

# PEDIATRIC TRACK

## MANAGING EXTREMES DURING SCHOOL SPORTS AND TESTING



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EMPOWERING PATIENTS  
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# DISCLOSURES

- Board of Directors and Director of Research: Diabetes Training Camp
- Advisory Board: Provention Bio, Sanofi
- Research Funding: NIDDK, JDRF, Provention Bio, Novartis
- Consultant: Provention Bio



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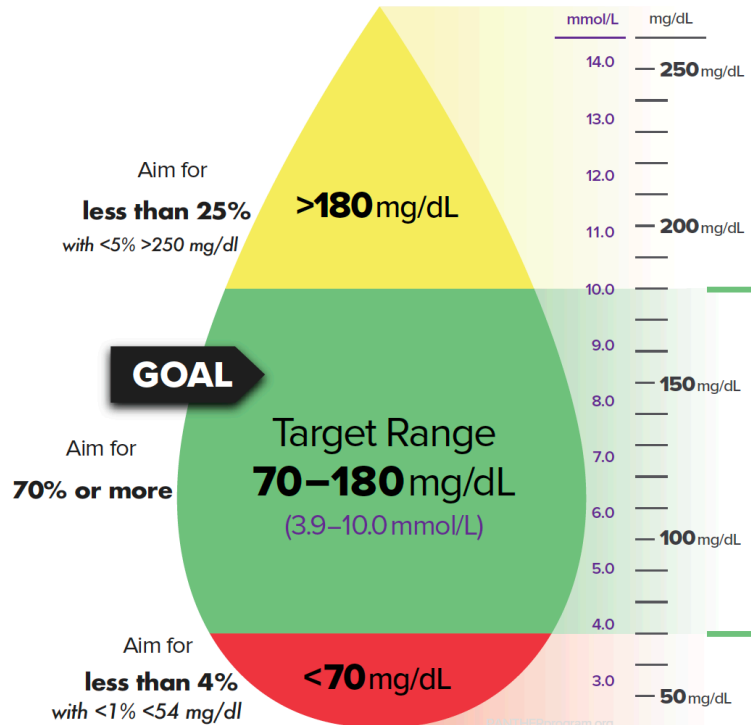
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**WHAT ARE THE  
“EXTREMES”?**

# DURING SPORTS PRACTICE OR TRAINING

*Blood glucose targets for health and performance should be individualized.*



ISPAD 2022, ADA 2023:  
**126-180 mg/dl (7-10 mmol/L)**

ISPAD 2022:  
Risk of low BG medium, then target 145–198 mg/dl  
Risk of low BG high, then target 162–216 mg/dl

figure adapted from PantherProgram.org

Riddell MC, et al., Diabetologia, 2020.



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# DURING SPORTS TOURNAMENT OR COMPETITION

*Blood glucose targets for health and performance should be individualized.*

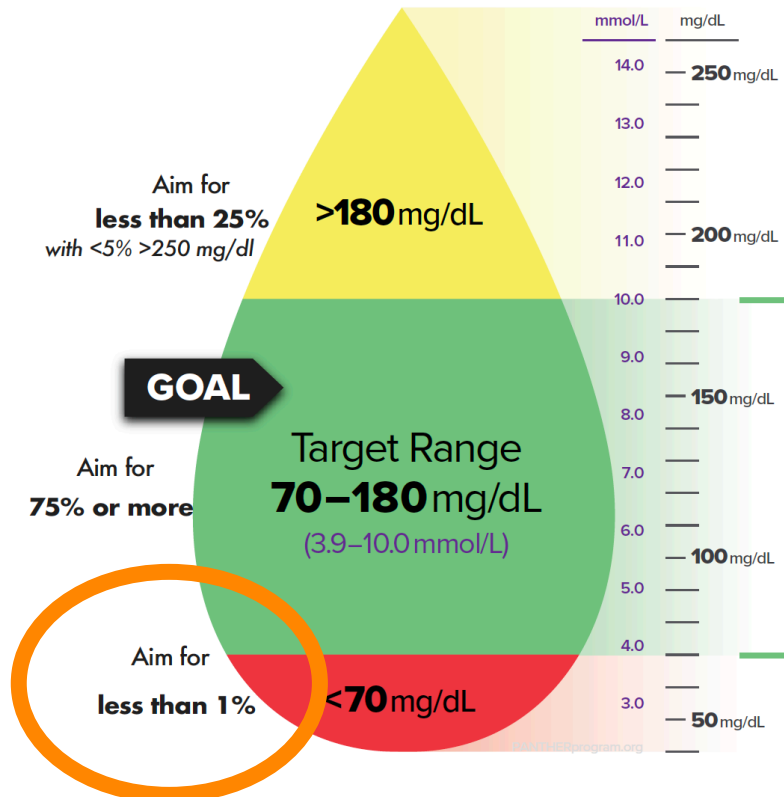


figure adapted from PantherProgram.org

- Sports skill performance 20% lower in youth 6-17 years when BG <65 mg/dl. (Kelly D et al., 2010)
- Athletic performance is consistently negatively impacted by low BG in research studies and in clinical histories.

Riddell MC, et al., Diabetologia, 2020.



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# DURING SPORTS TOURNAMENT OR COMPETITION



**100-168 mg/dl**

- improved reaction time
- Improved response accuracy
- Better vertical gravitational force tolerance

Ferguson DP et al., J Strength Cond Res. 2018



**120-180 mg/dl**

*Blood glucose targets for health and performance should be individualized.*

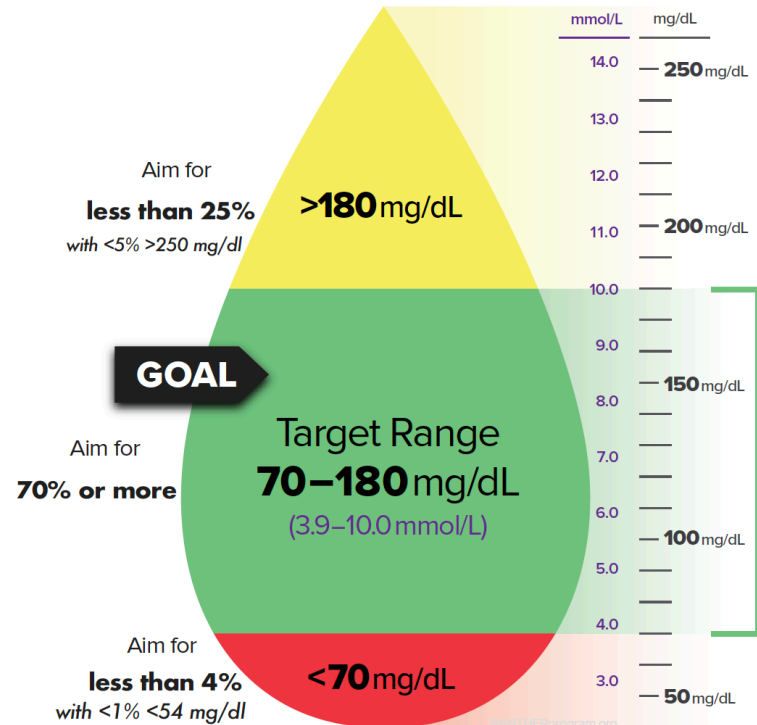


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# DURING TESTING AT SCHOOL



- Cognitive function impacted with both mild (<70 mg/dl) to severe low BG and high BG (>180 mg/dl)
- Time to complete testing increases with low BG (<70 mg/dl).
- Long Term: glycemic extremes are associated with poorer overall cognition and slightly lower performance in memory

figure adapted from PantherProgram.org



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# GOALS FOR MANAGING THE EXTREMES



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# 1. KNOW GLUCOSE TARGET AND KETONE CUT-OFFS

Blood Glucose	Carbohydrate and Glucose Management Strategies
<70 mg/dl	Treat low glucose and wait until >90 mg/dl for activity
70-130 mg/dl	Eat carbohydrates before activity and ensure glucose is rising
130-300 mg/dl	Start activity! Goal is 130-180 mg/dl
>300 mg/dl	Check ketones

- ISPAD 2022: Check ketones if BG >270 mg/dl
- ADA 2023: Intense activity should be postponed with marked high BG (BG >350 mg/dL), moderate to large urine ketones, and/or blood ketones >1.5 mmol/L. Caution may be needed when blood ketone levels are >0.6 mmol/L



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# 1. KNOW THE GLUCOSE AND KETONE CUT-OFFS

**Table 3: Exercise and School Attendance (for children on insulin injections and/or pump):**

**Definition of *Symptomatic* as used below\*: Flu-like symptoms, nausea and/or vomiting, abdominal pain, severe drowsiness, rapid, shallow or deep breathing, confusion.**

<b>IF Child's Symptoms &amp; BG level are...</b>	<b>and Ketone Level is ... then</b>	<b>Exercise</b>	<b>Stay in School</b>
≥300mg/dl first time, no symptoms	Not required <i>unless on pump</i>	Yes	Yes
≥300mg/dl - 2 consecutive times (for 2 hours or more), no symptoms	Negative to small	Yes**	Yes
≥300mg/dl <i>with symptoms*</i>	Negative or any ketones	No	No
≥300mg/dl, with or without symptoms and <i>urine ketones are moderate-large or blood ketones ≥1.0</i>	Urine: Moderate-Large or Blood ketones ≥1.0	No	No
≥300, 2 consecutive times, <i>no symptoms</i>	<i>Unable to check ketones</i>	No	Yes
≥300, with symptoms	<i>Unable to check ketones</i>	No	No

Blood glucose monitoring is critical.

If high BG, you need to be able to check ketones.



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## 2. KNOW YOUR TOOLS



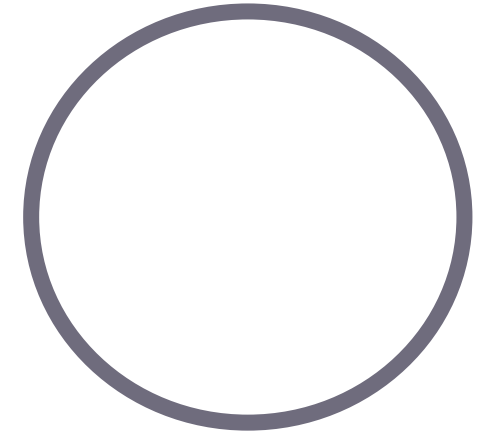
Managing blood glucose during school sports and testing can be complex, **yet** achievable.



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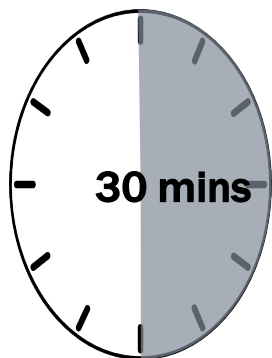


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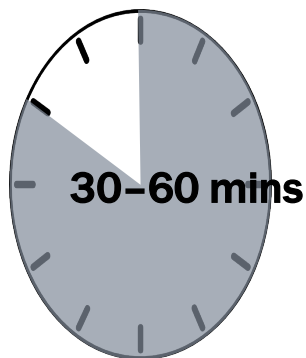
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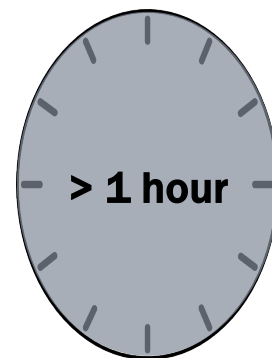
# CARBOHYDRATE INTAKE



- Carbohydrates may not be needed, unless blood glucose is dropping



- Carbohydrates may be needed for very strenuous activity or no insulin adjustment



- Carbohydrates may be needed for fuel (30-60 g/hr)

First goal is to reduce insulin

If high insulin on board (or glucose <130 mg/dl):

1. Consume ~15-30 g of carbohydrates per 30 minutes of exercise (0.5-1 g/kg/hr)
2. Consider carbohydrates with a high glycemic index

Adapted from PEAK Program; Riddell et al., Lancet. 2017



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# FUELING DURING ACTIVITY

## *FLUIDS OR EASILY DIGESTING CARBS*



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### 3. MINIMIZE YOUR INSULIN ON BOARD



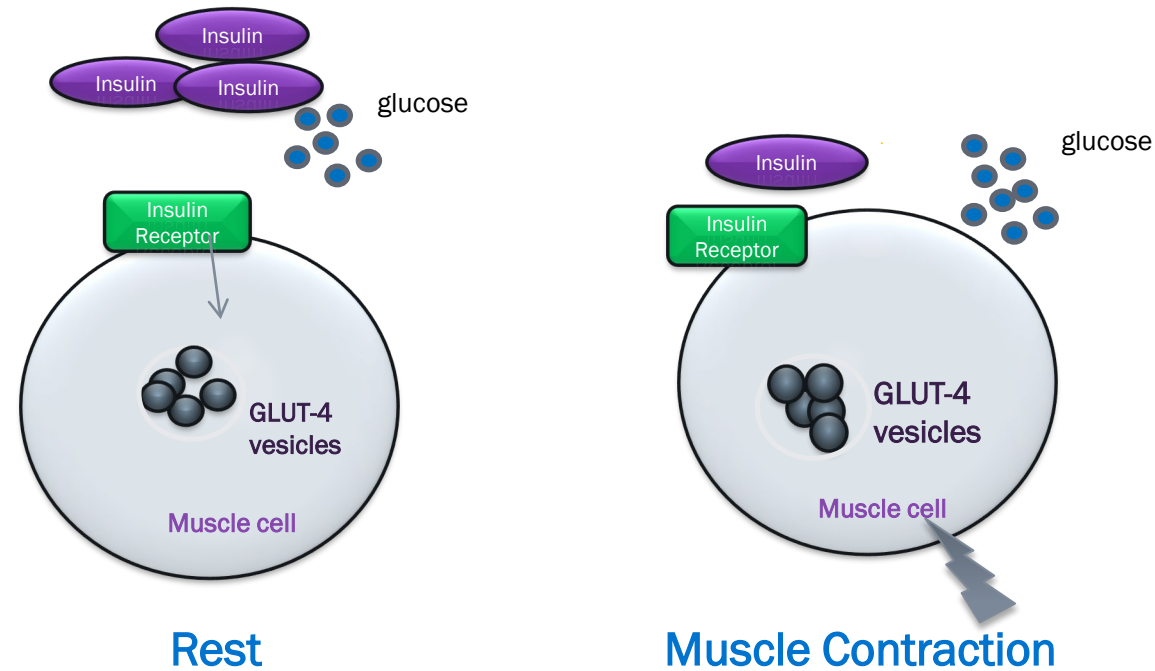
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# MUSCLE CONTRACTION MOVES GLUCOSE FROM BLOOD INTO CELLS FOR ENERGY JUST LIKE INSULIN



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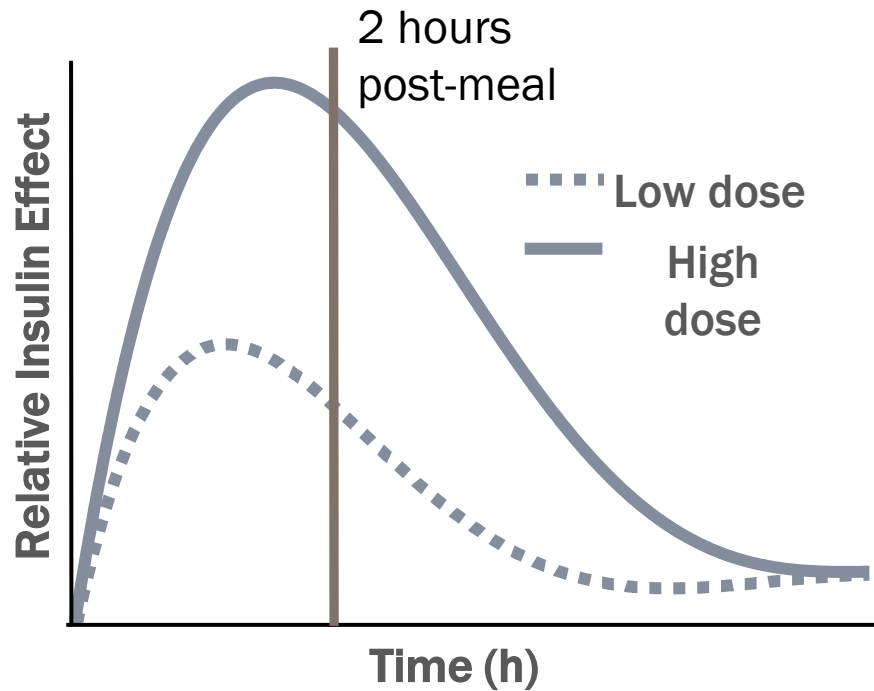


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# INSULIN MANAGEMENT: BOLUSES



Low and high dose of rapid-acting insulin have peaked by 2 hours

	Recommendations
	Consider the amount of insulin on board
Exercise $\leq 120$ mins after bolus insulin dose	<ul style="list-style-type: none"> <li>Reduce pre-exercise insulin dose by 25-75%; consume carbohydrates with low glycemic index at mealtime</li> </ul>
Exercise $> 120$ mins after bolus insulin dose	<ul style="list-style-type: none"> <li>If blood glucose is below target, must consume carbohydrates</li> </ul>

Riddell et al., Lancet. 2017



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# INSULIN MANAGEMENT: BASAL RATES BEFORE ACTIVITY THAT TYPICALLY CAUSES LOW BG

## Patients on MDI

- Basal insulin dose adjustment not routinely recommended
- Consider reducing basal dose by 20% to avoid low BG overnight

## Patients on Insulin Pumps

- Basal insulin dose reduction may be useful for exercise over 30 minutes (10-50%)
- Dose can be reduced up to 90 minutes before exercise

## Patients on Hybrid Closed Loop:

- Change 90-120 min or ASAP before activity
- Control IQ: exercise activity (140-160 mg/dl), manual start and stop
  - OP5: exercise target (150 mg/dl), set duration 1-24 hours
  - 780G: temporary target (150 mg/dl)
  - DIY APS (OpenAPS, AndroidAPS, Loop): temporary target, profile switch, overrides, or activity mode



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# 4. KEEP DEVICES CONNECTED



the original tubular belt

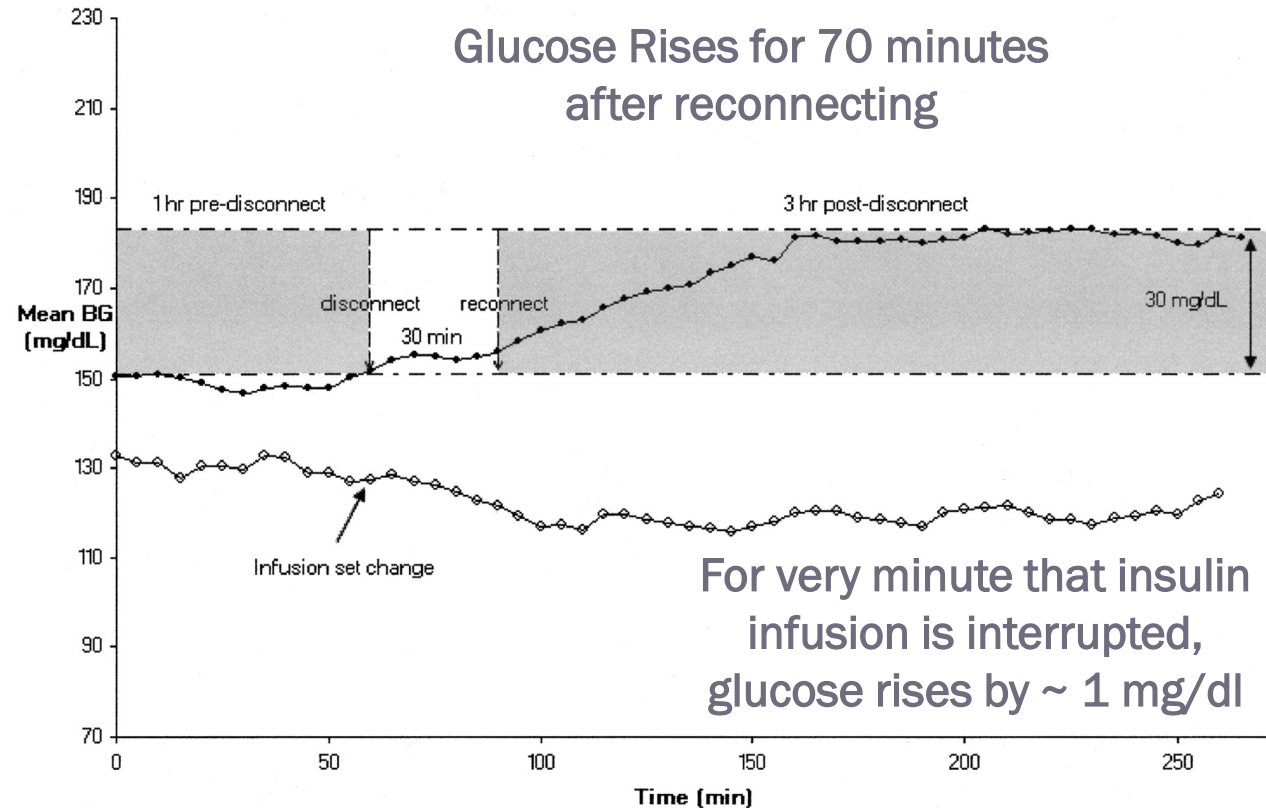


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# PUMP USERS: DISCONNECTING IMPACTS GLUCOSE LEVELS



Zisser H, Diabetes Care. 2008



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## STAY IN THE GAME (OR EXAM)

1. Know your blood glucose and ketone targets.
2. Know your tools: insulin, carbohydrate intake, timing of activity.
3. Minimize insulin on board *to avoid low glucose levels.*
4. Keep devices connected and know how to change settings for activity.



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“  
Chasing perfection with Type 1 diabetes is impossible. There's so much that's out of your hands and finding a way to remain calm and patient in moments where diabetes interrupts your life is the key.

*Nick Jonas*  
*Beyond Type 1*

You've got to be able to stay ahead of the game to be able to stay in it.

~Kate Moss