CHILDREN'S PROJECT ECHO: SCHOOL HEALTH

New trends and challenges in management of type 1 diabetes in school

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Pediatric Endocrinology

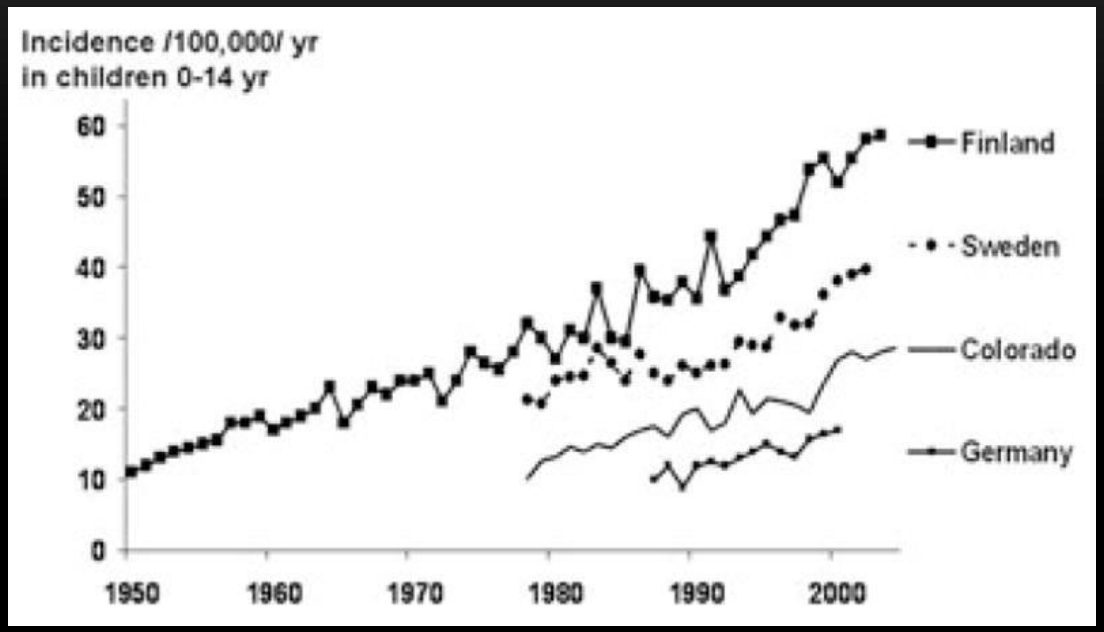
Children's Hospital & Medical Center

1/22/2020
PRESENTER DISCLOSURES

Consultant/ Speakers bureaus	No Disclosures
Research funding	No Disclosures
Stock ownership Corporate boards- employment	No Disclosures
Off-label uses	No Disclosures

OVERVIEW & LEARNING OBJECTIVES

- Understand how continuous glucose sensors work
- Learn how to use trend arrows in adjusting insulin doses



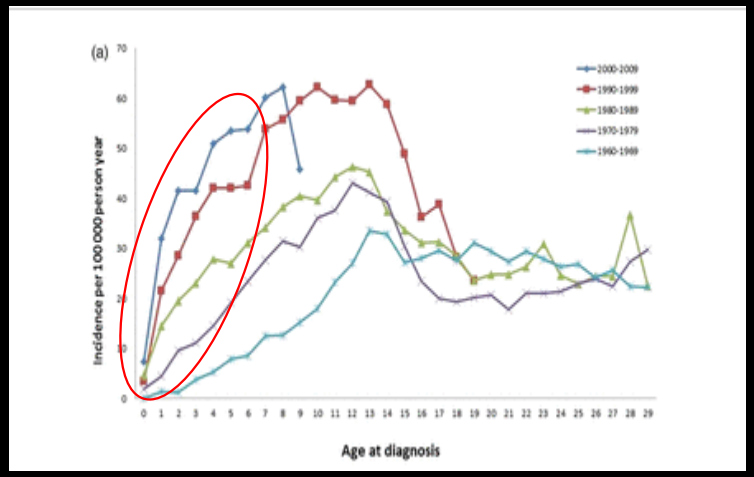
The Environmental Determinants of Diabetes in the Young (TEDDY) Study.

The incidence of T1D is doubling every 20 yrs since 1950

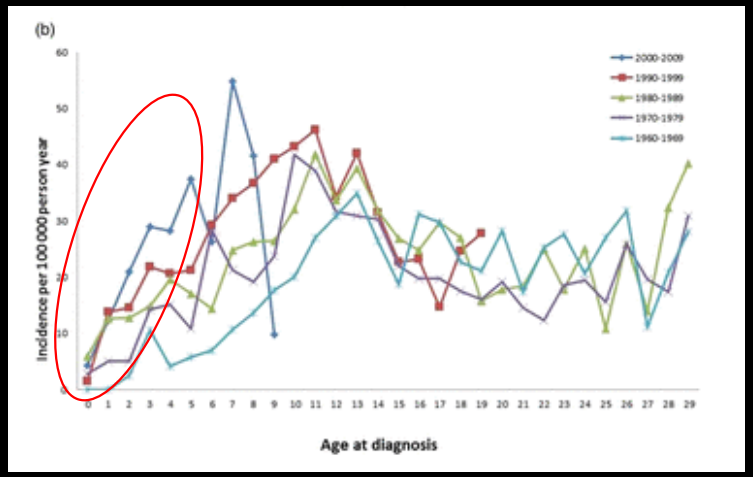
The trends and the risk of type 1 diabetes over the past 40 years: an analysis by birth cohorts and by parental migration background in Sweden.

Hussen HI, Persson M, Moradi T. *BMJ Open*. 2013;3(10):e003418.

(A)



(B)



Incidence of type 1 diabetes by age at diagnosis (0–30 years) and birth cohorts 1960–2009 among offspring of Swedes in Sweden (A) and immigrants in Sweden (B)

There is a shift towards a younger age at diagnosis

Diabetes Technology & Therapeutics, Vol. 21, No. 2 | Original Articles

State of Type 1 Diabetes Management and Outcomes from the T1D Exchange in 2016–2018

Nicole C. Foster, Roy W. Beck, Kellee M. Miller, Mark A. Clements, Michael R. Rickels, Linda A. DiMeglio, David M. Maahs, William V. Tamborlane, Richard Bergenstal, Elizabeth Smith, Beth A. Olson, Satish K. Garg, and for the T1D Exchange Clinic Network

	2010-2012	2016-2018
Insulin pump use	57%	63%
CGM use	7%	30%

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BURDEN OF DIABETES CARE AT SCHOOL:

- New "diabetes technologies"
- Increased demands and expectations
- Increased strain on school resources

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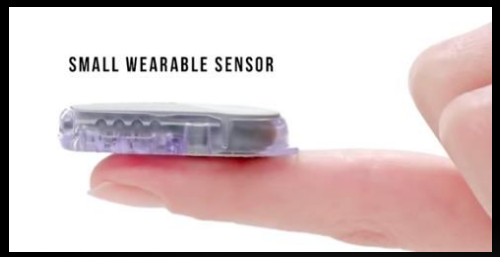
CONTINUOUS GLUCOSE MONITORING SENSOR



CONTINUOUS GLUCOSE MONITORING SENSOR

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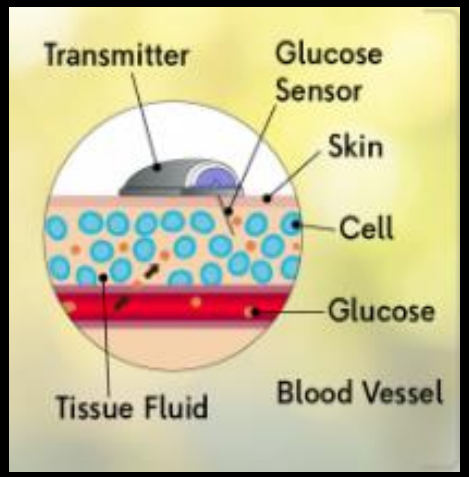
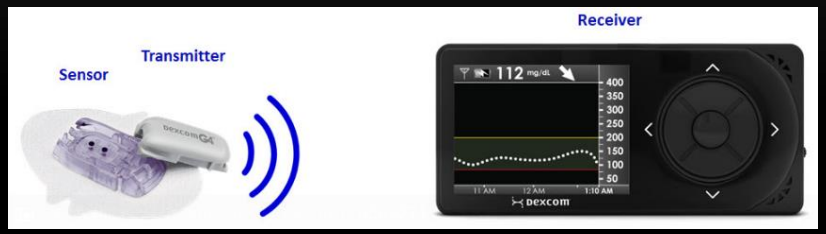
CONTINUOUS GLUCOSE MONITORING SENSOR





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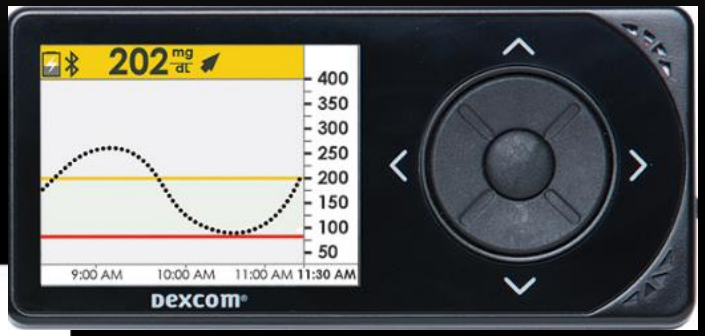
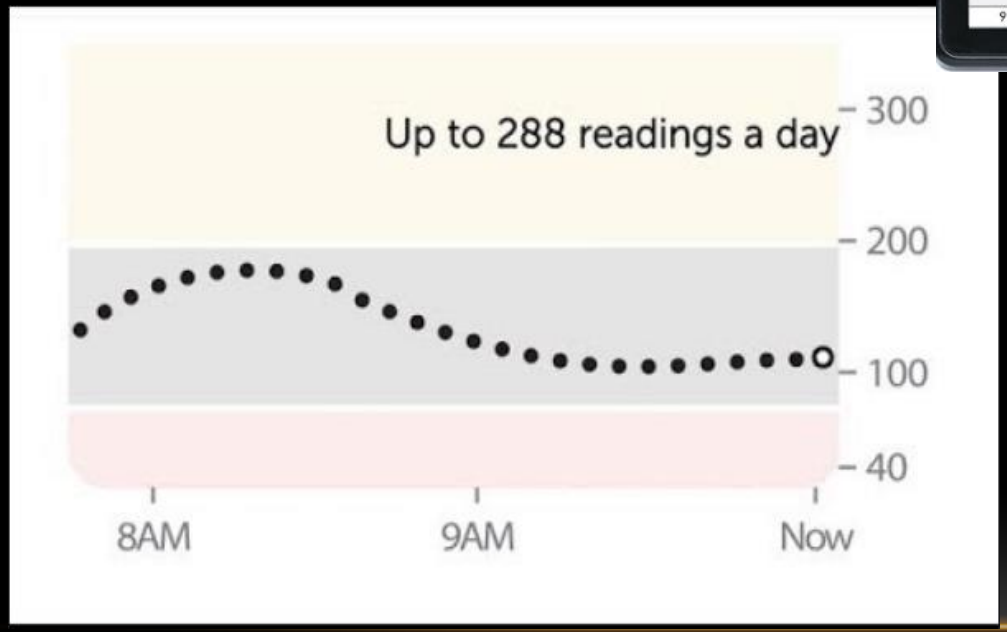
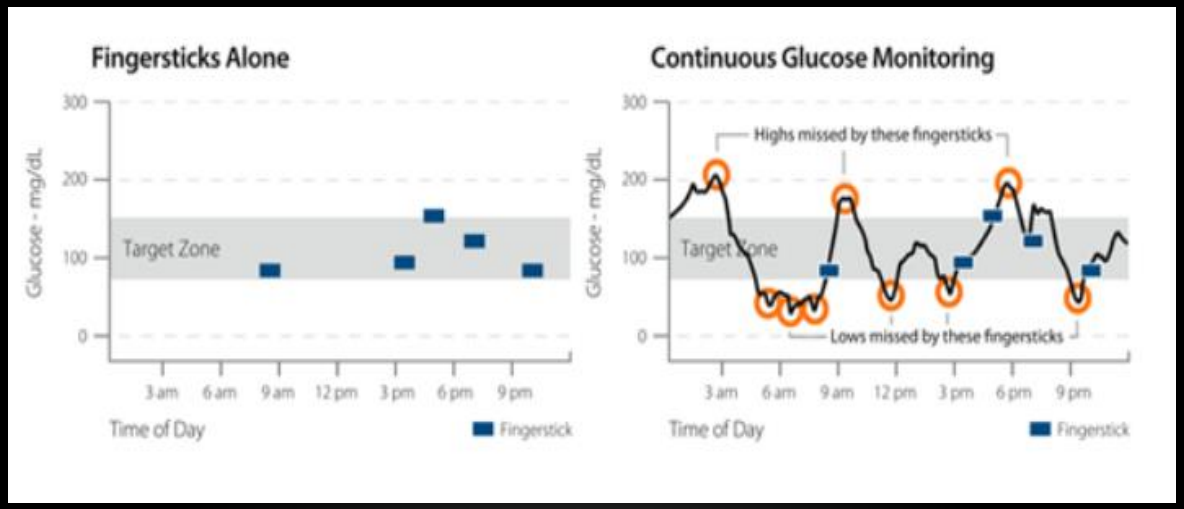




ADVANTAGES OF CGM USE

- **Able to visualize continuous glucose trends throughout the day**

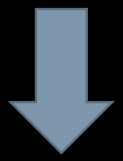


ADVANTAGES OF CGM USE

- **Able to detect rate of change of glucose levels**

ADVANTAGES OF CGM USE

- Able to visualize continuous glucose trends throughout the day
- Able to detect rate of change of glucose levels



Decrease in glucose variability

Decrease risk of hypoglycemia

Convenience

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Not all trend arrows are the same

Dexcom G5/G6*		Guardian Connect		FreeStyle Libre		Eversense	
Arrow	Meaning	Arrow	Meaning	Arrow	Meaning	Arrow	Meaning
⇈	**Glucose rapidly rising** >3 mg/dL/min >0.2 mmol/L/min	⇈	**Glucose rapidly rising** >3 mg/dL/min >0.2 mmol/L/min	—	—	—	—
↑	**Glucose rising** 2–3 mg/dL/min 0.1-0.2 mmol/L/min	↑↑	**Glucose is rising** 2–3 mg/dL/min 0.1-0.2 mmol/L/min	↑	**Glucose rapidly rising** >2 mg/dL/min >0.1 mmol/L/min	↑	**Glucose rapidly rising** >2 mg/dL/min >0.1 mmol/L/min
↗	**Glucose slowly rising** 1–2 mg/dL/min 0.06-0.1 mmol/L/min	↑	**Glucose slowly rising** 1–2 mg/dL/min 0.06-0.1 mmol/L/min	↗	**Glucose rising** 1–2 mg/dL/min 0.06-0.1 mmol/L/min	↗	**Glucose slowly rising** 1–2 mg/dL/min 0.06-0.1 mmol/L/min
→	**Glucose steady** *Increasing/decreasing* <1 mg/dL/min <0.06 mmol/L/min	—	**Glucose steady** Increasing/decreasing <1 mg/dL/min <0.06 mmol/L/min	→	**Glucose steady** *Increasing/decreasing* <1 mg/dL/min <0.06 mmol/L/min	→	**Glucose steady** *Increasing/decreasing* <1 mg/dL/min <0.06 mmol/L/min
↘	**Glucose slowly falling** 1–2 mg/dL/min 0.06-0.1 mmol/L/min	↓	**Glucose slowly falling** 1–2 mg/dL/min 0.06-0.1 mmol/L/min	↘	**Glucose slowly falling** 1–2 mg/dL/min 0.06-0.1 mmol/L/min	↘	**Glucose slowly falling** 1–2 mg/dL/min 0.06-0.1 mmol/L/min
↓	**Glucose falling** 2–3 mg/dL/min 0.1-0.2 mmol/L/min	↓↓	**Glucose is falling** 2–3 mg/dL/min 0.1-0.2 mmol/L/min	↓	**Glucose rapidly falling** >2 mg/dL/min >0.1 mmol/L/min	↓	**Glucose rapidly falling** >2 mg/dL/min >0.1 mmol/L/min
⇊	**Glucose rapidly falling** >3 mg/dL/min >0.2 mmol/L/min	⇊	**Glucose rapidly falling** >3 mg/dL/min >0.2 mmol/L/min	—	—	—	—

Review Article

Recommendations for Using Real-Time Continuous Glucose Monitoring (rtCGM) Data for Insulin Adjustments in Type 1 Diabetes

Journal of Diabetes Science and Technology
2017, Vol. 11(1) 138–147

DOI: 10.1177/1932296816663747
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Jeremy Pettus, MD[1] and Steven V. Edelman, MD[1]

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Adjusted Glucose Value for Dosing	
→ Glucose is not increasing/decreasing >1 mg/dl (0.06 mmol/l) per min	No Adjustment. Dose for current glucose value.
↗ Glucose increasing 1-2 mg/dl (0.06-0.11 mmol/l) per minute	Adjust UP -- current value plus **50 mg/dl** *Actual Range: 30-60 mg/dl*
↑ Glucose increasing 2-3 mg/dl (0.11-0.17 mmol/l) per minute	Adjust UP -- current value plus **75 mg/dl** *Actual Range: 60-90 mg/dl*
↑↑ Glucose increasing >3 mg/dl (0.17 mmol/l) per minute	Adjust UP -- current value plus **100 mg/dl** *Actual Range: 90-150 mg/dl*
↘ Glucose decreasing 1-2 mg/dl (0.06-0.11 mmol/l) per minute	Adjust DOWN -- current value minus **50 mg/dl** *Actual Range: 30-60 mg/dl*
↓ Glucose decreasing 2-3 mg/dl (0.11-0.17 mmol/l) per minute	Adjust DOWN -- current value minus **75 mg/dl** *Actual Range: 60-90 mg/dl*
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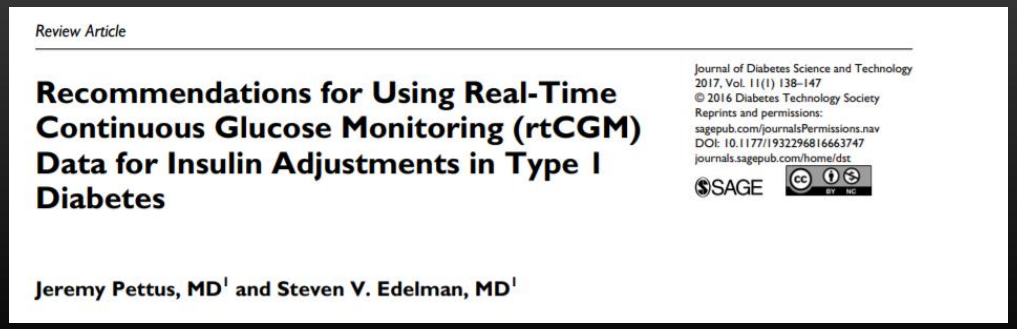
The most conservative response to down arrows is to delay insulin administration until the trend arrow turns horizontal.



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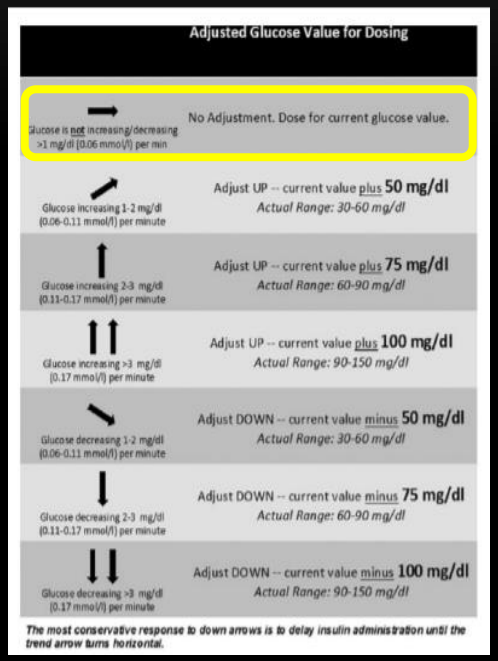

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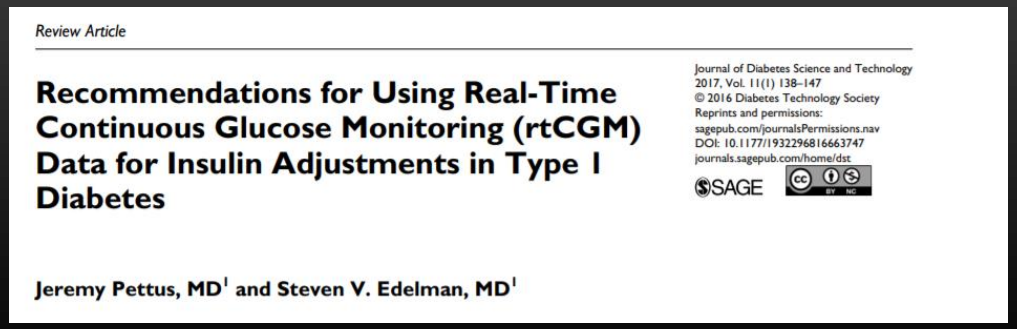
Glucose decreasing >3 mg/dl (0.17 mmol/l) per minute	Adjust DOWN -- current value minus **100 mg/dl** *Actual Range: 90-150 mg/dl*

The most conservative response to down arrows is to delay insulin administration until the trend arrow turns horizontal.

BG target	110 mg/dl
Carb intake	45g
Insulin to carb ratio	1:15g
Correction factor	1:50 mg/dl

Dose = _____

Dose : 3u + 2.2u = 5.2u



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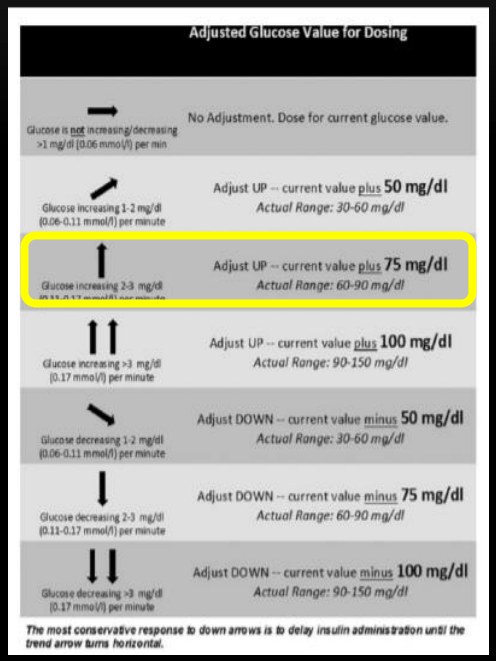
BG target	110 mg/dl
Carb intake	45g
Insulin to carb ratio	1:15g
Correction factor	1:50 mg/dl

Dose = _____

Dose : 3u + 3.7u = 6.7u



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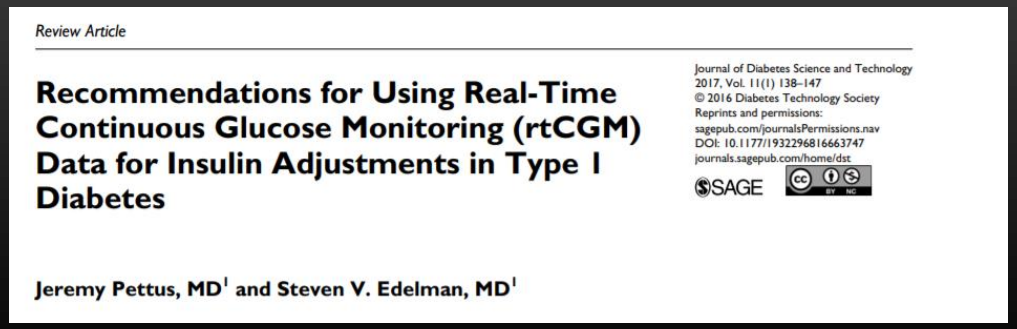
The most conservative response to down arrows is to delay insulin administration until the trend arrow turns horizontal.

Adjusted BG 295 mg/dl
(185 mg/dl over target)



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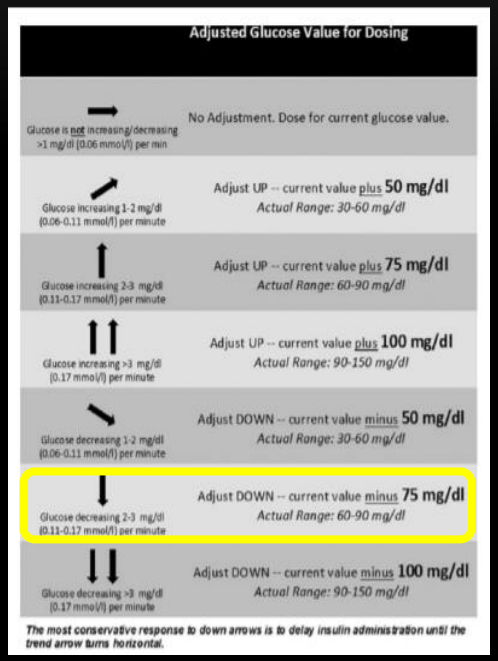

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The most conservative response to down arrows is to delay insulin administration until the trend arrow turns horizontal.

BG target	110 mg/dl
Carb intake	45g
Insulin to carb ratio	1:15g
Correction factor	1:50 mg/dl

Dose = _____

Dose : 3u + 0.7u = 3.7u

Adjusted BG 145 mg/dl
(35 mg/dl over target)

	220 mg/dL	220 mg/dL	220 mg/dL
Pettus/Edelman method	5.2u	6.7u	3.7u

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A Practical Approach to Using Trend Arrows on the Dexcom G5 CGM System to Manage Children and Adolescents With Diabetes

Lori M. Laffel,[1] Grazia Aleppo,[2] Bruce A. Buckingham,[3] Gregory P. Forlenza,[4] Lisa E. Rasbach,[5] Eva Tsalikian,[6] Stuart A. Weinzimer,[7] and Dennis R. Harris[8]

[1]Pediatric, Adolescent and Young Adult Programs, Joslin Diabetes Center, Harvard Medical School, Boston, Massachusetts 02215; [2]Division of Endocrinology, Metabolism and Molecular Medicine, Feinberg School of Medicine, Northwestern University, Chicago, Illinois 60611; [3]Department of Pediatric Endocrinology, Stanford University, Stanford, California 94305; [4]Barbara Davis Center, University of Colorado Denver, Aurora, Colorado 80045; [5]Division of Pediatric Endocrinology, Johns Hopkins Children's Center, Baltimore, Maryland 21287; [6]Division of Endocrinology and Diabetes, Department of Pediatrics, University of Iowa Carver College of Medicine, Iowa City, Iowa 52242; [7]Department of Pediatrics, Yale University School of Medicine, New Haven, Connecticut 06510; and [8]Endocrine Society, Washington, District of Columbia 20036

Suggested Approach to Adjusting Insulin Dose Using Trend Arrows in Pediatric Patients: Pre-meal and ≥3 Hours Post-meal

Trend Arrows		Correction Factor* (CF)	Insulin Dose Adjustment (U)
Receiver	App		
↑↑		<25	+4.0
		25–<50	+3.0
		50–<75	+2.0
		75–<125	+1.0
		≥125	+0.5
↑		<25	+3.0
		25–<50	+2.0
		50–<75	+1.0
		75–<125	+0.5
		≥125	No adjustment
↗		<25	+2.0
		25–<50	+1.0
		50–<75	+0.5
		75–<125	No adjustment
		≥125	No adjustment
→		<25	No adjustment
		25–<50	No adjustment
		50–<75	No adjustment
		75–<125	No adjustment
		≥125	No adjustment
↘		<25	-2.0
		25–<50	-1.0
		50–<75	-0.5
		75–<125	No adjustment
		≥125	No adjustment
↓		<25	-3.0
		25–<50	-2.0
		50–<75	-1.0
		75–<125	-0.5
		≥125	No adjustment
↓↓		<25	-4.0
		25–<50	-3.0
		50–<75	-2.0
		75–<125	-1.0
		≥125	-0.5

Insulin adjustments using trend arrows do not replace standard calculations using ICR and CF. Adjustments are increases or decreases of rapid-acting insulin in addition to calculations using ICR and CF. Adjustments using trend arrows are an additional step to standard care.

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LM Laffel, et al. Journal of the Endocrine Society. Vol 1. Issue 12. 1 December 2017, pages 1461-1476

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		≥125	No adjustment
↗		<25	+2.0
		25–<50	+1.0
		50–<75	+0.5
		75–<125	No adjustment
		≥125	No adjustment
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		25–<50	No adjustment
		50–<75	No adjustment
		75–<125	No adjustment
		≥125	No adjustment
↘		<25	-2.0
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		50–<75	-0.5
		75–<125	No adjustment
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		50–<75	-1.0
		75–<125	-0.5
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		25–<50	-3.0
		50–<75	-2.0
		75–<125	-1.0
		≥125	-0.5

Insulin adjustments using trend arrows do not replace standard calculations using ICR and CF. Adjustments are increases or decreases of rapid-acting insulin in addition to calculations using ICR and CF. Adjustments using trend arrows are an additional step to standard care.

- Uses insulin sensitivity factor
- Uses dose adjustments in “units” rather than as corrective values
- Can be used with MDI or pump therapy

LM Laffel, et al. Journal of the Endocrine Society. Vol 1. Issue 12. 1 December 2017, pages 1461-1476

BG target	110 mg/dl
Carb intake	45g
Insulin to carb ratio	1:15g
Correction factor	1:50 mg/dl

			
Pettus/Edelman method	5.2u	6.7u	3.7u
Endocrine Society approach	5.2u	6.2u	4.2u

Suggested Approach to Adjusting Insulin Dose Using Trend Arrows in Pediatric Patients: Pre-meal and ≥3 Hours Post-meal

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↑		<25	+3.0
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		50–<75	+1.0
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		≥125	No adjustment
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Endocrine Society Approach

1) 9 yr old child is about to eat lunch.
   No planned exercise.

   BG target : 120 mg/dl
   Carb : 50 g

   CF : 80
   ICR : 1:25g

⬆		<25	+3.0
		25–<50	+2.0
		50–<75	+1.0
		75–<125	+0.5
		≥125	No adjustment

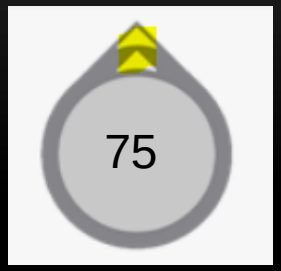
Dose : 2u + 0.5u + 0.5u = 3u

Endocrine Society Approach

2) 14 yr old child is about to eat breakfast.
No planned exercise.

BG target : 100 mg/dl
Carb : 70 g

CF : 25
ICR : 1: 7g



25 mg/dl under target

⬆⬆		<25 25–<50 50–<75 75–<125 ≥125	+4.0 +3.0 +2.0 +1.0 +0.5

Dose : 10u - 1u + 3u = 12u

3) 3 yr old toddler is about to eat lunch.
He is a good eater

BG target : 150 mg/dl
Carb : 40 g

CF : 125
ICR : 1: 20g

125 mg/dl over target

↓↓		<25	-4.0
		25–<50	-3.0
		50–<75	-2.0
		75–<125	-1.0
		≥125	-0.5

Dose : 2u + 1u - 0.5u = 2.5u

4) 7 yr old girl is about to eat lunch.
She has recess after lunch

BG target : 100 mg/dl
Carb : 60 g

CF : 100
ICR : 1: 20g

200 mg/dl over target

↑		<25	+3.0
		25–<50	+2.0
		50–<75	+1.0
		75–<125	+0.5
		≥125	No adjustment

No added insulin due to exercise

Dose : 3u + 2u = 5u

5) 7 yr old girl is about to go to PE

BG target : 100 mg/dl
Carb : - g

CF : 100
ICR : 1: 20g

No added insulin due to exercise

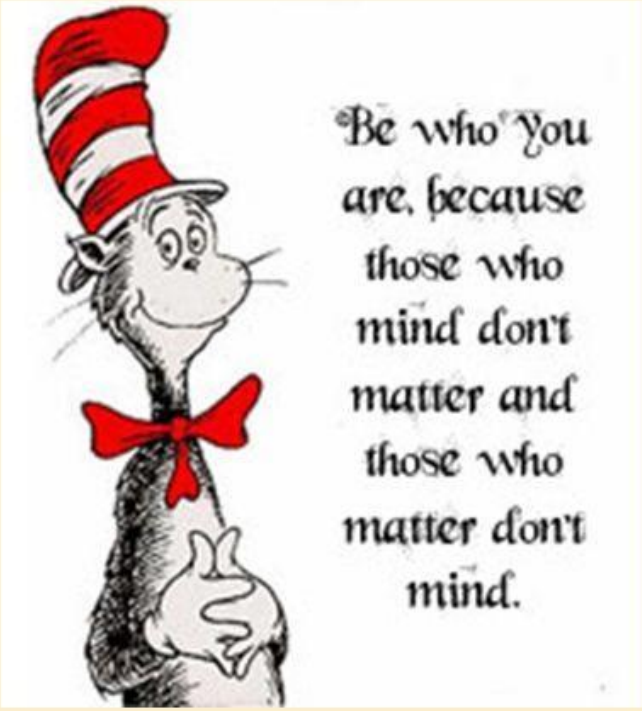
25 mg/dl over target

↓		<25	-3.0
		25–<50	-2.0
		50–<75	-1.0
		75–<125	-0.5
		≥125	No adjustment

Treatment : give her a snack before PE 8g – 30g

Size of snack depends on age, anticipated response to exercise, direction of trend arrows

Thank you for your attention!



Children's Project ECHO: School Health - ECHO ID#SH2019-005

School Nurse or Provider Information
Tori Oehlrich

School/Clinic/Facility Name
Schuyler Elementary School

De-Identified Case Information
SH2019-005

Age
6

Gender
Female

Patient Race
American Indian/Alaska Native

Patient Ethnicity
Hispanic or Latino

Current medications and allergies:
Humalog insulin
Lantus insulin
Allergic to Amoxicillin

What is your concern or goal for this case presentation?
This was my first student with a Continuous Glucose Monitor (Dexcom). At first, I was not sure about how it worked or what to expect. There was a language barrier with the family as well. I had to get an iPad from the school to connect to the CGM and I was concerned with that liability (how often I had to check it, did I have to carry it with me wherever I went, etc). This was a kindergarten student who was diagnosed less a year before, so there was an educational need for the family as well as for myself. We do not have a diabetes education specialist in our community and we live over an hour away from her endocrinologist.

History
History of presenting problem:
She was diagnosed after the beginning of her preschool year. Her blood sugars were very inconsistent, so she was given a CGM. Parents were very nice and easy to work with, but had high expectations and were nervous about her going to school full days. I was unable to get in contact with a diabetes educator who would be able to come out to our school and complete some education with both me and the parents.

Student-School Information
Current school grade
Kindergarten

School Performance
Good

Is the student on any of the following individual plans?
504

Family History
Primary caregiver
Biological mother

With whom does the patient live?
Parents and 3 siblings

Previous Trauma
Unknown

Is there anything else the HUB team should know to provide feedback and considerations?
This case has many issues.
1. This was a kindergarten student, new to our school system, as student was at Head Start last year for preschool.
2. Student was fairly newly diagnosed (under a year).
3. There was a language barrier with the family.
4. Nurse had not had any formal training for continuous glucose monitors.
5. Difficult for nurse to receive support and education as the child's doctor is over an hour away from the school.
6. Needing to use iPad at school - no knowing the liability of when to check, chart, etc.