Types of Diabetes
(Revised 1/3/06)

Definition: Diabetes mellitus is a medical disorder characterized by varying or persistent hyperglycemia (elevated blood sugar levels), especially after eating. All types of diabetes mellitus share similar symptoms and complications at advanced stages. Hyperglycemia itself can lead to dehydration and ketoacidosis. ...

en.wikipedia.org/wiki/Type_1_diabetes

HealthInsite, a web site provided by the Commonwealth Government of Australia, provides a description of the three basic types of diabetes. The three general types are:
(also see: NDIC, http://diabetes.niddk.nih.gov/dm/pubs/overview/)

Type 1 diabetes (previously known as insulin-dependent diabetes)
Type 1 diabetes is an auto-immune disease where the body's immune system destroys the insulin-producing beta cells in the pancreas. This type of diabetes, also known as juvenile-onset diabetes, accounts for 10-15% of all people with the disease. It can appear at any age, although commonly under 40, and is triggered by environmental factors such as viruses, diet or chemicals in people genetically predisposed. To live, people with type 1 diabetes must inject themselves with insulin several times a day and follow a careful diet and exercise plan.

[Another definition: An autoimmune disease in which the pancreas makes little or no insulin, resulting in an abnormally high blood sugar level. Formerly known as insulin-dependent diabetes or juvenile diabetes. www.cnn.com/HEALTH/library/DA/00050.html]

Type 2 diabetes (previously known as non-insulin dependent diabetes)
Type 2 diabetes is the most common form of diabetes, affecting 85-90% of all people with the disease. This type of diabetes, also known as late-onset diabetes, is characterized by insulin resistance and relative insulin deficiency. The disease is strongly genetic in origin but lifestyle factors such as excess weight, inactivity, high blood pressure and poor diet are major risk factors for its development. Symptoms may not show for many years and, by the time they appear, significant problems may have developed. People with type 2 diabetes are twice as likely to suffer cardiovascular disease. Type 2 diabetes may be treated by dietary changes, exercise and/or tablets. Insulin injections may later be required.

Gestational diabetes mellitus (GDM)
GDM, or carbohydrate intolerance, is first diagnosed during pregnancy through an oral glucose tolerance test. Between 5.5 and 8.8% of pregnant women develop GDM in Australia. Risk factors for GDM include a family history of diabetes, increasing maternal age, obesity and being a member of a community or ethnic group with a high risk of developing type 2 diabetes. While the carbohydrate intolerance usually returns to normal
after the birth, the mother has a significant risk of developing permanent diabetes while
the baby is more likely to develop obesity and impaired glucose tolerance and/or
diabetes later in life. Self-care and dietary changes are essential in treatment.

Some characteristics of Diabetes

Glucose levels for Type 1 Diabetes

Note the dramatic swings in blood glucose level with time for the diabetic.

http://www.llnl.gov/str/December01/Lane.html
Glucose tolerance test, typical patterns

http://204.147.80.67/~brecovery/correcting_chemistry.html
Impacts of Diabetes


Slide 2. The Epidemic Called Diabetes

These are some sentinel data on diabetes. Over 2000 people are diagnosed each day. It's a leading cause of new blindness, new end-stage renal disease, and nontraumatic amputations -- one of the things we do not pay enough attention to -- associated with peripheral arterial disease. So, diabetes is an epidemic in this country and throughout much of the world.

What are the impacts of diabetes? (Taken from NDIC)

- It affects 18.2 million people--6.3 percent of the U.S. population.
- It is a leading cause of death and disability.
- It costs $132 billion per year.
The flowing graph provides demographic data for diabetes in the U.S. (taken from NDIC)

Further, race/ethnicity demographic for type 2 diabetes is presented in the graph below.
Health Risks Associated with Diabetes:

Diabetes and Cardiovascular Risk

Macrovascular disease including coronary artery disease and other vascular events such as stroke and peripheral vascular disease is responsible for nearly 80% of all diabetes mortality, while 75% of all hospitalizations in diabetes patients is due to cardiovascular events.[4] Furthermore, because new-onset diabetes often does not cause any symptoms for many years, 1 out of 3 people with diabetes remains undiagnosed, even in developed countries such as the United States.[2,4] Therefore, it is not surprising that a third of patients already have cardiovascular disease (CVD) by the time they are diagnosed with diabetes.

Consider the problems that arise from diabetes as shown in the diagram below.
The health complications that arise from diabetes are shown in the slide presented below. (Taken from Contributions of Fasting and Postprandial Hyperglycemia to Micro- and Macrovascular Diabetic Complications, http://www.medscape.com/viewprogram/3036)

**Complications of Diabetes**

- **Microvascular**
  - Retinopathy
  - Neuropathy
  - Nephropathy

- **Macrovascular**
  - Cerebrovascular disease
  - Peripheral vascular disease
  - Coronary heart disease

Typical of Diabetic Neuropathy

A foot ulcer caused by diabetes. (Photograph by John Smith)
Possible Therapies:

Type 1 Diabetes. As the main problem is the autoimmune destruction of the cells that produce insulin for the body, insulin replacement is the main therapy goal.

**Drug Category: Short-acting insulins** -- With the most rapid onset of action, short-acting insulins are used whenever quick glucose utilization is needed (eg, before meals or when blood glucose >250 mg/dL). (such as HumulinR, NovolinR)

**Drug Category: Intermediate-acting insulins** -- With their slower onset of action and longer duration of action, these insulins usually are combined with faster-acting insulins to maximize benefits of a single injection. (such as Humulin N, Novolin N)

**Drug Category: Long-acting insulins** -- These insulins offer a very long duration of action and, when combined with faster-acting insulins, offer better glucose control for some patients. (such as Ultralente)

Type 2 Diabetes. In this disease state there are possible combinations of insulin issues, loss of insulin production, reduced insulin sensitivity, etc. No one drug therapy approach or combination is effective for all patients.

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**Sites of Action of Therapeutic Options for Type 2 Diabetes**

- Liver: Glucose production
- BIGUANIDES
- Thiazolidinediones
- Pancreas: Insulin secretion
- SULFONYLUREAS
- MEGLITINIDES
- NATEGLINIDE
- Muscle and adipose tissue: Peripheral glucose uptake
- THIAZOLIDINEDIONES
- Biguanides
- Intestine: Digestion and absorption of carbohydrates
  - α-GLUCOSIDASE INHIBITORS

Possible therapy for type 2 diabetes is presented in the slide below. (Taken from *Helping Type 2 Diabetics Get to Goal*, from [http://www.medscape.com/viewprogram/3036](http://www.medscape.com/viewprogram/3036))

**Drug Category: Sulfonylurea agents** -- These agents reduce blood glucose by increasing insulin secretion from pancreatic beta cells in patients with residual beta cell function. All are well absorbed; half-life and duration of action vary by agent. They include a first generation (chlorpropamide, tolbutamide, tolazamide, acetohexamide), second generation (glyburide, glipizide), and third generation (glimepiride). All cause mild hypoglycemia commonly; severe hypoglycemia is less common.
**Drug Category: Meglitinides** -- These agents are short-acting insulin secretagogues. They act on the ATP-dependent potassium channels in pancreatic beta cells, allowing opening of calcium channels and increased insulin release.

**Drug Category: Biguanides** -- These agents increase the sensitivity of insulin by decreasing hepatic gluconeogenesis (primary effect) and increase peripheral insulin sensitivity (secondary effect). They do not increase insulin levels or cause weight gain. Taken alone, they do not cause hypoglycemia.

**Drug Category: Alpha-glucosidase inhibitors (AGIs)** -- These agents inhibit the action of alpha-glucosidase, the enzyme responsible for digesting carbohydrates, in the intestine, thus delaying and attenuating postprandial blood glucose peaks. Undigested sugars are delivered to the colon, where they are converted into short-chain fatty acids, methane, carbon dioxide, and hydrogen. AGIs do not increase insulin levels or inhibit lactase; their major effect is to lower postprandial blood glucose levels (lesser effect on fasting levels). They do not cause weight gain. They may restore ovulation in women with anovulation due to insulin resistance. Used alone, AGIs do not cause hypoglycemia. Less than 2% is absorbed as active drug. They can be used as monotherapy or combined with a sulfonylurea agent, a thiazolidinedione, metformin, or insulin. Take with food to minimize adverse GI effects.

**Drug Category: Thiazolidinediones (glitazones)** -- These agents increase peripheral insulin sensitivity by increasing transcription of nuclear proteins that help increase uptake of glucose, probably through effects on free fatty acid levels. They take 12-16 wk to achieve maximal effect. They may restore ovulation in women with anovulation due to insulin resistance. They can be used as monotherapy or combined with a sulfonylurea agent, metformin, a meglitinide, or insulin.

For reviews see:

Diabetes Mellitus, Type 1 – A Review  [http://www.emedicine.com/EMERG/topic133.htm](http://www.emedicine.com/EMERG/topic133.htm)
Diabetes Mellitus, Type 2 – A Review  [http://www.emedicine.com/EMERG/topic134.htm](http://www.emedicine.com/EMERG/topic134.htm)
Diabetes Center  [http://www.mayoclinic.com/findinformation/conditioncenters/centers.cfm?objectid=0005A190-38A5-1B32-82D780C8D77A0000](http://www.mayoclinic.com/findinformation/conditioncenters/centers.cfm?objectid=0005A190-38A5-1B32-82D780C8D77A0000)