Diabetes - High Blood Sugar

After Hours Telephone Triage Protocols  |  Adult  |  2015

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.

INITIAL ASSESSMENT QUESTIONS

1. **BLOOD GLUCOSE**: "What is your blood glucose level?"
2. **ONSET**: "When did you check the blood glucose?"
3. **USUAL RANGE**: "What is your glucose level usually?" (e.g., usual fasting morning value, usual evening value)
4. **URINE KETONES**: "Do you check your urine for ketones?" If yes, ask: "What does the test show now?"
5. **TYPE 1 or 2**: "Do you know what type of diabetes you have?" (e.g., Type 1, Type 2, Gestational; doesn't know)
6. **INSULIN**: "Do you take insulin?" If yes, ask: "Have you missed any shots recently?"
7. **DIABETES PILLS**: "Do you take any pills for your diabetes?" If yes, ask: "Have you missed taking any pills recently?"
8. **OTHER SYMPTOMS**: "Do you have any symptoms?" (e.g., fever, frequent urination, difficulty breathing, dizziness, weakness, vomiting)
9. **PREGNANCY**: "Is there any chance you are pregnant?" "When was your last menstrual period?"

TRIAGE ASSESSMENT QUESTIONS

Call EMS 911 Now

Unconscious or difficult to awaken

\[ R/O: \text{diabetic ketoacidosis (DKA), severe hyperglycemia, profound hypoglycemia} \]

\[ CA: \ 40, \ 14, \ 16, \ 1 \]

Acting confused (e.g., disoriented, slurred speech)

\[ R/O: \text{DKA, severe hyperglycemia, hypoglycemia} \]

\[ CA: \ 40, \ 14, \ 13, \ 26, \ 1 \]

Very weak (e.g., can't stand)

\[ R/O: \text{DKA, severe hyperglycemia, hypoglycemia} \]

\[ CA: \ 40, \ 14, \ 13, \ 15, \ 1 \]

Sounds like a life-threatening emergency to the triager
Go to ED Now

[1] Vomiting AND [2] signs of dehydration (e.g., very dry mouth, lightheaded, etc.)
Reason: may need IV hydration, possible DKA
CA: 41, 92, 81, 1

R/O: DKA
CA: 41, 92, 81, 1

Go to ED Now (or PCP triage)

Blood glucose > 500 mg/dl (27.5 mmol/l)
CA: 42, 80, 87, 1

[1] Blood glucose > 240 mg/dl (13 mmol/l) AND [2] urine ketones moderate-large (or more than 1+)
R/O: DKA
CA: 42, 80, 87, 1

R/O: DKA
CA: 42, 80, 87, 1

[1] New onset Diabetes suspected (e.g., frequent urination, weak, weight loss) AND [2] vomiting or rapid breathing
CA: 42, 80, 87, 1

Vomiting lasts > 4 hours
R/O: DKA, dehydration
CA: 42, 80, 87, 1

Patient sounds very sick or weak to the triager
Reason: severe acute illness or serious complication suspected
CA: 42, 80, 87, 1

See Physician within 4 Hours (or PCP triage)

Fever > 100.5 F (38.1 C)
Reason: diabetics are immuno-compromised, consider possibility of bacterial infection
CA: 43, 72, 73, 27, 1

Call PCP Now

Blood glucose > 400 mg/dl (22 mmol/l)
Reason: significant hyperglycemia
CA: 49, 24, 27, 1

[1] Blood glucose > 300 mg/dl (16.5 mmol/l) AND [2] two or more times in a row
Reason: obtain PCP input regarding medication adjustment and diet
CA: 49, 27, 1
Urine ketones moderate - large

Reason: obtain PCP input regarding medication adjustment and diet
CA: 49, 25, 27, 1

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

CA: 49, 9, 1

See Physician within 24 Hours

[1] Symptoms of high blood sugar (e.g., frequent urination, weak, weight loss) AND [2] not able to test blood glucose

CA: 44, 6, 27, 1

New onset Diabetes suspected (e.g., frequent urination, weakness, weight loss)

CA: 44, 6, 27, 1

Call PCP within 24 Hours

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

Reason: obtain PCP input regarding insulin dosing
CA: 50, 9, 1

Home Care

[1] Blood glucose > 240 mg/dl (13 mmol/l) AND [2] uses insulin (e.g., insulin-dependent, all type 1 diabetics) (all triage questions negative)

Reason: hyperglycemia
CA: 48, 5, 6, 4, 11, 2, 3, 34, 35, 10, 8, 1

[1] Blood glucose > 240 mg/dl (13 mmol/l) AND [2] does not use insulin (e.g., not insulin-dependent; most type 2 diabetics) (all triage questions negative)

Reason: hyperglycemia
CA: 48, 5, 6, 11, 2, 3, 34, 35, 10, 33, 8, 1

Blood glucose 60-240 mg/dl (3.5 -13 mmol/l) (all triage questions negative)

CA: 48, 5, 22, 3, 34, 35, 2, 10, 23, 33, 7, 1

Sick day rules for diabetics who use insulin, questions about

CA: 48, 17, 28, 29, 30, 19, 20, 31, 32, 8, 1

Sick day rules for diabetics who do not use insulin, questions about

CA: 48, 18, 19, 21, 31, 32, 8, 1

CARE ADVICE (CA) -
1. **Care Advice** given per Diabetes - High Blood Sugar (Adult) guideline.

2. **Measure And Record Your Blood Glucose:**
   - 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.

3. **Daily Blood Glucose Goals:**
   - You and your doctor should decide on what your blood glucose goals should be.
   - Typical goals for most non-pregnant adults who perform daily finger-stick blood testing at home shown below.
     - *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)
     - A1C Level less than 7%

4. **Treatment - Insulin:**
   - Continue to take your insulin, as prescribed by your doctor.
   - Additional 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.

5. **High Blood Sugar (Hyperglycemia):**
   - Definition: Fasting blood glucose over 140 mg/dL (7.5 mmol/l) or random blood glucose over 200 mg/dL (11 mmol/l).
   - Symptoms of mild hyperglycemia: Frequent urination, increased thirst, fatigue, blurred vision.
   - Symptoms of severe hyperglycemia: Confusion and coma.
   - Contributing factors: Non-compliance with medications, non-compliance with diet, infection.

6. **Treatment - Liquids:**
   - Drink at least one glass (8 oz) 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.

7. **Call Back If:**
   - Urine ketones are moderate or large (or more than 1+)
   - Glucose over 300 mg/dL (16.5 mmol/l) two or more times in a row
   - You become worse.

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

9. **Call Back If:**
   - You have more questions.
   - You become worse.

10. **Check Urine For Ketones:**
    - All diabetics who require insulin therapy should keep a testing kit for urine ketones in their home. You can buy one at your local pharmacy.
    - Check your urine for ketones whenever you are ill or if your blood glucose is over 240 mg/dL (13 mmol/l).

11. **Treatment - Diabetes Medications:** Continue taking your diabetes pills.
13. **First Aid Advice For Hypoglycemia -- Glucose If Blood Glucose** less than 70 mg/dl (3.9 mmol/l) or **Unknown** (pending EMS arrival) for conscious patients:
   - Give sugar (15-20 grams glucose) by mouth IF able to swallow.
   - *Each of the following has the right amount of sugar:* milk (1 cup; 240 ml); juice or soda (1/2 cup; 120 ml); pre-packaged juice box (1 box); table sugar or honey (3 teaspoons; 15 ml); glucose tablets (3-4 tablets); glucose paste (15 grams); 4-5 saltine crackers.
   - Symptoms should begin to improve within 5 minutes. Full recovery may take 10-20 minutes.

14. **First Aid Advice for Hypoglycemia -- IM Glucagon** If Blood Glucose Under 70 mg/dl (3.7 mmol/l) or **Unknown** (pending EMS arrival):
   - If family has glucagon for hypoglycemic emergencies And the caller knows how to use it, encourage the caller to give the glucagon now.
   - Inject it IM into the upper outer thigh.
   - Adult dosage is 1 mg

15. **Note to Triager:** Don't worry about giving Glucose to a patient whose blood glucose is unknown (and could be high); if it turns out the blood glucose is high, the hospital can treat this easily.

16. **Note to Triager:** Don't worry about giving Glucagon to a patient whose blood glucose is unknown (and could be high); if it turns out the blood glucose is high, the hospital can treat this easily.

17. **Sick Day Rules - For Diabetics Who Take Insulin:**
   - Do not stop taking your insulin (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 every 3-4 hours. Write down the results. 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.

18. **Sick Day Rules - For Diabetics Who Do Not Use Insulin:**
   - 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.

19. **Sick Day Rules - 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 (120 - 240 ml) 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 over 240 mg/dl (13 mmol/l), drink sugar-free liquids (e.g., water, broth). If glucose under 200 mg/dl (11 mmol/l), drink sugar-containing liquids (e.g., sports drinks, juice, soda).
   - Advance diet as you improve.

20. **Sick Day Rules - 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.
21. **Sick Day Rules - 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)

22. **General Diabetes Advice:**
   - Physician: See your physician regularly.
   - Testing: Test your blood glucose - Follow your physician's advice regarding how often.
   - Record-keeping: Keep a daily record of how you are feeling and the results of your tests.
   - Medications: Take your diabetes medications as prescribed.
   - Eat healthy: Work with your doctor or a dietician to develop healthy meal plan.
   - Exercise: Staying physically active is important.
   - Eye exam: Get an eye exam once a year (by an ophthalmologist).
   - Feet: Keep your feet clean and dry; check your feet daily for sores.

23. **Resources** - Reliable educational information is available from:

24. **Recheck**: If you have not done so already, recheck your blood sugar to make certain that it is really that high.

25. **Drink Extra Fluids:**
   - Drink at least one glass (8 oz) of water per hour for the next 4 hours.
   - Adequate hydration will reduce hyperglycemia.

26. **Note to Triager**: Don't worry about giving **Glucagon** or **Glucose** to a patient whose blood glucose is unknown (and could be high); if it turns out the blood glucose is high, the hospital can treat this easily.

27. **Call Back If**:
   - Vomiting occurs
   - Rapid breathing occurs
   - You become worse.

28. **Insulin - Do Not Stop Taking It**:
   - If you are supposed to be using insulin, do not stop taking it.
   - The reason is that sometimes during an illness you may need even more insulin than usual.
29. **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.
   - **Total Daily Dose (TDD):** The TDD 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.
   - **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.

30. **Insulin - Decreased Insulin For Hypoglycemia:**
   - **Note To Triager:** Decreased insulin dosing is sometimes needed in patients with a blood glucose under 80 mg/dl (4.5 mmol/l), especially if there is decreased oral intake.
   - **Typical Sick Day Insulin Reduction:** For blood glucose under 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%.
   - **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.

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

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

33. **Expected Course - You should Call Your Doctor Within 1-3 Days if:**
   - Your blood sugar continues to get above 240 mg/dl (13 mmol/l).
   - Your blood sugar continues to be higher than the glucose goals your doctor set for you. It has been longer than 6 months since you had an Hemoglobin A1C test.

34. **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)
35. **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%

40. **Call EMS 911 Now**: Immediate medical attention is needed. You need to hang up and call 911 (or an ambulance). (Triager Discretion: I'll call you back in a few minutes to be sure you were able to reach them.)

41. **Go To ED Now**: You need to be seen in the Emergency Department. Go to the ER at __________ Hospital. Leave now. Drive carefully.

42. **Go To ED Now (or PCP triage)**:
   - **If No PCP Triage**: You need to be seen. Go to the ER/UCC at __________ Hospital within the next hour. Leave as soon as you can.
   - **If PCP Triage Required**: You may need to be seen. Your doctor will want to talk with you to decide what's best. I'll page him now. If you haven't heard from the on-call doctor within 30 minutes, go directly to the ER/UCC at ___________ Hospital.

43. **See Physician Within 4 Hours** (or PCP triage):
   - **If No PCP Triage**: You need to be seen. Go to _______________ (ED/UCC or office if it will be open) within the next 3 or 4 hours. Go sooner if you become worse.
   - **If PCP Triage Required**: You may need to be seen. Your doctor will want to talk with you to decide what's best. I'll page the doctor now. If you haven't heard from the on-call doctor within 30 minutes, call again. (Note: If PCP can't be reached, send to ED/UCC or office.)

44. **See Physician Within 24 Hours**:
   - **If Office Will Be Open**: You need to be examined within the next 24 hours. Call your doctor when the office opens, and make an appointment.
   - **If Office Will Be Closed And No PCP Triage**: You need to be examined within the next 24 hours. Go to __________ at your convenience.
   - **If Office Will Be Closed And PCP Triage Required**: You may need to be seen within the next 24 hours. Your doctor will want to talk with you to decide what's best. I'll page the doctor now. (Exception: from 10 pm to 7 am. Since this isn't serious, we'll hold the page until morning.)

45. **See PCP Within 3 Days**: You need to be examined within 2 or 3 days. Call your doctor during regular office hours and make an appointment. (Note: if office will be open tomorrow, tell caller to call then, not in 3 days).

46. **See PCP Within 2 Weeks**: You need an evaluation for this ongoing problem within the next 2 weeks. Call your doctor during regular office hours and make an appointment.

47. **Home Care - Information or Advice Only Call**.

48. **Home Care**: You should be able to treat this at home.

49. **Call PCP Now**: You need to discuss this with your doctor. I'll page him now. If you haven't heard from the on-call doctor within 30 minutes, call again.
50. **Call PCP Within 24 Hours**: You need to discuss this with your doctor within the next 24 hours.
   - **If Office Will Be Open**: Call the office when it opens tomorrow morning.
   - **If Office Will Be Closed**: I'll page him now. 
     (**Exception**: from 9 pm to 9 am. Since this isn't urgent, we'll hold the page until morning.)

51. **Call PCP When Office Is Open**: You need to discuss this with your doctor within the next few days. Call him/her during regular office hours.

52. **Go To L&D Now**: You need to be seen. Go to the Labor and Delivery Unit or the Emergency Room at __________ Hospital. Leave now. Drive carefully.

72. **Fever Medicines**:
   - For fever relief, take acetaminophen or ibuprofen.
   - Treat fevers above 101°F (38.3°C).
   - The goal of fever therapy is to bring the fever down to a comfortable level. Remember that fever medicine usually lowers fever 2-3°F (1-1.5°C). 
   **Acetaminophen (e.g., Tylenol)**:
     - Take 650 mg (**two 325 mg pills**) by mouth every 4-6 hours as needed. Each Regular Strength Tylenol pill has 325 mg of acetaminophen. The most you should take each day is 3,250 mg (10 Regular Strength pills a day).
     - Another choice is to take 1,000 mg (**two 500 mg pills**) every 8 hours as needed. Each Extra Strength Tylenol pill has 500 mg of acetaminophen. The most you should take each day is 3,000 mg (6 Extra Strength pills a day).
   **Ibuprofen (e.g., Motrin, Advil)**:
     - Take 400 mg (**two 200 mg pills**) by mouth every 6 hours as needed.
     - Another choice is to take 600 mg (**three 200 mg pills**) by mouth every 8 hours as needed.
     - The most you should take each day is 1,200 mg (six 200 mg pills a day), unless your doctor has told you to take more.
   **Naproxen (e.g., Aleve)**:
     - Take 220 mg (**one 220 mg pill**) by mouth every 8 hours as needed. You may take 440 mg (**two 220 mg pills**) for your first dose.
     - The most you should take each day is 660 mg (three 220 mg pills a day), unless your doctor has told you to take more.
   **Extra Notes**:
     - Acetaminophen is thought to be safer than ibuprofen or naproxen for people over 65 years old. Acetaminophen is in many OTC and prescription medicines. It might be in more than one medicine that you are taking. You need to be careful and not take an overdose. An acetaminophen overdose can hurt the liver.
     - McNeil, the company that makes Tylenol, has different dosage instructions for Tylenol in Canada and the United States. In Canada, the maximum recommended dose per day is 4,000 mg or twelve (12) Regular-Strength (325 mg) pills. In the United States, McNeil recommends a maximum dose of ten (10) Regular-Strength (325 mg) pills.
     - Before taking any medicine, read all the instructions on the package.
73. **Caution - NSAIDs (e.g., ibuprofen, naproxen):**
   - Do not take nonsteroidal anti-inflammatory drugs (NSAIDs) if you have stomach problems, kidney disease, heart failure, or other contraindications to using this type of medication.
   - Do not take NSAID medications for over 7 days without consulting your PCP.
   - Do not take NSAID medications if you are pregnant.
   - You may take this medicine with or without food. Taking it with food or milk may lessen the chance the drug will upset your stomach.
   - **Gastrointestinal Risk:** There is an increased risk of stomach ulcers, GI bleeding, perforation.
   - **Cardiovascular Risk:** There may be an increased risk of heart attack and stroke.

80. **Driving:** Another adult should drive.

81. **Bring Medicines:**
   - Please bring a list of your current medicines when you go to the Emergency Department (ER).
   - It is also a good idea to bring the pill bottles too. This will help the doctor to make certain you are taking the right medicines and the right dose.

87. **Bring Medicines:**
   - Please bring a list of your current medicines when you go to see the doctor.
   - It is also a good idea to bring the pill bottles too. This will help the doctor to make certain you are taking the right medicines and the right dose.

89. **Call Back If:**
   - You become worse.

92. **Note to Triager - Driving:**
   - Another adult should drive.
   - If immediate transportation is not available via car or taxi, then the patient should be instructed to call EMS-911.

**FIRST AID**

**FIRST AID Advice for Hypoglycemia -- Glucose**

... IF BLOOD GLUCOSE < 70 mg/dl (3.9 mmol/l) or UNKNOWN for conscious patients:

- Give sugar (15-20 grams glucose) by mouth IF able to swallow.
- Each of the following has the right amount of sugar: milk (1 cup; 240 ml); juice or soda (1/2 cup; 120 ml); pre-packaged juice box (1 box); table sugar or honey (3 teaspoons; 15 ml); glucose tablets (3 tablets); glucose paste (10-15 grams).
- Symptoms should begin to improve within 5 minutes. Full recovery may take 10-20 minutes.

**FIRST AID Advice for Hypoglycemia -- Glucagon**

... IF BLOOD GLUCOSE < 70 mg/dl (3.9 mmol/l) or UNKNOWN (pending EMS arrival):

- If family has glucagon for hypoglycemic emergencies AND the caller knows how to use it, encourage the caller to give the glucagon now.
- Inject it IM into the upper outer thigh.
- Adult dosage is 1 mg
- Glucagon can be used in unconscious patients.
- Symptoms should begin to improve within 5 minutes. Full recovery may take 10-20 minutes.
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 ketoacidosis (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, Detemir, 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


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SEARCH WORDS

BLOOD GLUCOSE
BLOOD SUGAR
COMA
DIABETES
DIABETES MELLITUS