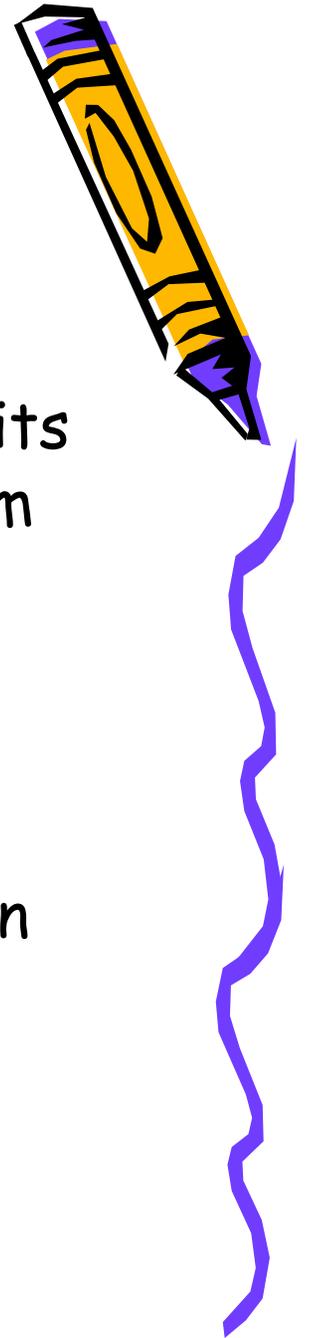
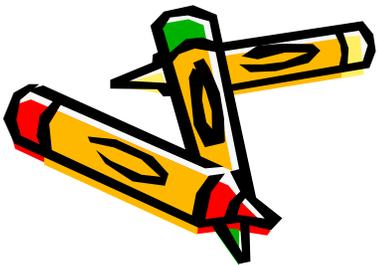
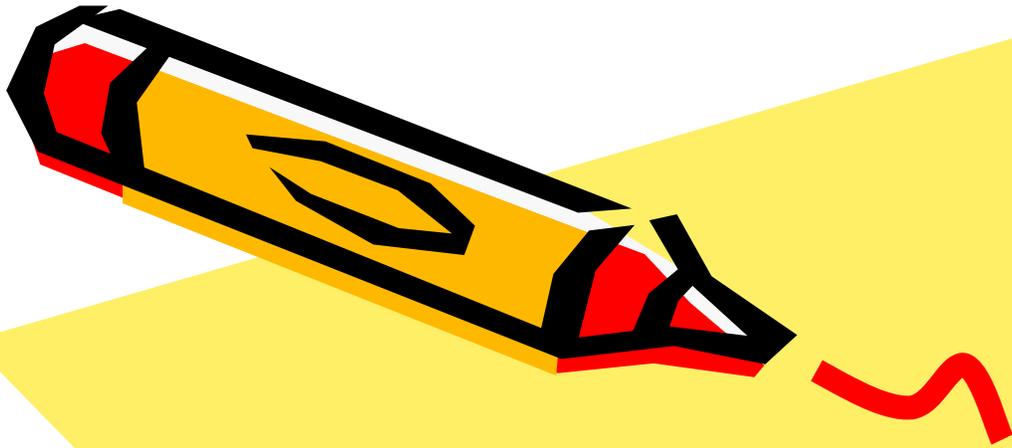


Accreditation

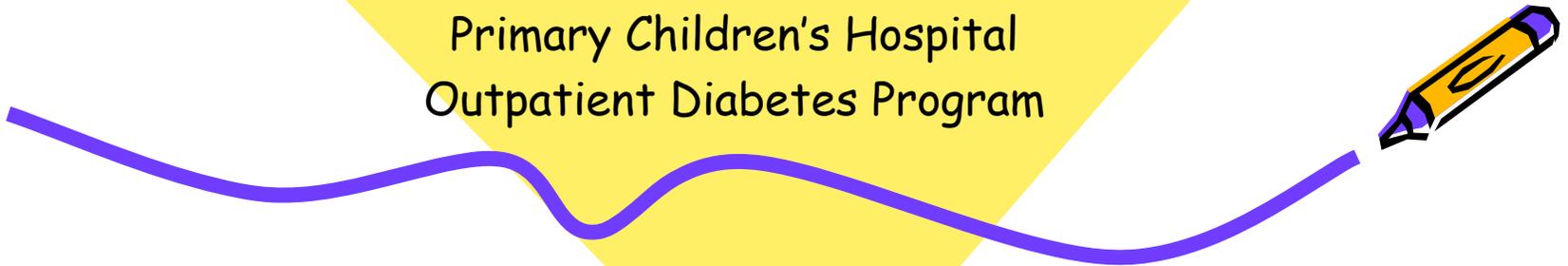
- The content of this Webinar presentation, in its enduring state, will expire on 03/19/2015 from this date on CNE's can no longer be awarded.
- Measures have been taken, by the Utah Department of Health, Bureau of Health Promotions, to ensure no conflict of interest in this activity.





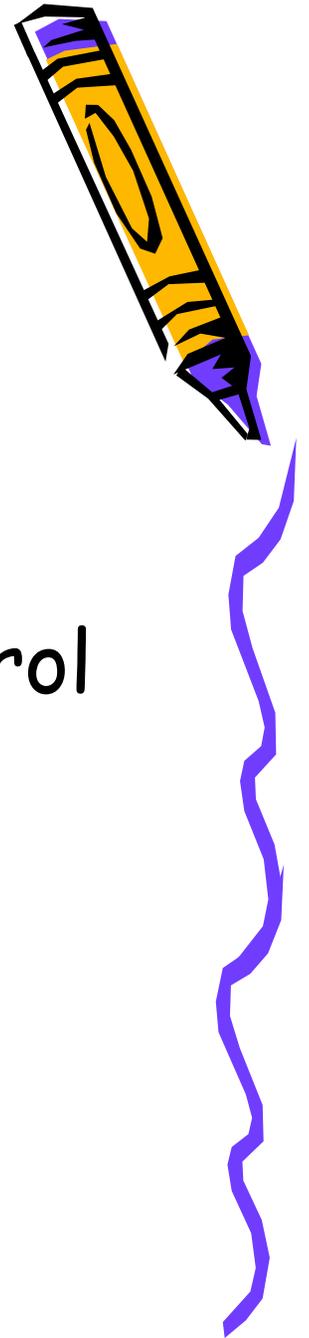
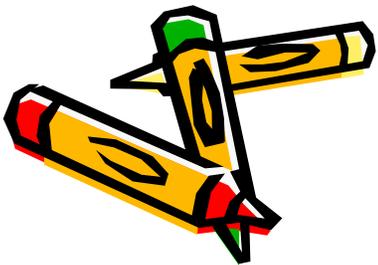
Pediatric Diabetes Overview

Trina Z. Brown, MS, APRN, CPNP, CDE
Primary Children's Hospital
Outpatient Diabetes Program



Objectives

- Briefly describe some of the proposed causes of T1DM.
- Describe age-based diabetes control targets.
- Describe diabetes treatment targeted to pediatric population.



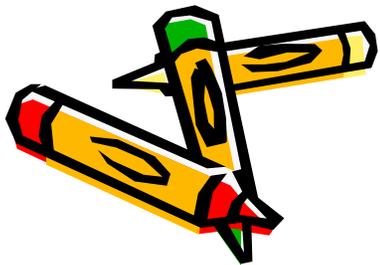
Epidemiology

Utah

- 3 per 1000 under age 18 years
- 33 per 100,000 children
- ~20-25% of T1DM population under age 5 years

PCH

- New Diagnoses 2013= **280**
- Pump starts 2013= **140**



National/International

2.2 cases per 1000 under age 20 years

Less than 10 years old:

19.7 per 100,000 new cases of T1DM

0.4 per 100,000 T2DM

Over 10 years old

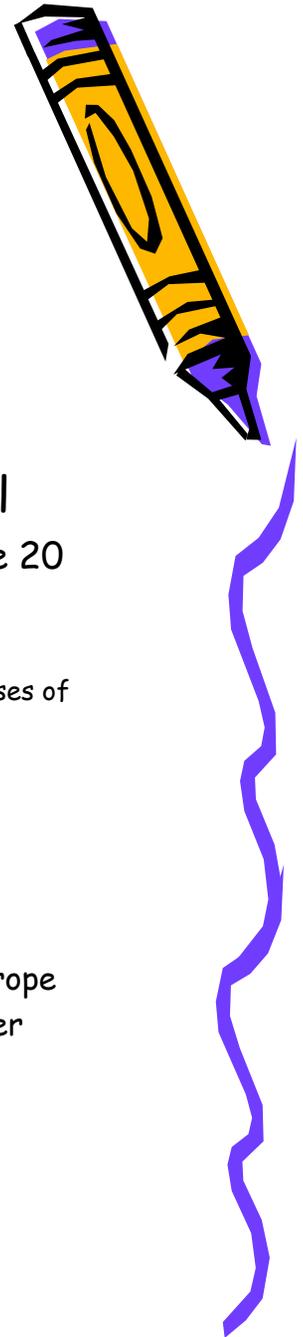
18.6 per 100,000 T1DM

8.5 per 100,000 T2DM

Increasing

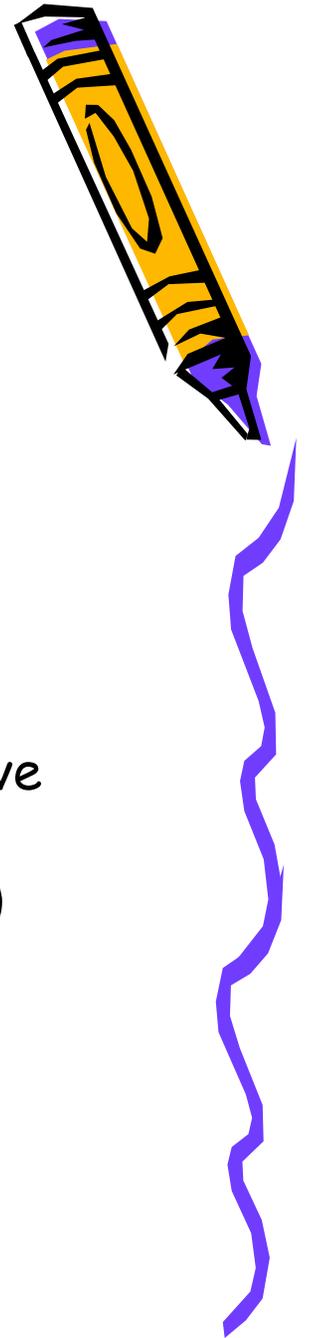
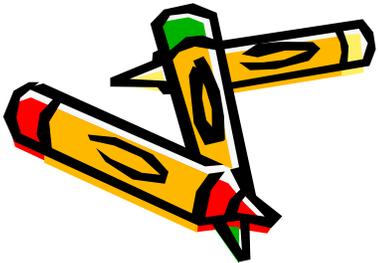
~3% per year US/3.9% Europe

Under age 5 years: **5.4%** per year in Europe



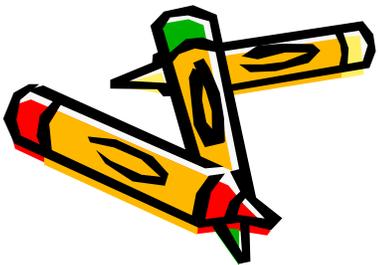
Genetic Susceptibility

- 40 loci (so far) known to affect disease susceptibility
 - HLA region on chromosome 6
- HLA Class II haplotypes
 - Greatest susceptibility
 - DRB1*0401-DQB1*0302
 - DRB1*0301-DQB1*0201
 - Provide Disease Resistance
 - DQA1*0102-DQB1*0602
 - DRB1*1501
- Insulin associated loci
 - VNTR
 - PTPN22
 - CTLA4
 - IL2RA
- Most thought to involve immune response (autoimmune included)



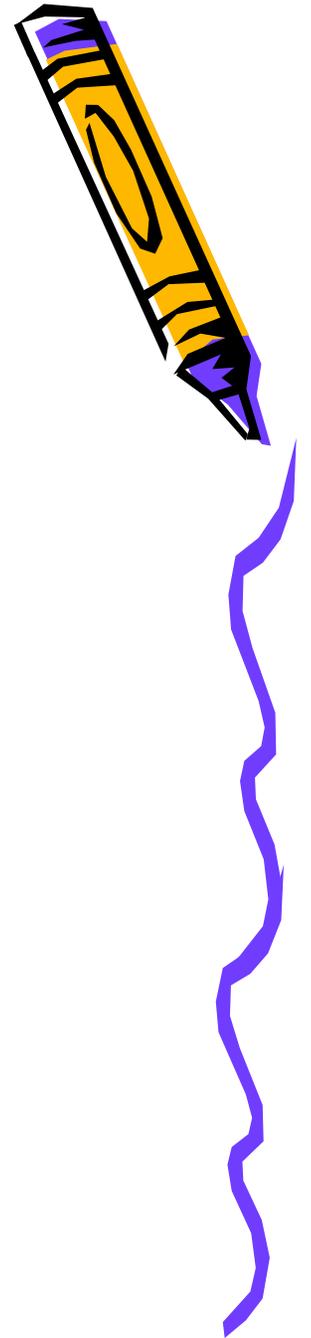
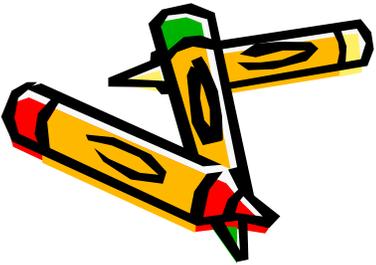
Environmental "Causes"

- Perinatal
 - Preeclampsia, neonatal respiratory disease, jaundice, maternal age >25 years
- Hygiene hypothesis
 - Improved "sanitation" increasing immune mediated disorders
- Viruses (IgM)
 - Enterovirus
 - Coxsackie
- Dietary
 - Cows Milk (beta-casein exposure)
 - Vitamin D (protective)
 - Omega-3 fatty acids (protective)
 - Early or late introduction of cereal (4-6 months of age)
 - Nitrates in drinking water

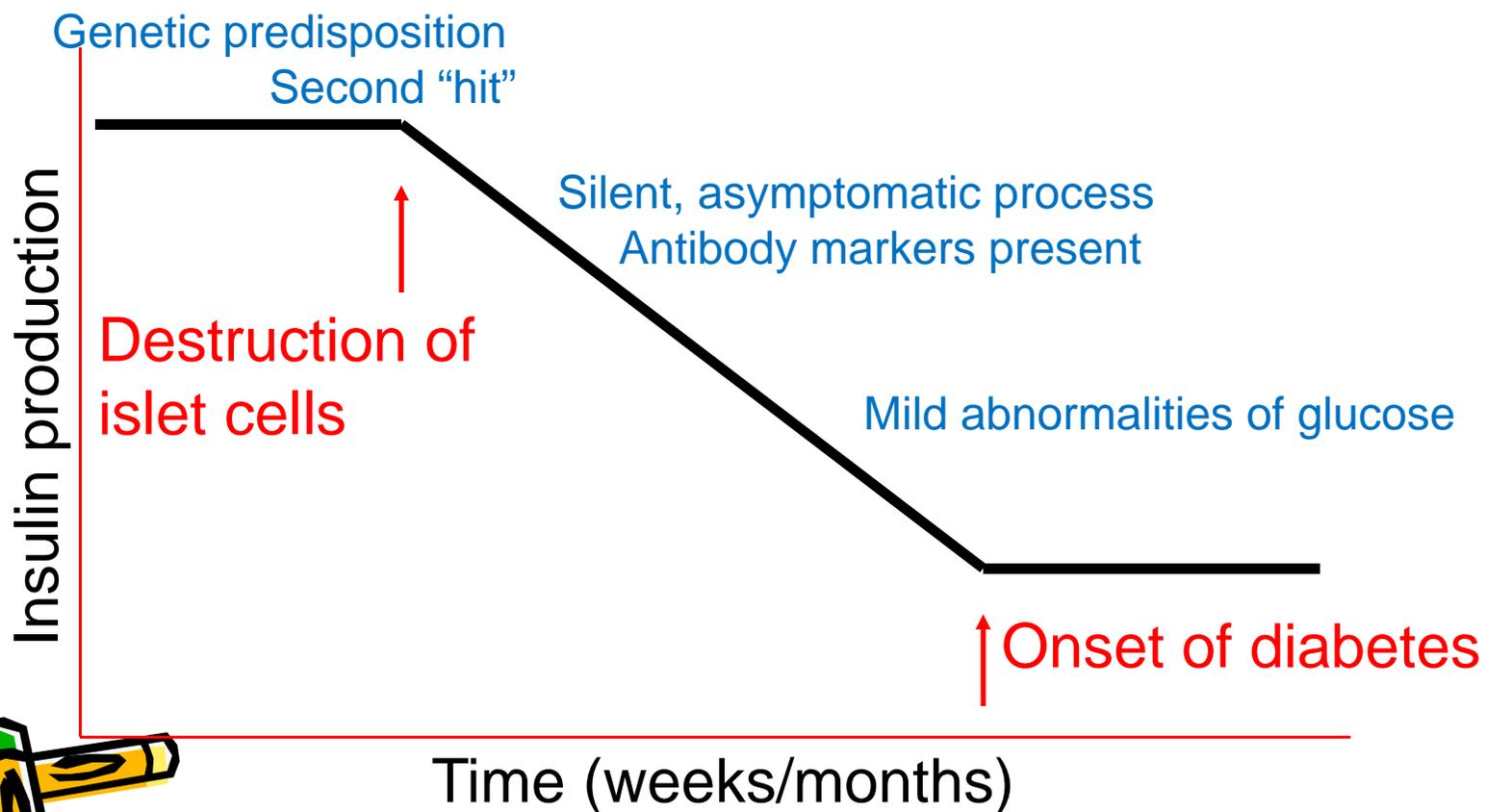


Risk⁴

- No family history: 0.4%
- Mother with T1DM: 1-4%
- Father with T1DM: 3-8%
- Both parents: as high as 30%

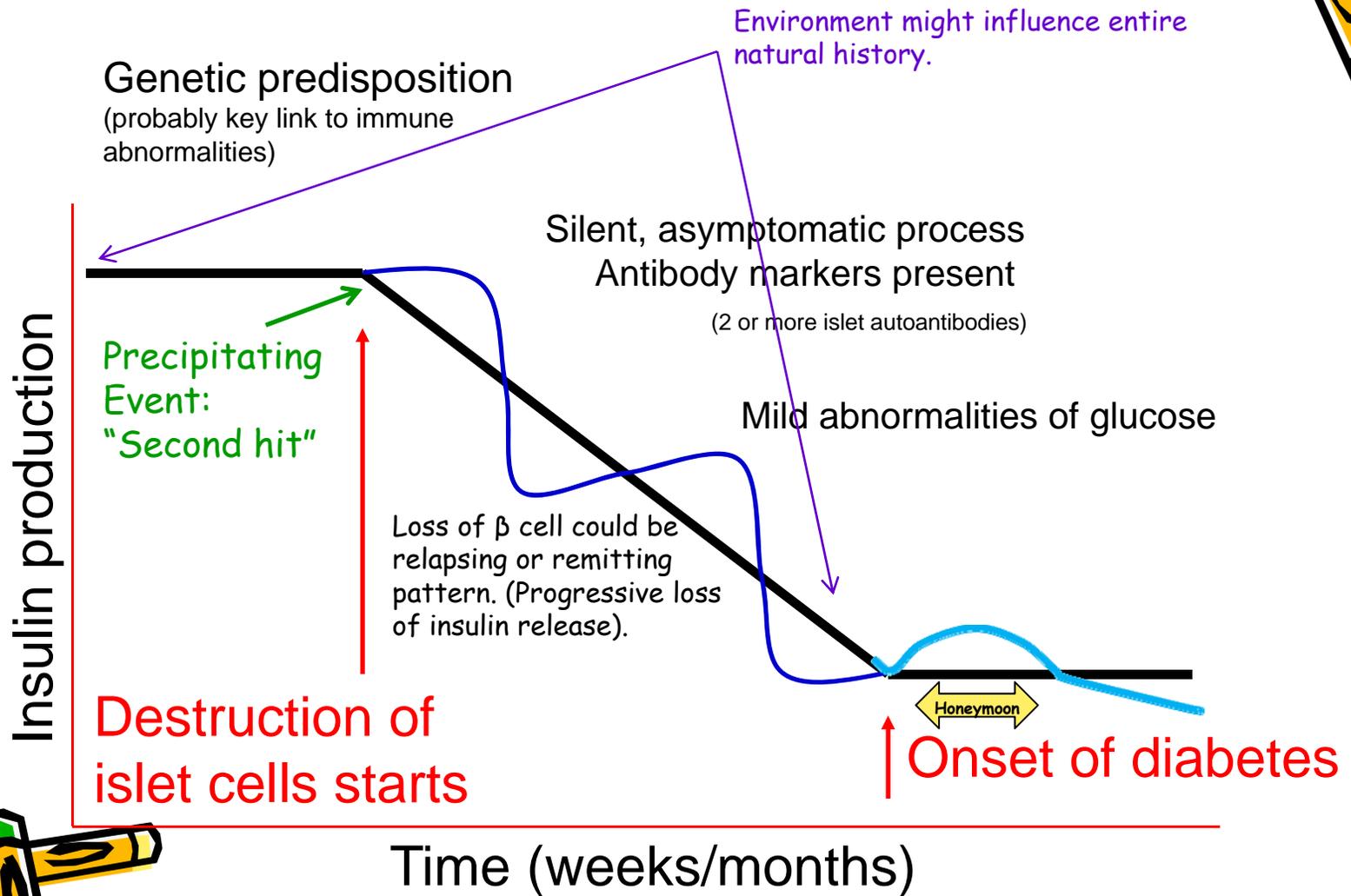


Onset of Type 1 Diabetes

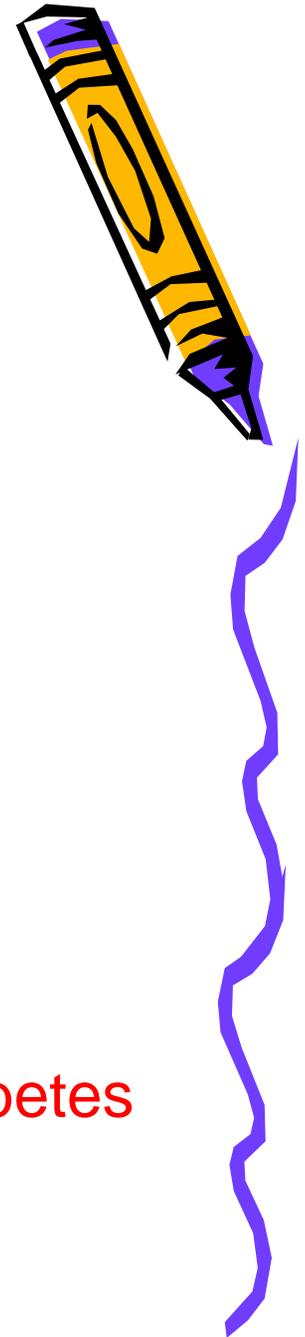
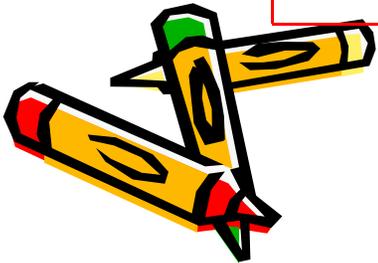


Natural History of type 1 diabetes. A re-creation of the model, originally proposed in 1986.²

Onset of T1DM

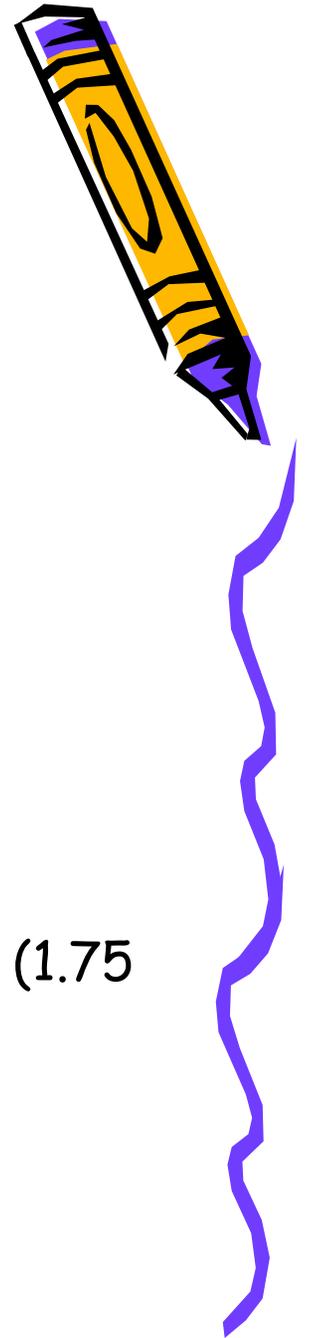
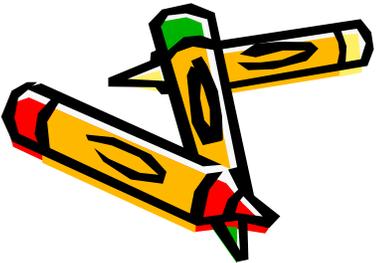


Natural History of type 1 diabetes with more theory, hypotheses, and detail.¹



Diagnosis

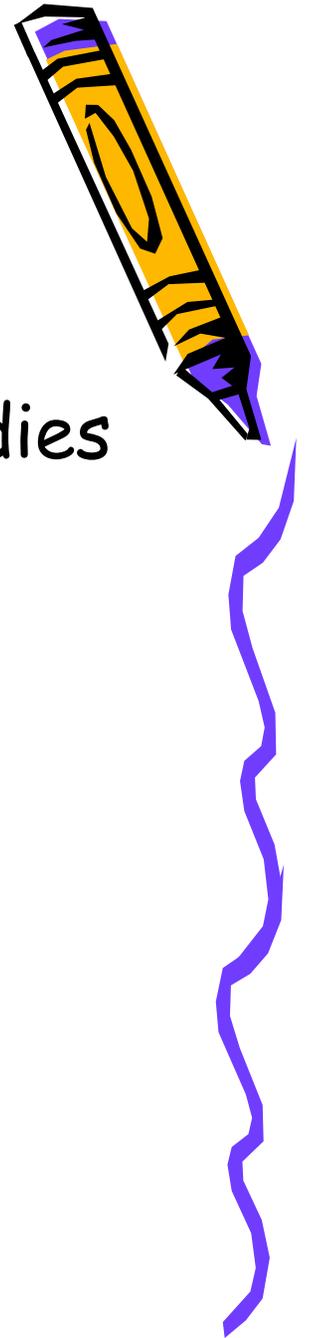
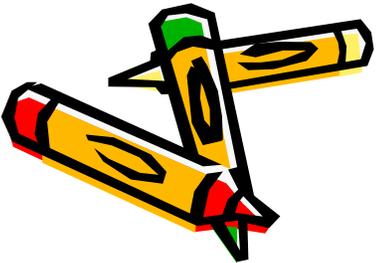
- New Onset
 - Classic triad: polyuria, polyphagia, polydipsia
 - More DKA and dehydration in pediatric population
- Diagnostic Criteria
 - Fasting Plasma Glucose (FPG) \geq 126 mg/dl
 - Random venous plasma glucose \geq 200 mg/dl
 - Plasma glucose \geq 200 mg/dl 2 hrs after glucose load (1.75 g/kg or 75 grams max)
 - Hgb A1c \geq 6.5% (more for dx of T2DM)



Autoimmunity

- 70-90% have immunological autoantibodies (10-30% do not (and still have T1DM))
 - Insulin Autoantibodies (IAA)*
 - Islet Cell Antibodies (ICA)
 - Islet Cell Antibodies to membranous tyrosine phosphatase (ICA-512)
 - Glutamic Acid Decarboxylase (GADA)*
 - Insulinoma-associated autoantigen 2 (IA2A)*
 - Zinc transporter 8 (ZnT8A)*

* Confirmed targets of autoantibodies in type 1 diabetes of man⁵



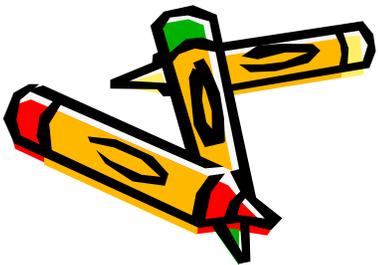
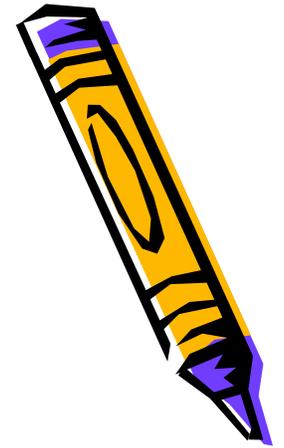
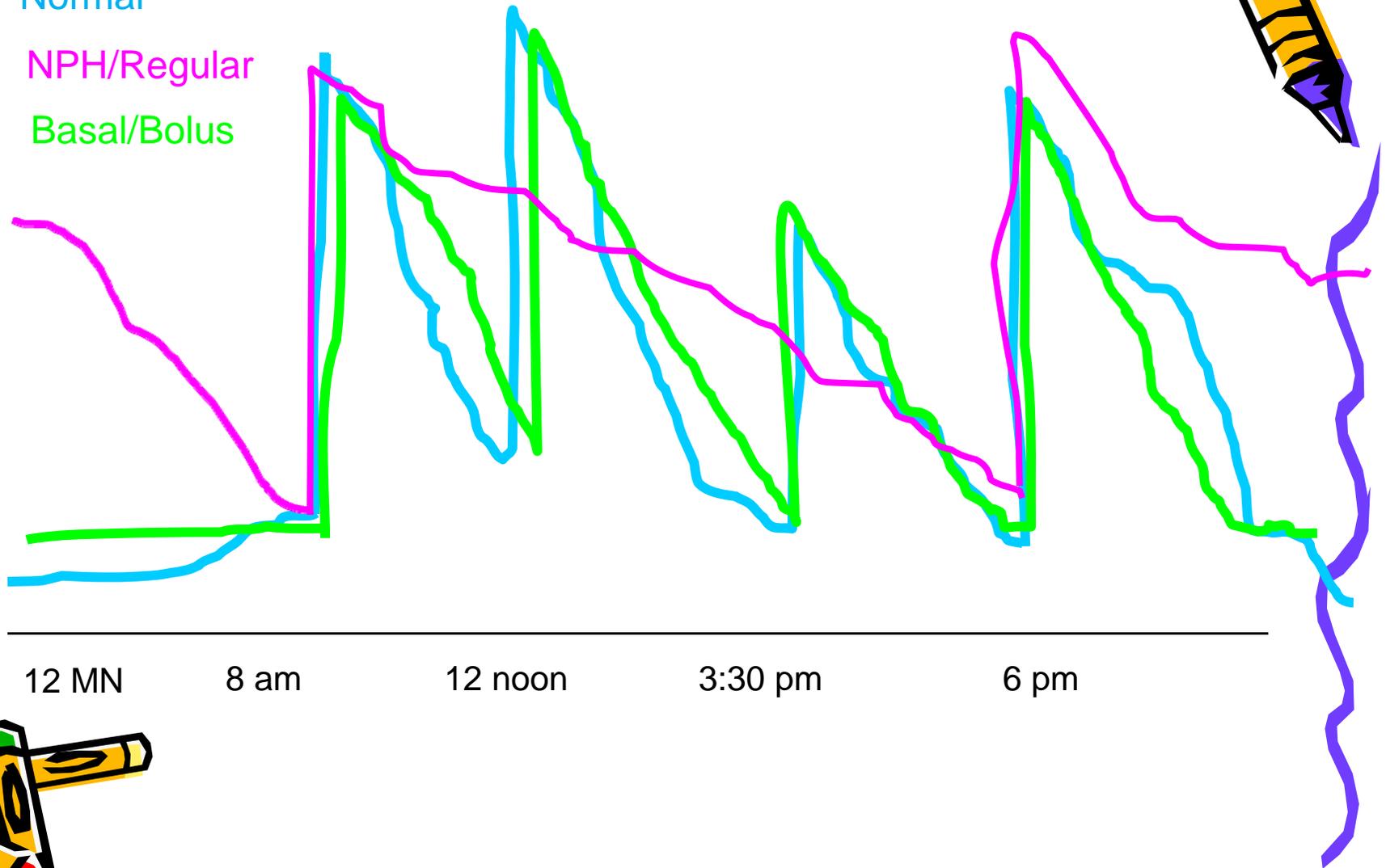
Treatment

Basal-Bolus Insulin

“Normal”

NPH/Regular

Basal/Bolus

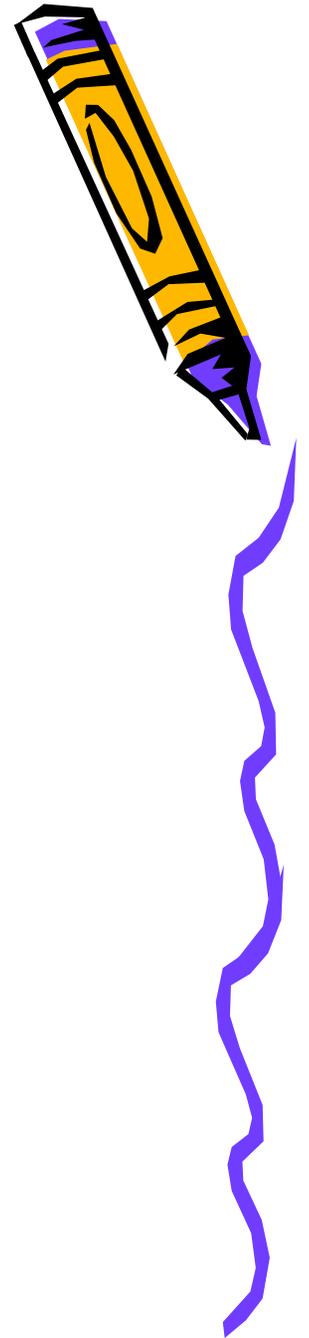
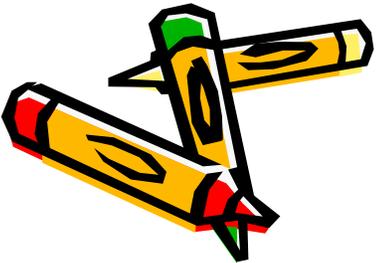


Targets

- Target **Blood Glucose**:

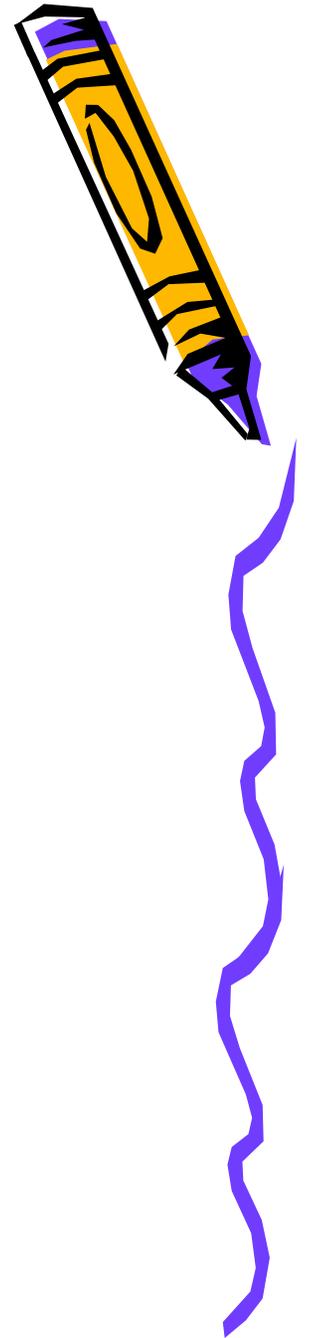
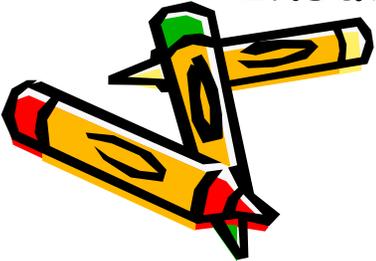
Up to age 7	100-200 mg/dl
7-11 years	80-160 mg/dl
12 and up	70-150 mg/dl
- Target **Hemoglobin A1C**:

Less than 6	7.5-8.5%
6-12 years	< 8.0%
13-19 years	< 7.5%
> 19 years	< 7.0%



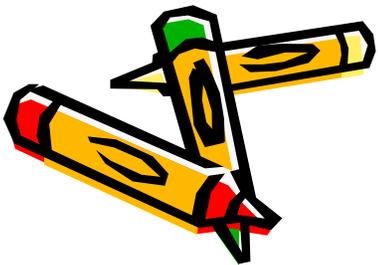
Education

- **Testing, glucometers**
- **Basal-Bolus Insulin** (No sliding scales)
 - Carbohydrate Ratio
 - Match insulin to food (not "feeding insulin")
 - Correction Factor
 - How much 1 unit of insulin decreases glucose
- **Carbohydrate Counting**
 - No exchanges
- **Insulin Administration**



Where do I Start????

- Guidelines to Dosing
- Approximate Total Daily Dose (TDD)
 - 0-6 years: 0.5 to 0.75 units/kg
 - 6-12 years: 0.75 to 1 units/kg
 - 12-~18 years: 1-1.5 units/kg
- Basal Insulin
 - ~ 40-50% of TDD
- Bolus
 - Rule of 1700 ($1700 \div \text{KG or TDD}$)
 - Approximate Correction Factor
 - Rule of 450 ($450 \div \text{KG or TDD}$)
 - Approximate Carbohydrate Ratio



Example:

6 year old
Weight: 19.3 kg

Basal Insulin: 6 to 7 units

($19.3 \times 0.75 \times 0.4$ (or 0.5) = 5.79-7.23 units)

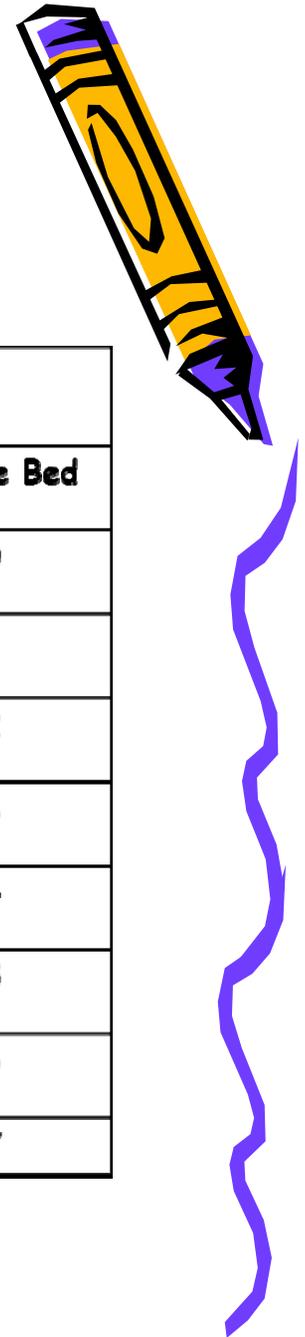
Carbohydrate ratio

1 unit per 25 grams of carbs
($450 \div 19.3 = 23.3$)

Correction Factor

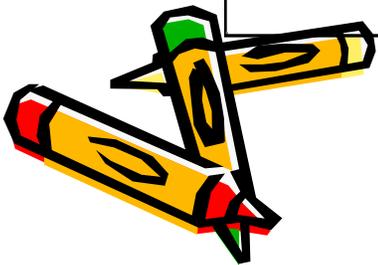
1 unit per 100 mg/dl over 200 mg/dl
or $\frac{1}{2}$ unit per 50 over 200 mg/dl
($1700 \div 19.3 = 88.08$)

Dosing Cards



Carbohydrate Dose (1:10)	
Grams of Carbohydrates	Units of Insulin
5-15	1
16-25	2
26-35	3
36-45	4
46-55	5
56-65	6
66-75	7

Correction Dose (1:50 over 150)		
BG	Pre-Meal	Before Bed
151-200	1	0
201-250	2	1
251-300	3	2
301-350	4	3
351-400	5	4
401-450	6	5
451-500	7	6
501-↑	8	7



*Different ratios and factors available at www.primarychildrens.org/diabetes

Insulin Delivery

Available pens that deliver $\frac{1}{2}$ unit doses

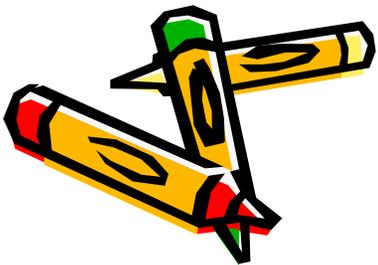
NovoPen Jr
NovoPen Echo



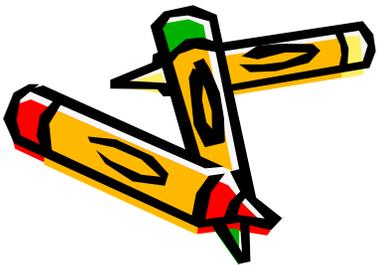
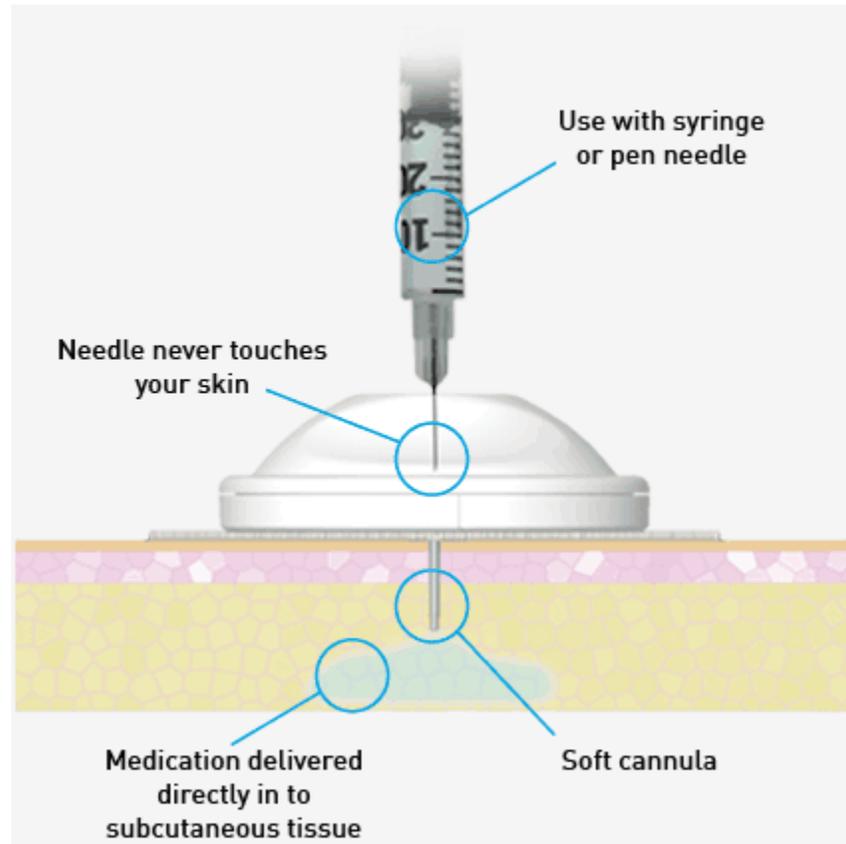
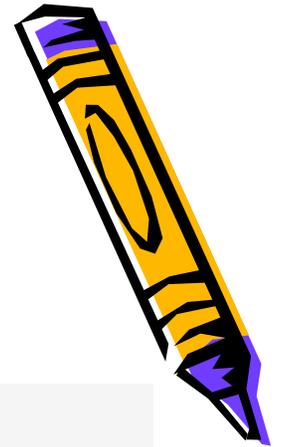
HumPen
LUXURA[®] HD



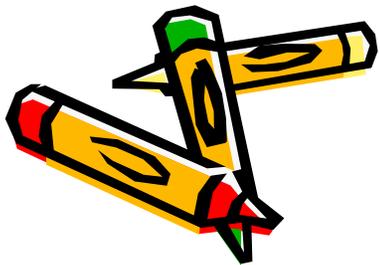
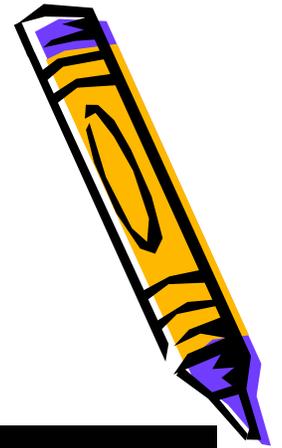
$\frac{1}{2}$ unit marked syringes



I-Port



CSII (Continuous Subcutaneous Insulin Infusion)



Continuous Glucose Monitor (CGM)

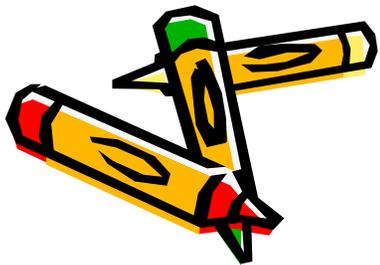
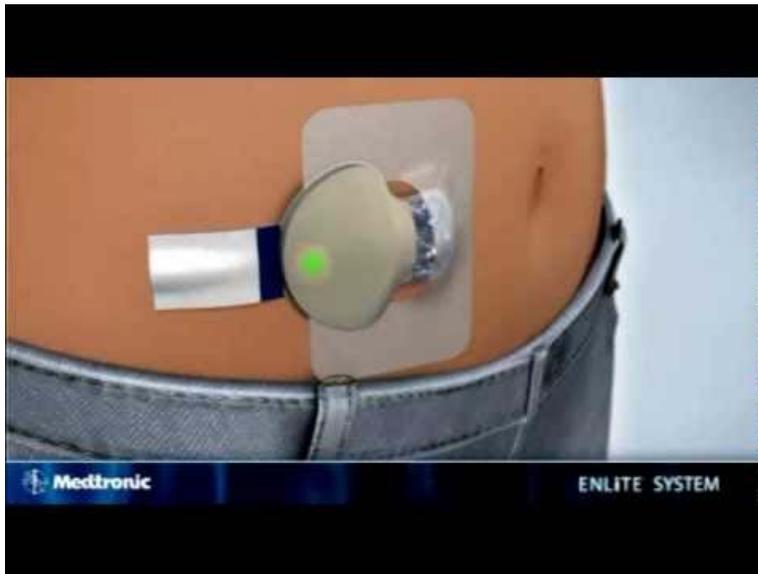
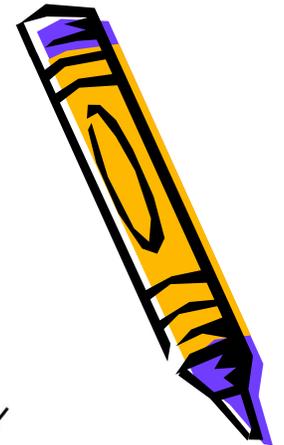
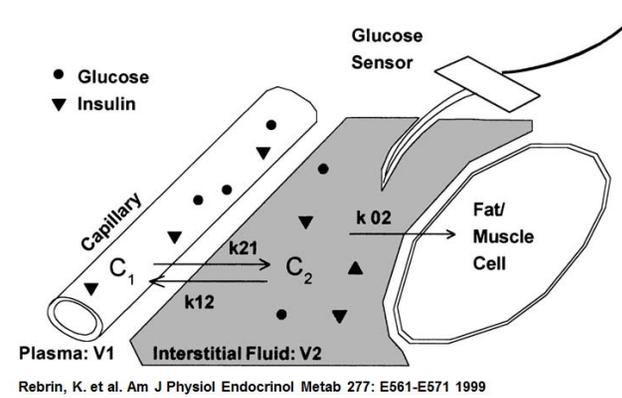


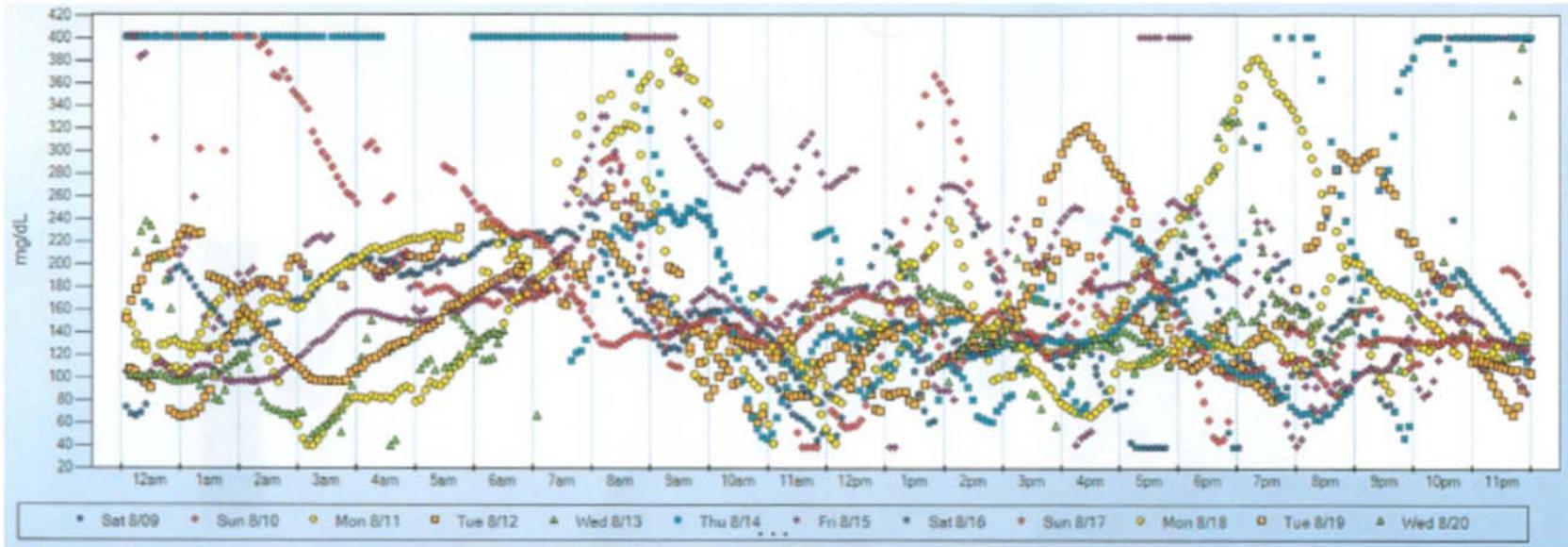
Fig. 1.



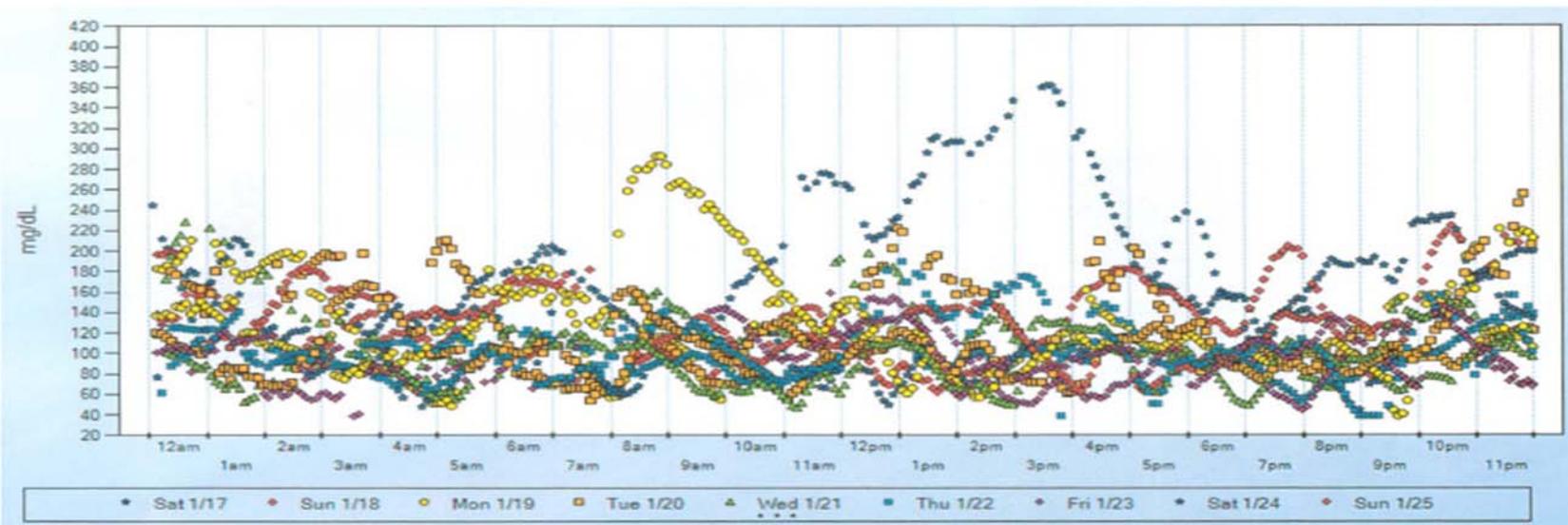
Copyright ©1999 American Physiological Society

AJP - Endocrinology and Metabolism



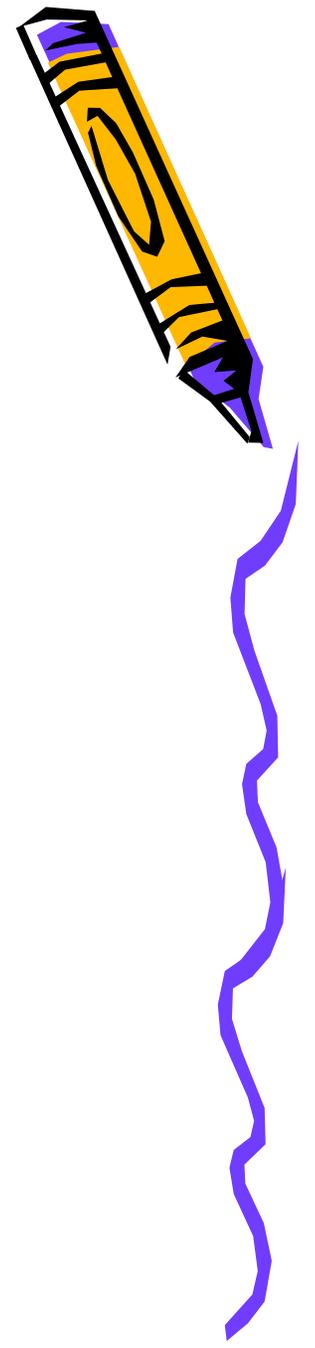
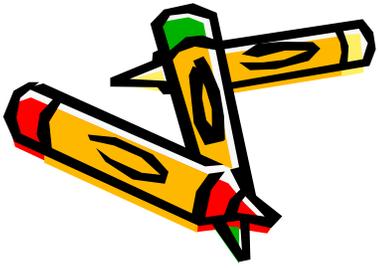


Time	12am	1am	2am	3am	4am	5am	6am	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm	7pm	8pm	9pm	10pm	11pm
AVG	197	182.5	183	180.4	179.8	170.5	208.2	227	251.8	203.2	152.6	132.5	136.1	156	152.9	150.5	150.9	173.6	169.2	164.3	156.2	165.5	196.6	183.9
SD	119	106.6	104	104.4	75.6	46.5	72.9	74.7	81.3	85.7	56.8	62.6	52.6	56.4	55.7	42.3	65.5	71.6	72.6	87.9	79.4	74.3	98.4	113.9



Time	12am	1am	2am	3am	4am	5am	6am	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm	7pm	8pm	9pm	10pm	11pm
AVG	140	124.4	114.2	114.9	100	114.7	125.5	103.9	121.7	117.3	111.9	112.1	127.4	123.7	108.7	109.4	127.4	114.1	106.9	105.6	102.2	104.5	143	136.8
SD	39.7	42.5	39.2	35.1	29.9	35.3	40	37.7	50.3	47.6	39.8	44.7	43.8	56	57	56.3	52	39.1	29.3	33.8	33.4	36.3	41	44.6





"Curative" Treatment??

Genetic predisposition
(probably key link to immune abnormalities)

Environment might influence entire natural history.

Insulin production

Precipitating Event:
"Second hit"

Silent, asymptomatic process
Antibody markers present

Mild abnormalities of glucose

Predict and Prevent

Preserve

Transplant?

Loss of β cell could be relapsing or remitting pattern. (Progressive loss of insulin release).

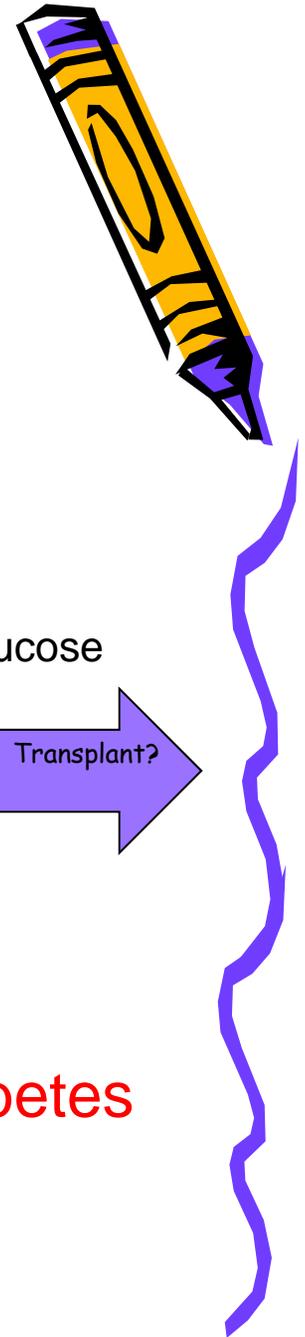
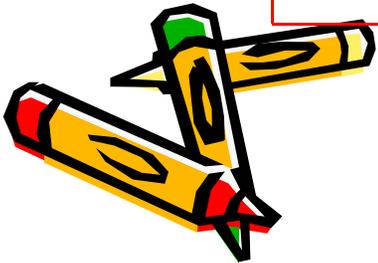
Destruction of islet cells starts

Honeymoon

Onset of diabetes

Time (weeks/months)

Natural History of type 1 diabetes.^{1,3}



References

1. Atkinson, M.A., Eisenbarth, G.S., Michels, A.W. (2013). Type 1 Diabetes. *The Lancet*, 383 (9911), 4-10. doi: 10.1016/S0140-6736(13)60591-7.
2. Eisenbarth, G.S. (1986). Type 1 diabetes mellitus. A chronic autoimmune disease. *N Engl J Med*, (314), 1360-68.
3. Gitelman, S. (2013, October). Altering the course of Type 1 Diabetes: An Update on Prevention and New Onset Clinical Trials. Speech presented at Primary Children's Hospital. Salt Lake City, Utah.
4. Levitsky, L.L., Misra, M. (2013). Epidemiology, presentation, and diagnosis of type 1 diabetes mellitus in children and adolescents. In J.I. Wolfsdorf (Ed.), UpToDate. Retrieved from <http://www.uptodate.com/home/index.html>
5. Pietropaolo, M. (2013). Pathogenesis of type 1 diabetes mellitus. In: I.B. Hirsch (Ed.), UpToDate. Retrieved from <http://www.uptodate.com/home/index.html>

