

## Correction dosing

- Replaces sliding scales
- Always give dose to cover food to be eaten
  - Dose dependent upon carbohydrate intake
  - Add extra Humalog units to cover additional food intake or correct for high blood sugar

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## Type 2 Diabetes

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
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## Type 2 Diabetes

- Obesity driven
  - Not all obese teens have diabetes
- Treatment is prevention
  - Lifestyle changes
  - Weight control and exercise
  - Appropriate for all overweight children
    - Limit TV and video time
    - Limit junk food

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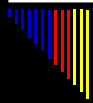
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## Incidence: Type 2 Diabetes

- Incidence is increasing
  - Incidence parallels the increasing obesity of children and teens
- Type 2 diabetes is the more common in African-American, Native American, Pacific Islander, and Hispanic children and teens
  - Genetic predisposition compounded by lifestyle
- Type 2 diabetes is caused by diet and lifestyle
  - Excess caloric intake, inadequate exercise
  - Obesity

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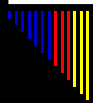
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## Etiology

- Genetic factors are poorly understood in most groups
  - Probably polygenic, specific loci have been implicated in certain ethnic groups
- Environmental factors are probably similar to adults
  - Obesity and sedentary lifestyle contribute to peripheral insulin resistance, compounded by decreased insulin secretion and increased hepatic gluconeogenesis

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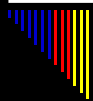
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## Etiology

- Puberty exacerbates incidence
  - GH is counter-regulatory hormone and increases peripheral insulin resistance
  - Insulin activity is 30% lower in Tanner 2-5 adolescents vs children and adults
- Focus on pubertal and peripubertal children (> 10 years of age)
  - Type 2 has been reported in children as young as 4 yrs

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## Childhood Obesity

- Prevalence of overweight children 1970-2000
  - 6-11 year olds: increased from 4% to 15%
  - 12-19 year olds: increased from 5% to 15%
- Prevalence of overweight children 1960-1980's remained constant at about
  - NHANES data, BMI > 95% for age and gender

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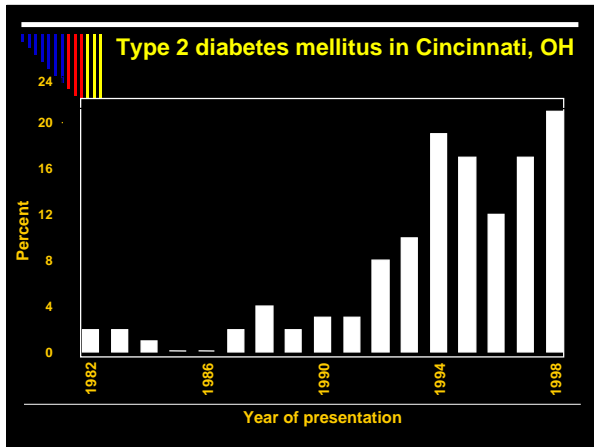
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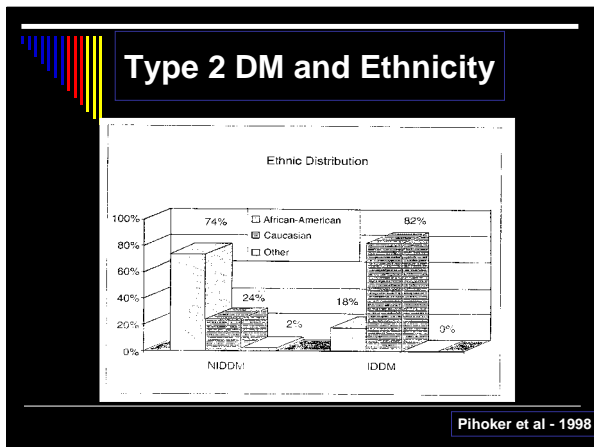
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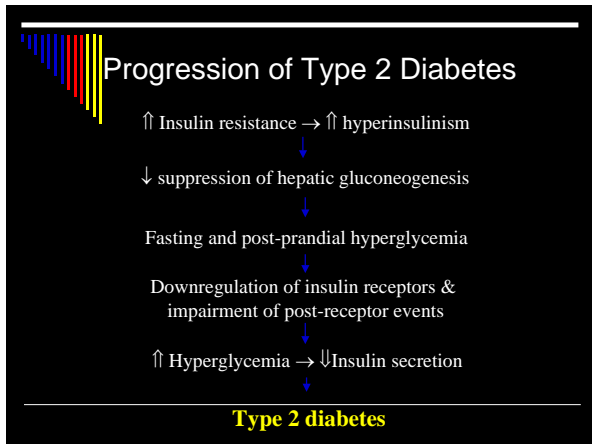
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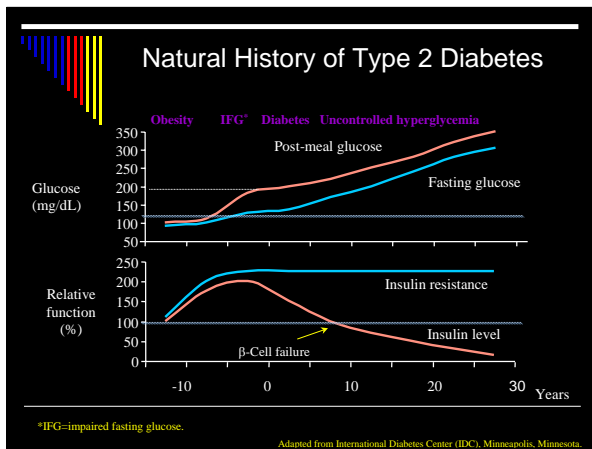
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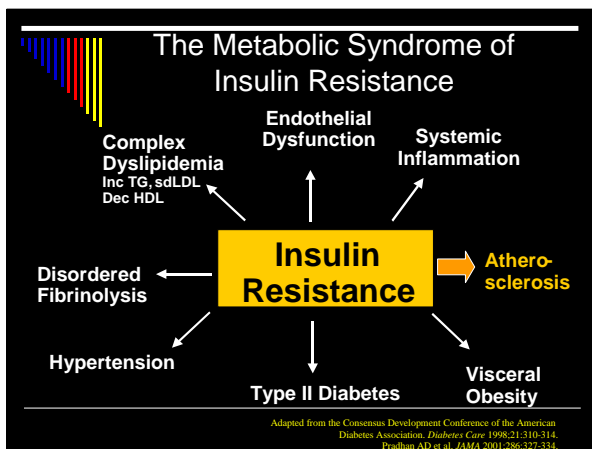
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
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## Oral Therapy

- Decrease glucose production
  - Biguanides: metformin
  - Thiazolidinediones: avandia, actos
- Increase insulin secretion
  - Sulfonylureas: glyburide
  - Meglitinides: prandin
- Increase peripheral glucose uptake
  - Thiazolidinediones: avandia
  - Biguanides: metformin
- Decrease intestinal glucose absorption
  - alpha-glucosidase inhibitors: precose

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
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## Biguanides (Metformin)

- Mechanism: decrease hepatic glucose production and improve peripheral insulin sensitivity
  - Side effects: nausea, abdominal cramps, diarrhea
- Contraindications: renal failure, hepatic failure, congestive heart failure, alcoholism
  - Hold for dehydration, iodinated contrast studies
- Advantage: little hypoglycemia, weight neutral
- Indications: Type 2 DM, PCO, Insulin resistance

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
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## Insulin Therapy in Type 2

- Initially:
  - Severe hyperglycemia, ketonuria
  - Protect teen from DKA while determining the type of diabetes
  - When other medications contraindicated, e.g. liver disease or chemotherapy, or peri-operative
  - Pregnancy
- Later
  - When  $\beta$  cell function no longer adequate and oral therapy is failing

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
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## Lifestyle Therapy

- First line of therapy
  - Potentially prevent type 2 diabetes in some teens??
- Nutrition
  - No medication will control blood glucose in the face of uncontrolled eating
  - Must have access to pediatric/adolescent nutritionists
  - Unlike current approach to type 1 diabetes, fat intake probably should be addressed initially
- Exercise
  - Increase peripheral glucose utilization by muscle, decrease body fat

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
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## Screening Children and Adolescents: Who?

- Children over 10 yrs or in puberty with the who are overweight:
  - BMI > 85% for age and sex, weight for height > 85th%, weight >120% ideal for height
- And have 2 of the following risk factors
  - Family history in first or second degree relative
  - American Indian, African-American, Hispanic, Asian/Pacific Islander
  - Signs of insulin resistance: acanthosis nigricans, PCOS, hypertension, dyslipidemia

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
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## Screening Children and Adolescents: How?

- Frequency: every 2 years
- Preferred test is the fasting plasma glucose
- Consider also:
  - 2 hour post prandial plasma glucose
    - may be abnormal before the fasting plasma glucose

Consensus statement from ADA, Pediatrics (2000) 105: 671

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
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## “Pre-Diabetes”

- Impaired glucose tolerance
  - 2 hour PG  $\geq$  140 mg/dl and  $<$  200 mg/dl
- Impaired fasting glucose
  - FPG  $\geq$  110 mg/dl but  $<$ 126 mg/dl
  - fasting glucose is elevated but not diagnostic of diabetes

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
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## Summary

- Incidence of type 2 diabetes in the pediatric population is increasing and it will become a significant source of morbidity and financial burden on our society – worldwide
- Prevention involves changing lifestyles and environment of our children and teens
- Treatment options are the same as those available for adults but with little or no research into safety and efficacy of these drugs in pediatric population

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
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## Treatment

- Prevention
- Insulin
  - Pro
    - Protect from DKA if child has type 1 while awaiting clarification of diagnosis
    - Impact of disease upon
    - Complete education
  - Con
    - Weight gain
    - Risk of hypoglycemia
    - Complexity

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
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## Medical Therapy: Insulin

- Approved for use in children
  - lots of experience with children
- Risk of severe hypoglycemia
- Significant potential for weight gain
- Increased need for monitoring

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
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## Medical Therapy: Metformin (glucophage)

- FDA approved for use in children/teens > 12 yrs for diagnosis of type 2 diabetes
- Side effects:
  - Low risk of hypoglycemia
  - GI side effects are generally well tolerated if dose is increased gradually
  - Weight neutral; perhaps some weight loss (5kg)
- Check creatinine before starting and q year
- Hold for IV contrast or dehydration
- Consider pregnancy issues

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## Medical Therapy: Oral Agents

- No others approved for children
  - Sulfonylureas: most experience in adults, good safety record
- Limited experience and limited studies
  - Unknown or unanticipated side effects
  - Haptotoxicity
- Use with caution and informed consent of family until more study data is available

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
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## Prevention

- Prevention is key
  - Delay onset in many cases, possibly eliminate in some
- Weight control
  - Exercise
  - Dietary: caloric and fat intake
  - Lifestyle: -48% vs untreated control
- Medications
  - Metformin: -31% vs untreated control

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
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## Medical Treatment of Obesity

- Zenical® (orlistat)
  - Approved for use by children and teens
  - Non-systemic lipase inhibitor, inhibits absorption of fat
    - Start after patient has had some success with diet alone (2.5 kg/week times 4 weeks); discontinue if not lost 5% body weight over 12 weeks; long term therapy limited to 2 years
    - Side effect of fat soluble vitamin deficiency, flatulence, diarrhea
- Bariatric surgery
  - Lifelong change in eating habits
  - Pregnancy?

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
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## Simple Start

- Eliminate sodas and restrict juice
  - Substitute fruit and vegetables
- Smaller portions
  - Allow seconds if hungry
  - Don't skip meals
- Limit trips to MacD's, Burger King, etc
  - When eating there, get smaller meals

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
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## Complications

- Same complications that adults face
  - Cardiac disease
    - Neuropathy
    - Nephropathy
- Will the complications be more severe?
  - Earlier age of onset????
  - Predisposition to be worse????

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
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## Long Term Issues

- Aggressively maintaining control
  - Are the adult paradigms appropriate?
  - Hgb A<sub>1c</sub>
  - Blood sugar testing
  - Weight control
- Management of lipid abnormalities
- Monitoring for cardiac disease at earlier ages
- Management during pregnancy

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
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## Summary

- Prevention of type 2 diabetes = Prevention of Obesity
  - Absolutely necessary for us as a society
  - Behavioral changes, start now with simple steps
  - Need studies of medications to treat obesity in children and teens
- Treatment of type 2
  - Need studies of medications
    - Teens are not just little adults
  - Entire family needs to commit to treatment
  - Mental health issues and support

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