Pediatric Diabetes: Diagnosis & Management Approaches

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Disclosures

No relevant disclosures

Learning objections

1. Be able to recognize presenting symptoms and diagnose diabetes in youth.
2. Appreciate that obese/overweight pediatric patients with dysglycemia warrant close follow-up and further pediatric endocrine evaluation/consultation.
3. Understand the role and indications for use of insulin in the management of type 2 diabetes (T2D) in youth.
4. Understand the role of intensive diabetes management in type 1 diabetes (T1D)
5. Approach management of diabetes in youth as chronic complex condition

Outline

1. Case presentation
2. Presentation & Diagnosis
3. Management
   - Psychosocial aspects
   - ADA Standards of Care and Glycemic Targets
   - AAP Key Policy Statements
   - Glycemic control & monitoring: BG Monitoring & CGM
   - Insulin: management
   - Caveats of T2D

Disclaimer: lots of information- some additional slides for reference

For more information

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

Organizational Principles to Guide and Define the Child Health Care System and/or Improve the Health of all Children

CLINICAL PRACTICE GUIDELINE

Management of Newly Diagnosed Type 2 Diabetes Mellitus (T2DM) in Children and Adolescents

Diabetes Care

Type 1 Diabetes Through the Life Span: A Position Statement of the American Diabetes Association

Jane L. Chiang,[1] M. Sue Kirkman,[2] Lori M.B. Laffel,[3] and Anne L. Peters,[4] on behalf of the Type 1 Diabetes Sourcebook *Authors**

DOI: 10.2337/dc14-1140

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Case Presentation

- 17 year 3 month old male admitted for management of uncontrolled diabetes and hyperglycemia.
- Initial labs/presentation: No distress. Glucose 213, pH 7.38, bicarb 16, trace ketones, HBa1c 14.2%
- Admission was his first pediatric endocrine evaluation after he was presumptively diagnosed with T2D at around the age of 13 years and started on Metformin by his PCP. HbA1c around that time was pre-diabetes range (~5.6 to 5.8%) and he was obese (BMI unknown).
- Over the past 1.5 years he has experienced ~90lb weight loss and HbA1c has increased to 14.2%. Current BMI now 21.1 (25-50th%).
- He has missed ~40 days of school because of fatigue and low energy level from his uncontrolled diabetes. Consequentially he failed some classes and had to repeat classes

DIABETES IN **YOUTH**

NOT JUST 1 TYPE

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DIABETES IN **OBESE** YOUTH

NOT JUST 2 TYPE

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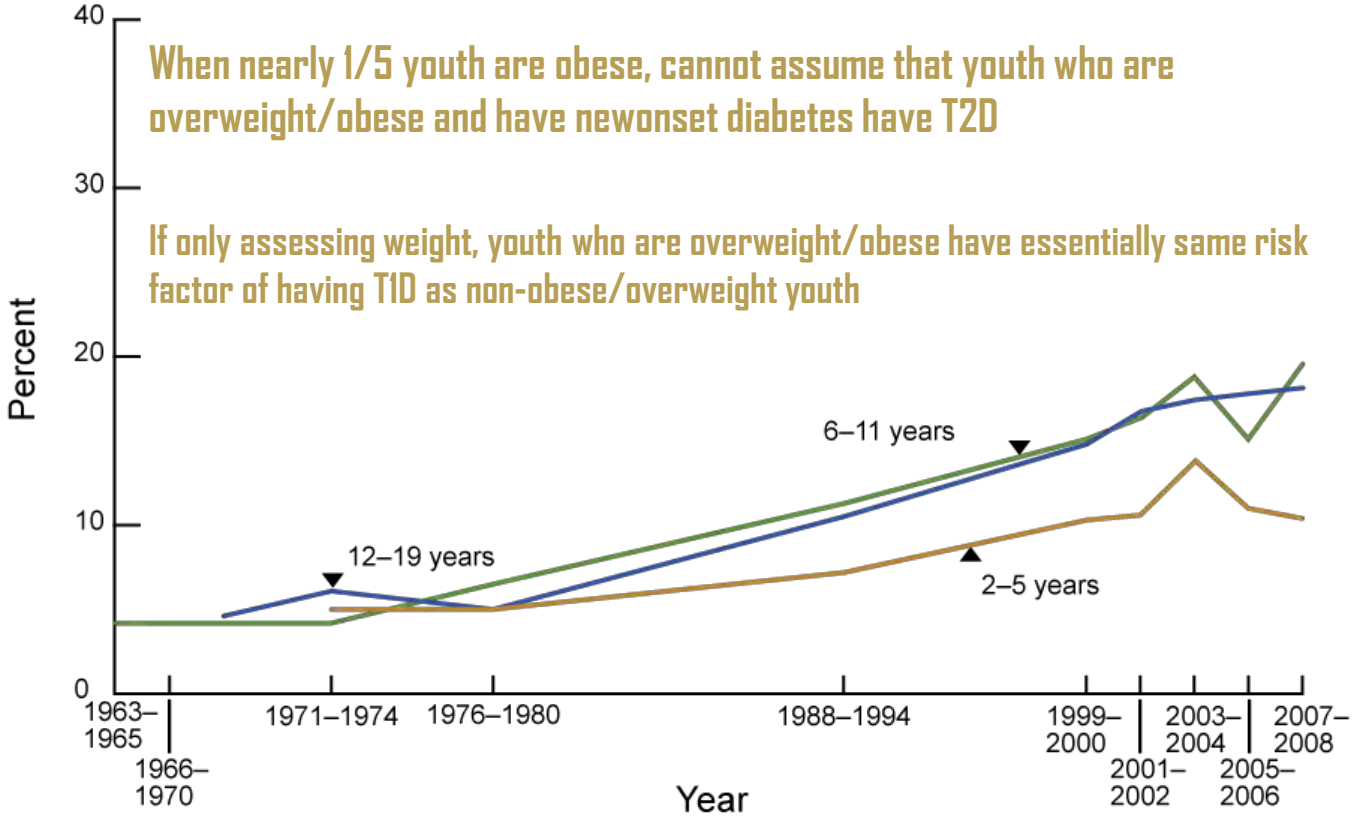
Classification of Diabetes

- **Type 1 diabetes (T1D):** autoimmune β-cell destruction
- **Type 2 diabetes (T2D):** Progressive insulin secretory defect…that leads to β-cell destruction
- **Other specific types of diabetes**
  - Monogenic diabetes and inherited defects insulin production/secretion (ie, "MODY" forms)
  - Cystic Fibrosis related Diabetes (CFRD)
  - Drug- or chemical-induced
  - **Gestational diabetes mellitus (GDM)**

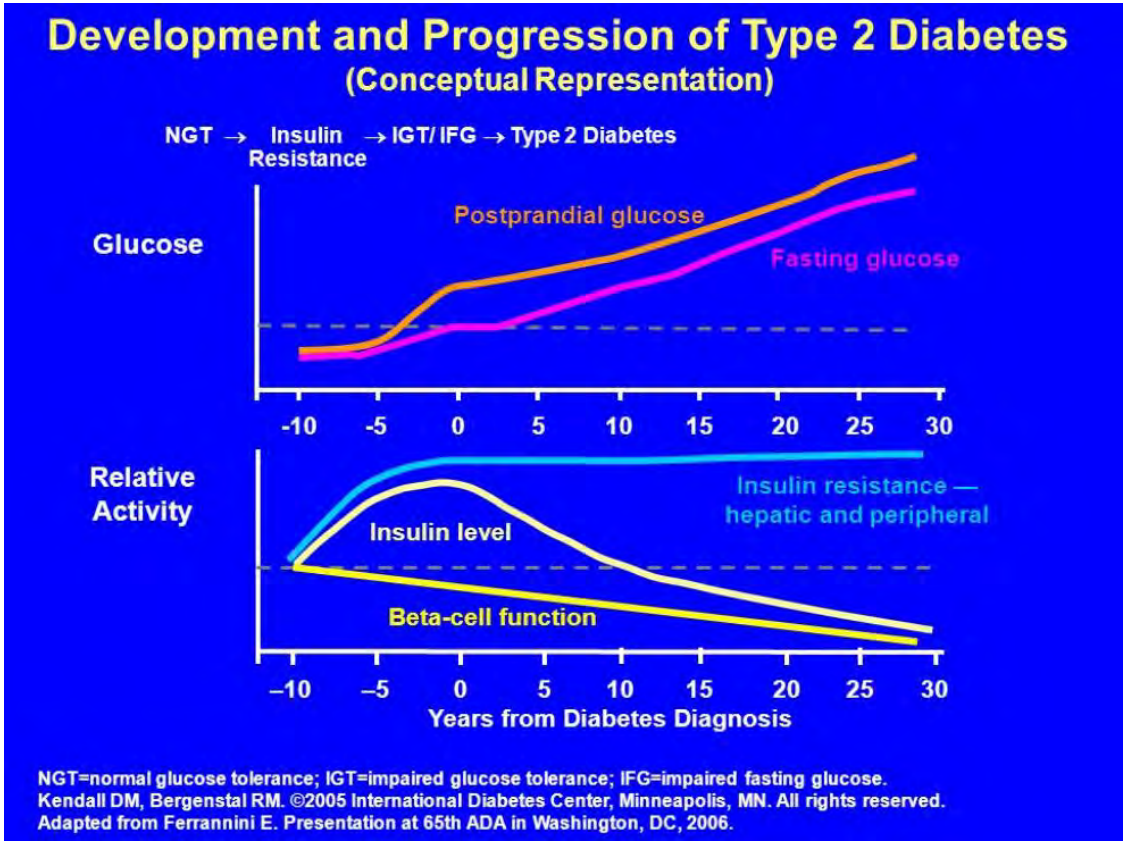
FOR THIS LECTURE, WE WILL FOCUS ON T1D VS. T2D

Figure 1. Trends in obesity among children and adolescents: United States, 1963–2008

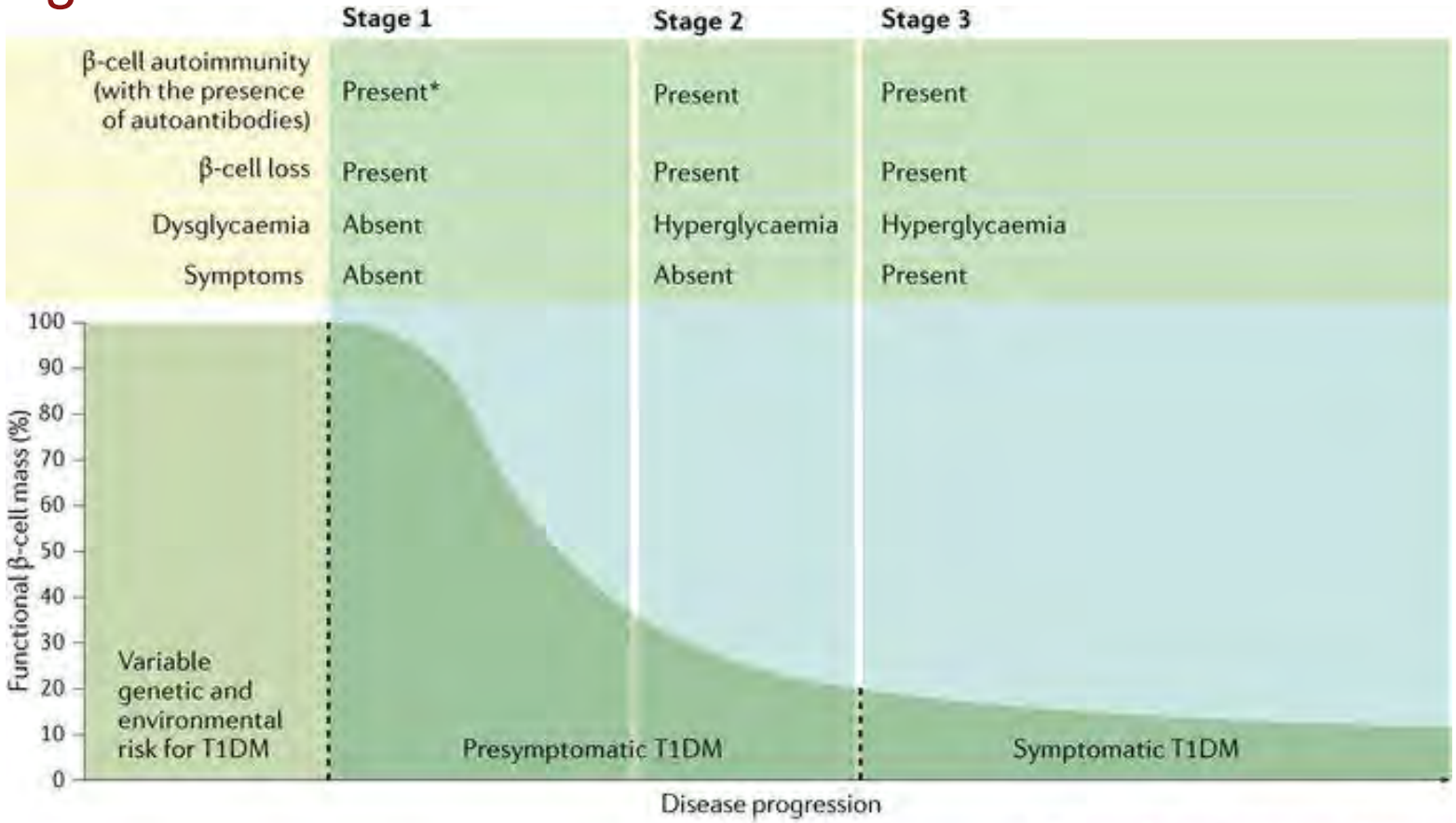


NOTE: Obesity is defined as body mass index (BMI) greater than or equal to sex- and age-specific 95th percentile from the 2000 CDC Growth Charts.
SOURCES: CDC/NCHS, National Health Examination Surveys II (ages 6–11), III (ages 12–17), and National Health and Nutrition Examination Surveys (NHANES) I–III, and NHANES 1999–2000, 2001–2002, 2003–2004, 2005–2006, and 2007–2008.

KEY CONCEPT: T2D is not insulin resistance…it is loss of beta cell function…and insulin resistance plays a role in progression towards T2D



Stages of T1D



Nature Reviews | Disease Primers

Katsarou, A. *et al.* (2017) Type 1 diabetes mellitus
Nat. Rev. Dis. Primers doi:10.1038/nrdp.2017.16

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DIABETES IN YOUTH

PRESENTATION & DIAGNOSIS

Criteria for the Diagnosis of Diabetes

A1C ≥6.5%
(not established in pediatrics but used)

OR

Fasting plasma glucose (FPG)
≥126 mg/dL (7.0 mmol/L)

OR

2-h plasma glucose ≥200 mg/dL
(11.1 mmol/L) during an OGTT

OR

A random plasma glucose ≥200 mg/dL
(11.1 mmol/L)

Diagnostic criteria is the same for T1D and T2D

Presentation Spectrums in T1D & T2D in Youth

Type diabetes	T1D	T2D
Onset	Typically rapids (over weeks to months)	Typically indolent (over months to years)
Overweight/obesity	+/-	>85%
Presenting sxs/course	More of a short/acute course	More indolent course
DKA / Ketones	~50% DKA	~50% ketonuria <25% DKA
Family Hx	~5% with T1D of 2nd degree relative with T1D Familial autoimmune conditions	>75% with 1st or 2nd degree relative with T2D
Co-morbidities	Autoimmunity: Thyroid (TPO, Tgb) Celiac (celiac panel) Adrenal insufficiency (21OH'ase Abs) Pernicious anemia (B12 deficiency) Vit D deficiency (Vit D25OH level) Vitiligo	Acanthosis nigricans (almost 100%) Hyperandrogenism and PCOS Metabolic syndrome/overlap OSA Microalbuminuria (~10% within 3 mo dx)
Insulin & c-peptide	Decrease insulin and c-peptide No increase levels with OGT	Usually normal or increased (but can be low) Inappropriate increase with OGT
Ethnicity	Caucasian most prevalent but effect ALL ethnicities	NA, AA, Latino, Pacific Islanders
Puberty	Any pubertal stage	More common Tanner Stage 4 to 5

Diagnosis of Pediatric T2D

ADA 2018 Standards of Care Recommendations:

- Given the obesity epidemic, distinguishing between T1D and T2D in children is difficult, but critical for determining the optimal treatment regimen

- Due to the significant comorbidities associated with T2D in youth, these tests are recommended at diagnosis:
  - Blood pressure measurement
  - fasting lipid panel
  - Albumin excretion assessment
  - Dilated eye examination

Thereafter, screening and treatment guidelines for in youth with T2D are similar to those with T1D.

Double diabetes?

Conventional wisdom:
Insulin resistance → T2D

Thinking critically:
Insulin resistance + T1D
T1D + insulin resistance

Screening Recommendations: Autoimmune Conditions (T1D)
ADA 2018 Standards of Care Recommendations:

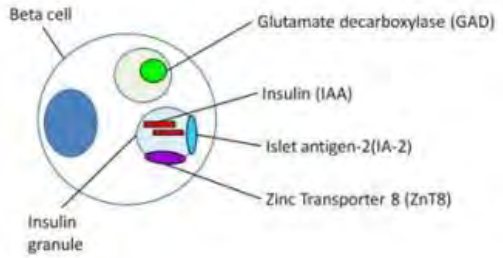
Screening

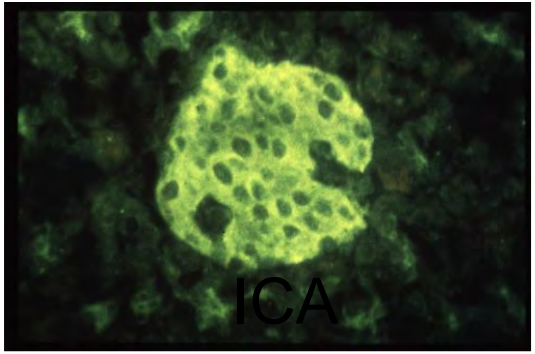
- Assess for the presence of additional autoimmune conditions at diagnosis and if symptoms develop E

Example autoimmune screening newonset pediatric diabetes patients:

- *Celiac panel: annual (1st five years after diagnosis)*
- *Autoimmune hypothyroidism: Antibodies (TPO and Tgb Abs) at diagnosis and TFTs (FT4 and TSH annually)*
- *Vit D Deficiency: VitD25OH annually*

Major Pancreatic Islet Autoantigens





Insulin autoantibodies

- ?
- **ZnT8**
- **IA-2 (ICA512BDC)**
- **GAA (GAD_{65})**
- **mIAA**

Negative antibodies do not ruleout T1D

How to order T1D Antibodies

LABCORP

Diabetes Autoimmune Profile

Includes: GAD-65, ICA 512, insulin antibodies, and ZnT8 antibodies.

TEST: 504050 Test number copied
CPT: 86337(x1); 86341(x3)

Specimen Requirements
Serum, **frozen**
Volume2.5 mL
Minimum Volume1.0 mL
Red-top tube or gel-barrier tube

QUEST

GAD65, IA-2, and Insulin Autoantibody

Alternative Name(s)

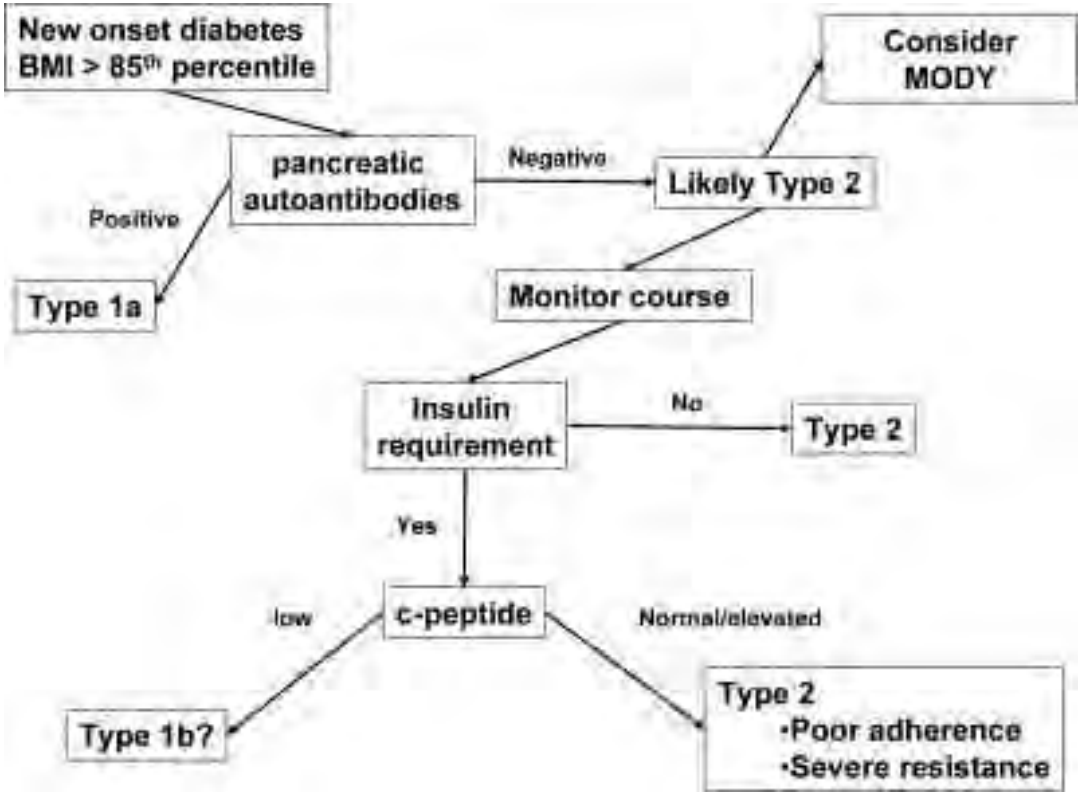
IA-2 Antibody, Panel,Diabetes Antibody Panel,Glutamic Acid Decarboxylase-65 Antibody Panel,Insulin Autoantibody, Panel

CPT Code is informational only; obtain the Test Code for ordering.

CPT Code(s)**

86337, 86341 (x2)

Diagnostic Approach Example: Determining Diabetes Type in Youth with BMI >85th %



Zeitler P. Approach to the obese adolescent with new-onset diabetes. *J Clin Endocrinol Metab.* 2010;95(12):5163–5170

DIABETES IN YOUTH

MANAGEMENT

A Fine Balance of Goals

- Best blood sugars as possible
- As few uncomfortable lows as possible
- Have a life

Adapted as presented by Dr. William Polonsky, AYUDA VTP E-Course (April 2014)

We do NOT say disease
We say condition or lifestyle

- Although a medical dictionary might describe diabetes as a disease, it is not an accurate description as it denotes illness/sickness

- Diabetes is more similar to a “condition” than a disease as diabetes requires you to make multiple daily decisions about your diabetes every day of the week, every day of your life

Kids BEFORE "diabetics"

Kids with diabetes are so much more than "diabetics."

THEY ARE PEOPLE WHO ARE… AND who have diabetes!!!

Although this is a subtle difference, "people first" language actually makes a big difference. Children realize that they are more than just their diabetes.

Pediatric Psychosocial Issues

ADA 2018 Standards of Care Recommendations:

- At diagnosis and during routine follow-up care, assess psychosocial issues and family stresses that could impact adherence with diabetes management E
  - Provide appropriate referrals to trained mental health professions, preferably experienced in childhood diabetes

- Encourage developmentally appropriate family involvement in diabetes management tasks for children and adolescents, recognizing that premature transfer of diabetes care to the child can result in nonadherence and deterioration in glycemic control. A

- Assess youth with diabetes for psychosocial and diabetes-related distress, generally starting at 7–8 years of age. B

Transition from Pediatric to Adult Care

ADA 2018 Standards of Care Recommendations:

- As teens transition into emerging adulthood, health care providers and families must recognize their many vulnerabilities **B** and prepare the developing teen, beginning in early to mid adolescence and at least 1 year prior to the transition **E**

- Both pediatricians and adult health care providers should assist in providing support and links to resources for the teen and emerging adult **B**

Diabetes Self-management Education and Support (DSME/DSMS)

ADA 2018 Standards of Care Recommendations:

- Youth with T1D and parents/caregivers (for patients aged <18 years) should receive diabetes self-management education and support at diagnosis and routinely thereafter that is B
  - **Culturally sensitive**
  - **Developmentally appropriate**
  - **Individualized**

Glycemic Goal

ADA 2018 Standards of Care Recommendations:

Plasma blood glucose goal range		A1C	Rationale
Before meals	Bedtime/ overnight		
90–130 mg/dL (5.0–7.2 mmol/L)	90–150 mg/dL (5.0–8.3 mmol/L)	<7.5%	A lower goal (<7.0%) is reasonable if it can be achieved without excessive hypoglycemia

Pediatric Glycemic Targets

Above Target

Target

Below Target

GENERAL:
70-180 mg/dL

- We do not say “good” or “bad” blood sugars
  - In target, above target (high), or below target (low)
  - Only ”bad” blood sugar is when we don’t use our brains to think why BG is above or below target- and sometimes we cannot figure out why and that is ok!
- Targets should be **individualized**, and lower targets may be reasonable based on benefit-risk assessment.
- Patients with higher A1cs who are accustomed to being above target are most likely going to have *relative symptoms of hypoglycemia* when in a standard “normal” target range.

Pediatric Glycemic Control

ADA 2018 Standards of Care Recommendations:

- All children and adolescents with T1D should **self-monitor blood glucose (SMBG)** levels multiple times daily, including pre-meal, pre-bedtime, and as needed for safety in specific clinical situations such as exercise, driving, or for symptoms of hypoglycemia. **B**

- **Continuous glucose monitoring (CGM)** should be considered in children and adolescents with T1D, whether using injections or continuous subcutaneous insulin infusion. **B**

- The majority of children and adolescents with T1D should be treated with intensive insulin regimens, either via **multiple daily injections** or **continuous subcutaneous insulin infusion**. **A**

- **Automated insulin delivery systems** improve glycemic control and reduce hypoglycemia in adolescents and should be considered in adolescents with T1D. **B**

Pediatric Diabetes

ISPAD

Pediatric Diabetes 2013
doi: 10.1111/pedi.12057

Pediatric Diabetes

Original Article

A contrast between children and adolescents with excellent and poor control: the T1D exchange clinic registry experience

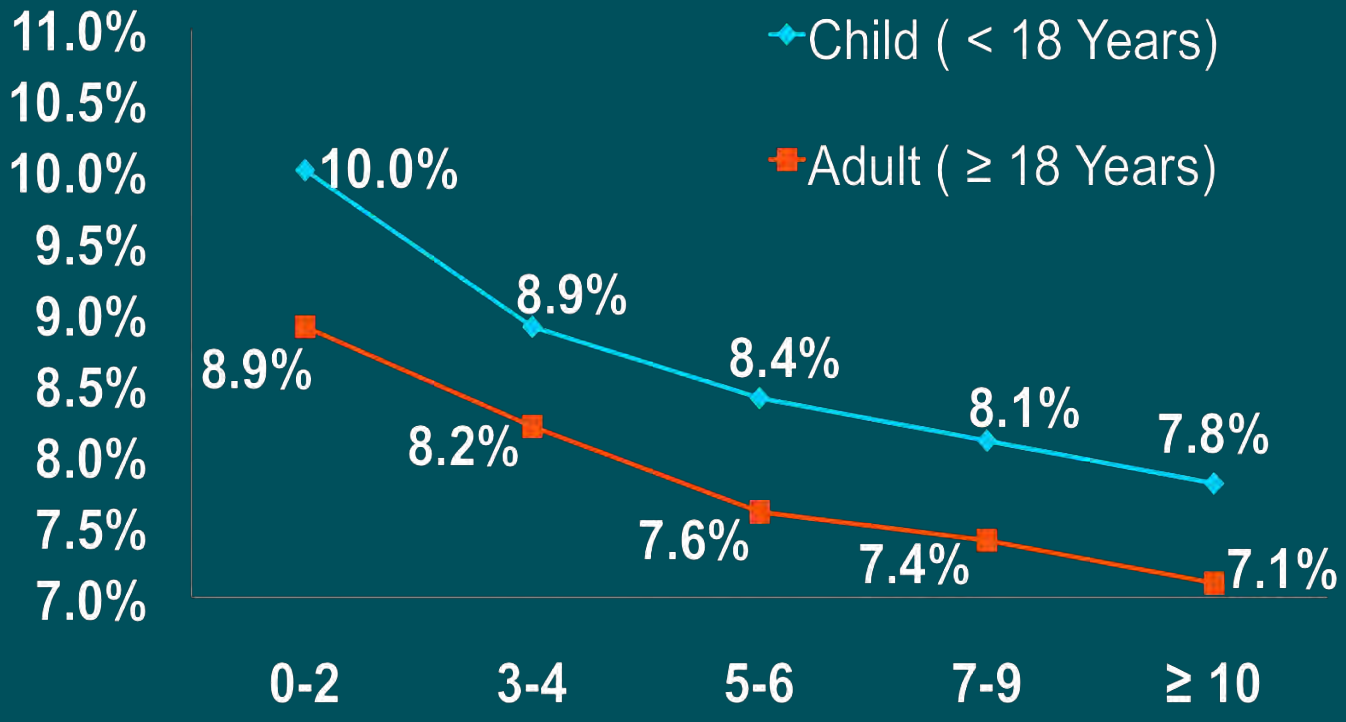
Campbell MS, Schatz DA, Chen V, Wong JC, Steck A, Tamborlane WV, Smith J, Beck RW, Cengiz E, Laffel LM, Miller KM, Haller MJ, T1D Exchange Clinic Network. A contrast between children and adolescents with excellent and poor control: the T1D exchange clinic registry experience. Pediatric Diabetes 2013.

Objectives: Optimizing glycemic control in pediatric type 1 diabetes (T1D) is essential to minimizing long-term risk of complications. We used the T1D Exchange database from 58 US diabetes clinics to identify differences in diabetes management characteristics among children categorized as having excellent vs. poor glycemic control.

Methods: Among registry participants 6–17 yr old with diabetes duration

Meredith S Campbell[a], Desmond A Schatz[a], Vincent Chen[b], Jenise C Wong[c], Andrea Steck[d], William V Tamborlane[e], Jennifer Smith[f], Roy W Beck[b], Eda Cengiz[g], Lori M Laffel[g], Kellee M Miller[b], and Michael J Haller[a]; for the and T1D Exchange Clinic Network[†]

Average HbA1c by frequency SMBG (self blood glucose monitoring)- excluding CGM (continuous glucose monitoring)



Beck R W et al. JCEM 2012;97:4383-4389

T1D Exchange

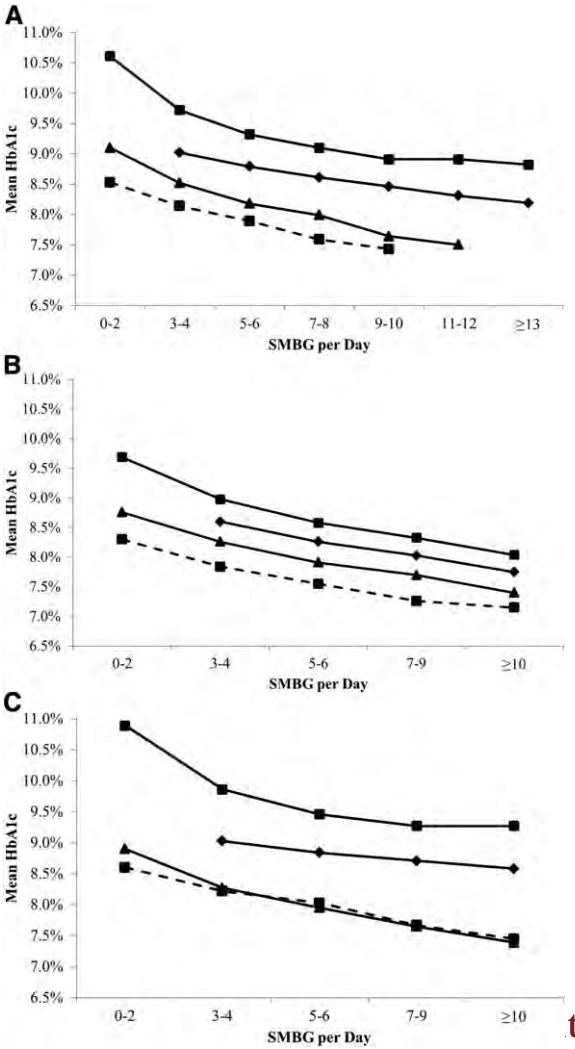
Relative Risk/Benefit Analysis

More SMBG checks (think CGM) =

More opportunities=

Lower HbA1c =

(?) Lower risk complicactions



American Diabetes Association. T1D Exchange

Miller K M et al. Dia Care 2013;36:2009-2014

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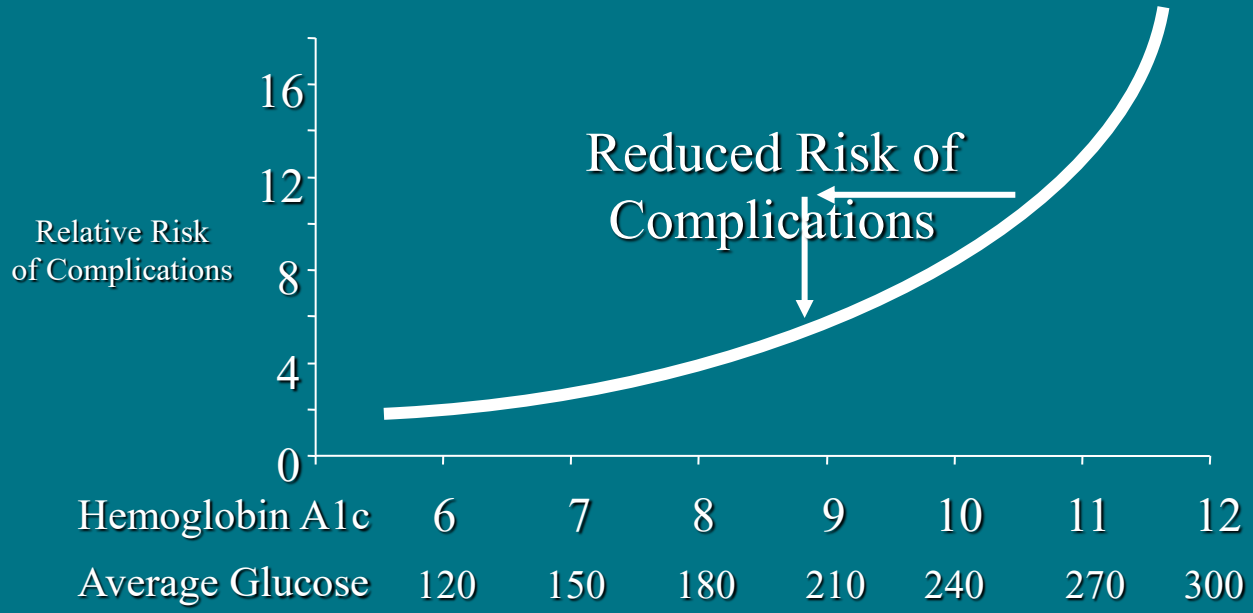
Representation of benefits of reduction HbA1c (T1D+T2D)

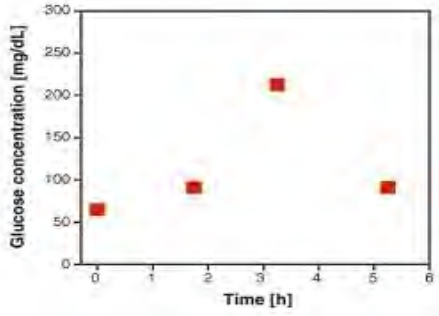


UKPDS 33. *Lancet.* 1998;352:837-853.
DCCT Research Group. *N Engl J Med.* 1993;329:977-986.

Slide adapted from Kendall D, International Diabetes Center, Minneapolis.

Review of glucose monitoring

Traditional “fingerstick” glucose testing

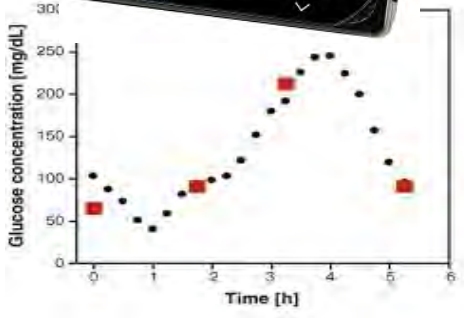


Continuous glucose monitoring (CGM)

1)Sensor

2)Transmitter

3) Receiver

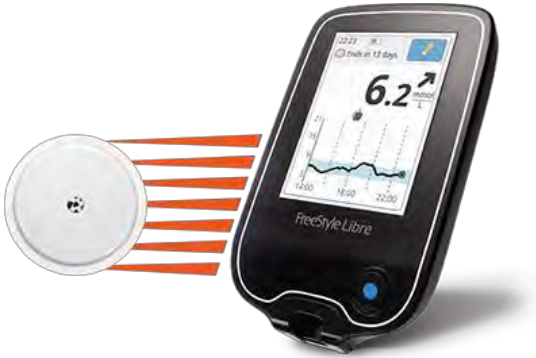


Available CGM Devices

Dexcom

Medtronic

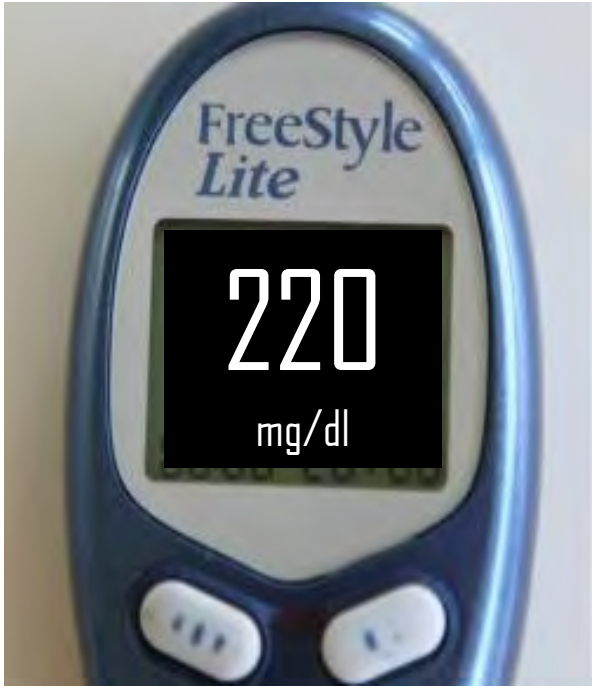
FreeStyle Libre (“Flash” CGM)



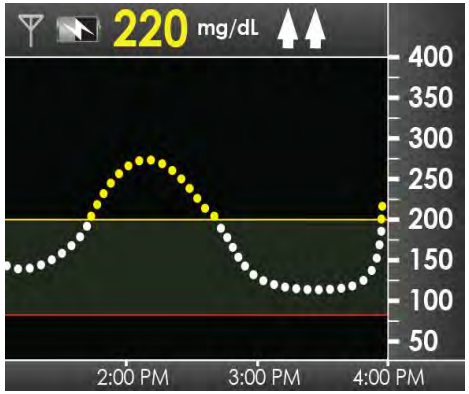
How CGM is used

- Real time glucose updates + trend allows timely intervention
- Alerts: low, high, rate of change, predictive
- Behavioral modification tool
- Provides robust data to better understand patterns

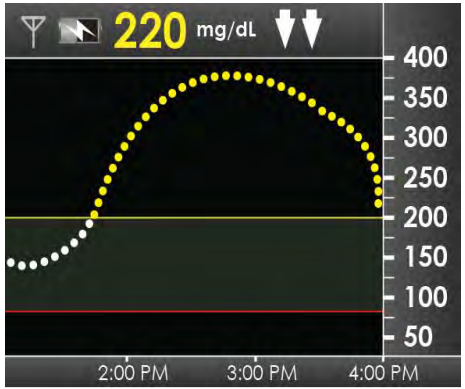
What to Do?



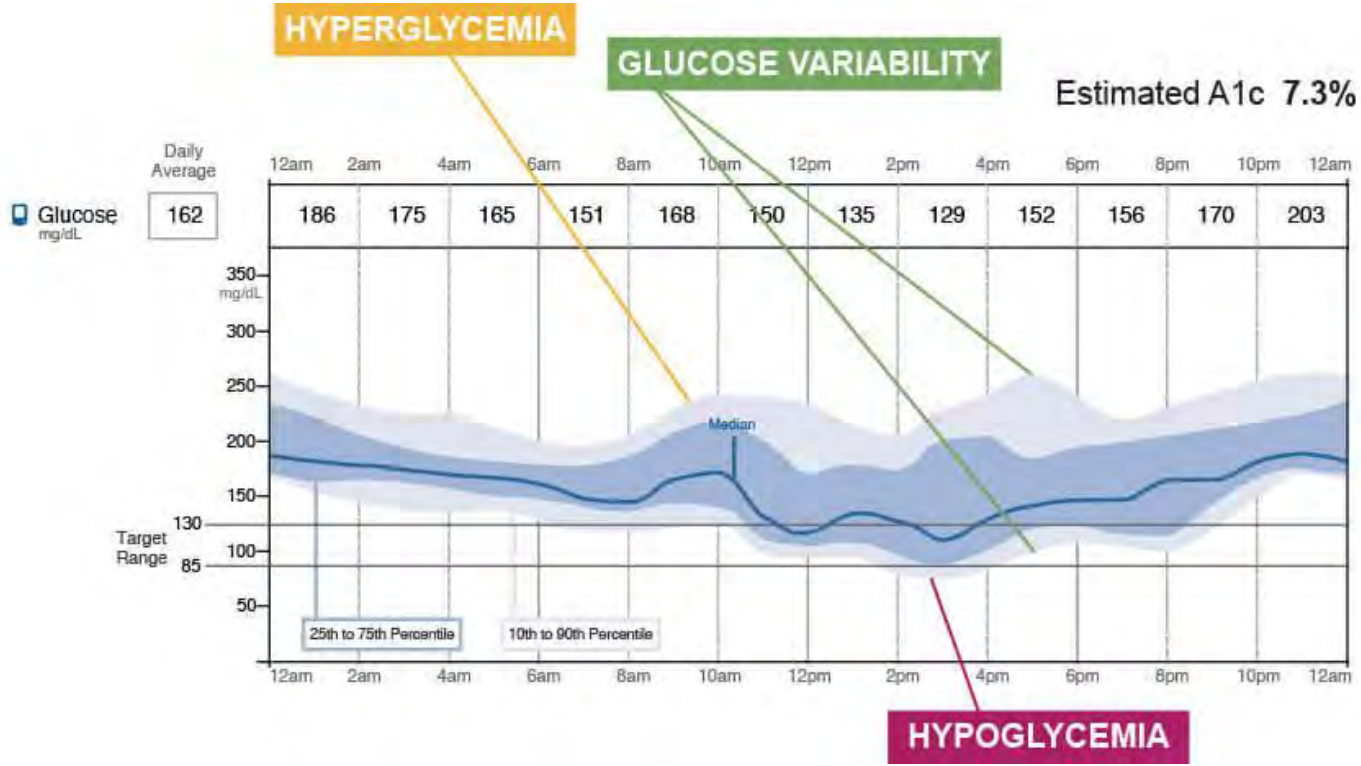
My pump always gives me the same answer



Take a larger than usual dose



No insulin and maybe eat carbs



BEYOND HbA1c Goals to Consider

- Minimize lows
- Maximize time in range
- Minimize the roller coaster of hi-low s (ie glucose variability)

p.s. have a life!

WAYS TO GIVE INSULIN PEDIATRIC DIABETES

Injections

Syringes/Pens: think about ½ units and needle length/Gauge (4mm, 32G)

Insulin Pump

Continuous Subcutaneous Insulin Infusion (CSII)

Different brands: think tubing vs non-tubing, CGM integration

Insulin Dosage Schedules

Conventional (Old): 1 to 2 shots/day

Conventional (Current/out-dated): 3 shots/day

Intensive Insulin Therapy (current): Basal/Bolus

- ✓ Continuous Subcutaneous Insulin Infusion (CSII, ie. “Pump” therapy)
- ✓ Basal Insulin + Bolus (fast-acting) insulin analog
  - › Basal usually given in evening before bed
  - › Sometimes Basal insulin is split between morning and bed
- ✓ Basal insulin + pump analog

Pre-Mixed insulins (ie, 70/30) should not be used in the pediatric population

AAP Key Action Statement on T2D in Youth: Insulin Therapy

Clinicians must ensure that insulin therapy is initiated for children and adolescents with T2DM:

1. who are ketotic or in diabetic ketoacidosis and who have venous or plasma blood glucose level > 250 mg/dl
2. whose Hemoglobin A1c is > 9% or
3. In whom the distinction between T1D and T2D is unclear.

Copeland KC, Silverstein J, Moore KR, et al, .; American Academy of Pediatrics. Management of newly diagnosed type 2 diabetes mellitus (T2DM) in children and adolescents. Pediatrics 2013;131:364–382

AAP Key Action Statement on T2D in Youth: Management

In all other instances, clinicians should **start metformin** as first-line therapy for children and adolescents at the time of diagnosis with T2DM, and initiate a **lifestyle modification** program including **nutrition** and **physical activity**.

Copeland KC, Silverstein J, Moore KR, et al, .; American Academy of Pediatrics. Management of newly diagnosed type 2 diabetes mellitus (T2DM) in children and adolescents. Pediatrics 2013;131:364–382

T2D Diabetes Management Approach

Based on initial symptoms, BG, and ketones

Symptoms s	Blood Glucose Glucose	Ketones	Treatment
No	< 250	Negative	Metformin +/- Insulin +lifestyle changes +underlying co-morbidities
No	> 250	Negative	Insulin +/- metformin +lifestyle changes +underlying co-morbidities
Yes	< 250	Negative	Insulin +/- metformin +lifestyle changes +underlying co-morbidities
Yes	<250	Positive	Insulin +/- metformin +lifestyle changes +underlying co-morbidities

y

ADDITIONAL INFORMATION

Advances in diabetes management

Insulin Pumps

Model 515

Model 715

Remote Monitoring

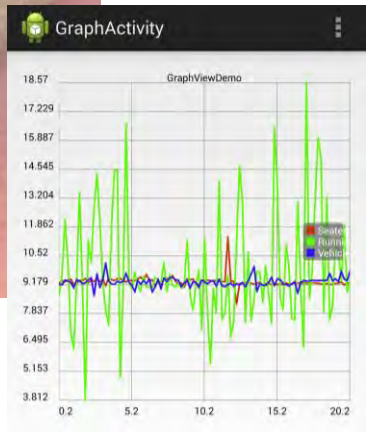
ırd University

Currently on Market
Medtronic 670G

Open APS

Introducing the iLet

Future of closed-loop



Healthy life styles & food choices

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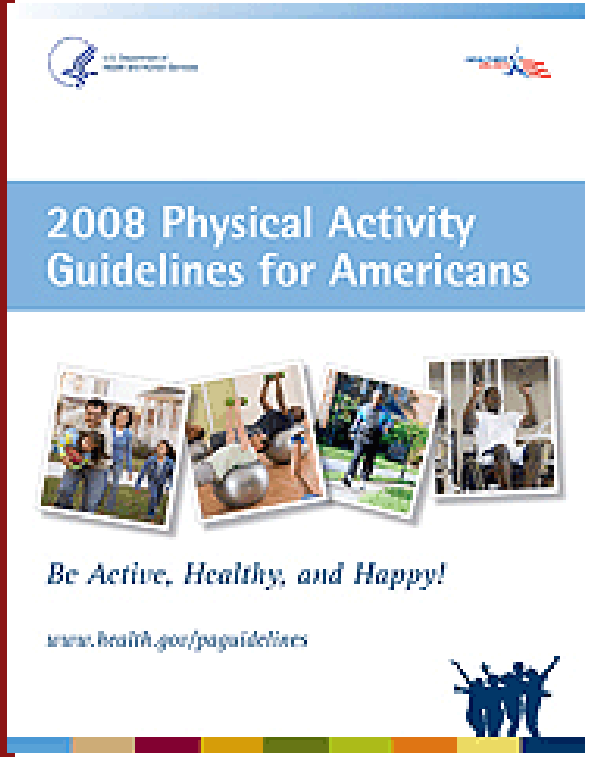
Physical Activity Guidelines For Children & AAP KEY ACTION STATEMENT



Children and adolescents should do 60 minutes (1 hour) or more of physical activity daily.

Aerobic: Most of the 60 or more minutes a day should be either moderate- or vigorous-intensity aerobic physical activity, and should include **vigorous-intensity physical activity** at least 3 days a week.

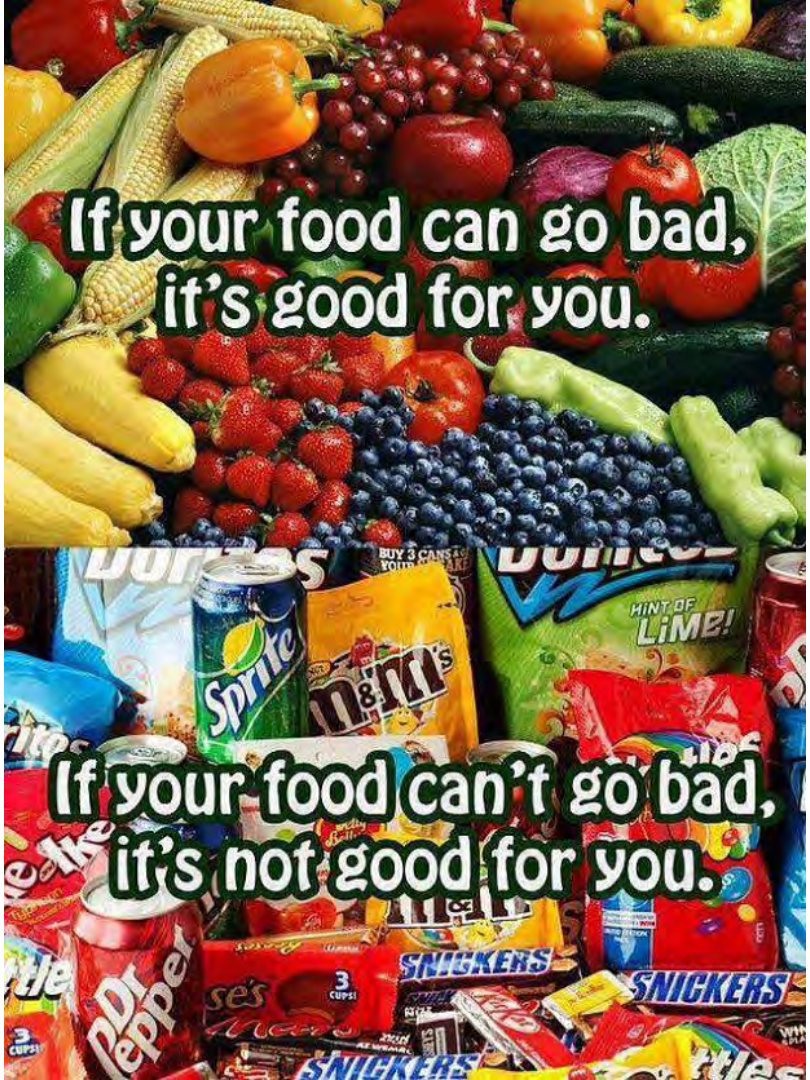
Muscle-strengthening: As part of their 60 or more minutes of daily physical activity, children and adolescents should include muscle-strengthening physical activity on at least 3 days of the week.

Bone-strengthening: As part of their 60 or more minutes of daily physical activity, children and adolescents should include bone-strengthening physical activity on at least 3 days of the week.

It is important to encourage young people to participate in physical activities that are appropriate for their age, that are enjoyable, and that offer variety.

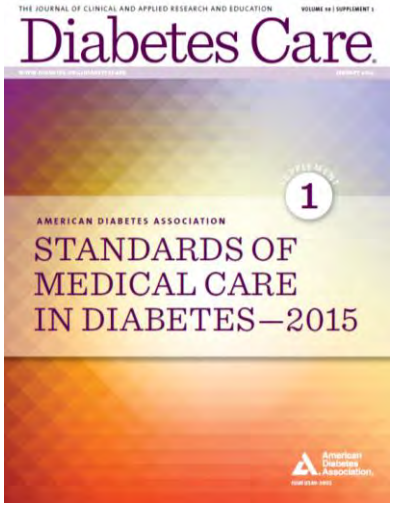
But any exercise is better than none!


EAT
REAL
FOOD


If your food can go bad,
it's good for you.
If your food can't go bad,
it's not good for you.
Sprite
m&m's
HINT OF LIME!
SNICKERS
SNICKERS
SNICKERS
Dr Pepper

Pediatric Diabetes HbA1c Goals

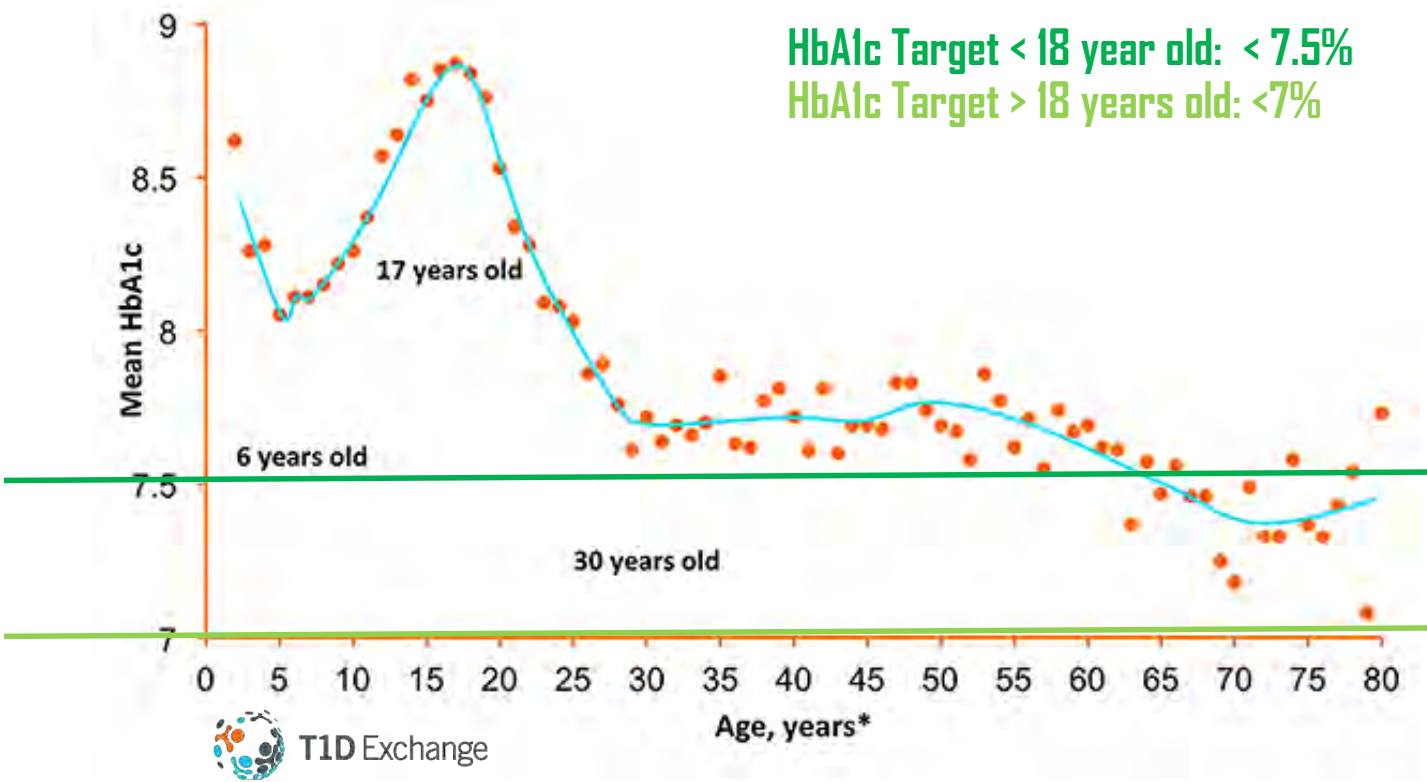
ISPAD
International Society for Pediatric and Adolescent Diabetes



All ages

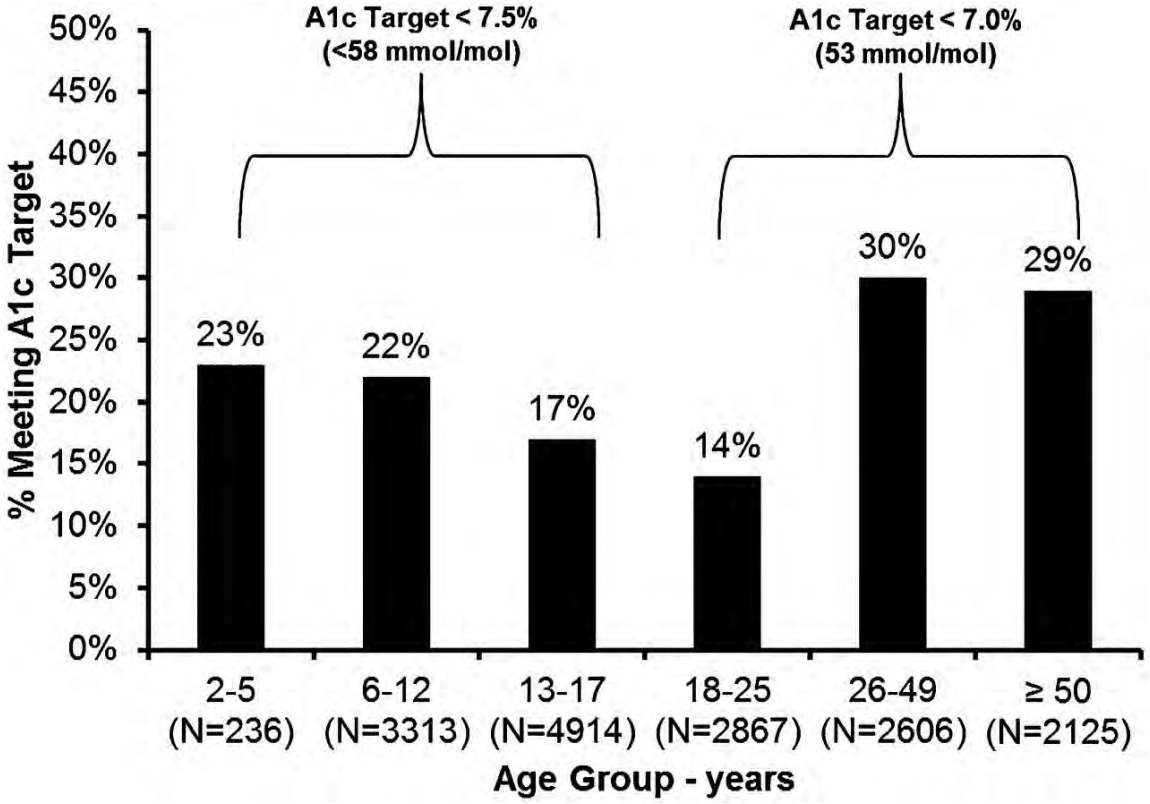
HbA1c < 7.5

Recognizing the facts: on average, the current system of deliver for T1D in the US is failing patients.



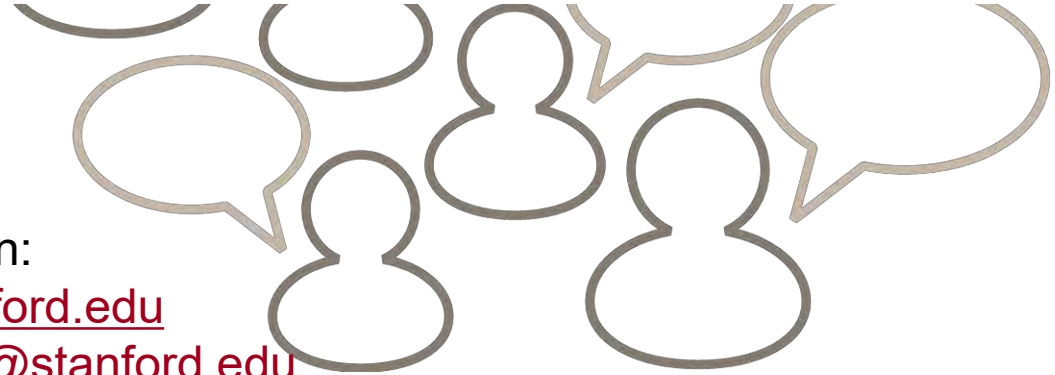
Miller KM, Foster NC, Beck RW, et al. Current state of type 1 diabetes treatment in the US: updated data from the T1D exchange clinic registry. Diabetes Care. 2015;38(6):971–978.

Bottom line:
System failure for patients with T1D of all ages



Miller KM, Foster NC, Beck RW, et al. Current state of type 1 diabetes treatment in the US: updated data from the T1D exchange clinic registry. Diabetes Care. 2015;38(6):971–978.

Discussion and Thank You!



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