Asthma Management in the School Setting Update

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Division of Allergy, Asthma, and Immunology
Children’s Mercy Hospital
Learning Objectives

01 Identify asthma symptoms and triggers.

02 Understand controller, reliever, and prednisone medication.

03 Explain nurse and student role in asthma treatment.

04 Assist student with appropriate use of inhaler with spacer.
Childhood Asthma Statistics

- In the United States, children who have asthma account for 7.5% of the population.
- In 2018, there were 192 childhood deaths related to asthma.
- Of those with asthma in 2018, almost 3 million children had an asthma attack.
- In 2016, childhood asthma accounted for approximately 80,000 inpatient hospital stays, nearly 550,000 emergency room visits, and close to 2.5 million physician office visits.
- The leading cause of chronic disease related absenteeism is childhood asthma. Greater than 10 million school days are missed every year leading to lower academic performance.
Normal Airways vs. Asthma Airways
Asthma Symptoms

- Cough; may be only symptom
- Wheeze: whistling sound
- Shortness of breath or rapid breathing
- Chest tightness or pain; may be described by child as chest “hurts” or “feels funny”
- Difficulty with physical activity due to symptoms
- Difficulty sleeping because of night time symptoms
Asthma Triggers

- Mold
- Pet dander
- Dust mites
- Colds
- Strong smells
- Pollen
- Cockroaches
- Weather
- Smoke
- Exercise
Asthma Triggers

Allergic
- Tree, grass, weed pollen
- Mold
- Dust mites
- Pet dander: most commonly dog and cat
- Cockroach

Non-Allergic
- Smoke
- Pollution
- Cold air
- Change in weather
- Emotions such as laughing or crying
Exercise Induced Asthma (EIA)

- Experience symptoms within 5 to 20 minutes of exercise
- Maximize exercise ability with proper diagnosis and treatment
- Quick reliever/rescue inhaler 15 minutes before exercise
- Drink plenty of fluids
- Stop exercise if symptoms occur
- Cool down at the end of exercise
Classroom Pets

Prevention

- Encourage no pet policy
- If not possible then:
  - Keep animal in their cage as often as possible
  - Keep animal away from ventilation system
  - Regularly clean their cages
  - Locate sensitive students furthest away from animal and habitat
  - Avoid animal coming in contact with carpets, upholstered furniture, stuffed toys, and pillows
Dust Mites

• Found in:
  • carpet
  • upholstered furniture or other fabric containing items
  • stuffed toys or animals
  • pillows

Dust/Dust Mite Prevention

• Remove/clean up dust frequently with damp cloth
• Vacuum carpets and fabric covered furniture frequently
• Wash stuffed toys, pillows, etc. frequently in hot water.
Mold

• Forms with moisture/water

Examples:
  • Water leaks
  • Standing water
  • Water stains

Mold Prevention

• Identify and immediately address mold

• Identify and immediately address source of moisture/water such as water leaks, standing water, or water stains

• Dry moisture/wet areas within 24 to 48 hours
Irritants

• Chalk
• Strong smelling markers
• Cleaning agents
• Air fresheners
• Paint

Prevention

• Limit use of irritating substances during school hours
Table 1. Asthma Severity Classifications According to the Expert Panel Report 2 National Asthma Guidelines

<table>
<thead>
<tr>
<th>Asthma Classification</th>
<th>Days With Symptoms</th>
<th>Nights With Symptoms</th>
<th>FEV&lt;sub&gt;1&lt;/sub&gt; or PEF (Predicted Normal)</th>
<th>PEF Variability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe persistent</td>
<td>Continual</td>
<td>Frequent</td>
<td>≤ 60</td>
<td>&gt;30</td>
</tr>
<tr>
<td>Moderate persistent</td>
<td>Daily</td>
<td>≥ 5/mo</td>
<td>&gt;60 to &lt;80</td>
<td>&gt;30</td>
</tr>
<tr>
<td>Mild persistent</td>
<td>&gt;2/wk</td>
<td>3-4/mo</td>
<td>≥ 80</td>
<td>20-30</td>
</tr>
<tr>
<td>Mild intermittent</td>
<td>≤2/wk</td>
<td>≤2/mo</td>
<td>≥ 80</td>
<td>&lt;20</td>
</tr>
</tbody>
</table>

Abbreviations: FEV<sub>1</sub>, forced expiratory volume in 1 second; PEF, peak expiratory flow.
Rules of Two

• Do you use a quick-relief inhaler more than two times a week?

• Do you wake up at night with asthma symptoms more than two times a month?

• Do you refill your asthma prescription more than two times a year?
Treatment Goals

• Prevent asthma exacerbations
• Minimize progression of asthma
• Optimal symptom management
• Avoid medication adverse effects
• Participate in physical activities/sports with minimal to no symptoms
• Sleep at night without symptoms
Controllers

Inhaled Corticosteroids (ICS): Metered-Dose Inhalers (MDI)

- Aerospan fluoroide 80mcg Meda Pharmaceuticals
- Alvesco budesonide 80mcg Sunovion
- Alvesco budesonide 160mcg Sunovion
- Asmanex HFA 160mcg Merck
- Asmanex HFA 200mcg Merck
- Flovent fluticasone propionate 44mcg GlaxoSmithKline
- Flovent fluticasone propionate 110mcg GlaxoSmithKline
- Flovent fluticasone propionate 220mcg GlaxoSmithKline

Inhaled Corticosteroids (ICS): Dry Powder Inhalers (continued on back)

- QVAR beclomethasone dipropionate 40mcg Teva
- QVAR beclomethasone dipropionate 80mcg Teva
- ArmonAir RespiClick fluticasone furoate 50mcg Teva
- ArmonAir RespiClick fluticasone furoate 100mcg Teva
- Arnuity Ellipta fluticasone furoate 55mcg GlaxoSmithKline
- Arnuity Ellipta fluticasone furoate 220mcg GlaxoSmithKline
Controller Inhalers

- Medication taken 1-2 times daily for long-term control
- Prevents inflammation and mucus build up
- **Inhaled corticosteroid metered dose:** Flovent, Qvar, Asmanex, Alvesco
- **Dry powder inhaled corticosteroid:** Asmanex Twisthaler, Pulmicort Flexhaler, Flovent Diskus, Arnuity Elipta
- **Combination inhalers:** Advair, Airduo Respliclick, Breo Ellipta, Dulera, Symbicort
Oral Steroids

- Treatment for moderate to severe asthma exacerbations
- Speed recovery from asthma exacerbation
- Prevent recurrence or worsening of symptoms
Quick Reliever/Rescue Inhalers

- Fast acting bronchodilator.
- Nebulizer also available, but inhaler is more portable.
- Relaxes muscles around the airway to treat cough, wheeze, tight chest, difficulty breathing.
- Use every 4 to 6 hours as needed for symptoms.
- 15 minutes before exercise as needed.
- Every 20 minutes x 3 during exacerbation.
# Student Asthma Treatment Form

**Keep on file for quick reference when a student uses asthma medication.**

**Student Asthma Treatment Form**

<table>
<thead>
<tr>
<th>Parent/Guardian Name:</th>
<th>Parent/Guardian Name:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home Phone:</td>
<td>Home Phone:</td>
</tr>
<tr>
<td>Work Phone:</td>
<td>Work Phone:</td>
</tr>
<tr>
<td>Cell Phone or Pager:</td>
<td>Cell Phone or Pager:</td>
</tr>
<tr>
<td>Student’s Primary Care Provider:</td>
<td>Student’s Primary Care Provider:</td>
</tr>
<tr>
<td>Phone:</td>
<td>Phone:</td>
</tr>
<tr>
<td>Student’s Asthma Provider:</td>
<td>Student’s Asthma Provider:</td>
</tr>
<tr>
<td>Date of Birth:</td>
<td>Date of Birth:</td>
</tr>
<tr>
<td>Phone:</td>
<td>Phone:</td>
</tr>
</tbody>
</table>

## Daily School Medication Plan

- **Quick Reliever Dose:**
  - [x] Albuterol/Kopenex® inhaler 2 puffs with spacer, OR
  - [ ] Albuterol/Kopenex® nebulizer solution 1 dose
  - [ ] Student may carry and administer Quick Reliever.
- **Frequency:**
  - [x] Give every 4 hours as needed for wheezing/cough/shortness of breath
  - [ ] Give 10-15 minutes before exercise, as needed
- **After Treatment:**
  - [x] Student may return to class room after Quick Reliever treatment.
  - [ ] Notify parent/guardian when Quick Reliever is given (except before exercise).

## School Emergency Plan

**Use this plan when:**
- Asthma symptoms of wheeze, cough, shortness of breath, or chest tightness continue after one treatment with Quick Reliever.

**What to do:**
- Have the student take Quick Reliever every 20 minutes up to 3 times in one hour.
- Treatments help determine the severity of the asthma episode.

**What to Do Next**
- The student has significant reduction in asthma symptoms.
- Contact parent/guardian for the need for emergency plan use.
- Student may need to begin Yellow Zone medications at home.
- Parent/Guardian may choose to have student return to class or to come pick student up from school.

### Good Response to School Emergency Plan (Yellow Zone)

- Some kids have a fast heart rate or feel jittery after using Albuterol.

### Poor Response to School Emergency Plan (Red Zone)

- Student has persistent asthma symptoms and may be struggling to breathe.
- Seek emergency medical care - call 911 or an ambulance.
- Use epinephrine® (if available) for life-threatening asthma episode.

**Side Effects of Medication**

- There might not be wheezing, because air can not move out of the inflamed airways.

**Signature of Parent/Guardian:** ____________________________  
**Signature of Physician/Nurse Practitioner:** ____________________________  
**Date:** 06/04/2020

**Children’s Mercy**
Recording Student Quick Reliever Use

- Keep a diary form or card with the asthma medication for each student to record every use.

<table>
<thead>
<tr>
<th>Asthma Medication Diary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
</tr>
<tr>
<td><strong>Medication/Dose/Frequency</strong></td>
</tr>
<tr>
<td>- Albuterol/Xopenex inhaler 2 puffs with spacer every 4 hours as needed for wheezing / cough</td>
</tr>
<tr>
<td>- Albuterol/Xopenex nebulizer solution 1 dose every 4 hours as needed for wheezing / cough</td>
</tr>
<tr>
<td><strong>Check and/or date when medication given (exclude before exercise)</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Month</th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
</tr>
</thead>
<tbody>
<tr>
<td>August</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>September</td>
<td></td>
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<tr>
<td>October</td>
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<tr>
<td>November</td>
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<tr>
<td>December</td>
<td></td>
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</tr>
</tbody>
</table>
Student Progress Note

Families of students using quick reliever more than twice a week should receive a notice such as this.

Dear Parents,

This is a note to keep you informed about your child’s asthma symptoms at school.

- Visits the health room more than twice a week to use their Quick Reliever medication due to asthma symptoms. (This excludes using the Quick Reliever before exercise)
- Visits the health room everyday or more to use their Quick Reliever medicine before PE and/or recess due to asthma symptoms.

Please keep in mind if your child is having any of the following, their asthma may not be well controlled:
- Asthma symptoms (cough, wheeze, chest tightness or short of breath) more than 2 days per week
- Use their Quick Reliever medication (Albuterol) more than 2 days per week (does not include using the Quick Reliever before exercise)
- Wake up at night with asthma symptoms more than 2 times per month
- Not able to do their usual activities (like play at recess or PE class)

If your child’s asthma is not well controlled, please schedule an appointment to talk with your Primary Care Provider. Your child may need further medicines to help control the asthma symptoms.

Your child needs the following at school:
- Spacer or spacer mask to use with the inhaler
- A Quick Reliever (Albuterol) inhaler medication at school (labeled original container from the pharmacy)
- Student Asthma Form for permission to give the Quick Reliever at school
- A Peak Flow Meter to help manage the asthma
- An Asthma Action Plan
- Other

Thank you,

[Signature]

School Nurse

School ____________________________ ____________________________

Phone (_____) _______ · _________    Fax (_____) _______ · _________
Spacers

- Small Mask (0-18 months)
- Medium Mask (1-5 years)
- Large Mask (5 years+)
- Mouthpiece (5 years+)
Spacer Use

Why use a **Spacer with an Inhaler?**

**Inhaler alone**
When an inhaler is used alone, medicine ends up in the mouth, throat, stomach and lungs.

**Inhaler used with spacer device**
When an inhaler is used with a spacer device, more medicine is delivered to the lungs.
Asthma Action Plan

- Varies among different organizations
- Must be provided to school nurse
- A guide for use of asthma medications to prevent and manage symptoms
- Identifies triggers
- Recognition and treatment for early signs of a flare-up
- Informs when to seek additional treatment (oral prednisone) or emergency care
Green Zone

Symptoms

• Child feels good
• Breathing is easy. No cough, wheeze, or difficulty breathing.
• Can play and sleep without symptoms.

What to do

✓ Child continues controller inhaler.
✓ Identify triggers and observe for asthma symptoms.

Green: You are feeling good.
Yellow Zone

Symptoms

- Child starts to have a flare up.
- Child starts having asthma symptoms.
- First sign child is getting a cold.

What to do

✓ Child needs to use rescue (quick relief) inhaler 2 puffs every 4 hours for asthma symptoms.

✓ Child will add an additional dose, increase the dose, or add another controller inhaler per Asthma Action Plan for 2 weeks.

✓ Child returns to Green Zone when symptoms resolve.
## Red Zone

### Symptoms
- Constant cough and wheeze.
- Difficulty breathing even at rest.
- Breathing may be rapid and difficult.
- May have suprasternal, substernal, or intercostal retractions.
- Difficulty walking, talking, or sleeping due to symptoms.

### What to do
- ✓ Start prescribed steroid immediately.
- ✓ Continue rescue (quick reliever) inhaler 2 puffs every 4 hours as needed for symptoms.
- ✓ Parent will need to contact asthma provider for potential follow up.
- ✓ Parent is to call 911 if symptoms are severe such as blue lips or fingernails.
Role of the School Nurse

- Maintain a current asthma action plan for each student with asthma.
- Recognize potential asthma triggers and signs/symptoms of an attack.
- Assist student with proper administration of inhaler using a spacer.
- Know which students can safely self-carry/self-administer asthma medication. Any use of a rescue inhaler must be reported to school staff. Student must be appropriately monitored for potential need to intervene.
- Identify when emergency services, 911, should be called (i.e. no access to treatment for an asthma attack, signs of poor oxygenation such as blue lips or fingernails).
Student Role

• Obtain a current asthma action plan from their asthma provider.

• Provide the school nurse with this plan along with the inhaler and spacer. Place in a sealable plastic bag.

• Label the bag with student name, grade, and teacher.

• Notify school staff of asthma symptoms when they occur or if they worsen.
"My job is mostly seasonal. The busiest times are cold season, flu season, and allergy season."
Healthy Children Learn Better


Diabetes Update
Tiffany Musick, DO
Pediatric Endocrinologist
Co-Director of the Diabetes Center
CMH Population

- 2125 total patients with Diabetes
- ~300 patients with Type 2 Diabetes Mellitus
Epidemiology

• 1.54 cases per 1000 youth younger than 20 years of age

• Prevalence by Race
  • 2.0 per 1,000 in non-Hispanic children
  • 1.34 per 1,000 in African American children
  • 1.00 per 1000 in Hispanic children
The SEARCH for Diabetes In Youth Study: Prevalence (Index Year 2001) and Incidence Rates (Incident Years 2002–2005 combined) of Type 1 Diabetes among 5 Race-Ethnicity Groups by Age Category

<table>
<thead>
<tr>
<th>Race-Ethnicity</th>
<th>Age Category</th>
<th>0–4 years (95% CI)</th>
<th>5–9 years (95% CI)</th>
<th>10–14 years (95% CI)</th>
<th>15–19 years (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NHW</td>
<td>Prevalence per 1,000</td>
<td>0.38 (0.33, 0.44)</td>
<td>1.63 (1.53, 1.75)</td>
<td>2.56 (2.43, 2.70)</td>
<td>3.22 (3.07, 3.38)</td>
</tr>
<tr>
<td></td>
<td>Incidence per 100,000</td>
<td>19.4 (17.8, 21.1)</td>
<td>30.1 (28.1, 32.2)</td>
<td>32.9 (30.9, 35.0)</td>
<td>11.9 (10.8, 13.2)</td>
</tr>
<tr>
<td>AA</td>
<td>Prevalence per 1,000</td>
<td>0.22 (0.14, 0.34)</td>
<td>0.90 (0.72, 1.11)</td>
<td>1.79 (1.55, 2.08)</td>
<td>2.32 (2.02, 2.66)</td>
</tr>
<tr>
<td></td>
<td>Incidence per 100,000</td>
<td>12.0 (9.6, 14.8)</td>
<td>19.3 (16.3, 22.9)</td>
<td>21.3 (18.3, 24.8)</td>
<td>9.5 (7.4, 12.0)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>Prevalence per 1,000</td>
<td>0.17 (0.12, 0.25)</td>
<td>0.70 (0.59, 0.84)</td>
<td>1.47 (1.30, 1.67)</td>
<td>1.71 (1.51, 1.94)</td>
</tr>
<tr>
<td></td>
<td>Incidence per 100,000</td>
<td>10.2 (8.3, 12.6)</td>
<td>18.2 (15.5, 21.3)</td>
<td>18.4 (15.6, 21.5)</td>
<td>8.7 (6.8, 11.1)</td>
</tr>
<tr>
<td>API</td>
<td>Prevalence per 1,000</td>
<td>0.18 (0.11, 0.30)</td>
<td>0.34 (0.23, 0.49)</td>
<td>0.62 (0.47, 0.81)</td>
<td>0.93 (0.74, 1.16)</td>
</tr>
<tr>
<td></td>
<td>Incidence per 100,000</td>
<td>5.2 (3.3, 8.0)</td>
<td>7.6 (5.3, 10.9)</td>
<td>9.1 (6.6, 12.5)</td>
<td>5.7 (3.8, 8.6)</td>
</tr>
<tr>
<td>Navajo</td>
<td>Prevalence per 1,000</td>
<td>0</td>
<td>0.16 (0.06, 0.41)</td>
<td>0.15 (0.06, 0.38)</td>
<td>0.43 (0.23, 0.79)</td>
</tr>
<tr>
<td></td>
<td>Incidence per 100,000</td>
<td>1.13 (0.20, 6.49)</td>
<td>3.28 (1.11, 9.64)</td>
<td>1.95 (0.53, 7.10)</td>
<td>4.05 (1.57, 10.37)</td>
</tr>
</tbody>
</table>
Pathophysiology of Type 1 Diabetes Mellitus

- Beta cell death caused by autoimmune destruction.
- Thought to be caused by an autoimmune trigger.
- 80% of the pancreatic cells have to die before signs/symptoms present.
- Genetic predisposition
  - Chromosome 6- Major Histocompatibility Complex
    - DR3-DQ2
    - DR4-DQ8
      - DR2-DQ6 is protective
Timeline for Developing Type 1 Diabetes Mellitus

Van Belle T L et al. Physiol Rev 2011;91:79-118
Signs and symptoms

- Polyuria
- Polydipsia
- Polyphasia
- Nocturia/Bed wetting – new onset in a previously potty trained child
- Weight loss
- Nausea/vomiting
- Dehydration
- Lethargy
Diagnostic criteria

• Fasting plasma blood sugar ≥ 126
• Random plasma blood sugar ≥ 200
• Glucosuria occurs when blood sugar is ≥ 180
A1c Calculation

• How do you know what the average blood sugar is based on the Hemoglobin A1c?
  • (A1c – 2) x 30 = average blood sugar
  • EX: A1c = 11
    • (11-2) x 30 = 270 mg/dL
Labs obtained at onset

- C-peptide
- Insulin antibodies
- ICA-512 antibodies
- GAD 65 antibodies
- Zinc transporter antibodies
- Hemoglobin A1c
- TSH algorithm = ~ 20% of patients have thyroid dysfunction
- Celiac algorithm = 5% of patients
Therapy

Aspart, lispro, glulisine

Plasma Insulin Levels

Hours

0 2 4 6 8 10 12 14 16 18 20 22 24

Regular

NPH

Detemir

Glargine
<table>
<thead>
<tr>
<th>Type of Insulin</th>
<th>Onset of Action</th>
<th>Peak of Action</th>
<th>Total Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rapid acting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aspart, lispro,</td>
<td>10-15 minutes</td>
<td>30-90 minutes</td>
<td>2-3 hours</td>
</tr>
<tr>
<td>glulisine</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short acting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regular</td>
<td>30-60 minutes</td>
<td>2-4 hours</td>
<td>6-9 hours</td>
</tr>
<tr>
<td>Intermediate acting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NPH</td>
<td>1-2 hours</td>
<td>3-8 hours</td>
<td>12-15 hours</td>
</tr>
<tr>
<td>Long Acting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glargine</td>
<td>1-2 hours</td>
<td>No peak</td>
<td>24 hours</td>
</tr>
<tr>
<td>Determir</td>
<td>1-2 hours</td>
<td>No peak</td>
<td>16-24 hours</td>
</tr>
<tr>
<td>Degludec</td>
<td>Steady stated after 3 days</td>
<td>No Peak</td>
<td>40 hours</td>
</tr>
</tbody>
</table>
Honeymoon period

• 10-20% of the pancreatic Beta cells are still present.
• Once adding insulin, this decreases the glucotoxicity that was present and will help to preserve the Beta cell function.
• Can be a couple of months to a year.
Hypoglycemia

• Blood sugar less than 80 in child less than 5
• Blood sugar less than 70 in a child 5 and above
• Mild to Moderate – treat with 15 grams short acting carbohydrate and recheck in 15 minutes
• Severe - give glucagon and call 911 or go to ED
Sick day management
Hyperglycemia

- Correction factor = 1800/ Total Daily Dose
- May only give every 2 hours
Sick day management

• Still need to be taking insulin even if ill
• Will usually have them dose after meals to ensure that they eat all of the food that is offered
• Need to be eating carbs every 4 hour
  • 15 grams of carbs at least
    • ½ cup juice
    • 1 piece of bread
    • 4-6 oz decaf regular soda
    • ½ twin popsicle
Sick day management

• Check for ketones for BG >240 or ill
  • Moderate ketones 10% of TDD
  • Large ketones 20% of TDD
  • Only give doses every 2 hours
<table>
<thead>
<tr>
<th>Green Zone – High Blood Sugar NO Ketones</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Correct high blood sugar using Correction Factor</td>
</tr>
<tr>
<td>• Correction Factor (Insulin Sensitivity Factor) 1 unit will drop the blood sugar ____ points</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Yellow Zone – High Blood Sugar with Trace to Small Ketones</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Correct high blood sugar using Correction Factor</td>
</tr>
<tr>
<td>• Correction Factor (Insulin Sensitivity Factor) 1 unit will drop the blood sugar ____ points</td>
</tr>
<tr>
<td>• Drink plenty of fluids for the Ketones</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Red Zone – High Blood Sugar with Moderate to Large Ketones ACT IMMEDIATELY</th>
</tr>
</thead>
<tbody>
<tr>
<td>• CHANGE OUT PUMP SITE: GIVE CORRECTIONS AS SHOTS.</td>
</tr>
<tr>
<td>• Give corrections for BG &gt; 240. If BG &lt;240, then give carbohydrates to raise blood sugar to &gt; 240.</td>
</tr>
<tr>
<td>• Dose for Moderate Ketones _____ Units (10% Total Daily Dose)</td>
</tr>
<tr>
<td>• Dose for Large Ketones _____ Units (20% of Total Daily Dose)</td>
</tr>
<tr>
<td>• Drink plenty of fluids for the Ketones.</td>
</tr>
<tr>
<td>• Check blood sugar and for Ketones every 2 hours. Repeat dosing for Moderate and Large Ketones as listed above</td>
</tr>
</tbody>
</table>
| • If you still have Ketones after 4 hours, notify Endocrinology ON Call. (816-234-3000 – Ask to speak to Diabetes Doctor on
Automated technology and ketones

- Auto mode must be turned off after correction is given. Instructions are in the school orders.
- Control IQ must be turned off when treating for moderate/large ketones.
- Instructions are in the school orders.
Diabetic Ketoacidosis
Pathogenesis of Diabetic Ketoacidosis

- Decreased vascular resistance
- Nausea
- Vomiting
- Abdominal pain
Treatment of DKA

- **Insulin**
  - Stops the production and ketones
  - Allows for utilization of the glucose
  - 0.1 units/kg/hr IV drip

- **Fluids**
  - Volume depleted
  - Give initial bolus
  - Followed with fluid replacement – 1 ½ times maintenance
Definition of DKA

- Venous pH < 7.3
- Bicarb < 16 mmol/L
- Hyperglycemia (glucose > 200 mg/dL)
- Ketonemia
- Ketonuria
DKA evidence

- Most evidence for DKA management comes from non-RCT studies
- Cochrane- nothing
- Consensus guidelines published by ISPAD in 2018
  - Prior update was in 2009. Only difference in guidelines was that recent RCT showing no difference in cerebral injury in patients rehydrated at different rates with either 0.45% or 0.9% saline.
Basic Principles of DKA management

• Correct acidosis
• Rehydrate
• Decrease hyperglycemia
• Treat any underlying triggers
• Avoid complications of DKA (and DKA management)
  • Cerebral edema
  • Hypokalemia
  • Hypoglycemia
  • others
How common is DKA at diagnosis?

• Present in 15-67% of new onset diabetics
  
Who is at risk for DKA at onset?

• Children younger than 4 y/o
• No first degree relative with T1DM
• Lower socioeconomic status
Who is at risk for DKA?

• In known diabetics the risk for DKA is 1-10% per patient per year
  • Risk is increased for the following:
    • Poor diabetic control
    • Adolescent females
    • Psychiatric disorders
    • Difficult social situation
    • Insulin pump therapy
What are factors for poor control?

- Adolescents, (very young)
- Increased duration of diabetes
- Younger maternal age
- Less frequent of self-glucose checks
- Low level of family support
- Poor adherence

  
  
Fluid Bolus

• Recommendations: The volume and rate of administration depend on clinical status of patient
  • Volume of bolus is typically 10 cc/kg over 1-2 hours (E)
  • Max fluid volume 1 L (E)
  • Rare instances may require a second 10 cc/kg bolus (E)
Maintenance fluids

• Previous IV and oral fluids must be calculated into deficit replacement

• Recommendations
  • Rate of IV fluid should be calculated to rehydrate evenly over 48 hours (E)
  • Urinary losses should NOT be replaced (E)
Potassium Recommendations

• Potassium replacement is required (A)
• Replacement should be based on serum K+ measurements (E)
• Start K+ with insulin therapy or sooner if pt. is hypokalemic (E)
• If hyperkalemic, document UOP first (E)
• K+ concentration should be 40 meq/L (E)
• No evidence for preference among K+ salts
  • KCl- may lead to hyperchloremia
  • KPhos- no benefit from phosphate replacement
  • KAacetate (C)
Insulin Therapy

• No evidence exists for optimal timing of insulin therapy to begin
  • Is usually started after IVF bolus is completed
    • Less dramatic osmotic shifts
    • Potentially less risk for cerebral edema (C)
What dose of insulin?

• Physiologically, 0.1 u/kg/hour of regular insulin will result in glucose disposal, inhibit lipolysis and ketogenesis
Acid-Base Management

- Fluid and insulin replacement correct acidosis without bicarbonate (A)
- Bicarbonate confers no clinical benefit (B)
- May replace if acidosis is “profound” (A)
  - No specific criteria established
Cerebral Edema

• Overall mortality rate from DKA is 0.15-0.3%
  • Cerebral edema accounts for 57-87% of all deaths in DKA
    • Both case-control studies
Cerebral edema

• Usually presents 4-12 hours into therapy but can be present before treatment has begun (B)
• Symptoms include HA, change in level of consciousness, inappropriate slowing of heart rate, increase in blood pressure (C)
Prevention of DKA- known diabetics

- Comprehensive patient education and 24-hour access to diabetes team via telephone reduce rates of DKA (A)
- No evidence of positive impact of mental health interventions (B)
- Insulin administration by responsible adult results in 10-fold decrease in DKA episodes (B)
Blood ketones vs. urine ketones

• Monitoring ketones may help predict risk for DKA or recurrent DKA.
• Blood ketones measure beta-hydroxybutyrate, urine ketones measure acetoacetate.
• Blood ketones more accurately reflect the current state of ketosis.
Blood ketones vs. urine ketones


- 2 randomized control trials and 2 cohort studies. Bias was low to moderate.

- Blood ketone testing compared with urine testing was associated with reduced frequency of hospitalization (one study), reduced time to recovery from diabetic ketoacidosis (three studies), cost benefits (one study) and greater satisfaction (one study, intervention group only).
DKA Clinical Practice Guideline

• See the CMH DKA CPG on the web: just search “Clinical Practice Guidelines” then click on “diabetic ketoacidosis”.
• It is on the external website.
Type 2 Diabetes Mellitus
Epidemiology

• Incidence
  • 22 cases per 100,000 youth
    • This equals about 3600 new cases a year.

• SEARCH Study for Diabetes in Youth
  • Age
    • 42 per 100,000 youth for ages 10-19 years of age
    • 1 per 100,000 youth for ages 0-9 years of age
    • Mean age is between 12-16 years of age
    • Females > males
Epidemiology

• Prevalence by Race
  • American Indians: 74 per 100,000
  • Black: 105 per 100,000
  • Non-Hispanic whites: 19 per 100,000

• Gestational Diabetes
  • 50% risk of a child developing Type 2 Diabetes if the mother has gestational Diabetes or Type 2 Diabetes during pregnancy.
Etiology

• Multifactorial
  • 74-100% of patients have a 1st degree relative with Type 2 Diabetes Mellitus
    • Only 5% of Type 1 DM patients have a relative with T1DM
  • TCF7L2 gene mutation is associated with impaired insulin secretion and defective insulin processing
    • 1.4 x increased risk of developing T2DM
Pathogenesis

• Insulin resistance with non-immune mediated deficiency in insulin secretion
  • The body does not respond well to the insulin and in turn makes more insulin.
  • The insulin receptors downregulate and so there are less receptors present to respond to the insulin.
• There is an increase in inflammatory markers, which leads to decreased insulin production
  • Elevated plasma free fatty acids
Lifestyle

• Pediatric obesity is a major contributor to the development of Type 2 diabetes mellitus.
• It only takes 100 extra calories a day to gain one pound per month.
• Drinking one glass of sugar containing drinks a day will lead to a 16 pound weight gain per year
  • Regular soda
  • Gatorade/G2
  • Sweet tea
  • Kool Aid
  • Flavored milk
Indications to screen

• Overweight or Obese
• With 2 of the following risk factors:
  • FH of T2DM (1st or 2nd degree relatives)
  • Race (American Indian, African American, Hispanic/Latino, or Asian/Pacific Islander)
  • Acanthosis Nigricans
  • HTN
  • SGA
  • Cardiovascular disease
  • Hypervirilization
  • Steatohepatitis
  • PCOS
Differences

**Type 1 Diabetes**
- White race more common
- No family history of type 1 diabetes
- Associated autoimmunity
- No acanthosis nigricans
- Acute symptom onset
- Ketosis
- Diabetes-associated antibodies present

**Type 2 Diabetes**
- Non-white race more common
- First degree relative with type 2 diabetes
- No associated autoimmunity
- Acanthosis nigricans present
- Insidious onset
- No ketosis
- Diabetes-associated antibodies absent
Today trial and type 2 management

- 10-17 years of age with T2DM <2 years
- BMI 85% or greater
- Fasting C-peptide of 0.6 ng/mL
- Exclusion criteria
  - Renal insufficiency
  - Uncontrolled HTN
  - Liver disease
  - Uncontrolled Hyperlipidemia
Today trial and type 2 management

• Three treatment arms
  • Metformin monotherapy (51.7%)
  • Metformin and intensive lifestyle modifications (46.6%)
  • Metformin and Rosiglitazone (38.6%)

• Primary outcome = length of time to glycemic failure defined as an A1c of 8.0% or greater for at least 6 months or an inability to wean off injections.

• 45.6% reached glycemic failure in 3.86 years
Failure rates in sex and race

• Sex
  • Metformin and Rosiglitazone proved to be the most effective in girls (only 35% failure)
  • No differences noted among the different arms and boys

• Race
  • Non-Hispanic Blacks has the highest failure rate at 52.8% - Metformin monotherapy was the least effective in this group
  • Hispanics 45%
  • Non-Hispanic Whites 36.6%
Durable control

• A1c greater than 6.3% or more at the time of initiation of Metformin therapy was shown to be a predictor of eventual loss of glycemic control
  • For every 0.1% increase, there was a 16% increase in loss of glycemic control, with a median time of loss of control of 11 months
Complication Rate and Type 2 Diabetes Mellitus

- Hypertension
  - 11.6% at baseline
  - 33.8% by the end of the study
- Microalbuminuria
  - 6.3% at baseline
  - 16.6% by the end of the study
- Retinopathy
  - 13.7% - only performed in the last year of study
- Hyperlipidemia
  - 4.5% at baseline on statin therapy
  - 10.7% by the end of the study
Latest Drug approved

- Victoza (Liraglutide) has now been approved for use in Type 2 Diabetes Mellitus in children 10 and up
- It is a GLP-1 (Glucagon-like peptide 1) that decreased blood glucose by enhancing secretion of insulin
- Studied patients from 10-17 years of age. Assigned to either placebo or to receive SQ Liraglutide for 26 weeks followed by 26 weeks open label
- 134 patients received at least 1 dose of Liraglutide.
- A1c dropped by 0.64% on those receiving Liraglutide versus 0.42% on placebo
- Increased GI side effects in Liraglutide group
Continuous Glucose Monitoring (CGM)
How Sensors Work

• Contains 3 parts:
  • **Sensor**-thin filament underneath the skin
  • **Transmitter**-battery device that transmits data
  • **Receiver**-device that displays data

• Continuously measures glucose in fluid between the cells
• 7-14 day wear (depending on brand)
Fingersticks vs CGM data

- Missed highs
- Missed lows
- Target Zone

Glucose Value vs Time

- Finger stick
- CGM
Cgm gives more data

• A finger stick number can’t tell you which way the BG is headed and how fast it’s getting there.

• CGM can observe effects of exercise, food choices, etc. on blood glucose.

If you saw this number, what would you do?

If you saw this instead, would you do something differently?
Dexcom G6

- Stand-alone CGM
- Able to dose using CGM data
- No finger sticks required
- 10-day wear
- Has alarms for highs and lows
- Data sent directly from transmitter to apple, android device, or receiver
  - If sent to smart device, data can be followed from up to 5 iPhones or Android phones
  - Check for Android compatibility
- FDA approved 2 y/o and older
Freestyle Libre

- Stand-alone CGM
- Must swipe in order to view data
- Able to dose using CGM data
- No finger sticks required
- Can scan with receiver or iPhone app
  - iPhone 7 or newer
  - Check for Android compatibility
- 14-day wear
- No alarms for highs or lows
- Libre 1.0 approved for 18 and up.
- Libre 2.0 recently approved by FDA for 4 and older.
Medtronic Guardian Connect

• Stand-alone CGM
• Fingerstick (calibration) required every 12 hours
• 7-day wear
• Data sent directly from transmitter to apple device (patient must have apple device)
  • If sent to smart device, data can be followed from up to 5 iPhones or Android phones
  • Check for Android compatibility
• Does have alarms for highs and lows
• FDA approved for 14 y/o and older
Pumps
The First Pumps: 1978
NO Long Acting Insulin While on a Pump

YOU MUST REMAIN ATTACHED TO INSULIN PUMP AT ALL TIMES (EVEN WHILE SLEEPING)

Possible exceptions:
1. Showering or bathing
2. Swimming
3. Sports
How the Insulin Pump Works: Basal Insulin

• Basal Rate: constant flow background insulin

• Replaces your long acting insulin

• An insulin pump continuously gives rapid acting insulin in small doses.
  • Example: If on shots you take 24 units of Lantus, you would receive 1 unit of fast-acting insulin per hour on an insulin pump.
  • The basal rate can be adjusted to deliver different rates of flow throughout the day or night.
How the Insulin Pump Works: Bolus Insulin

- **Bolus** - dose given with meals, snacks, or glucose correction
  - Will calculate precise dose needed by entering BG and or grams of carbohydrate
  - Insulin delivered accurately with no extra injections
  - No fear of stacking insulin
Profile of Individual on Multiple Daily Injections

- **Breakfast**
- **Lunch**
- **Dinner**

**Plasma Insulin**

- **Short Acting Insulin**
- **Long Acting Insulin**

**Time**

- 4 am
- 6 am
- 8 am
- Noon
- 6 pm
- 9 pm
- Midnight

**Children’s Mercy**
Profile of Individual on Insulin Pump Therapy

Only short acting insulins are used in the pump.
You fill the pump’s “reservoir” with enough insulin to last you 2-3 days
- Tandem minimum: 110 units
- Medtronic: no minimum

Insulin travels into your body through a flexible tube that ends with a tiny cannula that is inserted under the skin and changed every 2-3 days at home.

An infusion set is held in place with a little adhesive patch stuck to your skin.
Infusion Set Options:
Plastic Cannula or Steel Cannula

Disconnected at site
- Inserted with needle and then needle removed; plastic cannula stays under skin

Disconnected at secondary sticker
- Inserted with needle and needle stays under skin

Steel cannula
Medtronic MiniMed
630G or 670G
Mini-med 630G

- Can be integrated with Guardian Link transmitter
  - Does not replace finger sticks, but limits them (minimum 2 BG’s per day)
    - Suspends insulin when low predicted and restarts once BG is rising
- Capability to dose from meter (without Bolus Calculator)
- Waterproof
- Powered by an AA battery
- Minimum insulin fill: no minimum
- Holds up to 300 units insulin
- FDA approved for 8 y/o and older
Minimed 670G

- Can be integrated with the Medtronic Guardian sensor
  - Does not replace finger sticks, but limits them (minimum 2 BG's per day)
  - Auto mode adjusts basal every 5 minutes
  - A temporary Exercise target of 150 mg/dl can be set
  - Must be 7 years old and use at least 8 units per day

- Several modes:

  - Pump only
  - Pump + CGM
  - Auto Mode

** Pump FDA approval for 7 y/o
Profile of Individual on Hybrid Closed Loop System

- Basal is automatically adjusted
  - Must check BG 2-4 times per day and dose for carbohydrates

Plasma insulin

Breakfast, Lunch, Dinner

Bolus

Auto Basal Delivery

Time

4:00  8:00  12:00  16:00  20:00  24:00  4:00  8:00
Tandem t:slim X2
Tandem t:slim X2

- Touch screen display
- Can integrate Dexcom G6 CGM
  - Able to dose using CGM data with no calibrations
  - Basal IQ or Control IQ
- Able to plug in to computer and upgrade to newest pump software when available
- Powered by plugging into a USB
- Minimum fill is 110 units
- Holds up to 300 units

*FDA approved for 6 y/o and older
Tslim X2 Control IQ

• Use with Dexcom G6 sensor
  — No calibrations (BG) needed- 2 hour warm up period when Dexcom G6 is first placed
  — Adjusts basals every 5 minutes as needed
  — Giving a correction bolus as needed – 1 correction bolus per hour as needed
  — Must be 6 years old and have a total daily dose of 10 units or weigh greater than 55 pounds

**FDA approval for 6 y/o and older**
Control IQ settings
If Sleep or Exercise Activities has not been enabled

- **180 mg/dL**
  - **Delivers**: An automatic correction if BG is predicted to be greater than 180 mg/dL
  - It can give up to 1 correction bolus per hour as needed

- **160 mg/dL**
  - **Increases**: Basal insulin if BG is predicted to be greater than 160 mg/dL
  - It can adjust basals every 5 minutes as needed

- **112.5 mg/dL**
  - **Maintains**: Current basal settings

- **70 mg/dL**
  - **Decreases**: Basal insulin if BG is predicted to be less than 112.5 mg/dL
  - **Stops**: Basal insulin if BG is predicted to be less than 70 mg/dL
Control IQ Algorithm features

• Sleep Activity:
  • Up to 2 profiles can be set up for different times
  • Set to a blood glucose goal of 110-120 mg/dL

• Exercise Activity:
  • Set a narrower and higher range bg goal of 150 mg/dL to reduce the likelihood of natural blood glucose drop during and following exercise
Insulet
Omnipod and Omnipod Dash
Omnipod

- No tubing
- Must have Personal Diabetes Manager (PDM) to give bolus
- Needle is never seen with insertion
- Pod is waterproof, PDM is not
- Powered by an AA battery
- Minimum insulin fill: 85 units
- Holds up to 200 units insulin
Omnipod Dash

• No tubing
• Touch screen display
  – Bluetooth pod: data can be sent to cloud without uploading
  – Calorie king in bolus calculator
• Secondary iPhone Apps
  – “Display” lets user see their data
    • Includes “find my PDM” feature
  – “View” lets caregivers view data
• Must have PDM to give bolus
• Powered by plugging into a USB
• Minimum insulin fill: 85 units
• Holds up to 200 units insulin

**Special release - Not available for all areas**
You fill the pod’s reservoir
- Minimum 85 units/3 days

Insulin travels through a tiny cannula inside the pod. Change every 3 days at home.

Pod held in place by an adhesive patch stuck to skin
Pump apps

- Each pump company has an app that simulates each pump.
- Omnipod
- T:Simulator
- MiniMed670G (also has 630G in the app as well)
Special Instructions for hybrid closed loops

• For Patients on Hybrid Closed Loop Systems (Medtronic 670G in AutoMode & Tandem X2 in Control IQ):

• These pumps automatically adjust the basal rates (background insulin) based off Continuous Glucose Monitor readings. They can predict both high and low blood glucoses and subsequently stop/lower/increase insulin being delivered to maintain BG in target. If the blood glucose is < 70 mg/dL, treat hypoglycemia per usual (as discussed below).

• If ketone dosing is required, follow these steps:
  • Treat ketones per the ketone section in this document, including pump infusion site change
  • Disable Hybrid Closed Loop System
    • Medtronic 670G in AutoMode: Options > SmartGuard > AutoMode > AutoMode (again to turn off) > Save
    • Tandem X2 in Control IQ: Options > My Pump > Control IQ > Slide Toggle to Off > Check Mark to Confirm

• For patients prone to hypoglycemia with activity and exercise, follow these instructions
  • Medtronic 670G in AutoMode: Main Menu > Temp Target > Set Duration. Will automatically disable at end of specified time
  • Tandem X2 in Control IQ: Options > My Pump > Exercise START. Disable following the same steps.
Case Scenarios
Scenario #1

9 year old male with hyperglycemia on shots.
Scenario #1

- Correct hyperglycemia (above 140 mg/dL) per the directions below
  - If BG is > 240 mg/dL check ketones, and follow appropriate ketone instruction below
  - If BG is < 240 mg/dL and patient is on an insulin pump, enter blood glucose into pump and administer correction dose
  - If BG is < 240 mg/dL and patient is on injections, corrections may be given using the ordered regimen below no more than approximately every 3 hours
    - Use Insulin Sensitivity Factor
  - ISF: 75
  - Instructions on ISF use: Take child’s current blood glucose and subtract 120. Take the remainder and divide it by the ISF. The result is the number of units of fast-acting insulin that should be given
    - Use age appropriate table below to give corrections with meals (no more than every 3 hours)

<table>
<thead>
<tr>
<th>&lt;5 years old</th>
<th>Insulin (units)</th>
<th>5-10 years old</th>
<th>Insulin (units)</th>
<th>11 years and older</th>
<th>Insulin (units)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood glucose (mg/dL)</td>
<td>1</td>
<td>Blood glucose (mg/dL)</td>
<td>2</td>
<td>Blood glucose (mg/dL)</td>
<td>3</td>
</tr>
<tr>
<td>300-449</td>
<td>1</td>
<td>225-299</td>
<td>1</td>
<td>200-249</td>
<td>1</td>
</tr>
<tr>
<td>450+</td>
<td>2</td>
<td>300-374</td>
<td>2</td>
<td>250-299</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>375-449</td>
<td>3</td>
<td>300-349</td>
<td>3</td>
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<td></td>
<td>450+</td>
<td>4</td>
<td>350-399</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>400-449</td>
<td>5</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>450-499</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>500+</td>
<td>7</td>
</tr>
</tbody>
</table>
Scenario #1

- Blood glucose is 300.
- ISF is 75
- Ketones are negative

Calculation = \[ \text{[Blood glucose} - \text{Target}] / \text{ISF} \]

- 300-120/75 = 2.4

Use the rules for rounding and give 2 units via injection
Scenario 1b

- Patient is newly diagnosed, so the school orders say to use the chart.

- So patient would receive 2 unit.

- Patient is getting less because he is newly diagnosed and in the honeymoon period.

<table>
<thead>
<tr>
<th>Blood glucose (mg/dL)</th>
<th>Insulin (units)</th>
<th>Blood glucose (mg/dL)</th>
<th>Insulin (units)</th>
<th>Blood glucose (mg/dL)</th>
<th>Insulin (units)</th>
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<tr>
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<td>300-374</td>
<td>2</td>
<td>250-299</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>375-449</td>
<td>3</td>
<td>300-349</td>
<td>3</td>
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<td>450-499</td>
<td>6</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>500+</td>
<td>7</td>
</tr>
</tbody>
</table>
Scenario 1c

• Pt is on a pump.
• Enter blood glucose into the pump, and it will determine the correction.
Ketone Management

• If moderate-large ketones:
  • Drink 6-8 ounces water every hour that glucose is elevated and ketones positive
  • Additional rapid acting insulin is required by injection (pump MAY NOT be used for ketone doses)
  • Use Total Daily Dose (TDD) of insulin as discussed above. This dose SHOULD NOT be combined with any other correction dosing for hyperglycemia. It may, however, be combined with carbohydrate dosing if the student is eating.
  • For moderate ketones give 10% of the TDD of insulin (units)
  • For large ketones give 20% of the TDD of insulin (units)
  • For students on insulin pumps
    • The student (or parent/guardian) should also change the pump site. If a new pump site is not immediately available, injections should then be given for carb and correction dosing (using settings from the insulin pump)
    • Blood glucose and ketones should be rechecked in 2 hours. If BG remains elevated and ketones are still moderate or large, follow the instructions above for subsequent insulin doses (every 2 hours)
  • Gym Class: Students with moderate-large ketones should not exercise until ketones are cleared
Scenario 2

- 12 year old female with a blood glucose of 300 and moderate ketones on MDI. She has not eaten recently or had any recent corrections.
If moderate-large ketones:

- Drink 6-8 ounces water every hour that glucose is elevated and ketones positive
- Additional rapid acting insulin is required by injection (pump MAY NOT be used for ketone doses)
- Use Total Daily Dose (TDD) of insulin as discussed above. **This dose SHOULD NOT be combined with any other correction dosing for hyperglycemia. It may, however, be combined with carbohydrate dosing if the student is eating.**
  - For **moderate** ketones give 10% of the TDD of insulin (6 units)
  - For **large** ketones give 20% of the TDD of insulin (12 units)
- For students on insulin pumps
  - The student (or parent/guardian) should also change the pump site. If a new pump site is not immediately available, injections should then be given for carb and correction dosing (using settings from the insulin pump)
- Blood glucose and ketones should be rechecked in 2 hours. If BG remains elevated and ketones are still moderate or large, follow the instructions above for subsequent insulin doses (every 2 hours)
- Gym Class: Students with moderate-large ketones should not exercise until ketones are cleared
Scenario 2

• Give patient 6 units via injection ONLY.
• Recheck blood glucose and ketones in two hours.
Scenario 2b

- Pt is on a pump with Control IQ and has a blood glucose of 300 and moderate ketones
For Patients on Hybrid Closed Loop Systems (Medtronic 670G in AutoMode & Tandem X2 in Control IQ):

• If ketone dosing is required, follow these steps:
  • Treat ketones per the ketone section in this document, including pump infusion site change
  • Disable Hybrid Closed Loop System
    • Medtronic 670G in AutoMode: Options > SmartGuard > AutoMode > AutoMode (again to turn off) > Save
    • Tandem X2 in Control IQ: Options > My Pump > Control IQ > Slide Toggle to Off > Check Mark to Confirm
Scenario 2 b

• Change out the pump site.
• Turn off Control IQ. Will turn back on once ketones resolve.
• Give 6 units via injection.
• Recheck blood glucose and ketones in 2 hours.
• Encourage fluids to clear the ketones.
Scenario 2 c

• Pt has recently eaten and dosed and has a blood glucose of 300 and moderate ketones.
• Check blood glucose and ketones two hours after last dose of insulin given.
• Encourage sugar free fluids.
• If patient is on a pump, change out pump site at that time.
Scenario 3

- 5 year old male with blood glucose of 60 and able to talk.
Hypoglycemia Treatment (Blood Glucose less than 70 mg/dL):

• Treat with 15 grams of quick-acting carbohydrate such as ½ cup juice or 4 glucose tabs without dosing with insulin
• Blood glucose should be rechecked in 15 minutes
• If the child’s next meal or snack is more than 30 minutes away, follow this treatment with 10-15 grams of complex carbohydrate such as crackers and peanut butter without dosing insulin
• Student should return to class as soon as blood glucose has returned to normal and symptoms lessen
• If child is unable to swallow, 1-ounce cake gel may be used
• If child is unconscious or having a seizure due to low glucose, administer glucagon, call 911, and notify family
• Glucagon is available in multiple formulations, please follow the instruction based on the preparation carried by student
• Intramuscular: 1mg IM for children over 5 years of age and 0.5 mg for children under 5 years of age
• Intranasal: 3 mg intranasal for patients > 4 years
Diabetes and COVID-19

• Patients with diabetes are not considered at higher risk to catch COVID-19.
• Patients with diabetes at higher risk for complications if they contract COVID-19. This is based on adult literature.
• We have been mailing A1c kits to patient’s homes.
• We have been offering Telehealth visits.
References

