink sugar-containing liquids (e.g., sports drinks, juice, soda).
   - **Advance diet as you improve.**

6. **Liquids:**
   - **Drink more fluids, at least 8-10 glasses daily (8 oz or 240 ml each glass).**
   - **Even more liquids are needed if there is fever, vomiting, or diarrhea.**

7. **Check Blood Glucose:**
   - When you are ill, you should measure your blood glucose every 2-4 hours.
   - Write down the results.
8. **Check Urine for Ketones:**
- Check your urine for ketones whenever you are ill or if your blood glucose is more than 240 mg/dL (13 mmol/l).
- You can buy a testing kit at your local pharmacy.

9. **Call Back If:**
- Blood glucose more than 300 mg/dL (16.5 mmol/l), 2 or more times in a row.
- Urine ketones become moderate or large
- Vomiting lasting more than 4 hours or unable to drink any liquids
- Rapid breathing occurs
- You become worse or have more questions.

### Sick Day Rules for Diabetics Who Do Not Use Insulin

1. **General:**
   - *Do not stop taking your diabetes medications.* (Reason: during illness the blood sugar often rises).
   - *Check your blood glucose every 3-4 hours.* Write down the results.
   - *Check for ketones in your urine.* Ketones can be a sign of dehydration or poorly controlled diabetes.
   - *Drink liquids.* It is important to prevent dehydration. Drink small amounts frequently.
   - *Avoid hypoglycemia.* If your appetite is bad, you are not eating solid food, and your blood glucose is less than 200 mg/dl (11 mmol/l), then you should be drinking sugar-containing liquids. Examples are soda, clear juices, sports drinks.

2. **Diet:**
   - *Appetite OK, minimal nausea:* Continue your normal diabetic meal plan. Avoid spicy or greasy foods.
   - *Appetite fair, moderate nausea:* Eat a bland diet. Try small amounts of food 6-8 times a day. Take 1/2 to 1 cup of food or liquids every 1-2 hours.
   - *Appetite poor, severe nausea, can't eat solid food:* Drink plenty of liquids. Try to drink 4-8 oz (120-240 ml) per hour. If glucose more than 240 mg/dl (13 mmol/l), drink sugar-free liquids (e.g., water, broth). If glucose less than 200 mg/dl (11 mmol/l), drink sugar-containing liquids (e.g., sports drinks, juice, soda).
   - Advance diet as you improve.

3. **Liquids:**
   - Drink more fluids, at least 8-10 glasses daily (8 oz or 240 ml each glass). Even more liquids are needed if there is fever, vomiting or diarrhea.
   - If glucose over 240 mg/dl (13 mmol/l), drink sugar-free liquids (e.g., water)
   - If glucose under 120 mg/dl (6.5) mmol/l), drink sugar-containing liquids (e.g., sports drinks, juice, soda)

4. **Check Blood Glucose:**
   - When you are ill, you should measure your blood glucose every 3-4 hours.
   - Write down the results.

5. **Check Urine for Ketones:**
   - Check your urine for ketones whenever you are ill or if your blood glucose is more than 240 mg/dL (13 mmol/l).
   - You can buy a testing kit at your local pharmacy.

6. **Call Back If:**
   - Blood glucose more than 300 mg/dL (16.5 mmol/l), 2 or more times in a row.
   - Urine ketones become moderate or large
   - Vomiting lasting more than 4 hours or unable to drink any liquids
   - Rapid breathing occurs
   - You become worse or have more questions.

### Additional Resources
Causes of High Blood Sugar (Hyperglycemia)

- Noncompliance with taking insulin or other diabetes medicines. Forgetting to take insulin is the most common cause.
- Malfunction of an individual's insulin pump
- Noncompliance with diabetes diet
- Infection
- Steroid medications (e.g., Prednisone, Medrol dose pack)
- Combination of these factors

Diabetes Mellitus

Definition: Diabetes mellitus is an endocrine condition in which patients have elevated blood glucose levels (hyperglycemia). The classic symptoms of untreated or undertreated diabetes are: frequent urination (polyuria), polydipsia (excessive thirst), and involuntary weight loss.

The Role of Insulin: Insulin is a hormone produced by the pancreas to help process food. Eating food makes the blood glucose rise and insulin makes the blood glucose fall.

Classification of Diabetes Mellitus: There are 4 different classes of diabetes mellitus: type 1 diabetes, type 2 diabetes, gestational diabetes mellitus, and other.
• **Diagnosis:** Probably the best way to diagnose diabetes is an A1C test with a value of 6.5% or above. There are two other tests that have been long been used for diagnosing diabetes: a fasting plasma glucose (FPG) > 126 mg/dL (7.0 mmol/L) and a 2-hour oral glucose tolerance test (OGTT) with a glucose > 200 mg/dL (11.1 mmol/L).

**Type 1 Diabetes**

- **Other names:** Insulin Dependent Diabetes Mellitus (IDDM), Juvenile Onset Diabetes.
- **Physiology:** There is no production of insulin by the body.
- **Ketosis-prone:** Patients with this type of diabetes are ketosis-prone, which means that if they do not receive daily insulin shots their bodies break down fats and produce ketones. The ketones spill into the urine and can be measured. Patients with type I diabetes are susceptible to developing diabetic keto-acidosis (DKA), a life-threatening condition.
- **Onset:** It most commonly first appears in childhood or adolescence. Approximately 10% of diabetics are type 1.
- **Treatment:** Insulin therapy is always required and needs to be given subcutaneously at least once daily. Patients striving for tighter control of their blood glucose will take insulin more often than once a day. Recommended therapy for type 1 diabetes includes: 1) use of multiple-dose insulin injections (3–4 injections per day) and 2) matching of mealtime (prandial) insulin to carbohydrate intake, premeal blood glucose, and anticipated activity.

**Type 2 Diabetes**

- **Other names:** Non-insulin dependent diabetes mellitus (NIDDM), adult-onset Diabetes
- **Physiology:** In Type 2 diabetes, there is decreased insulin production and decreased sensitivity to insulin.
- **Not ketosis-prone:** These patients are not prone to ketosis. DKA rarely occurs.
- **Onset:** It more commonly develops in elderly and overweight adults.
- **Treatment:** The initial and most important treatments are exercise and weight loss. When these measures fail, there are oral medications (e.g., metformin) that can be prescribed to help the body make more insulin or use the insulin more effectively. Occasionally patients require insulin therapy.

**Gestational Diabetes**

- Gestational diabetes is diabetes that is found for the first time when a woman is pregnant.
- **Physiology:** In gestational diabetes, the body is not making sufficient insulin to keep pace with the weight gain and other hormonal changes of pregnancy.
- **Not ketosis-prone:** These patients are not prone to ketosis. DKA rarely occurs.
- **Onset:** It occurs during pregnancy.
- **Treatment:** A meal plan and regular physical activity are important.

**Diabetic Ketoacidosis (DKA)**

- **Definition:** Blood glucose > 250 mg/dl (12 mmole/L) with acidosis and ketosis (urine ketones moderate to large)
- **Symptoms of DKA:** In addition to symptoms of hyperglycemia, fruity odor on breath, vomiting, rapid/deep breathing, confusion, and coma.
- **Causes:** Noncompliance with using insulin in type 1 diabetes, infection.

**Five Types of Insulin for Diabetes**

- **Rapid-acting** (Humalog/lispro, NovoLog/aspart): onset 5-15 minutes; peaks 30-90 minutes; lasts 4-6 hours.
- **Short-acting** (Regular, Humulin R, Novolin R): onset 30-60 minutes; peaks 2-3 hours; lasts 5-8 hours.
- **Intermediate-acting** (NPH, Lente, Humulin N, Humulin L, Novolin N, Novolin L): onset 2-4 hours; peaks 4-12 hours; lasts 10-18 hours.
- **Long-acting** (Lantus/glargine, Determir, Levemir): onset 2-4 hours; no true peak; lasts 18-24 hours.
• **Pre-mixed** (Humulin 70/30, Humulin 50/50, Humalog mix, NovoLog mix): two peaks; lasts 10-16 hours; depends on mixture.

**Insulin Administration - Different Dosing Regimens**

- **Sliding Insulin Scale:** Generally only used in the hospital.
- **Insulin Algorithm:** The patient checks his/her blood glucose before each meal and then adjusts insulin dosing based upon BOTH the blood glucose and an estimated caloric count for the meal. This is considered “prandial” insulin because it is given with (just before) meals. Rapid-acting (Humalog/lispro or Novolog/aspart) or short-acting (Regular) are used for prandial insulin dosing.
- **Once-daily Insulin:** This is not considered physiologic insulin dosing as it only provides the "basal" insulin and does not provide the needed prandial increases. However, it may be an effective addition for some type 2 diabetic patients on oral medications as their need for insulin is low. Intermediate-acting insulin (NPH) or long-acting insulin (Lantus/glargine) are used.
- **Twice-daily Insulin:** Intermediate-acting insulin (NPH) or long-acting insulin (Lantus/glargine) can be used in twice-daily regimens. Twice-daily insulin dosing may be sufficient for type 2 diabetic patients because they still make sufficient insulin on their own to handle prandial (mealtime) insulin needs.
- **Flexible Insulin Regimens:** In this type of regimen both an intermediate-acting insulin (for basal insulin needs) AND a rapid or ultrashort-acting insulin (for prandial insulin needs) are used.

**Five Types of Oral Medications for Diabetes**

- **Sulfonylureas:** Examples include glyburide (Micronase, Diabeta), glipizide (Glucotrol, Glucotrol XL), and glimepiride (Amaryl).
- **Biguanides:** Examples include metformin (Glucophage, Fortamet).
- **Thiazolidinediones:** Examples include rosiglitazone (Avandia) and pioglitazone (Actos).
- **Alpha-glucosidase inhibitors:** Examples include acarbose (Precose) and miglitol (Glyset).
- **Meglitinides:** Examples include repaglinide (Prandin) and nateglinide (Starlix).

**Goals for Diabetes Management**

- **HbA1c:** The HbA1c is the primary goal for diabetes management. Depending on the patient, it should be measured 2-4 times a year. The American Diabetes Association (ADA) recommends a goal of less than 7.0% for nonpregnant adults.
- **Blood Glucose:** Depending on the patient, the blood glucose should be measured 1-3 times per day. The ADA recommends the following blood glucose goals:
  - Preprandial (before meal): 70-130 mg/dL (3.9-7.2 mmol/l)
  - Postprandial (2-3 hours after a meal): Less than 180 mg/dL (10 mmol/l)
- **Goals Should be Individualized Based Upon:** age/life expectancy, duration of diabetes, comorbid conditions, hypoglycemic unawareness, history of severe hypoglycemic reactions, and other individual considerations.
- **Internet Resource:** ADA Standards of Medical Care in Diabetes 2012; available at: [http://care.diabetesjournals.org/content/35/Supplement_1/S11.full.pdf+html](http://care.diabetesjournals.org/content/35/Supplement_1/S11.full.pdf+html)

**Glycosylated Hemoglobin (HbA1c)**

The HbA1c provides a good estimate of how well a patient has managed his / her diabetes during the past 2-3 months. With good diabetes management the HbA1c goes down and with poor management it goes up. In general, the higher the HbA1c, the greater the risk of the long-term diabetic complications.

- **Goal:** The American Association of Clinical Endocrinologists (AACE) and the American College of Endocrinology (ACE) recommend a target glycosylated hemoglobin level (HbA1c) of less than 6.5%. The American Diabetes Association (ADA) recommends a goal of less than 7.0% for nonpregnant adults. The Canadian Diabetes Associations also recommends a goal of less than 7.0%

**Long-Term Complications of Diabetes Mellitus**

- Eye disease (e.g., retinopathy): Diabetes is leading cause of blindness.
• Heart disease (e.g., coronary heart disease, myocardial infarction)
• Kidney disease (e.g., renal failure, proteinuria)
• Nerve disease (e.g., peripheral and autonomic neuropathy)
• Stroke

Converting Glucose Levels: MG/DL and MMOL/L

• In the United State glucose is typically measured using the units MG/DL. Nearly every country in the world (including Canada) measures glucose levels using the units MMOL/L.
• To convert mmol/l of glucose to mg/dl, multiply by 18.
• To convert mg/dl of glucose to mmol/l, divide by 18 or multiply by 0.055.

REFERENCES


15. Laffel L. Sick day management in Type 1 Diabetes. Endocrinol Metab Clin North Am. 2000;29(4);707-723.


