# Diabetes at Camp: Ketones and Sick Days

***Module 10 of 12***

**Special thanks to the team below and everyone who contributed to this work.**

Abby Hollander, MD
Professor of Pediatrics
Division of Pediatric Endocrinology and Diabetes
Washington University School of Medicine and
St. Louis Children's Hospital, One Children's Place
St. Louis, MO

Vicki Moran, PhD, RN, CNE, CDE, PHNA-B, TNS
Assistant Professor
St. Louis University School of Nursing
St. Louis, MO

Stephanie Kassels, DNP, FNP-BC, CDE
Nurse Practitioner
Memorial Hospital
North Conway, NH

Carla Cox, PhD, RD, CDE, CPT
Providence Medical Group, Endocrinology,
Diabetes and Nutrition, Missoula, MT
Mountain Vista Medicine
Kamas, UT

Kelly Mueller, MS, PMP
Vice President, Consumer and Community Impact
American Diabetes Association
Arlington, VA

Emily Fay
Territory Director, Youth and Family Initiatives
American Diabetes Association
Denver, CO

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# Objectives

## At the end of this module, the participant should be able to:

- Describe how ketones occur in diabetes and treatments used to reduce ketones
- Utilize a sick day action plan to reduce ketones
- Recognize diabetic ketoacidosis (DKA) and demonstrate treatment needed

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# What Are Ketones?

- Organic compounds produced from breakdown of fat
- Used by cells as fuel when glucose is not available
- In diabetes, **KETONES = NOT ENOUGH INSULIN**
- High blood levels of ketones cause:
  - Abdominal pain
  - Nausea and vomiting
  - Diabetic ketoacidosis (DKA)

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# What Causes Ketones?

- Not enough insulin
  - Missed doses
  - Ineffective insulin (overheated, frozen, or expired)
  - Pump malfunction
- Stress
  - Infection
  - Dehydration
  - Starvation
- In diabetes, both things are present, but one may be predominate:
  - if camper had no insulin doses in 24 hours, he/she would need little additional stress to have high ketones
  - if a camper has influenza, he/she could experience DKA at lower blood glucose levels than normal

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# Does High Blood Glucose Cause Ketones?

- Short answer: NO
- **Lack of insulin** typically causes both high blood glucose and ketones
- During illness with vomiting/not eating, camper can have **LOWER** blood glucose and ketones
- Overeating will cause high blood glucose, but may **NOT** cause ketones

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# When to Check for Ketones?

## Check for KETONES:

- If blood glucose is over 300 mg/dL **OR** per camp protocol **OR** per camper's sick day action plan
- With any episode of vomiting
- Any missed insulin dose
- Any time camper "feels sick"
- **Check when sick, even if blood glucose is low**

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# Testing Urine Ketones

1. Remove one new urine ketone test strip from bottle
2. Have camper urinate directly onto end of test strip **OR** urinate into a clean container and dip the test strip into the urine
3. Wait for the amount of time listed on the back of the ketone strip bottle (15-60 seconds depending on the brand)
4. Compare the color change on the test strip to the colors pictured on the ketone strip bottle to get results
5. If ketones are present, action should be taken

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# Ketone Strip Storage

- Store in a dry place
- Avoid extreme temperatures
- Keep in original container
- Containers are good for 6 months after opening or by expiration date

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# Blood Ketone Meters


- Ketones may be checked by fingerstick with NovaMax or Precision Xtra meters
- Different strips are used for ketone checks than blood glucose checks
- Beta hydroxybutyrate (most prevalent ketone) is what is measured

**Interpretation of Blood Ketone Values**

**Negative =** Less than 0.6 mmol/L

**Trace/Small** = 0.6 - 1.5 mmol/L

**Moderate to Large Ketones=** 1.5-3 mmol/L

**Immediate Medical Attention Required = Greater Than 3.0 mmol/L**

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# Treating Trace/Small Ketones

## Drink water!

- Drink 1 oz. per year of age, every hour
- Example: A 9-year-old should drink 9 oz. of water every hour

## Keep checking ketones

- Keep checking with each urination until you have two negative tests in a row or blood ketones are checked each hour until less than 0.6 mmol/L.

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# Treating Moderate/Large Ketones


**Drink water,** 1 ounce per year of age per hour and keep checking until two negative or under 0.6 mmol/L

Use sick day action plan to give extra insulin (next two slides)

If camper has a pump, insulin should be administered via **subcutaneous injection** until urine ketones are below small or blood ketones < 0.6 mmol/L

If camper has a pump, pump site should be changed

No strenuous activity until urine ketones are below moderate or blood ketones are < 1.0 mmol/L

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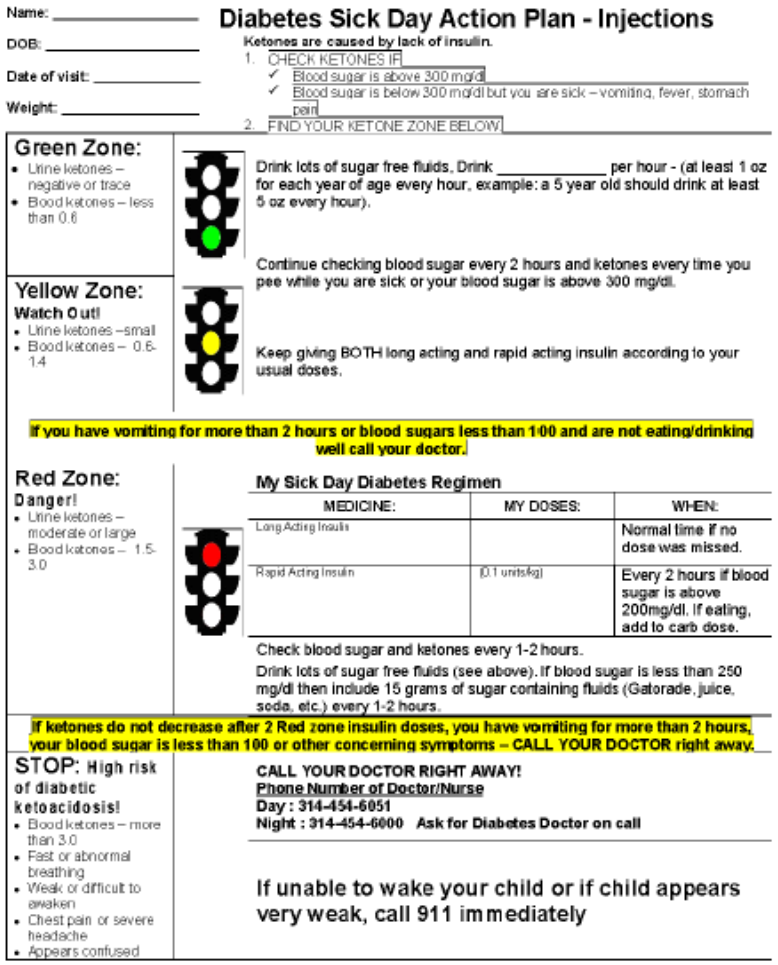
# Sick Day Action Plan - Camper on Injections

- Camper should have a sick day plan on file from diabetes care provider/team
- Common plans for mod/lg ketones:
  - 0.1 units/kg Humalog/Novolog every 1-2 hours
  - Double usual correction for high glucose every 1-2 hours
- Ongoing fluid intake is important.
- If ketones are remaining moderate or higher, camper has persistent vomiting, or camper has rapid breathing—transport to closest hospital



Name: _____
DOB: _____
Date of visit: _____
Weight: _____

**Diabetes Sick Day Action Plan - Injections**

Ketones are caused by lack of insulin.

1. CHECK KETONES IF
   - ✓ Blood sugar is above 300 mg/dl
   - ✓ Blood sugar is below 300 mg/dl but you are sick – vomiting, fever, stomach pain
2. FIND YOUR KETONE ZONE BELOW

**Green Zone:**
- Urine ketones – negative or trace
- Blood ketones – less than 0.6

Drink lots of sugar free fluids. Drink _____ per hour - (at least 1 oz for each year of age every hour, example: a 5 year old should drink at least 5 oz every hour).

Continue checking blood sugar every 2 hours and ketones every time you pee while you are sick or your blood sugar is above 300 mg/dl.

**Yellow Zone:**
**Watch Out!**
- Urine ketones –small
- Blood ketones – 0.6-1.4

Keep giving BOTH long acting and rapid acting insulin according to your usual doses.

**If you have vomiting for more than 2 hours or blood sugars less than 100 and are not eating/drinking well call your doctor.**

**Red Zone:**
**Danger!**
- Urine ketones – moderate or large
- Blood ketones – 1.5-3.0

**My Sick Day Diabetes Regimen**

| MEDICINE: | MY DOSES: | WHEN: |
|---|---|---|
| Long Acting Insulin | | Normal time if no dose was missed. |
| Rapid Acting Insulin | (0.1 units/kg) | Every 2 hours if blood sugar is above 200mg/dl. If eating, add to carb dose. |

Check blood sugar and ketones every 1-2 hours.
Drink lots of sugar free fluids (see above). If blood sugar is less than 250 mg/dl then include 15 grams of sugar containing fluids (Gatorade, juice, soda, etc.) every 1-2 hours.

**If ketones do not decrease after 2 Red zone insulin doses, you have vomiting for more than 2 hours, your blood sugar is less than 100 or other concerning symptoms – CALL YOUR DOCTOR right away.**

**STOP: High risk of diabetic ketoacidosis!**
- Blood ketones – more than 3.0
- Fast or abnormal breathing
- Weak or difficult to awaken
- Chest pain or severe headache
- Appears confused

**CALL YOUR DOCTOR RIGHT AWAY!**
**Phone Number of Doctor/Nurse**
**Day : 314-454-6051**
**Night : 314-454-6000 Ask for Diabetes Doctor on call**

If unable to wake your child or if child appears very weak, call 911 immediately

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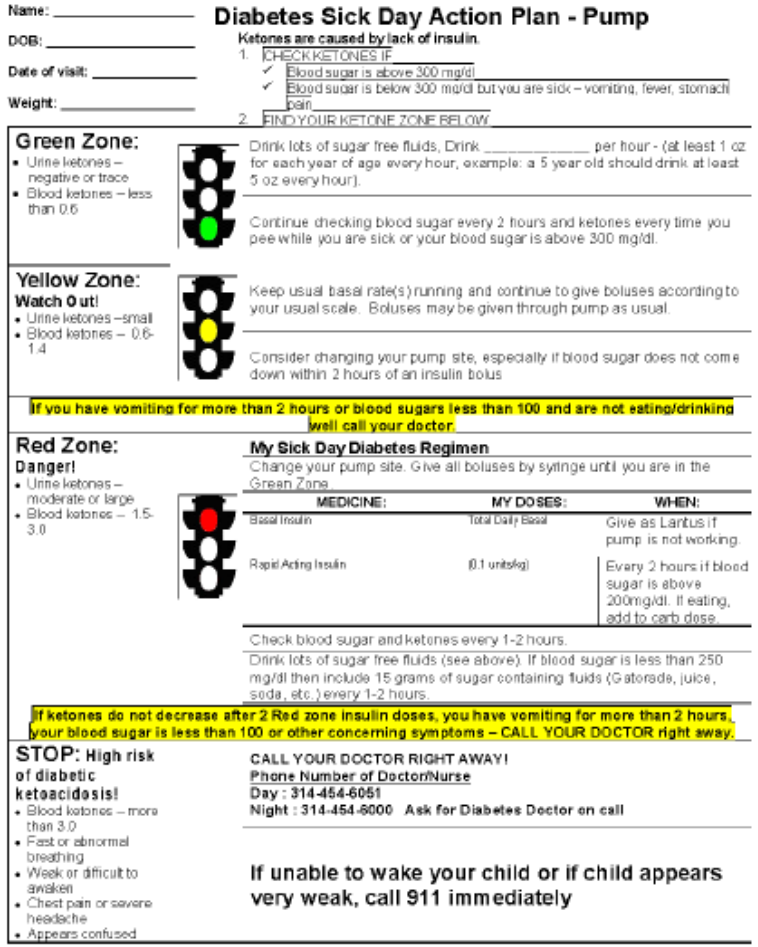
# Sick Day Action Plan - Camper on a Pump

- Same as for camper on injections, **PLUS**
- If urine ketones are moderate or large **AND/OR** blood ketones greater than 1.0, must change pump site.
- **All bolus insulin is given by syringe until urine ketones are below small AND/OR blood ketones are < 0.6.**
- Encourage fluids, observe for DKA



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**Diabetes Sick Day Action Plan - Pump**

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**Green Zone:**
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Drink lots of sugar free fluids, Drink _____ per hour - (at least 1 oz for each year of age every hour, example: a 5 year old should drink at least 5 oz every hour).

Continue checking blood sugar every 2 hours and ketones every time you pee while you are sick or your blood sugar is above 300 mg/dl.

**Yellow Zone:**
**Watch Out!**
- Urine ketones –small
- Blood ketones – 0.6-1.4

Keep usual basal rate(s) running and continue to give boluses according to your usual scale. Boluses may be given through pump as usual.

Consider changing your pump site, especially if blood sugar does not come down within 2 hours of an insulin bolus

**If you have vomiting for more than 2 hours or blood sugars less than 100 and are not eating/drinking well call your doctor.**

**Red Zone:**
**Danger!**
- Urine ketones – moderate or large
- Blood ketones – 1.5-3.0

**My Sick Day Diabetes Regimen**

Change your pump site. Give all boluses by syringe until you are in the Green Zone.

| MEDICINE: | MY DOSES: | WHEN: |
|---|---|---|
| Basal Insulin | Total Daily Basal | Give as Lantus if pump is not working. |
| Rapid Acting Insulin | (0.1 units/kg) | Every 2 hours if blood sugar is above 200mg/dl. If eating, add to carb dose. |

Check blood sugar and ketones every 1-2 hours.

Drink lots of sugar free fluids (see above). If blood sugar is less than 250 mg/dl then include 15 grams of sugar containing fluids (Gatorade, juice, soda, etc.) every 1-2 hours.

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# Diabetic Ketoacidosis (DKA)

## What is DKA?

- Ketone production severe enough to cause low blood pH (acidosis)
- Life-threatening complication of type 1 diabetes

## How is DKA treated?

- IV fluids and IV insulin
- Hospital monitoring (often ICU)

## What are symptoms of DKA?

- Vomiting and abdominal pain
- Heavy/rapid breathing
- Cool extremities/dehydration
- Confusion/altered mental status

## Complications of DKA

- Electrolyte disturbances and cerebral edema

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# Summary

- In people with diabetes, **insulin deficiency** and **increased stress** lead to production of ketones
- Campers should have a sick day action plan outlining fluid and insulin administration to treat ketones
- Vomiting, heavy breathing, and abdominal pain may indicate the presence of **DKA**, **a serious metabolic disturbance that requires urgent medical treatment**

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# Assessment

**1. Several campers in a cabin have a virus with vomiting, including a camper with diabetes. What is the best approach?**

A. Reduce insulin to avoid hypoglycemia

B. Check blood glucose and ketones and use sick day plan

C. Check blood glucose only since you know why there is vomiting

D. Keep camper NPO until no vomiting for 4 hours

**2. A camper has a blood glucose of 345 before lunch. She tells you she forgot to give her breakfast bolus dose through her pump. She should:**

A. Add her breakfast dose to her calculated lunch dose

B. Not eat lunch

C. Check ketones

D. Take lunch dose through pump

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# Assessment

**3. A 10-year-old camper with diabetes and a pump vomits before breakfast. He tells you the pump site was all the way out when he woke up. His blood glucose is 221. He should:**

A. Put in a new site and give an insulin bolus immediately

B. Drink 10 oz. of water immediately

C. Dose with insulin after breakfast in case he vomits again

D. Check ketones and use sick day plan

**4. A 14-year-old camper comes back from a 2-day overnight. She has vomited twice this afternoon and cannot remember whether she took her Lantus (glargine) last night. She took Humalog (lispro) at breakfast but not lunch since she was feeling sick and didn't eat. She has abdominal pain and her breathing seems deeper than normal. She should:**

A. Be taken to the nearest hospital

B. Lie down and rest for an hour

C. Drink 14 oz. of water per hour

D. Drink soda to settle her stomach

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# Assessment

**1. Several campers in a cabin have a virus with vomiting, including a camper with diabetes. What is the best approach?**

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**B. Check blood glucose and ketones and use sick day plan**

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