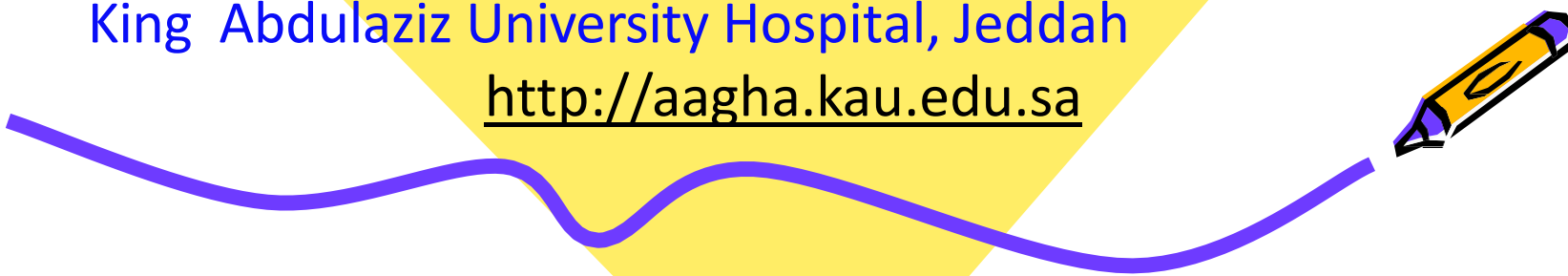




# Hypoglycemia in children with diabetes

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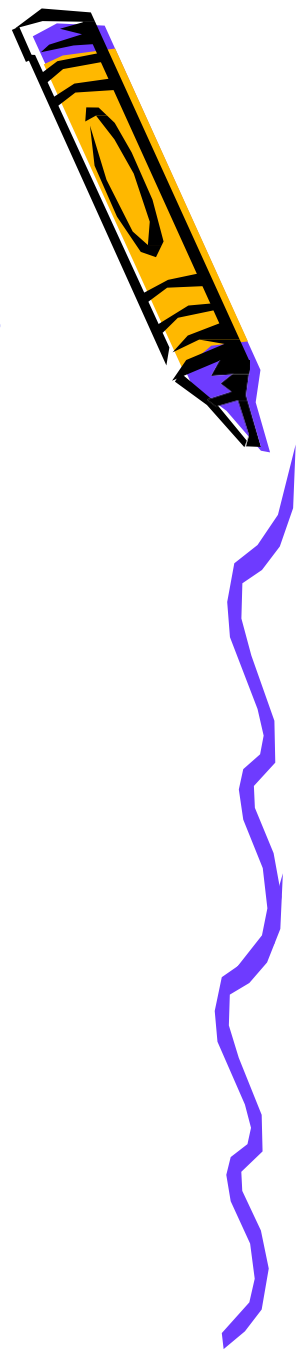
# Objectives

- To understand definition of hypoglycemia.
- To list the common symptoms of hypoglycemia.
- To describe the common causes of hypoglycemia.
- To understand how to prevent & manage hypoglycemia.
- To understand basics of insulin dose adjustment.



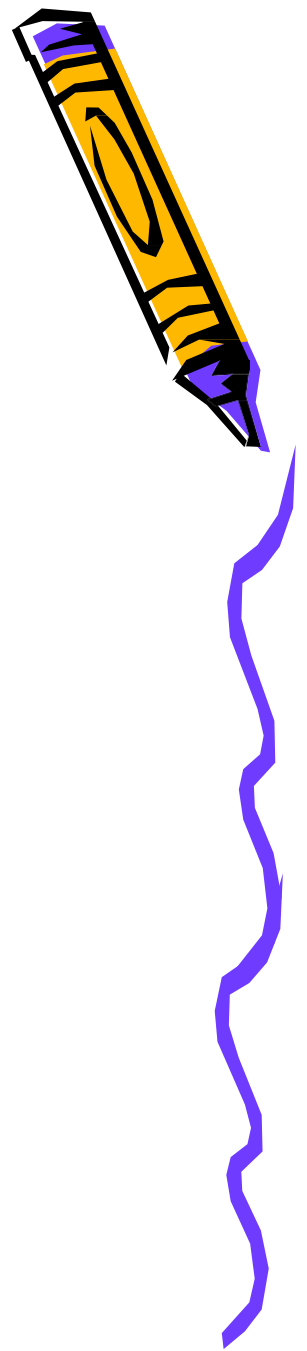
# Definition

- Precise definition remains controversial.
- Most agreed definition, if glucose value  $\leq 3.9$  mmol/l (70mg/dl) in children & adolescents with diabetes.
- Young children below 4 years of age, if glucose reading  $\leq 80$  mg/dl.
- Hypoglycemia may be symptomatic or asymptomatic (**hypo unawareness**).



# Normal & target blood glucose ranges

- Normal blood glucose levels in people who do not have diabetes
  - Fasting: 70 – 100 mg/dl.
  - After meals: up to 140 mg/dl.
- Target blood glucose levels in people who have diabetes
  - Before meals: 90 – 130 mg/dl.
  - 2 hours post meals: < 180 mg/dl.
- Hypoglycemia in patient with diabetes is  $\leq 70$  mg/dl (3.9 mmol/l), while normally, when glucose value is  $\leq 60$  mg/dl (3.3 mmol/l).

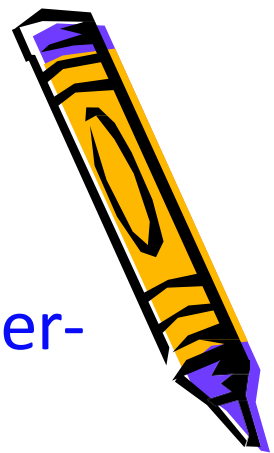


# HYPOGLYCEMIA UNAWARENESS

- Is the term given when patients with diabetes, do not experience the first stage of symptoms & are unaware that their blood glucose are low.
- Possible reasons for this include:
  - Frequent low or untreated blood glucose levels.
  - Young age group.
  - long standing diabetes
  - Patient with poor control diabetes with autonomic neuropathy.



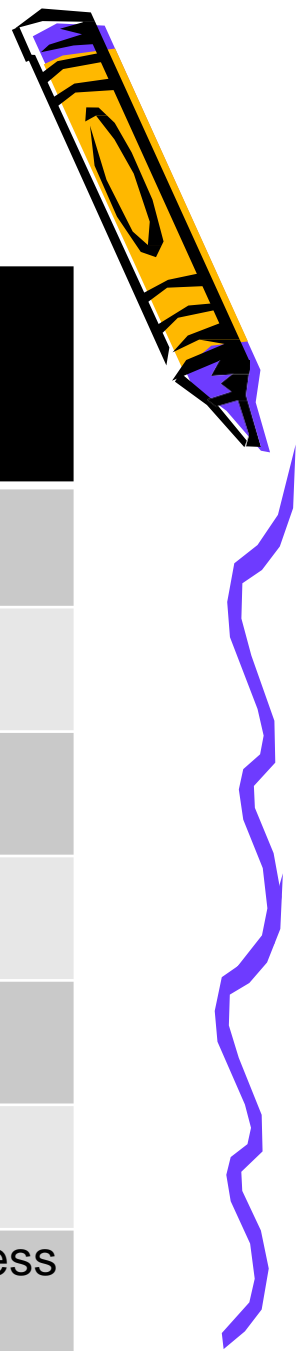
# Counter-Regulatory Responses to Hypoglycemia



- Glucagon & adrenaline are rapid-acting counter-regulatory hormones.
- When hypoglycemia is prolonged, growth hormone & cortisol are released.
- The integrity of glucose counter-regulation is disturbed by type 1 diabetes with time
- In diabetic subjects glucagon & adrenaline responses to insulin-induced hypoglycemia are characteristically lost.



# Symptoms of Hypoglycemia

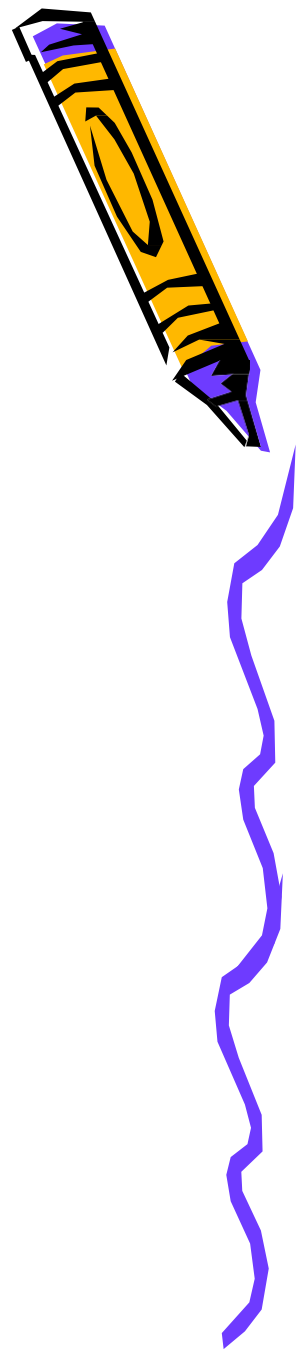


Neurogenic (autonomic)	Neuroglycopenic
Tremor	Difficulty Concentrating
Palpitation	Dizziness/ Confusion
Sweating	Weakness
Anxiety/ nervousness	Drowsiness
Hunger	Vision Changes
Perspiration	Difficulty Speaking
irritability	Seizure/ loss of consciousness



# Symptoms

- Hunger.
- Nervousness & shakiness.
- Perspiration.
- Dizziness or light-headedness.
- Sleepiness.
- Confusion.
- Fatigue.
- Mood swings.
- Irritability.
- Difficulty speaking.
- Hypoglycemia can also happen while sleeping:
  - cry out or have nightmares.
  - find that pajamas or sheets are damp from perspiration.
  - feel tired, irritable, or confused when wake up.

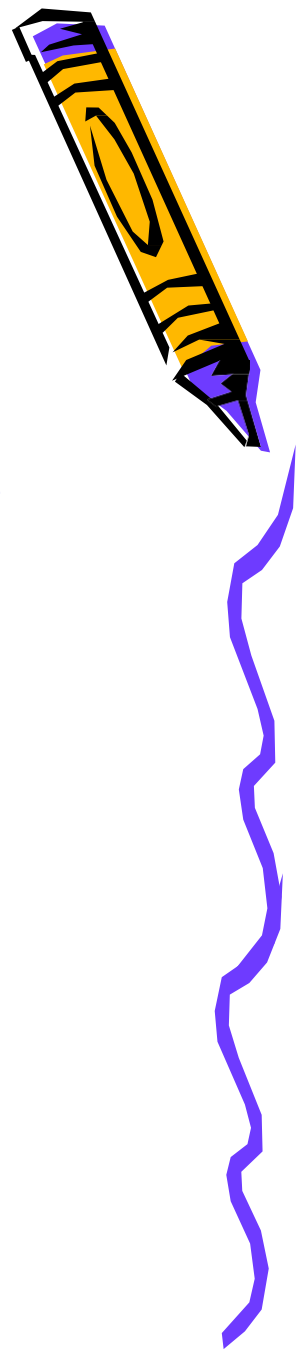




# Causes of Hypoglycemia

The most common causes of hypoglycemia are:

- Inadequate or missed meals or snacks.
- Excessive physical activity (unplanned or more prolonged than usual).
- Insulin administration errors (e.g. inadvertent reversal of morning and evening doses).
- Vomiting & diarrhea.
- Other associated diseases with type 1 DM (Addison's disease, Celiac disease).
- Unknown cause.



# Severity of Hypoglycemia

- **Mild**
    - Autonomic symptoms present.
    - Individual is able to self-treat.
  - **Moderate**
    - Autonomic & neuroglycopenic symptoms present.
    - Individual is still able to self-treat, but need others help.
  - **Severe**
    - Requires the assistance of another person.
    - Unconsciousness / seizure may occur.
- Plasma glucose is typically  $< 2.8$  mmol/L.



## Partial Remission or Honeymoon Phase

- In 60-80 % of children & adolescents, insulin requirements decrease transiently following initiation of treatment.
- The partial remission phase commences within days or weeks of the start of insulin therapy & may last for weeks to 2 years.
- Frequent hypoglycemia attacks happen in this period.
- Usual requirement of insulin is less than 0.5 unit/kg/day.
- HbA1c usually during this period less than 7%.
- As low dose subcutaneous insulin therapy does not prolong residual beta cell function.



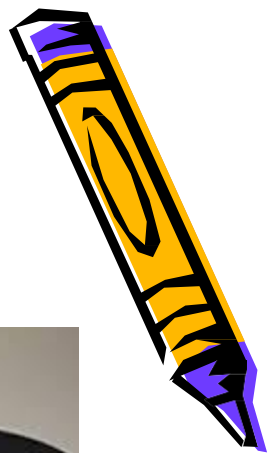
# Prevention

## Advices to the child with Diabetes:

- Check blood glucose regularly & whenever symptoms of hypoglycemia occur
- Search for the cause of hypoglycemia (missing meals, snacks, exercise .....etc).
- Recognize the symptoms of hypoglycemia & checking glucose readings immediately.
- Carry glucose tablets or hard candy at all times.
- Wear medical ID bracelet or diabetic ID card.
- let friends, co-workers, or family members know how to give an injection of glucagon.
- Eat full meal at regular times; do not skip meals or eat partial meals.
- Extra snack prior of exercise.

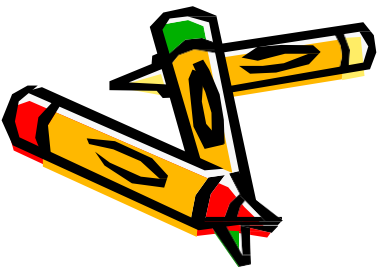
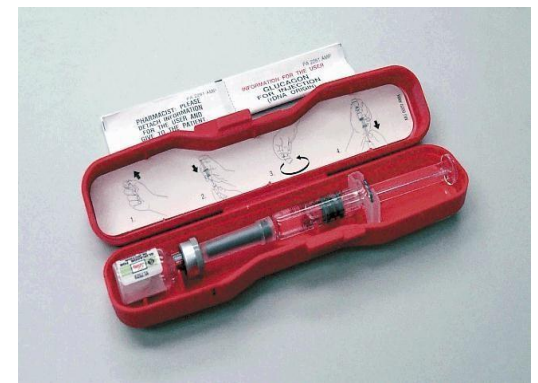


# Diabetes Bracelet



# Preventing Hypoglycemia

- Check BG 4-6 times /day.
- Carry glucose tablets.
- Have Glucagon Kit available.



# Hypoglycemia in School

- Teachers at schools should be informed about symptoms of hypoglycemia & appropriate treatment.
- It may be useful for member of the diabetes team to visit the school & provide education to the teachers.
- Children should not be restricted in activities at school but extra carbohydrate should be given prior to sports & physical activities.
- Easily absorbed carbohydrate should be available at school as well one kit of Glucagon injection.

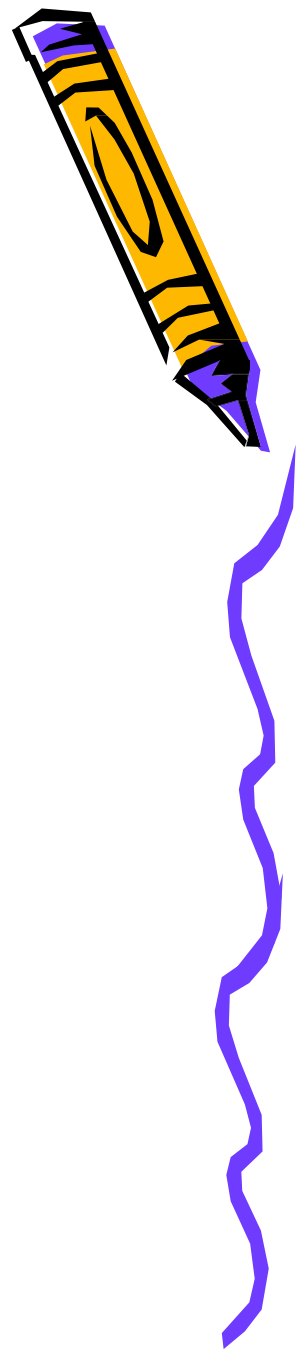


Diabetes Technology (sensors & Pumps) help  
in prevention of hypoglycemia episodes in  
children with diabetes.





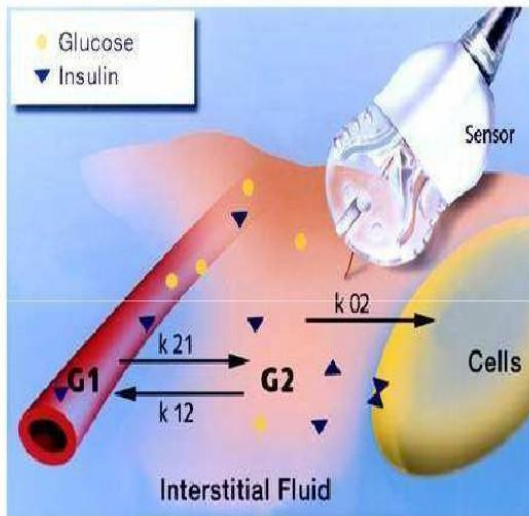
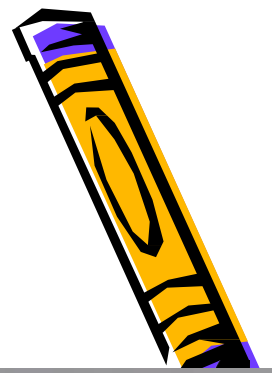
# Continuous Glucose Monitoring System (CGMS)



- Minimally invasive sensors use a catheter containing sensor inserted into the subcutaneous interstitial space to measure the interstitial glucose.
- They are replaced every 7-14 days & require calibration 2-3 times daily with SMBG.
- Dexcom & Minimed sensors are available locally.
- Flash glucose monitoring (Free style libre) is also available.



# Subcutaneous glucose sensor



# Availability of various CGMS





### Trend Graphs

Shows the effect of diet, exercise, medication and lifestyle on glucose levels.

### Alarms

Protect patients by warning of low and high glucose levels.

### Continuous Readings

Help patients take action sooner

Up to 288 glucose readings per day, every 5 minutes, 24 hours a day

### Trend Arrows

Point up or down to show the direction and rate of change in glucose levels

### Wireless Transmitter

Small, discreet and waterproof

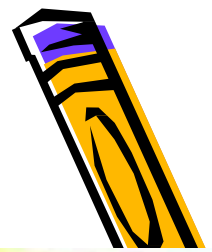
### Glucose Sensor

Up to 3-day of continuous use.

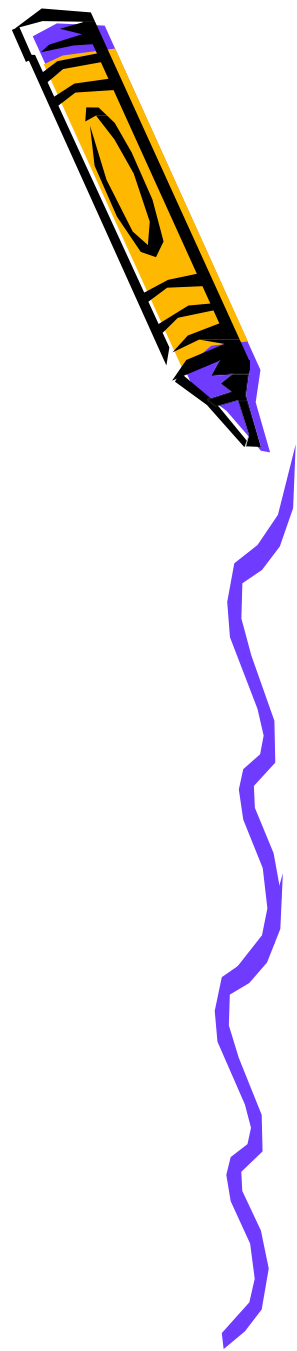




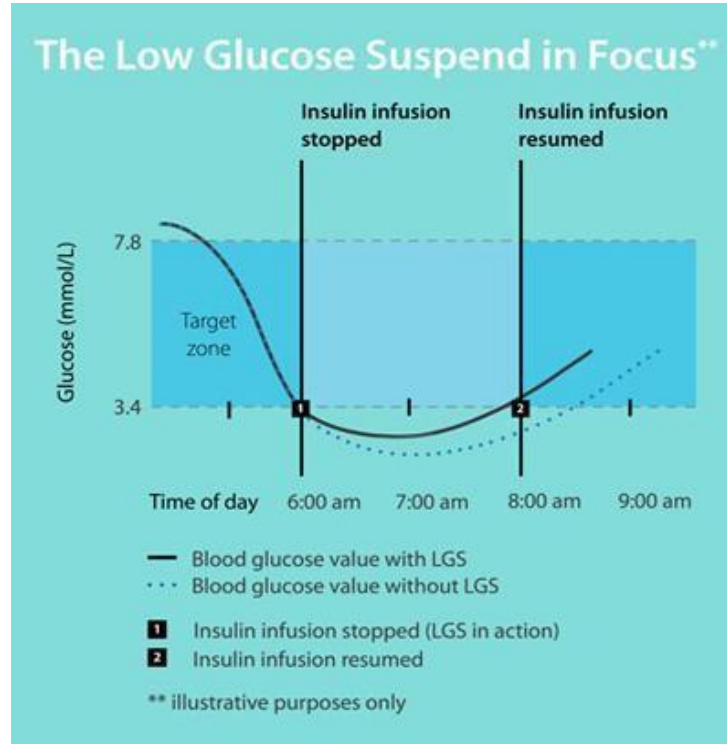
# Abbott Freestyle Navigator®



# Sensor Augmented Insulin Pumps (SAP)



Medtronic MiniMed 530G system



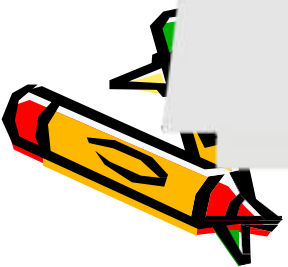
# SMARTGUARD™ TECHNOLOGY PROVIDES ADVANCED PROTECTION AGAINST HYPOGLYCEMIA (AUTO SUSPENSION & AUTO-RESUME OF INSULIN)

## AUTO SUSPEND

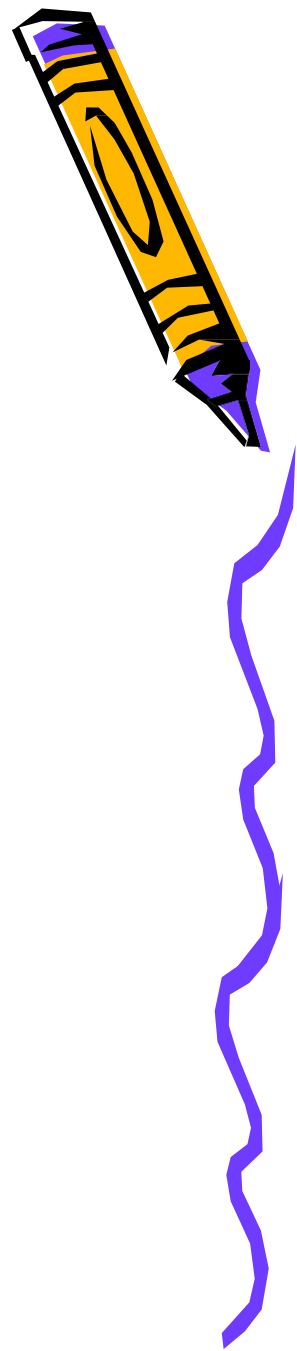


## AUTO RESUME

- ✓ Auto based on SG value
- ✓ Auto based on 2 hour max



Treatment





# Mild to moderate hypoglycemia

## Rule of 15:

- Immediate consumption of 15gm of simple form of carbohydrate:
  - 15g of glucose in the form of glucose tablets
  - 15mL / 3(teaspoons) or 3 packets of glucose dissolved in Water.
  - 100 mL 1/2(cup) of juice or regular soft drink.
  - 6 Life savers 2.5=1(g of carbohydrate)
  - 15mL 1(tablespoon) of honey.
- Followed by 15 gram snack of complex carbohydrate to maintain normoglycaemia until the next meal or snack .

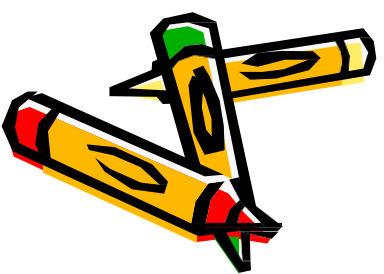


# Severe Hypoglycemia

- For severe hypoglycemia therapy is urgent.
- People who are either unconscious, fitting are unable to Swallow.
- Nothing should be given by mouth.
- Parents are taught to administer glucagon by injection (SC, IM,).
  - 0.5mg  $\leq$  years of age or  $\leq$ 25kg.
  - 1.0mg  $\geq$  years of age or  $\geq$ 25kg.
- If no response in 10minutes, check blood glucose. If still low repeat once again.
- Follow-up with carbohydrate foods and frequent monitoring.
- In hospital: intravenous dextrose 2-4 ml/kg of 5-10% dextrose, followed by continuous dextrose infusion to maintain blood glucose level between 4-8 mmol/l.



# Glucagon Kit for treatment of severe Hypoglycemia



Glucagon, one of the first-line treatments for severe hypoglycemia in a real-world setting, is unstable in an aqueous form. Available kits contain powdered glucagon that must be reconstituted in a multistep process before the drug can be administered to a patient, and a caregiver may also be required to decide on the correct dose to administer to a child based on his or her body weight.

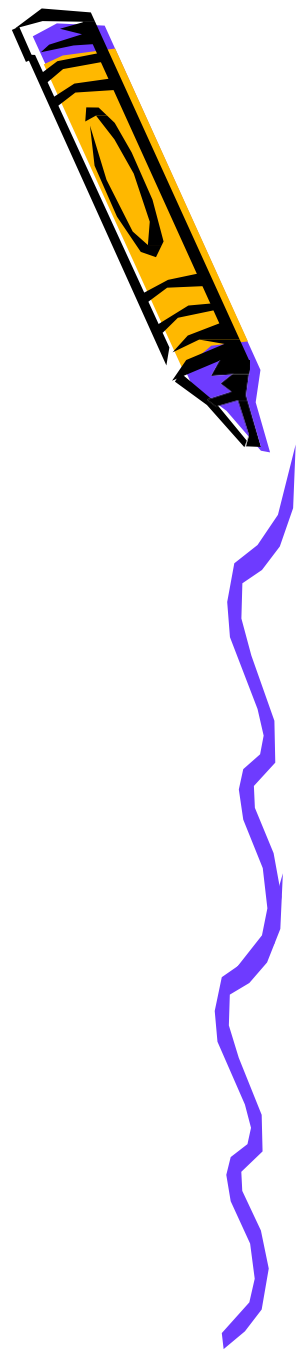
Nasal glucagon (Baqsimi, Eli Lilly) delivers glucagon as a dry powder spray in a portable, single-use, ready-to-use device.

# Nasal Glucagon

Now  
FDA  
Approved!

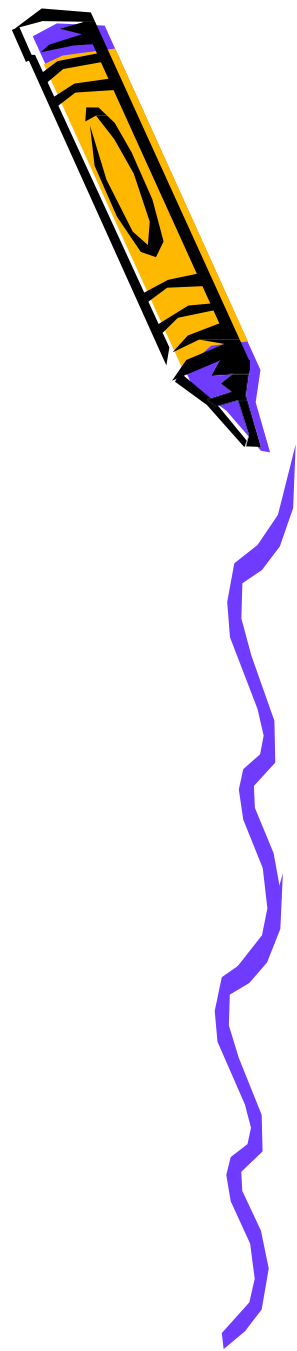


# Insulin dose adjustment

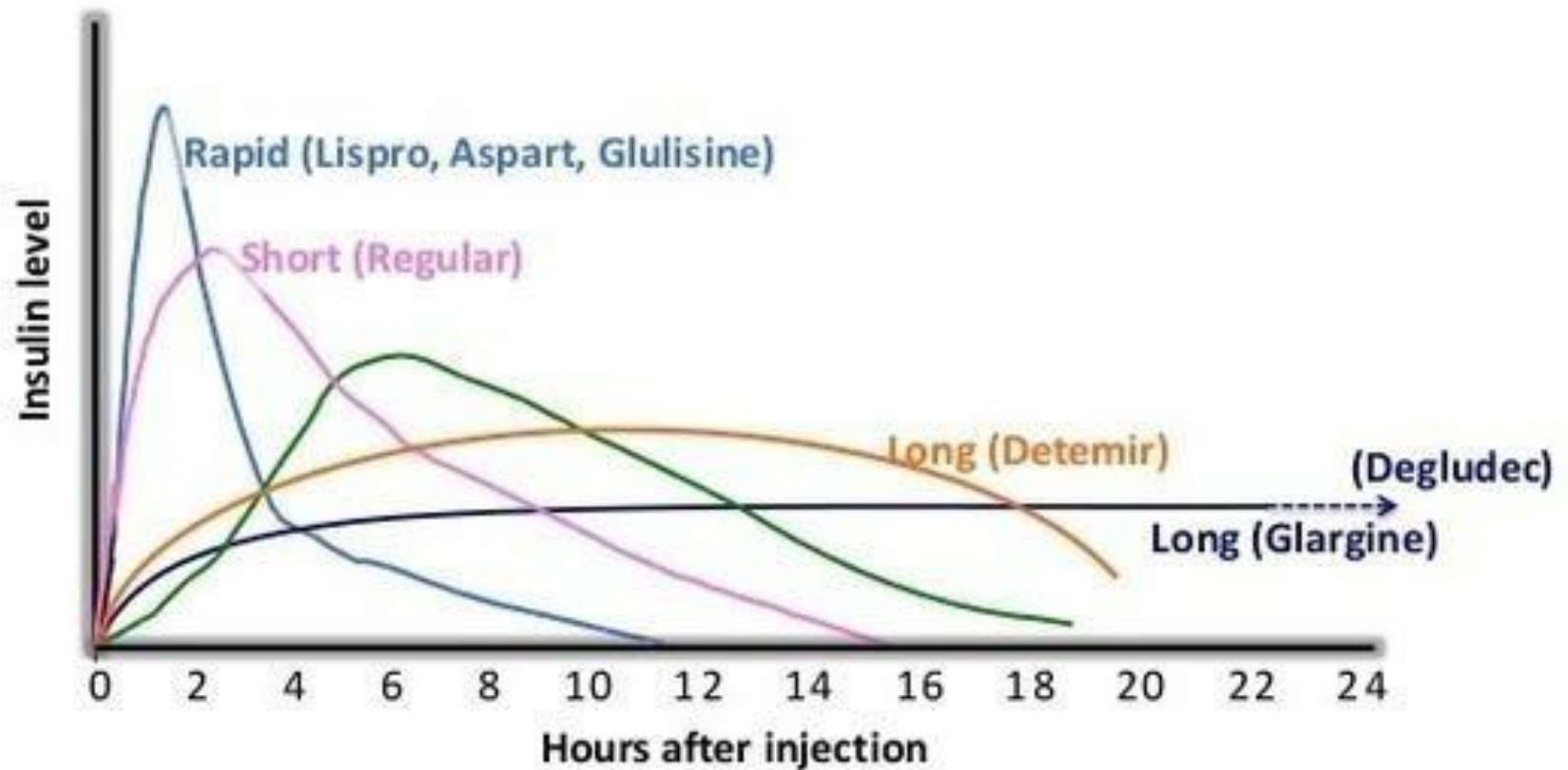


# Insulin Adjustment

- Depend on insulin regimen.
- Depends on type of insulin used.
- Other factors are involved.
- Time of hypoglycemia.
- Single attacks Vs repeated.
- Total insulin daily dose.
- Rule of thumb: adjustment of the dose 10-20% of total daily dose.



- Therapeutic options: *Insulins*



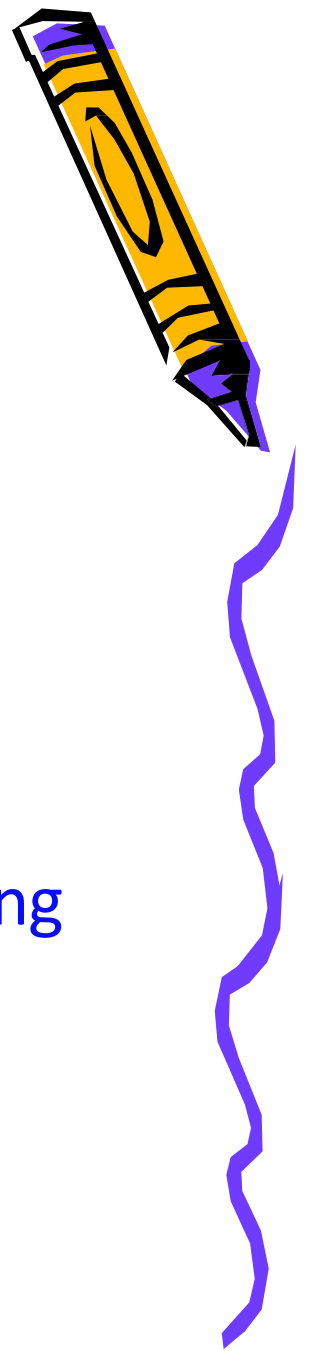
# New Insulin

**TRESIBA<sup>®</sup>**  
insulin degludec injection 100 U/mL, 200 U/mL





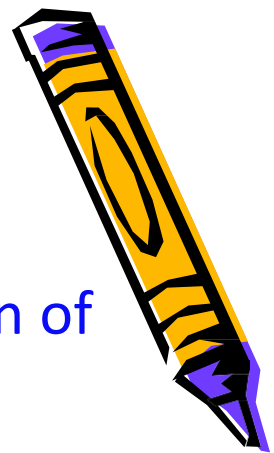
# Insulin Adjustment



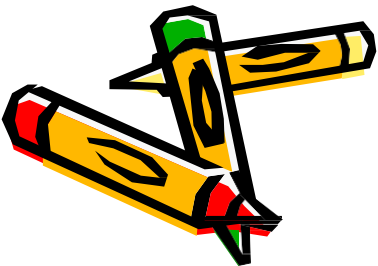
- If hypoglycemia happens in:
  - Pre BF ---- adjust long –acting insulin.
  - Pre-Lunch --- adjust morning short / Rapid acting insulin.
  - Pre-Dinner --- adjust Lunch short / Rapid acting insulin.
  - Pre-Bed --- adjust evening short/ rapid acting insulin.



# Recommendations & Principles



- Hypoglycemia is the most frequent acute complication of type 1 diabetes.
- Severe hypoglycemia should be avoided in children, especially in those less than 5 years.
- Blood glucose values should be maintained above 3.9 mmol/l (70 mg/dl) in children & adolescents with diabetes.
- Children & adolescents with diabetes should wear some form of identification or warning of their diabetes.
- All children & adolescents with diabetes should carry glucose tablets or readily absorbed carbohydrate and have glucagon available at home.



# Recommendations & Principles



- Hypoglycemia in children is largely preventable; however there is a significant proportion of severe hypoglycemic episodes in which no obvious cause can be determined
- School teachers and carers at schools should be informed of the symptoms & appropriate.
- treatment of hypoglycemia and should have access to advice when necessary.
- In the hospital setting severe hypoglycemia should be treated with intravenous dextrose
- Intramuscular or subcutaneous glucagon is an effective way of treating severe hypoglycemia in a home-care setting.





Thank you

