

Diabetes Basics in 2019 2nd Annual Sweet Science Conference

Mark Vanderwel, MD

April 5 & 6, 2019

Content Outline 1

- Definition of Diabetes
 - Incidence
- Types of Diabetes and specific management differences
- History of Diabetes
- Pathophysiology of Type 1 diabetes
- Types of Insulin
 - Basal-Bolus Regimen
 - Changing insulin needs during growth and development
- Diabetes Technologies

Content Outline 2

- Diabetes Management at School
 - Different types of families
 - Glucose monitoring techniques and regimens
 - Dose calculation and Carbohydrate Counting
 - Nutrition/meal patterns/preprandial dosing
 - Optimal injection techniques (including pen/syringe/pump)
 - Rotating insulin injection sites and vigilance for lipohypertrophy
 - Hypoglycemia/hyperglycemia/ketones

Content Outline 3

- Making Diabetes Connections

- Social Media
- Podcasts
- Diabetes Applications
- Summer Camps

Future of diabetes management

- JDRF goals
- Free-Flowing Discussion

Definition of Diabetes

- A GROUP of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action or both
- The chronic hyperglycemia of diabetes is associated with long-term damage, dysfunction and failure of various organs, especially the eyes, kidneys, nerves, heart and blood vessels
- “Diagnosis and Classification of Diabetes Mellitus”; Diabetes Care 2004 Jan; 27(suppl 1): s5-10

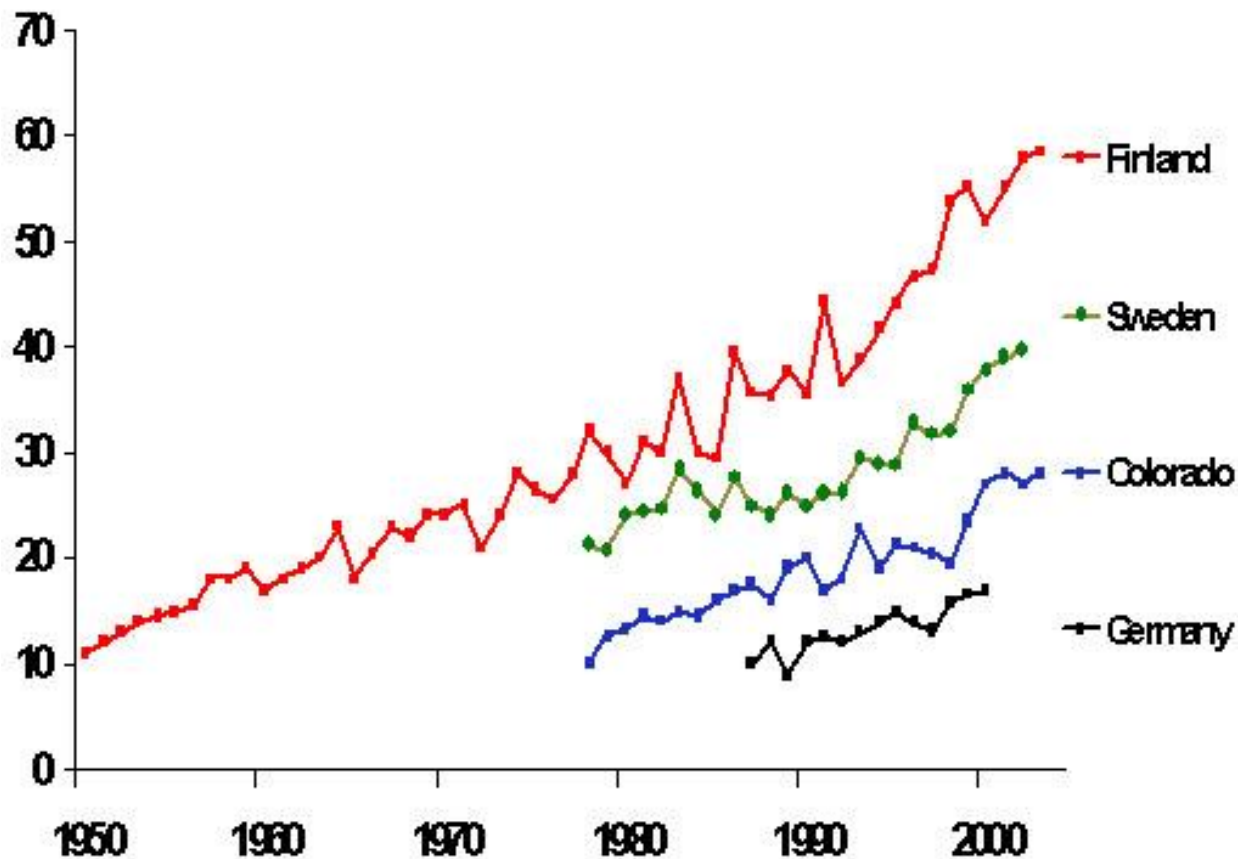
ADA Definition of Diabetes

- Symptoms of diabetes and a casual plasma glucose > 200
- Fasting BG > 126
- 2 hour BG > 200 during an OGTT
- In absence of symptoms, criteria confirmed by repeat testing on a different day

Prevalence

- 0.22% of people aged 20 or younger
- About 1:350 children and adolescents have type 1
- SEARCH for Diabetes in Youth
- Between 2001 and 2009 there was a 21% increase in T1D prevalence in USA
- Type 2 is increasing exponentially in youth

Annual New Cases of T1DM for every 100k children 0-14



(Ann NY Acad Sci. 2008 December; 1150:1-13)

Common “Types” of Diabetes

- Type 1
- Type 2
- “Type 1 ½”
- Gestational
- Stress/Medication induced hyperglycemia
- “Pre-Diabetes”

Less Common “Types” of Diabetes

- Genetic defects of B cell function
 - MODY
- CFRD
- Iatrogenic
- Disorders of Exocrine Pancreas causing Endocrine insufficiency

Misconceptions

- You're born with diabetes
 - With both type 1 and 2, the risk of developing diabetes is related to multiple genes
 - Environment plays a role
- “You brought diabetes on yourself”
 - Environment plays a role, especially with type 2, but...

Type 1 vs. Type 2

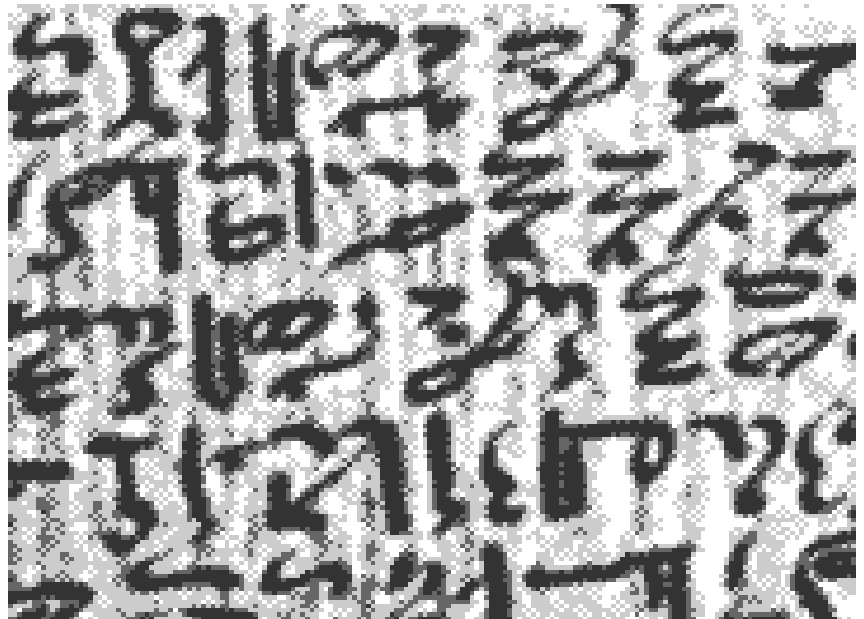
- Insulin deficiency vs. Insulin resistance
- The door key analogy
- Differences in management
 - Oral agents
 - Exercise
 - Insulin usage
 - Ketones
 - Glucagon

Goals for Individual Diabetes Patients

- Minimize short term crises
 - Hypoglycemia
 - DKA
- Minimize long term complications
 - Hemoglobin A1C < 7
- Normalcy in lifestyle

History of Diabetes

- First known mention 1552 BC
 - Ebers papyrus
 - Hesy-Ra, an Egyptian physician documented frequent urination as a symptom of a mysterious disease that also caused emaciation



History of Diabetes

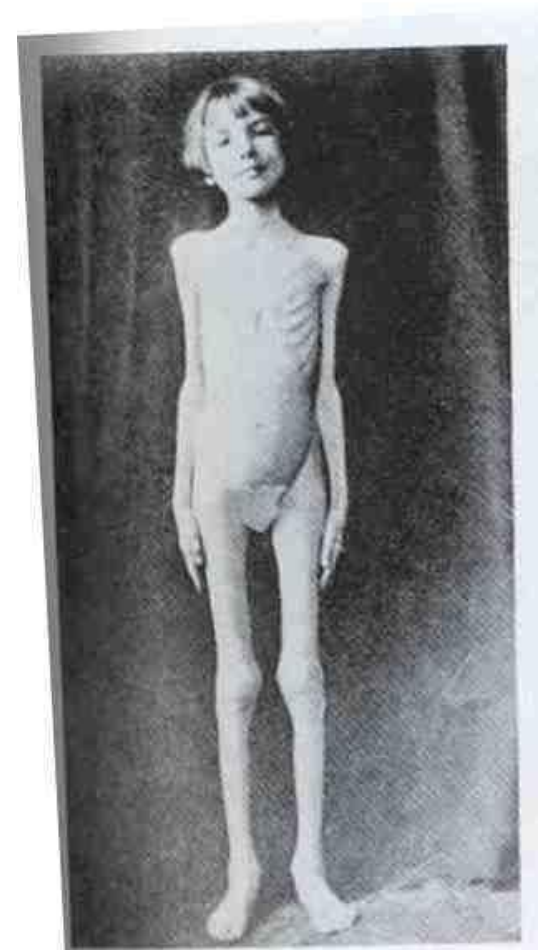
- Hindu medicine circa 1500 BC
 - Ancient writings note that ants are attracted to the urine of people with an emaciating disease
- 250 BC
 - Apollonius of Memphis is credited with the term diabetes meaning siphon for a disease that drained patients of more fluid than they could consume
- Celsus encyclopedia
 - Greek physician Arataeus described the melting down of flesh and limbs into urine (First century AD)
- Around the 11th century
 - Diabetes mellitus (honey) was written and physicians became “water tasters” to diagnose it

History of Diabetes Treatment

- 15th century
 - Exercise such as horseback riding was thought to relieve excessive urination
- 1797
 - Rollo observed that eating starchy food increased the sugar in the urine and recommended a diet of only the fat and meat of animals
- 1870's Franco-Prussian War
 - Apollinaire Bouchardat (French physician) noted that diabetes symptoms improved with war-related food rationing

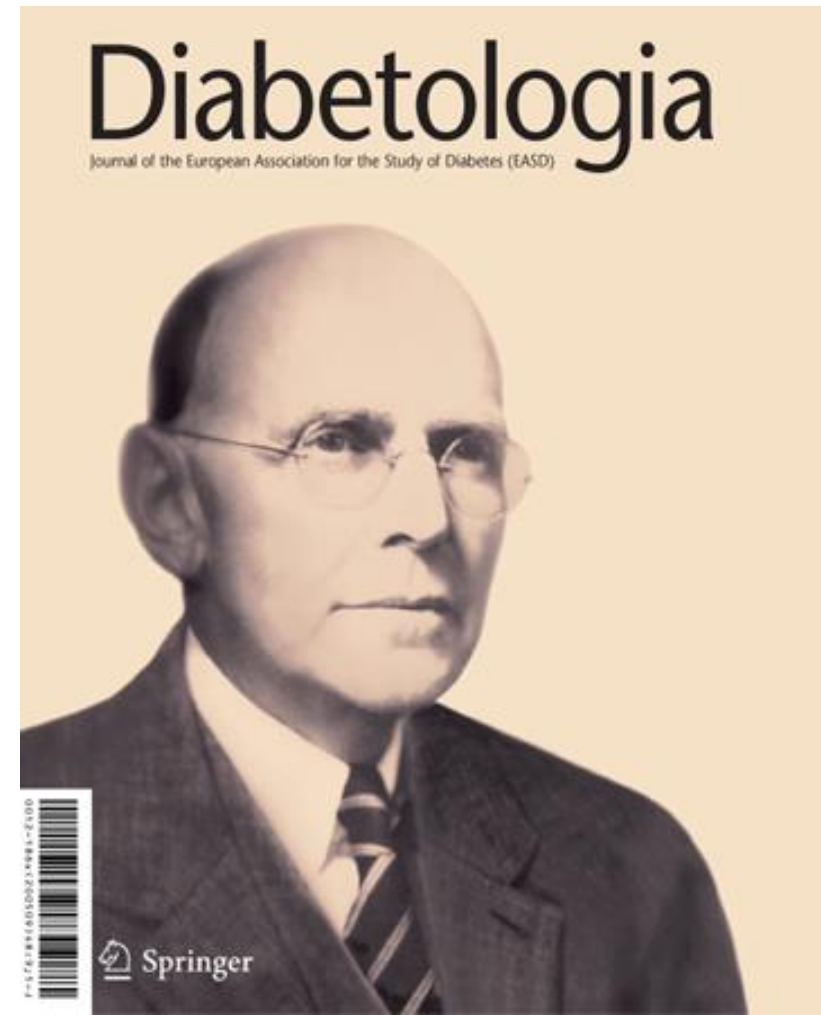
History of Diabetes Treatment

- Fad diets of early 20th century
 - Oat-cure (8 oz of oatmeal mixed with 8 oz of butter to be consumed every 2 hours)
 - Potato therapy
 - Starvation diet



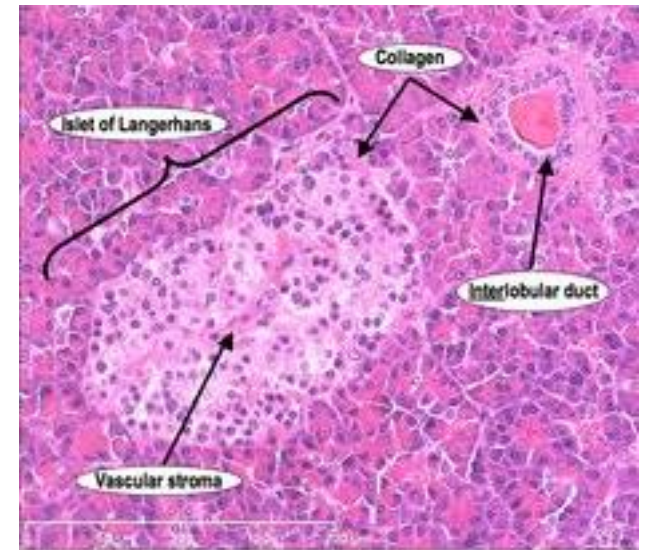
History of Diabetes Treatment

- 1916 Elliott Joslin creates the textbook “The Treatment of Diabetes Mellitus”
 - Fasting diet combined with regular exercise could significantly reduce the risk of death
 - After insulin was “discovered”, he was adamant that good glucose control (restricted carb diet), exercise, frequent testing and insulin adjustment) would reduce complications



History of Insulin

- 1869
 - Langerhans, a German medical student, discovered that the pancreas has two types of cells
 - One set secretes the normal pancreatic fluids
 - The other cells (which became known as the islets of Langerhans) had an unknown function

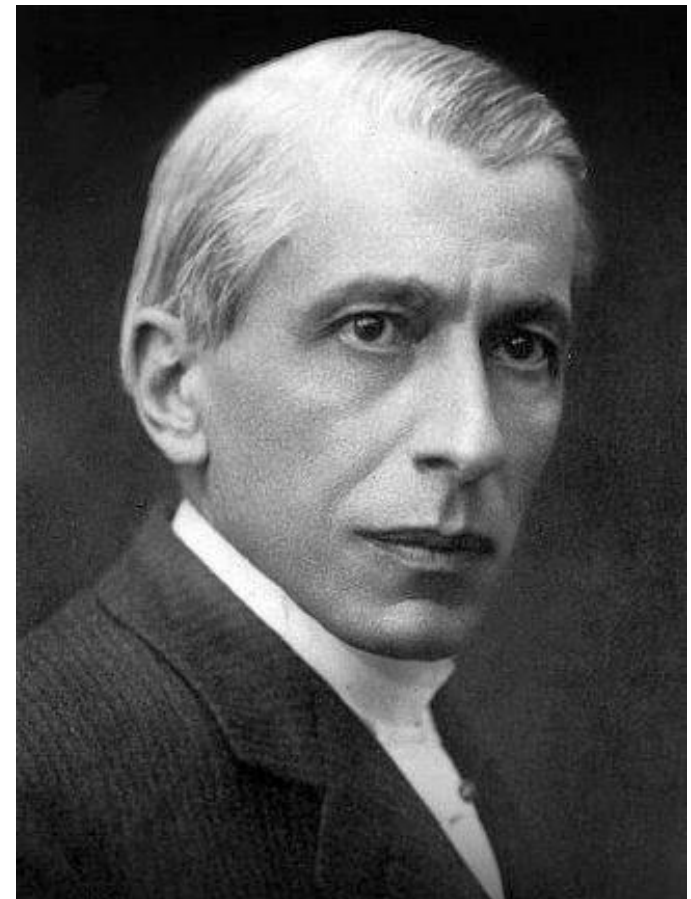


History of Insulin

- 1889
 - Minkowski and von Mering (Strasbourg, France) showed that the removal of a dog's pancreas could induce diabetes
- 1908
 - Georg Zuelzer found that injecting pancreatic extract could help control diabetes, but the side effects were extreme
- 1909
 - de Meyer of Belgium proposes the name insulin (Latin for Island) for the unknown pancreatic substance
- 1920
 - Frederick Banting begins his pancreatic extract experiments

History of Insulin

- 1916
 - Nicolae Paulescu of Romania developed an aqueous pancreatic extract which when injected into a dog, normalized blood sugars
 - He was called to service in World War I
- August 1921
 - Paulescu publishes an article describing the successful isolation of pancreine
- April 10, 1922
 - Paulescu secures a Romanian patent for pancreine



The Discovery of Insulin

- 1921 (University of Toronto)
 - Frederick Banting and Charles Best isolate insulin from dog pancreases
 - 1922 James Collip purified the insulin and treated patient Leonard Thompson
 - Occurred in the laboratories of John Macleod



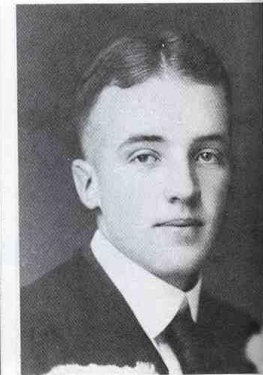
Frederick Grant Banting (1891-1941).



John James Rickard Macleod (1876-1935).



James Bertram Collip (1892-1965).



Charles Herbert Best (1899-1978).

The Discovery of Insulin

- 1923
 - Banting and Macleod were awarded the Nobel Prize in medicine (Banting split his prize with Best, MacLeod split his prize with Collip)
 - This drove Banting crazy
 - It also drove Paulescu crazy, who wrote to the Nobel committee that he was the one to first discover insulin
 - These claims were rejected



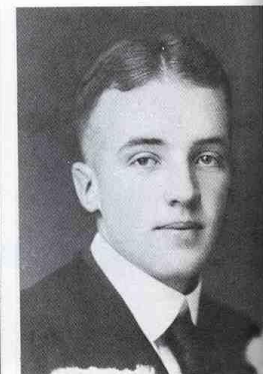
Frederick Grant Banting (1891-1941).



John James Rickard Macleod (1876-1935).



James Bertram Collip (1892-1965).



Charles Herbert Best (1899-1978).



Before and after pictures of a 1922 patient of Dr. H. Rawle Geyelin.
Thought to be too indelicate for lay viewing in the 1920s.

Diabetes Management in the 20th Century

- 1923
 - Eli Lilly begins commercial production of insulin (initially called Isletin)
- 1930's
 - Protamine zinc insulin was the first insulin to be modified for physiologic convenience
- 1945
 - NPH insulin was introduced



Diabetes Management in the 20th Century

- 1983
 - The first biosynthetic human insulin is introduced (until this date, manufacturers had to stockpile animal pancreatic tissue)
- 1996
 - FDA approves the first insulin analog, insulin lispro. (Other rapid acting analogs (aspart, glulisine) follow)
- 2000
 - The first basal insulin analog, insulin glargine becomes available. (Other basal insulin analogs (detemir, degludec) follow)

Diabetes Management in the 20th Century

- 1944
 - Uniform insulin syringe is developed
- 1960's
 - Home testing for glucose in the urine helps improve control
- 1970
 - Ames introduces the first glucose meter for hospital use
- 1983
 - The reflolux becomes the first meter for home BG testing



Diabetes Management in the 20th Century

- 1993
 - The Diabetes Control and Complications Trial (DCCT) publishes a landmark report

The New England Journal of Medicine

©Copyright, 1993, by the Massachusetts Medical Society

Volume 329

SEPTEMBER 30, 1993

Number 14

**THE EFFECT OF INTENSIVE TREATMENT OF DIABETES ON THE DEVELOPMENT AND
PROGRESSION OF LONG-TERM COMPLICATIONS IN INSULIN-DEPENDENT DIABETES
MELLITUS**

THE DIABETES CONTROL AND COMPLICATIONS TRIAL RESEARCH GROUP*

Gap in Medical Knowledge

- As Joslin had been insisting for decades, could intensively managing type 1 diabetes reduce the risk of complications?
- Up to the early 90's, the traditional method of managing type 1 diabetes was one or two fixed doses of insulin per day.
- Was it really worth it to check blood sugar more often and give insulin more than once or twice a day?

Diabetes Control and Complications Trial

- 1441 patients with type 1 diabetes diagnosed more than a year but less than 15 years were recruited
- Randomly assigned into conventional treatment group (one or two daily insulin injections) or intensive therapy group (more frequently monitored blood glucose and at least three daily injections)
- Patients followed on average of 6.5 years (from 1983 through 1989 to 1993)

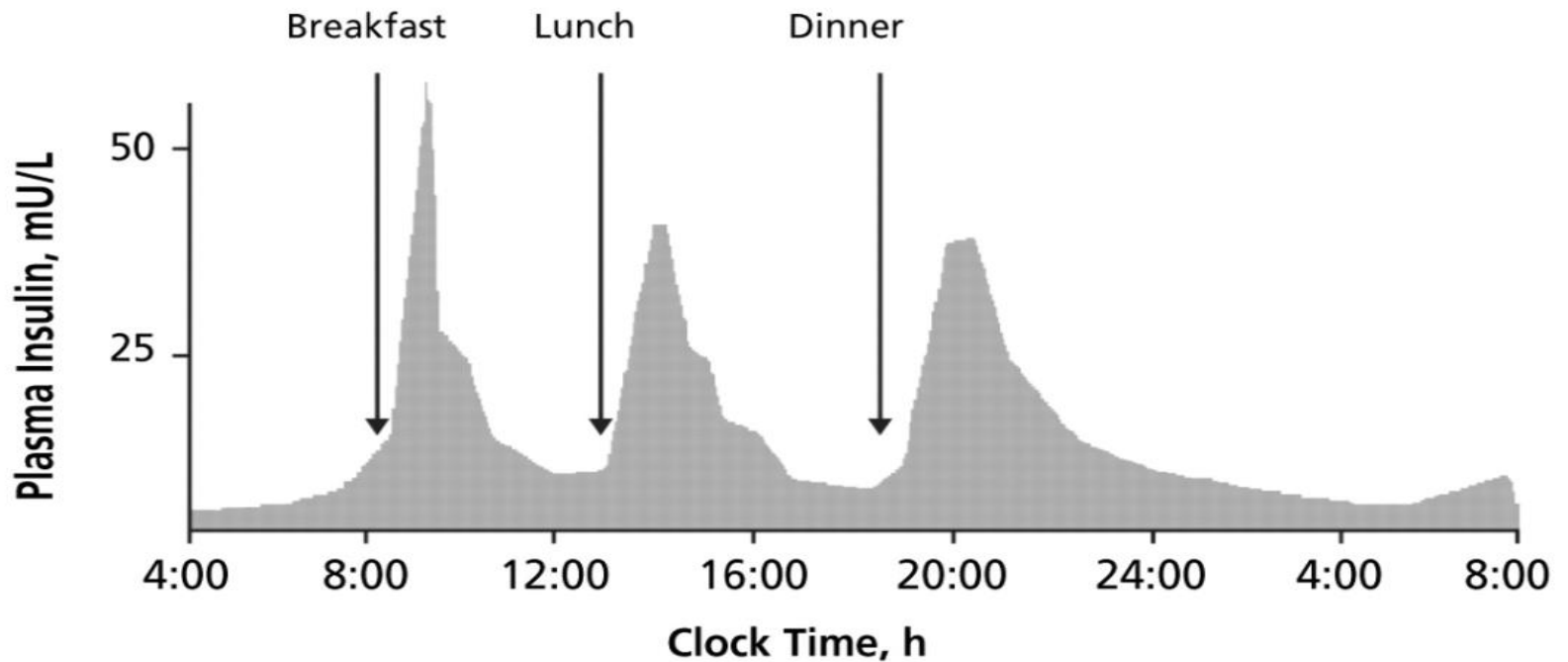
DCCT results

- Intensive control therapy reduced risk of developing retinopathy by 76%
 - In those who had mild retinopathy, intensive control slowed the progression by 54%
- Intensive control therapy reduced microalbuminuria (40 mg/day) by 39%
 - And reduced albuminuria (300 mg/day) by 54%
- Intensive control therapy reduced clinical neuropathy by 60%
- Severe hypoglycemic events did increase by 200-300%

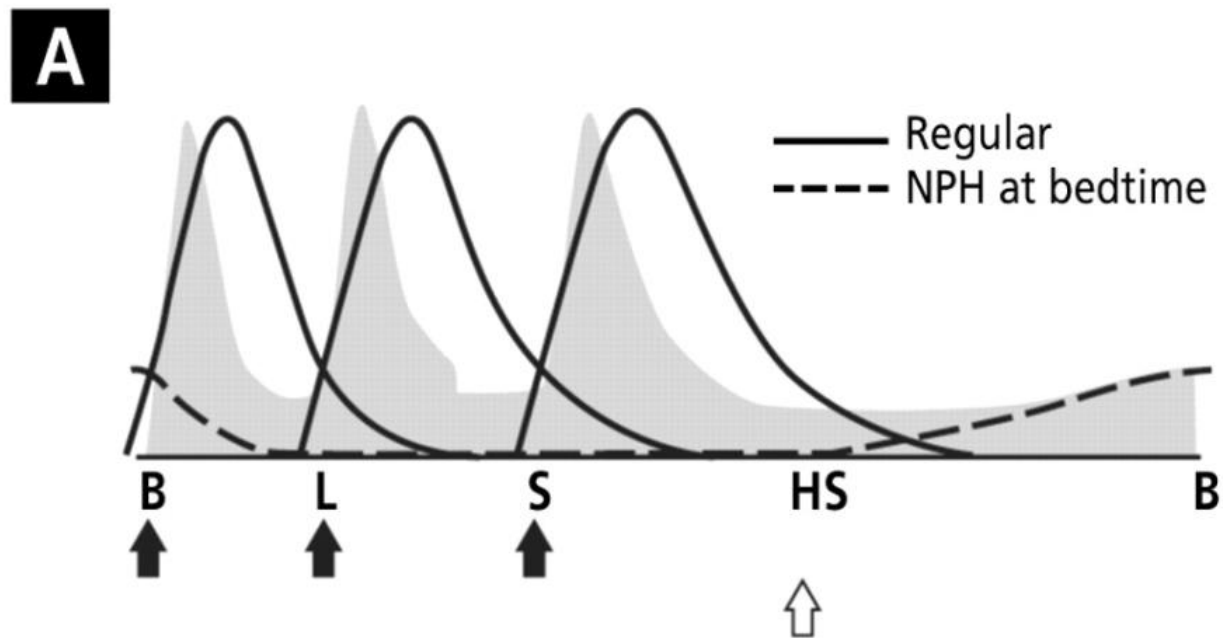
DCCT

- Prior to the DCCT, there was no medical proof that the additional burden of intensive insulin therapy was worth the inconvenience
- DCCT also provided quantifiable justification to HCP's that the additional expenses associated with intensive glycemic control and close monitoring of diabetes were cost effective
- Treatment radically changed for both type 1 and type 2 diabetes patients
- The goal became to mimic physiologic insulin secretion

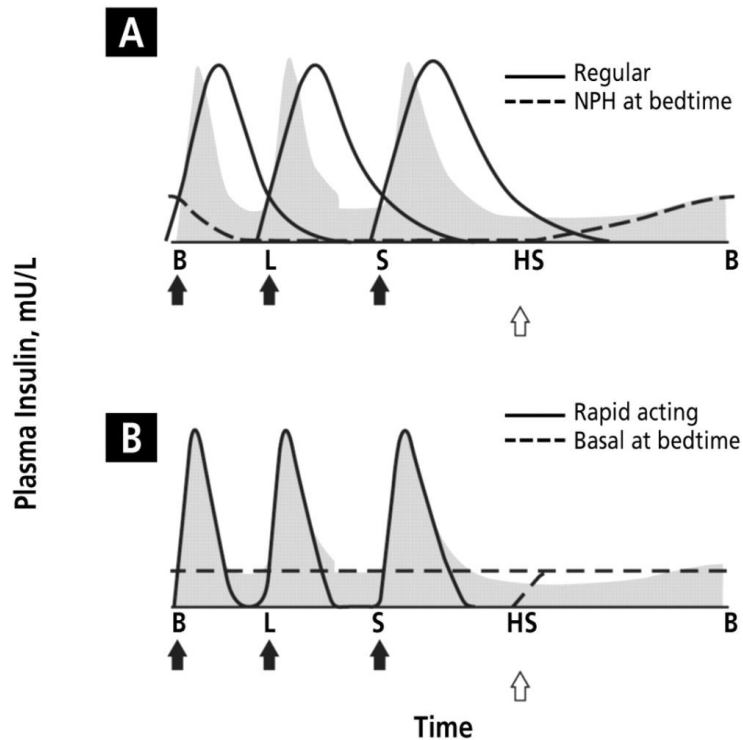
Physiologic insulin secretion (in a non-diabetic)



Mimicking physiologic insulin secretion before 1996



Mimicking physiologic insulin secretion after 1996 and 2000



- In 1996, rapid acting insulin analogs became available
- Injectable basal insulin followed in 2000

- Journal of the American Osteopathic Association, January 2009, v. 109, 26-36

Alternative Regimens

- There are still some patients who use NPH
 - Pre-mixed insulin regimens (70/30, 75/25, 50/50)
 - NPH can be the best insulin to cover overnight tube feedings
- These regimens may be covered in more detail by Dr. Paulo next

Diabetes Technologies

- I will defer to Dr. Dennis for more in depth coverage later today

Diabetes At School

- My goals for a child at school
 - Avoid severe hypoglycemia
 - Avoid DKA
 - Improve long-term control to reduce complications
 - Keep the child with her/his peers!
- Different family situations
 - The hyperintense family
 - The overly laid back family

Glucose Monitoring at School

- When to check sugars?
 - Everyone is different
 - In general, before meals
 - Post-prandial BG's can lead to insulin stacking
 - As needed for signs and symptoms of hyperglycemia or hypoglycemia

Dose Calculation/Carb Counting

- Likely covered in depth by Mrs. Scott last night
- Some kids will come in with their entire lunch labeled and others will eat school lunch where the listed carb counts may not always be perfect.

Nutrition/Preprandial Bolusing

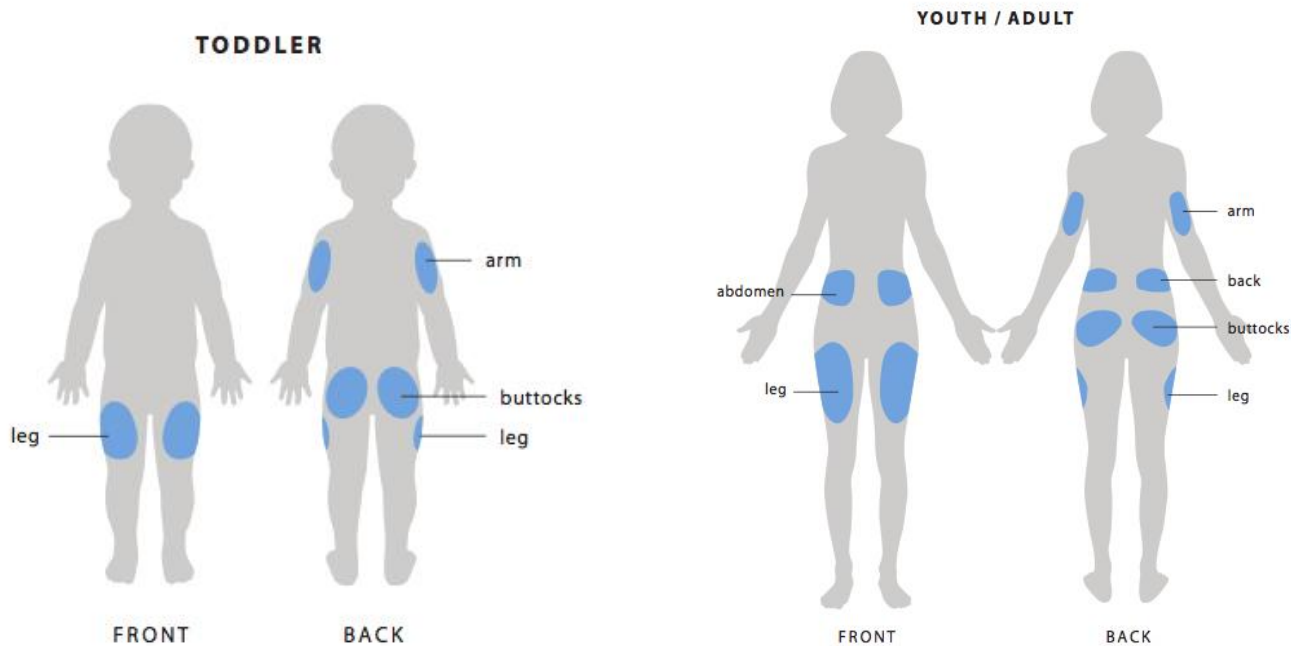
- We're playing soccer, not golf
- Try to get the insulin and the food to hit the bloodstream at the same time

Injection Techniques (Injection site rotation)

- Too many kids want their shot (or infusion set) in the same place, which leads to lipohypertrophy
- As nurses, you can advocate for shot rotation

Potential Insertion Sites

- Screen for lipohypertrophy
 - This may indicate poor insulin delivery



Hypoglycemia

- Likely to be covered in more depth by Dr. Houk
- My goal:
 - Get the sugar back up and get the kid in the classroom

Hyperglycemia

- My goal
 - Check for ketones, give the insulin required and get the kid back in the classroom

Ketones

- Follow more closely, but unless the child is vomiting, give insulin and fluid and see if the child can get back into the classroom

504 plans

- Details the actions the school will take to make sure the student with diabetes is medically safe, has the same access to education as other children, and is treated fairly.

Typical Provisions of a 504 Plan

- Multiple staff members are trained to check BG, administer insulin and glucagon
- All school staff can recognize symptoms of highs and lows
- Capable students can self-manage anywhere and keep their supplies with them
- Assistance provided in the classroom to increase safety and decreased missed time

Typical Provisions of a 504 plan (continued)

- Full participation in all extracurricular activities and field trips
- Permission to eat when necessary
- Permission to take extra trips to the bathroom and get water
- Permission for extra absences for appointments and sick days
- Testing parameters for high or low sugars

Social Media



- Tudiabetes.org
- Diabetes Social Media Advocacy (twitter)
- Glu (website)
- Beyond type 1
- Children With Diabetes
- Nightscout Foundation

Support Groups

- JDRF
- Facebook
- Project Blue November

Podcasts

- Diabetes Daily Grind: Real Life Diabetes
- Sound Bites with Melissa Joy Dobbins
- Diabetes Connections with Stacey Simms

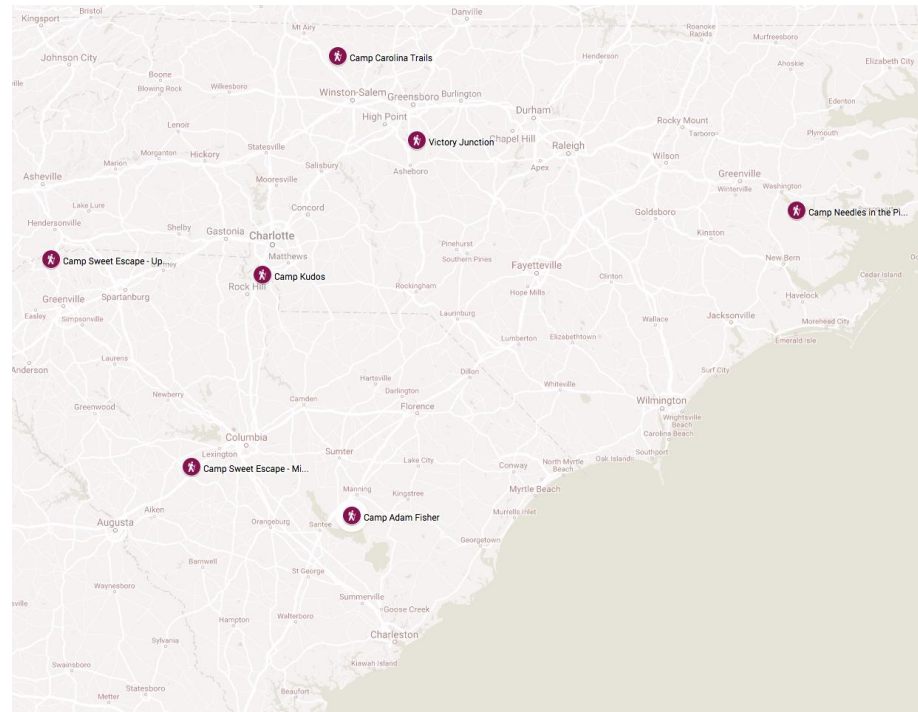


Diabetes Applications

- Calorie King (may only be available on iOS)
- GoMeals (android)
- App that goes with the meter

Summer Camps

- More may exist, but these are the ones I know of
- Camp Sweet Escape Upstate and Midlands
- Camp Adam Fisher
- Camp Carolina Trails
- Victory Junction
- Camp Needles in the Pines
- Camp Kudos (Day Camp)



Discussion