Diabetes

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Definition:

- "A metabolic disease in which the body's inability to produce any or enough insulin causes elevated levels of glucose in the blood."

Types of diabetes:

- Type 1
- Type 2
- Gestational diabetes
- Prediabetes

Currently, at least 1 out of 3 people will develop the disease in their lifetime

Type 1 diabetes:

In adults, type 1 diabetes accounts for approximately

5%

of all diagnosed cases of diabetes

– Also known as juvenile diabetes

– Usually diagnosed in children and young adults

– When body's own immune system destroys the insulin producing cells of the pancreas – beta cells – which produce insulin

– Only 5% of people have this disease

– Body does not produce insulin

– Is not preventable

  • No primary intervention

– Causes?

  • Predisposition to diabetes – genetics - and something (i.e. weather, virus ... etc) in environment triggers the disease
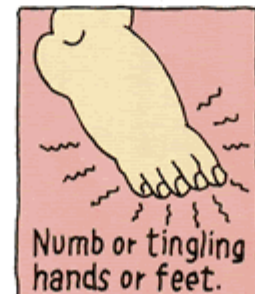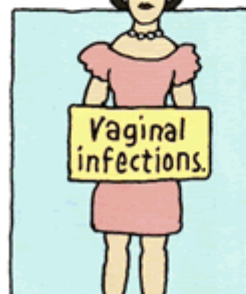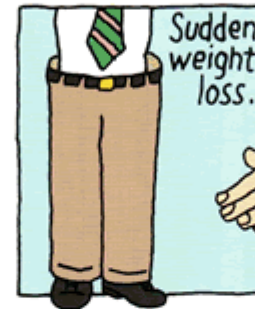
Symptoms of Diabetes:

Common symptoms of diabetes include:

- Excessive thirst and appetite
- Increased urination (sometimes as often as every hour)
- Unusual weight loss or gain
- Fatigue
- Nausea, perhaps vomiting
- Blurred vision
- In women, frequent vaginal infections
- In men and women, yeast infections
- Dry mouth
- Slow-healing sores or cuts
- Itching skin, especially in the groin or vaginal area

DIABETES
KNOW THE SYMPTOMS

Always tired.

Frequent urination.

Sudden weight loss.

Wounds that won't heal.

Always hungry.

Sexual problems.

Blurry vision.

Vaginal infections.

Numb or tingling hands or feet.

Always thirsty.

Type 2 diabetes:

– Most common form of diabetes – about 90% of cases
– Used to be called adult onset, non insulin dependent diabetes
– Body produces insulin, but does not use it properly
  • glucose doesn't move into cells, they pile up in the bloodstream
– sx's when they do occur are often ignored because they may not seem serious

TYPE 2

BODY CANNOT USE INSULIN PROPERLY
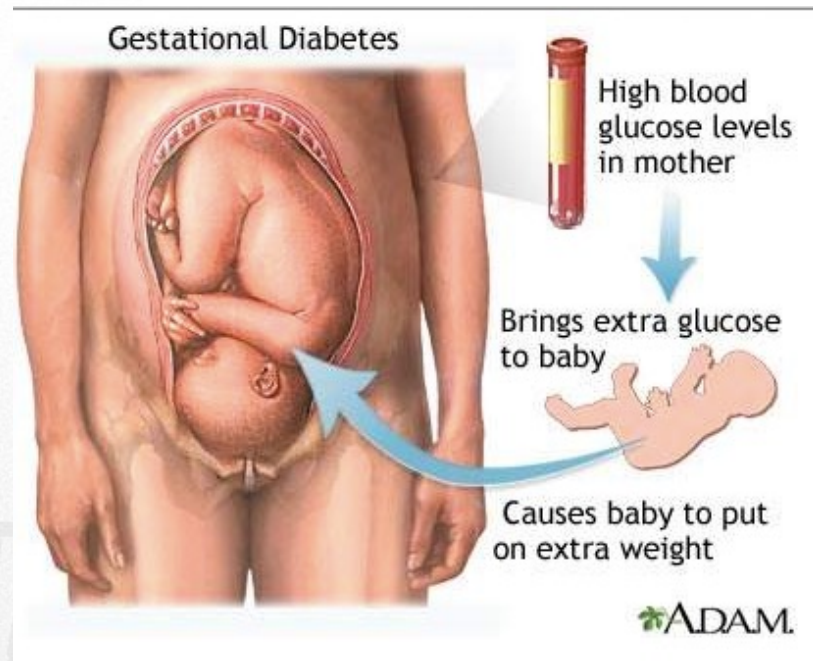• Can develop at any age
• Most cases can be prevented

Risk factors:

- Genetics
- Family pmHx
- Polycystic ovary syndrome
  - Irregular menses
- Race
  - African Americans, Hispanics and Asians > whites
- Age
  - After age 45, but increases in younger adults and children
- Environmental factors
  - Inactivity
  - Weight gain

Gestational diabetes mellitus (GDM):

- Having diabetes during pregnancy
  - Family Hx of diabetes, overweight prior to pregnancy?
- Having gestational diabetes puts you at risk for diabetes type 2
- Giving birth to a baby >9 lbs also puts you at risk for type 2
- 18 out of every 100 pregnant females will develop GDM

Gestational Diabetes

High blood glucose levels in mother

Brings extra glucose to baby

Causes baby to put on extra weight

ADAM.

Complications for uncontrolled diabetes:
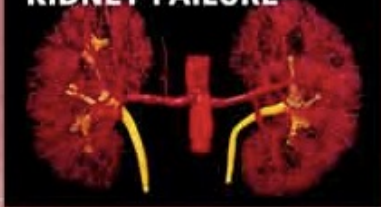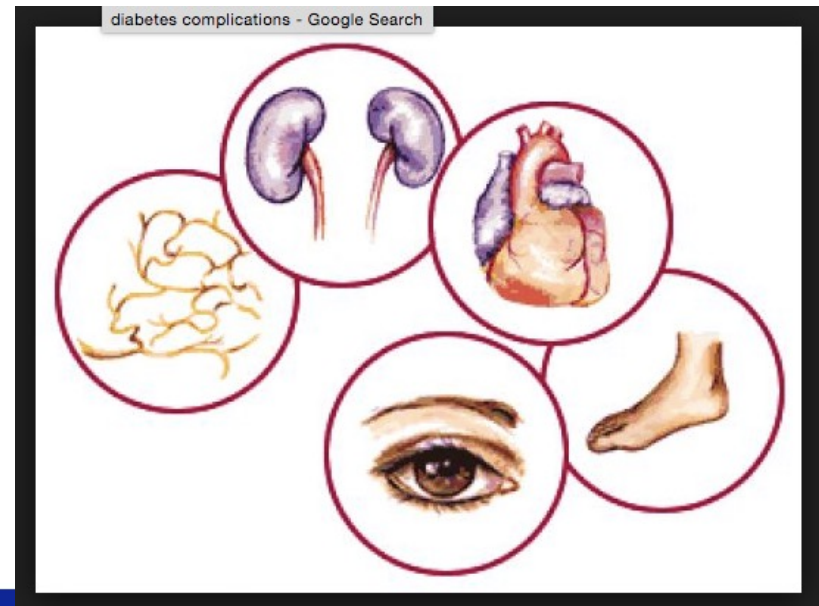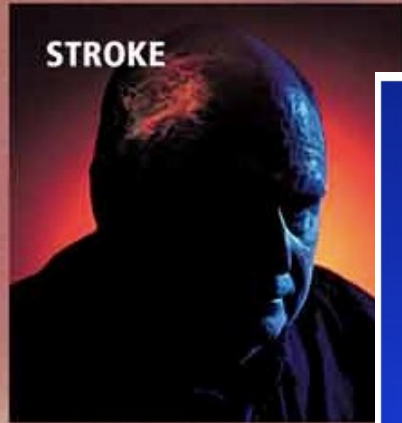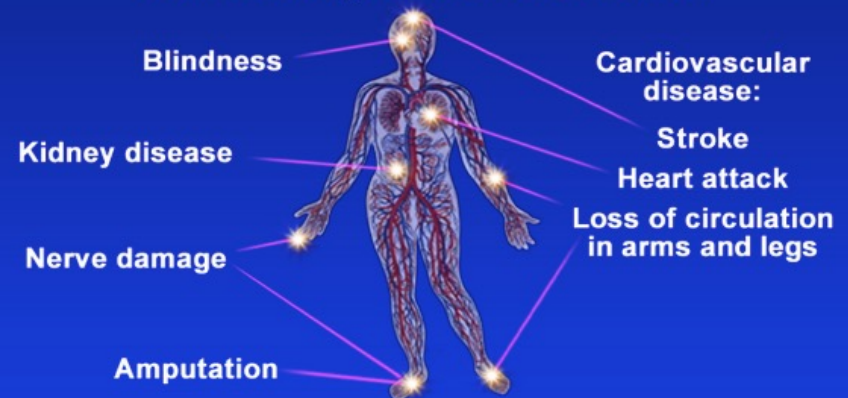
How to monitor your diabetes:
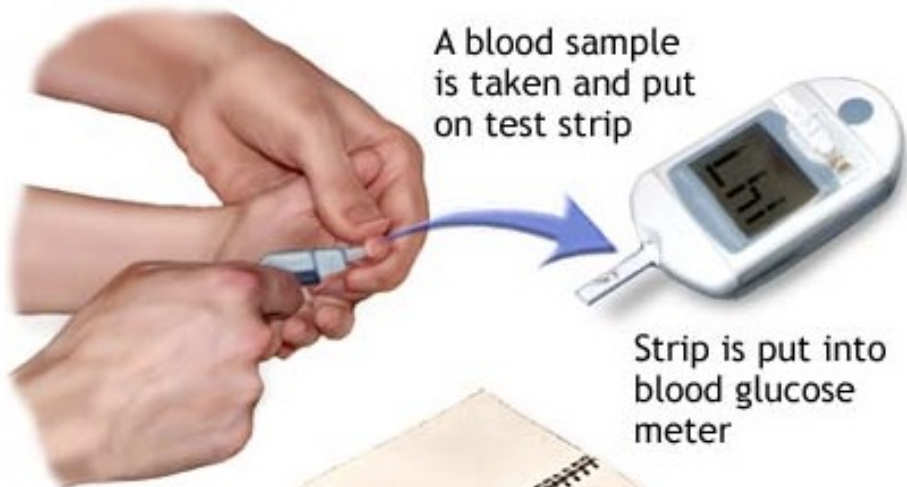
A blood sample is taken and put on test strip

Strip is put into blood glucose meter

A log book is a helpful aid in keeping track of blood glucose levels

ADAM.

Blood Sugar Classification	Fasting Blood Sugar Levels	Post Meal Blood Sugar Levels
Normal	70-100 mg/dL	70-140 mg/dL
Prediabetes	101-125 mg/dL	141-200 mg/dL
Diabetes	125 mg/dL and above	200 mg/dL and above

Preventions:

- Type 1:
  - Not preventable, as of right now.
    - Studies on ways to possible prevent further destruction of the beta cells

Identifying Type 1 Diabetes before Beta Cell Loss

Martin Hessner, PhD | Medical College of Wisconsin | Basic Science Award | Funded for 3 years at $345,000

Type 1 diabetes is thought to progress without symptoms for several years in most patients prior to diagnosis. During this critical time, while beta cells are destroyed, the disease is often not detected until beta cell loss is substantial enough for the patient to notice symptoms of advanced disease. By that time, it is typically too late to effectively intervene with therapies that may preserve beta cells.

Dr. Hessner is investigating so-called "biomarkers," which are components in blood or tissue samples that can be measured to predict which individuals are most likely to develop type 1 diabetes. His work is unique, because it aims to detect biomarkers that are present before beta cell destruction progresses to clinical symptoms, up to 5 years or more prior to disease onset.

One potential candidate biomarker may be related to inflammation. Dr. Hessner recently showed that family members of people with type 1 diabetes have an enhanced inflammatory state that is regulated
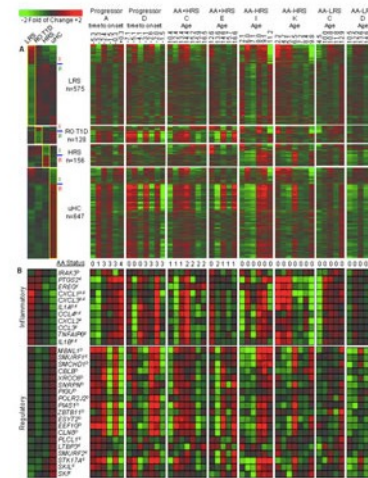
  - Maintain and control sugar levels, insulin injection
  - Healthy life style – exercise and diet
  - Islet transplantation?

Preventions:

- Type 2:
  - Primary: maintain a healthy lifestyle
  - Secondary: check HgA1c, adjust diet
    - HgA1c – blood sugar avg over span of 3 months
      - Measures what % of your Hg is coated with sugar
      - Nl = 4 % - 5.6%, pre diabetes = 5.7% -6.4% and diabetes = 6.5% +
  - Tertiary: exercise and eat well
  - Foot exam?

Preventions:

- Gestational diabetes:
  - Physical activity
    - Researchers found being physically active before and after their pregnancy reduced their risk of GDM by about 70% or more
  - Diet
    - A study showed that each 10 gram increase in fiber a day reduced their risk of GDM by 26%

U.S. Prevalence:

A SNAPSHOT

DIABETES IN THE UNITED STATES

CDC
CENTERS FOR DISEASE CONTROL AND PREVENTION

DIABETES

29.1 MILLION

29.1 million people have diabetes

That's about 1 out of every 11 people

1 OUT OF 4 do not know they have diabetes

U.S. Prevalence:

Overall Numbers, Diabetes and Prediabetes

- **Prevalence**: In 2012, 29.1 million Americans, or 9.3% of the population, had diabetes.
  - In 2010 the figures were 25.8 million and 8.3%.

- **Undiagnosed**: Of the 29.1 million, 21.0 million were diagnosed, and 8.1 million were undiagnosed.
  - In 2010 the figures were 18.8 million and 7.0 million.

- **Prevalence in Seniors**: The percentage of Americans age 65 and older remains high, at 25.9%, or 11.8 million seniors (diagnosed and undiagnosed).

- **New Cases**: The incidence of diabetes in 2012 was 1.7 million new diagnoses/year; in 2010 it was 1.9 million.

- **Prediabetes**: In 2012, 86 million Americans age 20 and older had prediabetes; this is up from 79 million in 2010.

- **Deaths**: Diabetes remains the 7th leading cause of death in the United States in 2010, with 69,071 death certificates listing it as the underlying cause of death, and a total of 234,051 death certificates listing diabetes as an underlying or contributing cause of death.

American Population With Diabetes

Year	Millions of People
2010	25.8
2012	29.1
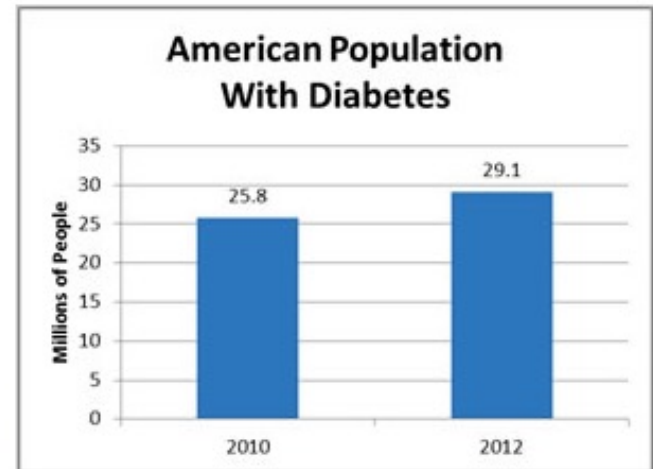
Age-Adjusted Rate per 100 of Civilian, Noninstitutionalized Population with Diagnosed Diabetes, by Race and Sex, United States, 1980-2011
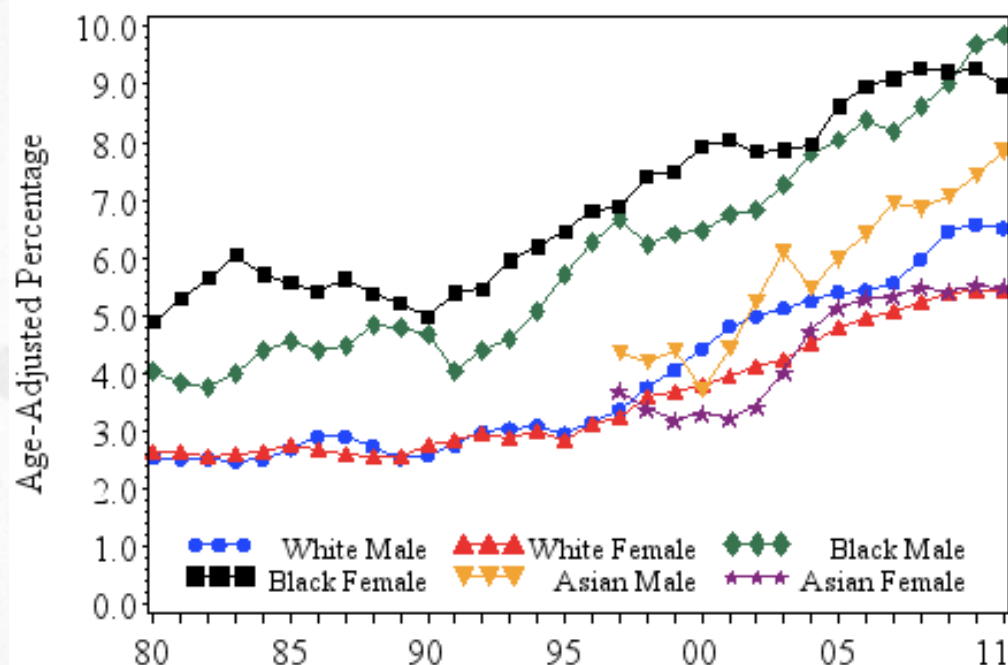

Year	White				Black				Asian			
	Male		Female		Male		Female		Male		Female	
	Rate	Std Error	Rate	Std Error	Rate	Std Error	Rate	Std Error	Rate	Std Error	Rate	Std Error
2008	6.0	0.16	5.2	0.13	8.6	0.40	9.3	0.29	6.8	0.58	5.5	0.61
2009	6.5	0.16	5.4	0.13	9.0	0.40	9.2	0.30	7.0	0.52	5.4	0.60
2010	6.6	0.15	5.4	0.12	9.7	0.38	9.3	0.32	7.4	0.55	5.5	0.56
2011	6.5	0.16	5.4	0.14	9.9	0.43	9.0	0.37	7.8	0.69	5.5	0.48

Incidence of Diagnosed Diabetes per 1,000 Population Aged 18–79 Years, by Age, 1980–2011
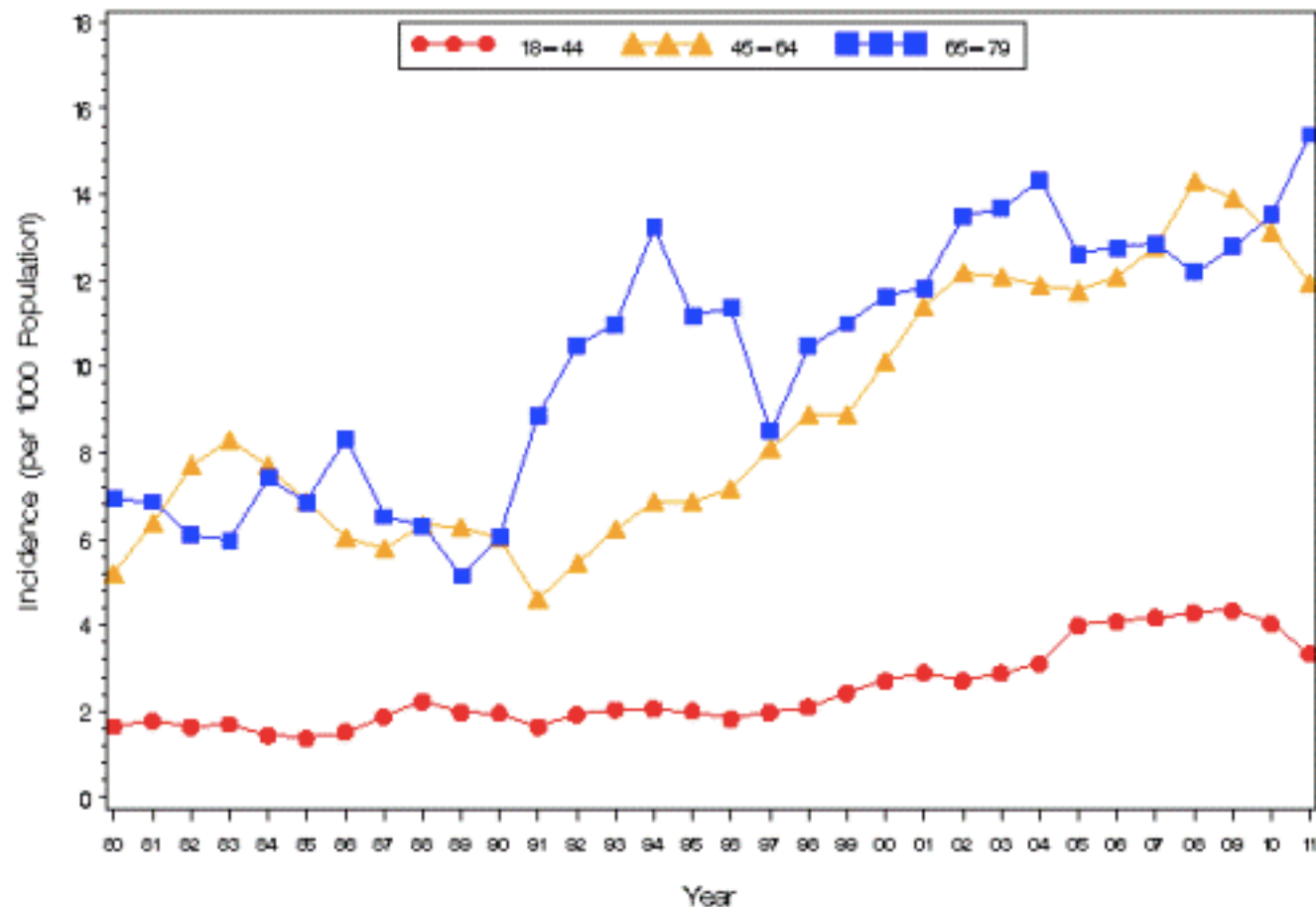
Age-Adjusted Incidence of Diagnosed Diabetes per 1,000 population Aged 18-79 Years, by Education, United States, 1980-2011
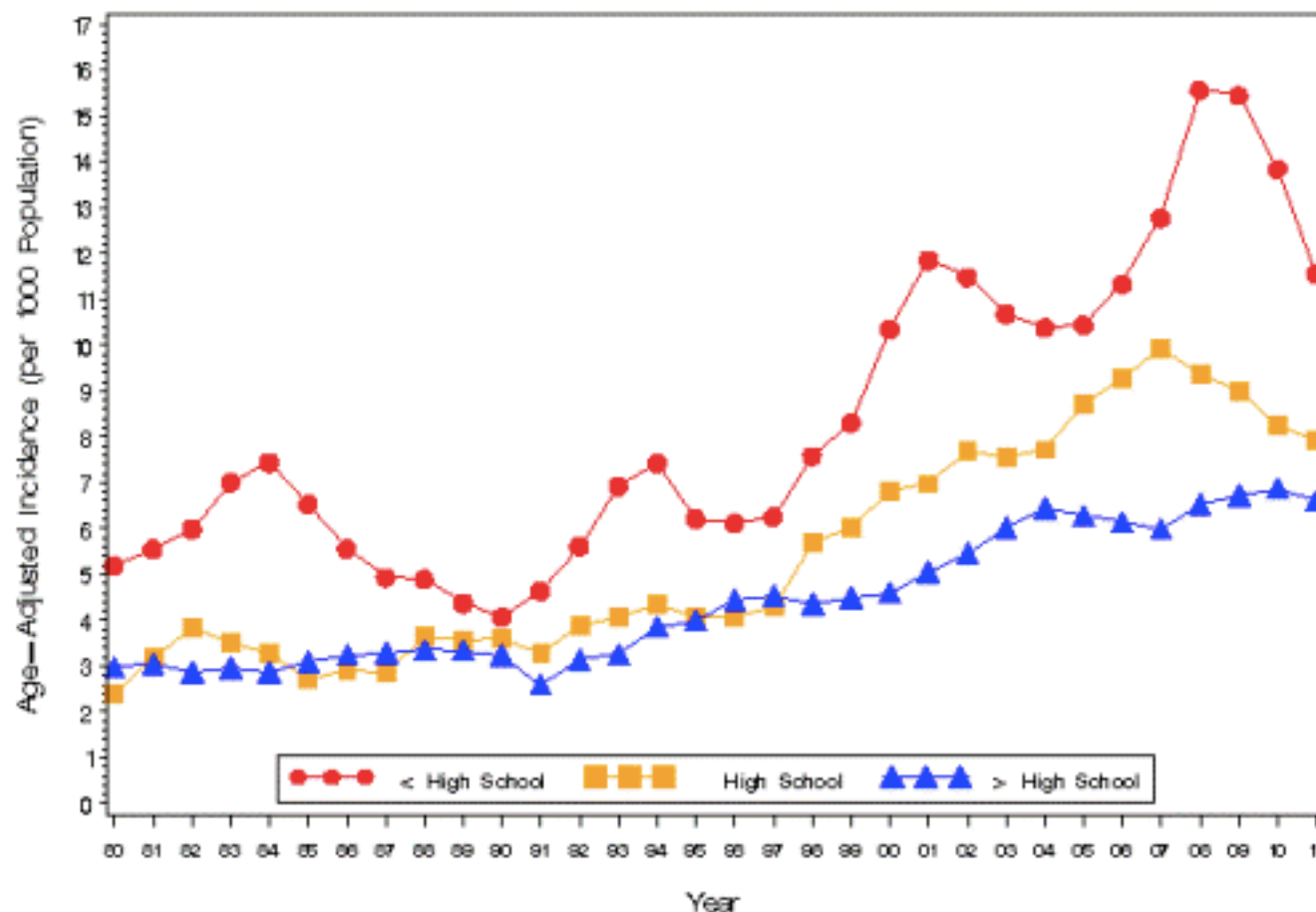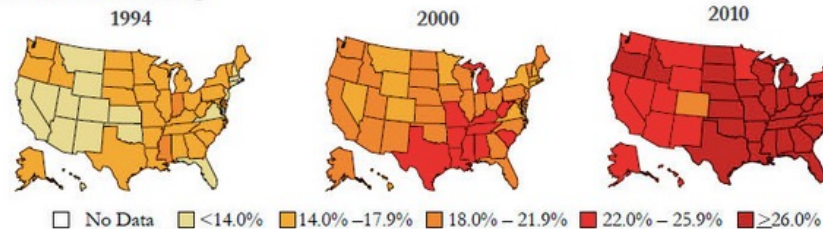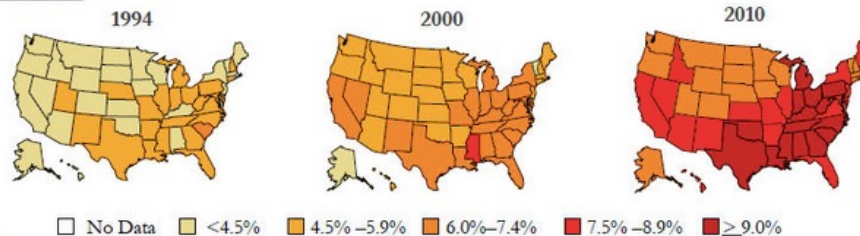
Diabetes and Obesity:

Age–Adjusted Prevalence of Obesity and Diagnosed Diabetes Among U.S. Adults Aged 18 years or older

CDC's Division of Diabetes Translation. National Diabetes Surveillance System available at http://www.cdc.gov/diabetes/statistics

Although excess weight increases the rate of type 2 diabetes, it's worth remembering that most overweight people don't have diabetes, and many people with type 2 are of normal weight or only moderately overweight—so again, it's not clear-cut.

Research:

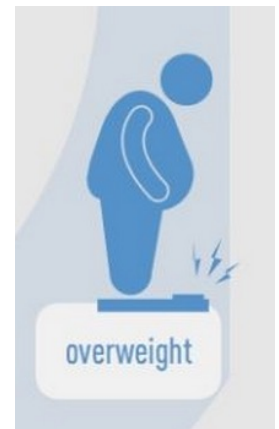## Primary Prevention of Type 2 Diabetes

Hu, FB, et al: Diet, lifestyle, and the risk of type 2 diabetes mellitus in women. N Engl J Med 2001;345:790-7.

This prospective cohort study followed 84,941 female nurses from 1980 to 1996; the subjects were initially free of diagnosed cardiovascular disease, diabetes, and cancer. The investigators defined a "low risk" group based on five characteristics:

- BMI < 25
- a diet high in cereal fiber and polyunsaturated fat and low in trans fat and glycemic load
- moderate-to-vigorous physical activity for at least 30 min per day
- no current smoking
- consumption of an average of at least half a drink of an alcoholic beverage per day.

After 6 years of follow-up, the study found that overweight or obesity was the single most important predictor of type 2 diabetes. However, "... lack of exercise, a poor diet, current smoking, and abstinence from alcohol use were all associated with a significantly increased risk of diabetes, even after adjustment for the body-mass index. "

Only 3.4% of the women in the cohort met the criteria for being "low-risk." Nevertheless, compared with the rest of the cohort, these low-risk women had a risk ratio of 0.09 (95% confidence interval: 0.05 - 0.17), suggesting that 91% of the cases of type 2 diabetes in the cohort (95% confidence interval: 38-95%) could be attributed to a lifestyle that did not conform to the low-risk criteria. They concluded that the majority of cases of type 2 diabetes could be prevented by the adoption of a healthier lifestyle.

overweight

Cost of Diabetes (US):

COST

$245 **BILLION** — Total medical costs and lost work and wages for people with diagnosed diabetes

Risk of death for adults with diabetes is **50% HIGHER** than for adults without diabetes

$$ $ Medical costs for people with diabetes are **twice as high** as for people without diabetes

Cost of Diabetes

Updated March 6, 2013

- $245 billion: Total costs of diagnosed diabetes in the United States in 2012
- $176 billion for direct medical costs
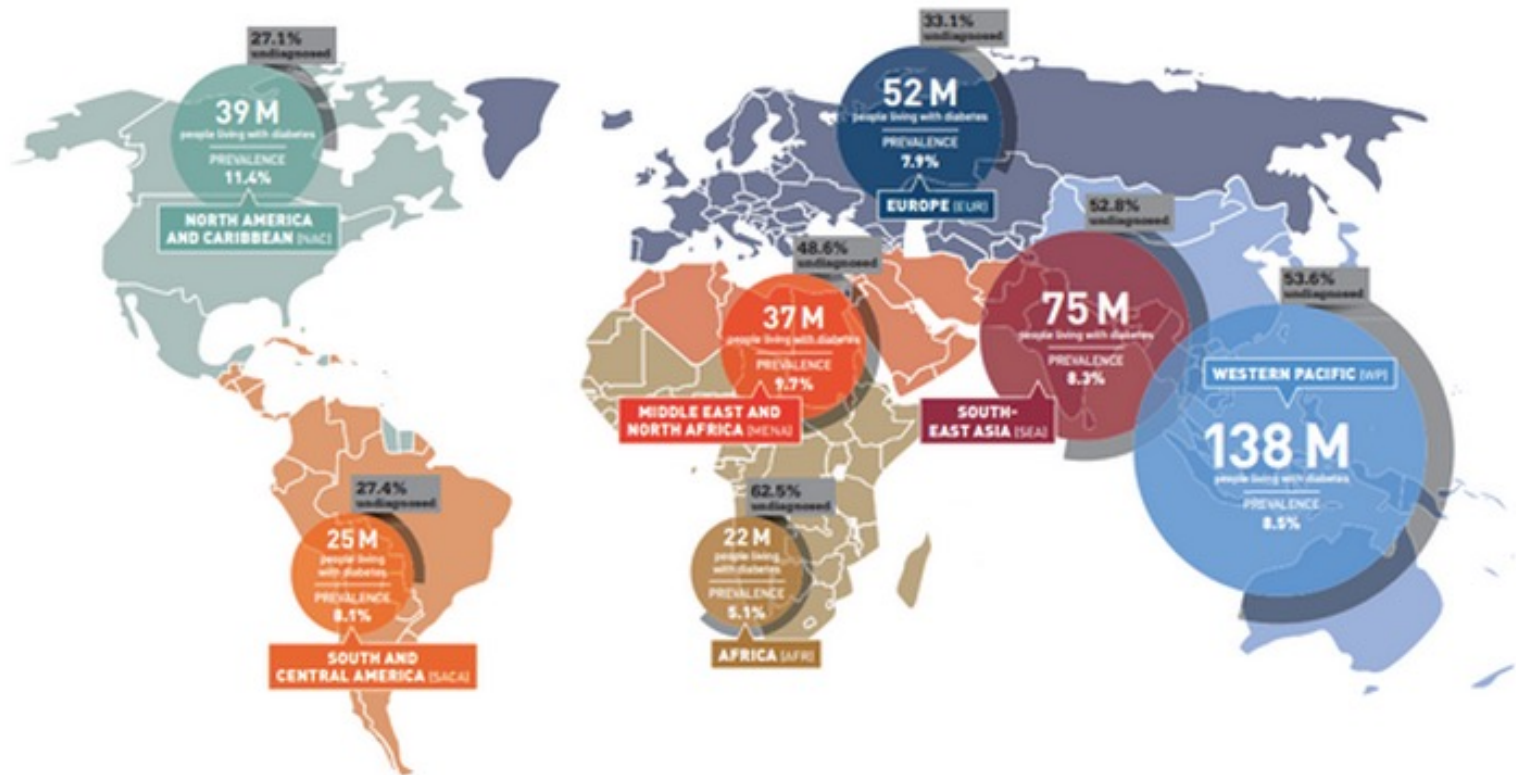- $69 billion in reduced productivity

After adjusting for population age and sex differences, average medical expenditures among people with diagnosed diabetes were 2.3 times higher than what expenditures would be in the absence of diabetes.

Global prevalence:
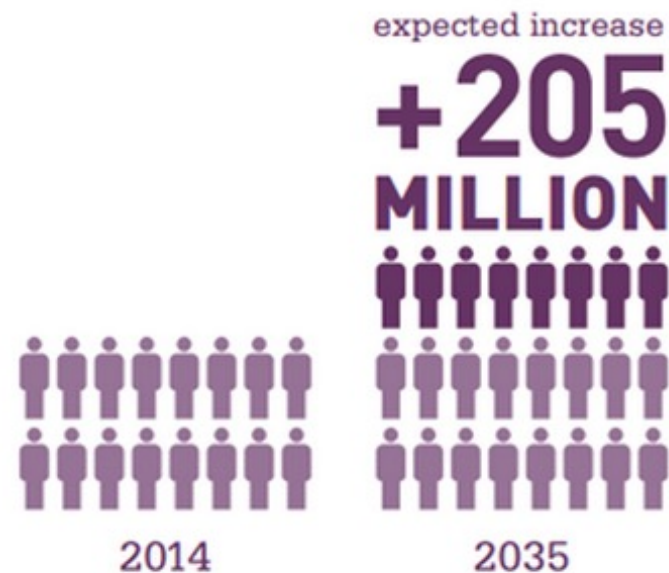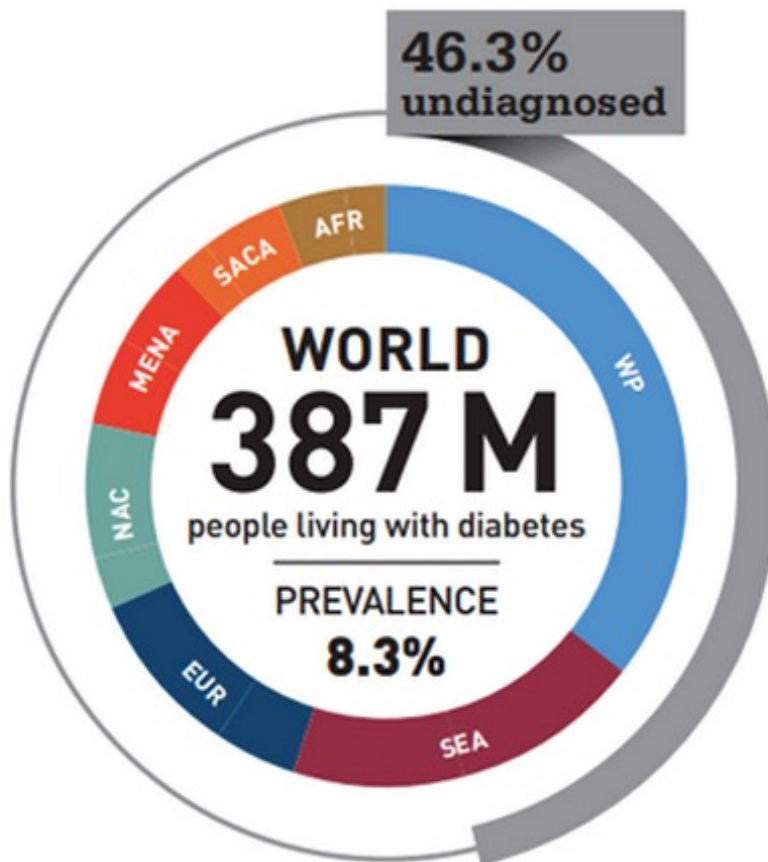
Global prevalence:

Prediabetes:

PREDIABETES

86 MILLION

86 million people — more than 1 out of 3 adults — have prediabetes

9 OUT OF 10 do not know they have prediabetes

Without weight loss and moderate physical activity

15–30% of people with prediabetes will develop type 2 diabetes within 5 years

5 YEARS

Prediabetes:

- Diabetes prevention program
  - Lifestyle intervention group vs medicated group with Metformin vs placebo group
  - 3,243 participants were overweight and had prediabetes
  - Lifestyle intervention reduced diabetes by 58%
  - Metformin reduced diabetes by 31%
    - Effective in both sexes ages 25-44 yoa and BMI of 30 +

  Summary: Type 2 diabetes can be prevented/delayed with activity and diet.

Twin study:

"Non-identical twins generally share 50 per cent of their DNA and it is usually said that identical twins share 100 per cent of theirs. Despite this, we found 1 400 places on the identical twins' DNA where there was a difference in DNA methylation between the diabetic and the non-diabetic. It is believed that these differences are due to differences in lifestyle and this confirms the theory that type 2 diabetes is strongly linked to lifestyle."

Identical twins are proof that **genes alone are not enough, however.** Identical twins have identical genes; therefore, they should have the same genetic risk for a disease—right? Not necessarily. Research has found that if one identical twin has type 1 diabetes, the other twin will get the disease about 50 percent of the time. For type 2 diabetes, that risk rises to as much as 4 in 5. In both type 1 and type 2, identical twins have a much higher risk of both developing diabetes than non-identical (fraternal) twins, which further supports the fact that genetics is involved.
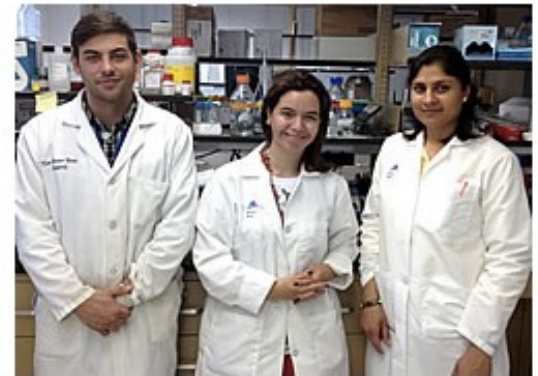
The Future:

Regenerating Human Beta Cells

Nathalie Fiaschi-Taesch, PhD |Icahn School of Medicine at Mount Sinai | Basic Science Award |Funded for 3 years at $345,000

Both type 1 and type 2 diabetes result from a complete or partial loss of beta cell number and function. Thus, from a therapeutic standpoint, activating the regeneration of human beta cells could prevent, or even reverse the onset of diabetes. Multiple approaches to beta cell replacement have been developed, including regeneration of an individual's own beta cells, induction of human beta cells from stem cells, reprogramming of beta cells from other differentiated cell types, use of nonhuman beta cell sources (pig or non-human primate islets), and, finally, expansion of human beta cells from deceased donors. Regardless of the origins, there is a clear need for more beta cells for cell replacement therapies for diabetes.

The Future:

Brown Fat Transplant May Aid in Weight Loss and Diabetes Management

A study conducted by ADA-funded researchers at the Joslin Diabetes Center suggests that brown fat transplants could help combat obesity and lower the risk of developing type 2 diabetes. In the January 2013 issue of *The Journal of Clinical Investigation*, Laurie J. Goodyear, PhD, and postdoctoral fellow Roeland J.W. Middelbeek, MD, show that increasing brown fat via transplantation dramatically promotes weight loss and improves blood-glucose control in mice – results that they hope may translate to humans.

There are at least two types of adipose (fat) tissue. White adipose tissue is the more common type that lies below the skin, stores excess fat in the body, and expands with weight gain. Brown adipose tissue, on the other hand, is derived from muscle and is highly thermogenic. In other words, it burns energy to produce heat and maintain body temperature in warm-blooded organisms. Unlike white adipose tissue, the quantity of brown fat in the body is inversely proportional to body mass index (BMI), meaning that lean people tend to store more of this type of fat than people that are overweight, leading to the characterization of brown fat as "good" fat.

Websites:

- http://www.idf.org/about-diabetes
  - global
- http://www.diabeteseducator.org/

- http://www.cdc.gov/diabetes/home/

- http://www.diabetes.org/
  - U.S.

- **Questions?**