Diabetes: In the United States and in Your Dialysis Unit

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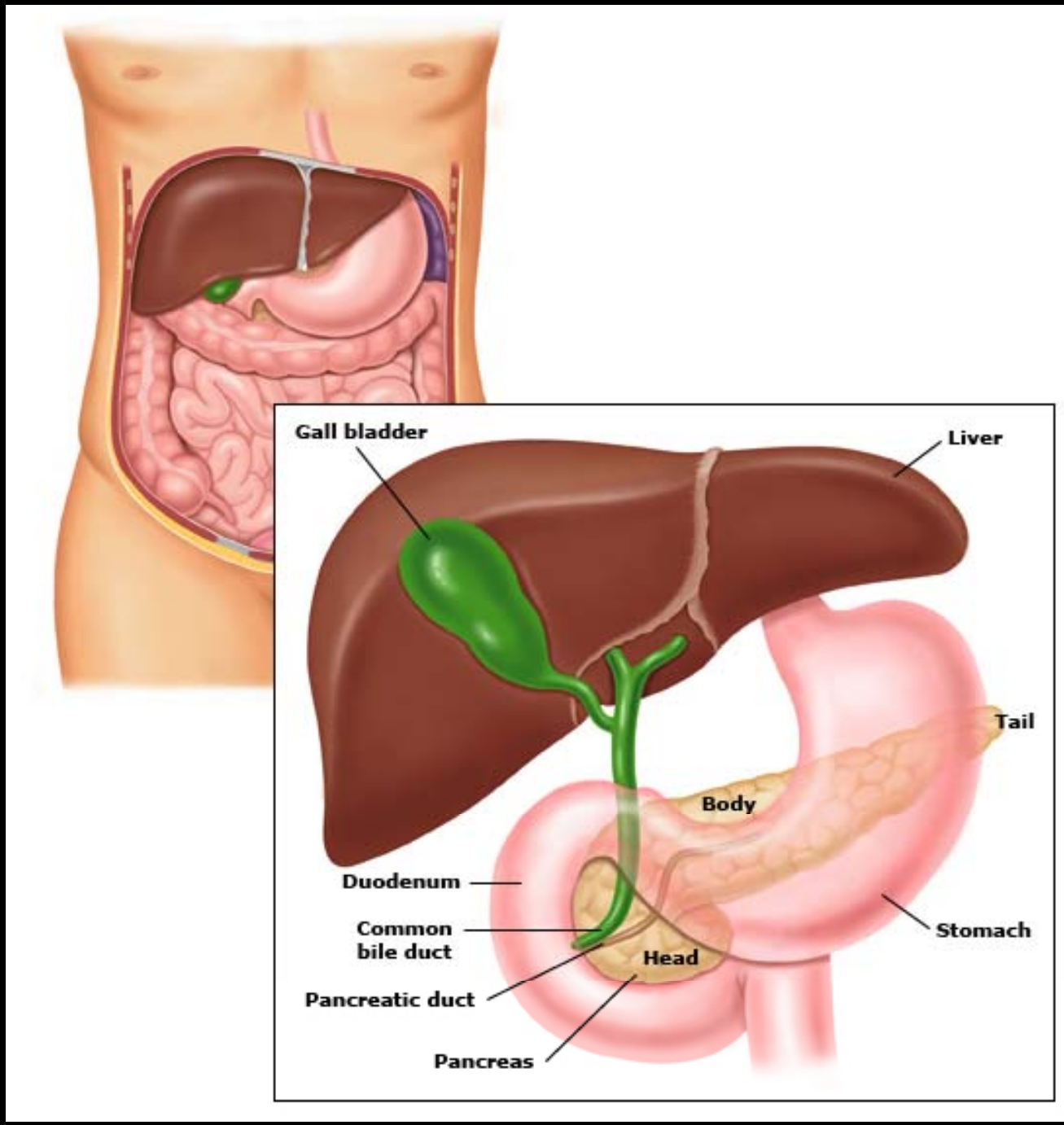
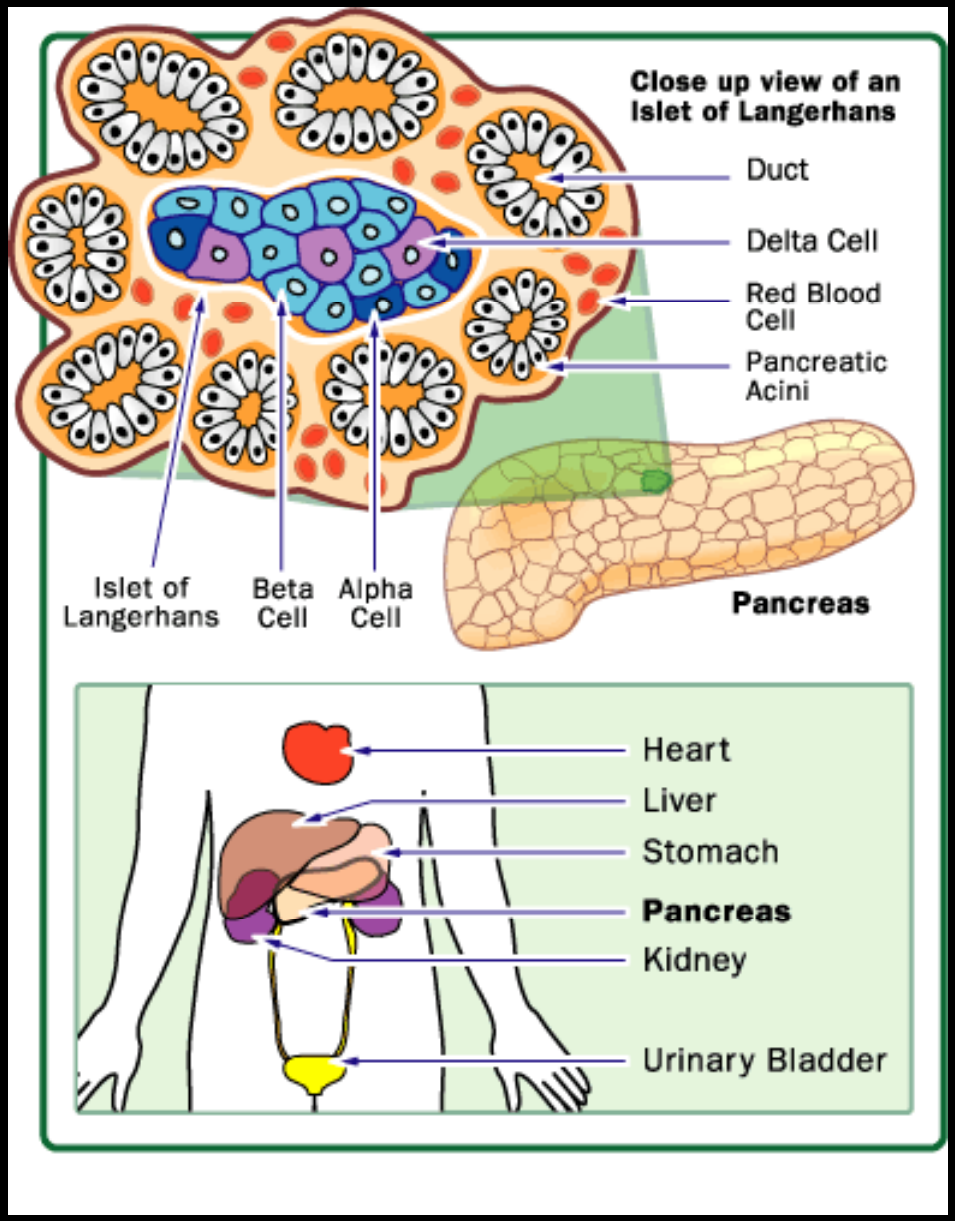
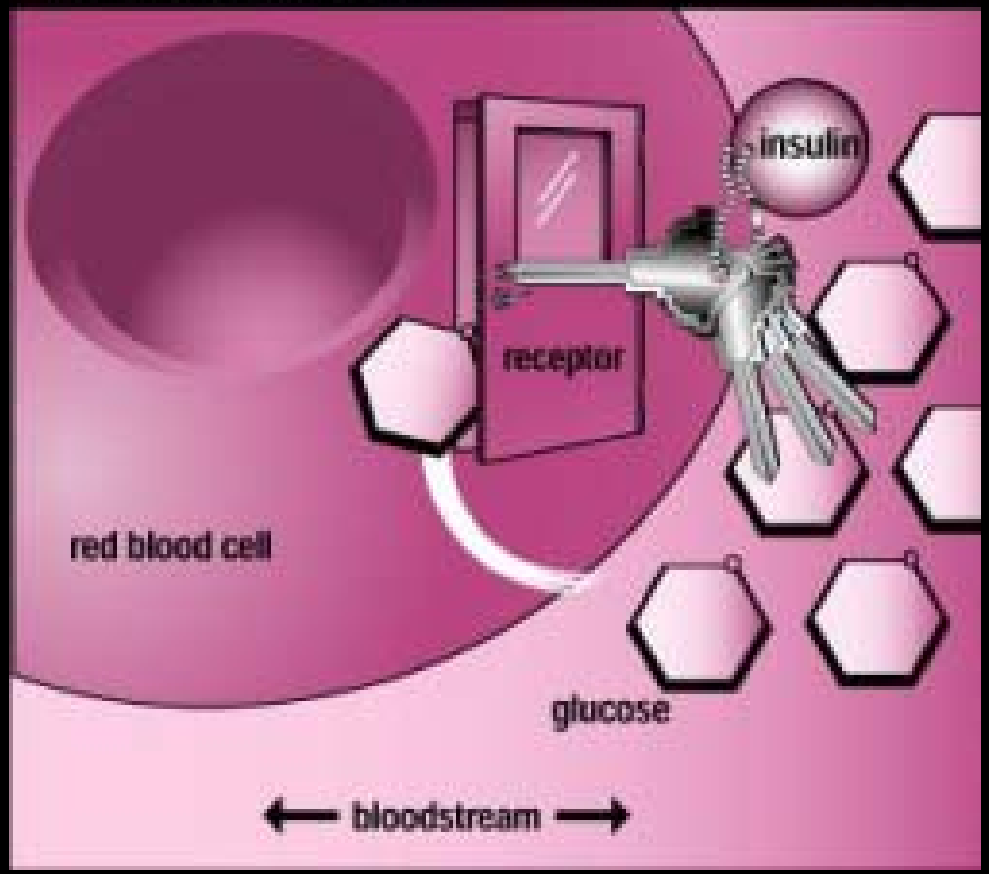
Objectives

- 1. Definition and causes of diabetes
- 2. Complications of diabetes
- 3. Special problems of diabetes in patients treated with dialysis
- 4. What you can do to help your dialysis patients with diabetes


Gall bladder
Liver
Tail
Body
Duodenum
Common bile duct
Stomach
Head
Pancreatic duct
Pancreas


Close up view of an Islet of Langerhans
Duct
Delta Cell
Red Blood Cell
Pancreatic Acini
Islet of Langerhans
Beta Cell
Alpha Cell
Pancreas
Heart
Liver
Stomach
Pancreas
Kidney
Urinary Bladder

The Role of Insulin



Classification of Diabetes

Type I: destruction of beta cells in the pancreas, no insulin production.

Type II: deficiency of insulin production, or resistance to the effect of insulin

Gestational diabetes

Diagnosis of Diabetes

Fasting glucose of ≥ 126 mg/dL (normal is less than 100 mg/dL) OR

Hemoglobin A1C of > 6.5 mg/dL (normal is < 5.7 mg/dL) OR

2 hour post-prandial glucose of ≥ 200 mg/dL (nomal is less than 140 mg/dL) OR

A random glucose of ≥ 200 mg/dL in a patient with symptoms of hyperglycemia

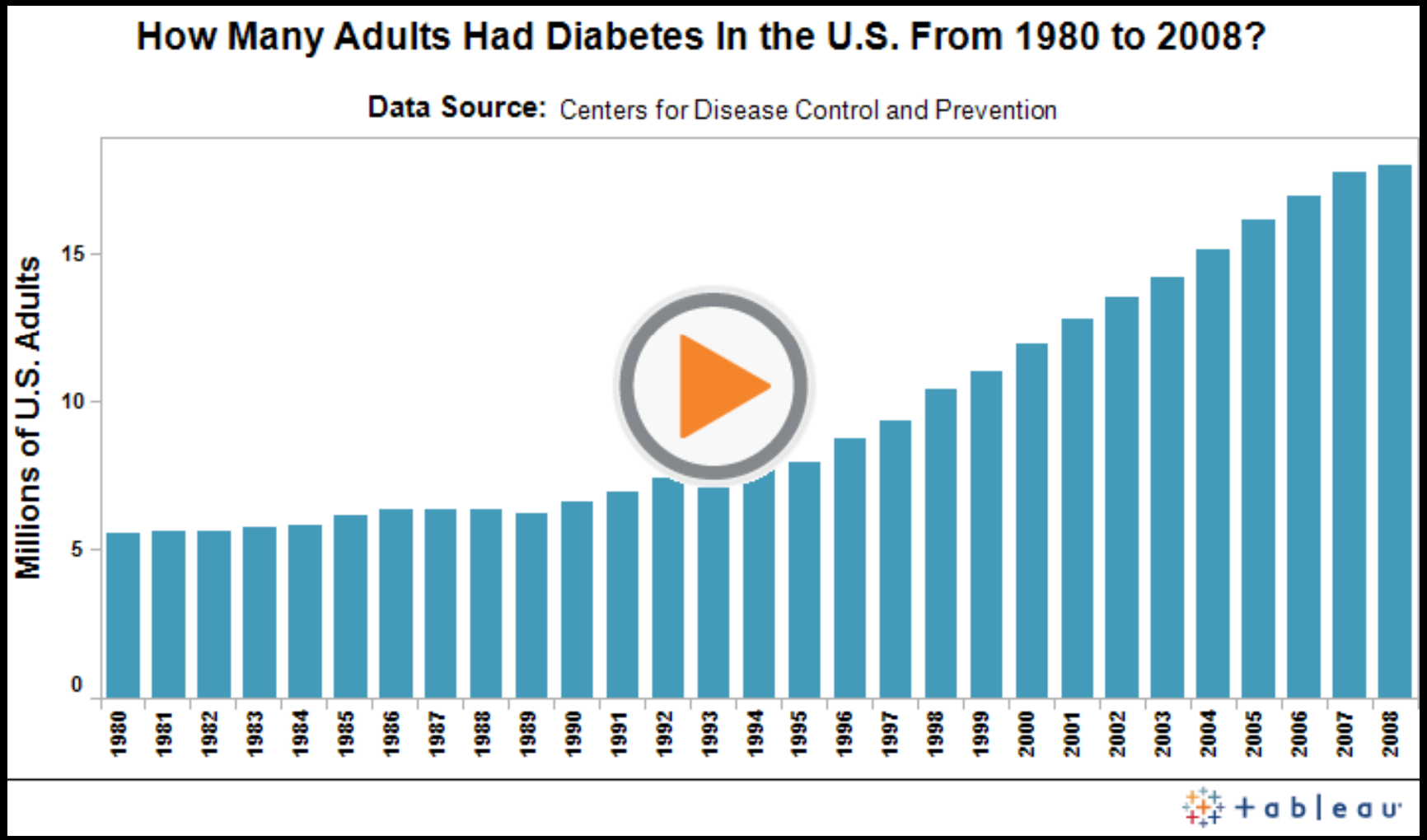

How Many Adults Had Diabetes In the U.S. From 1980 to 2008?
Data Source: Centers for Disease Control and Prevention
Millions of U.S. Adults
0
5
10
15
1980
1981
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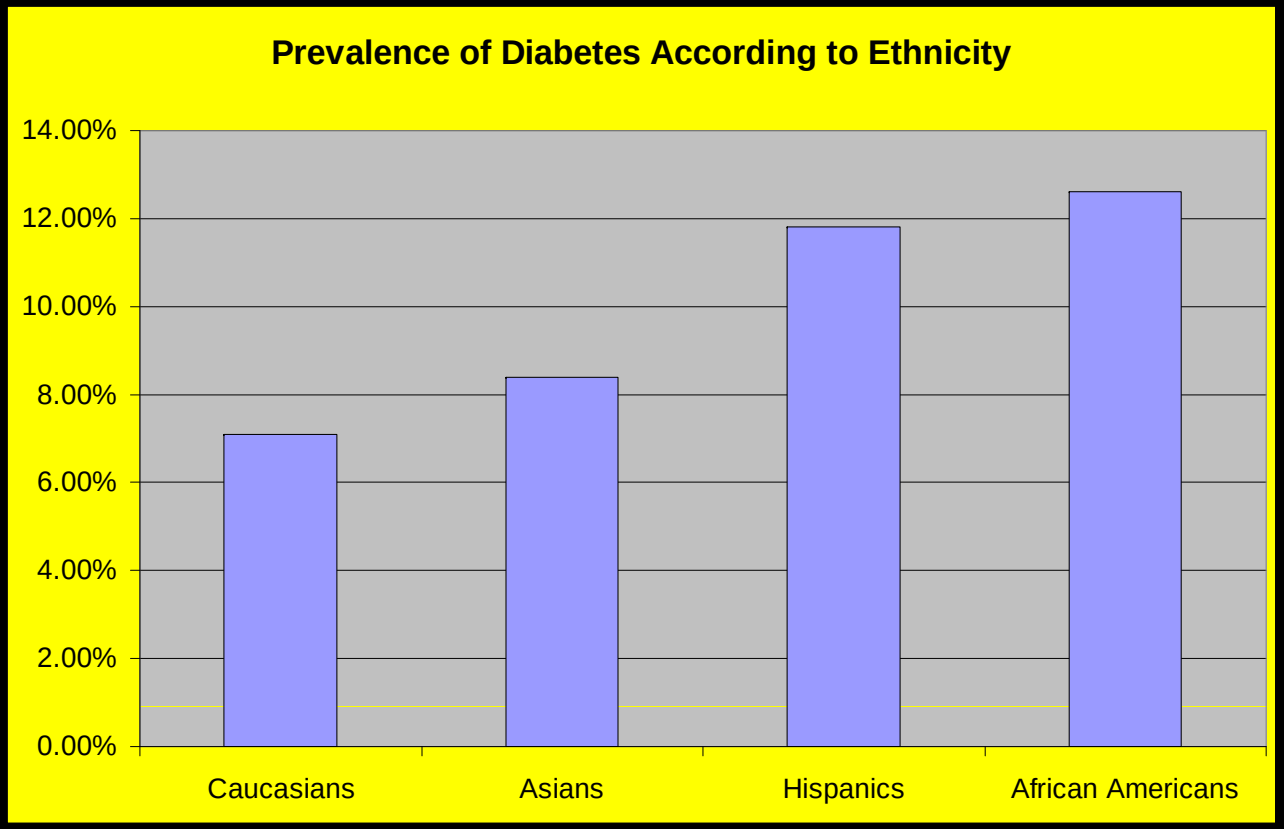
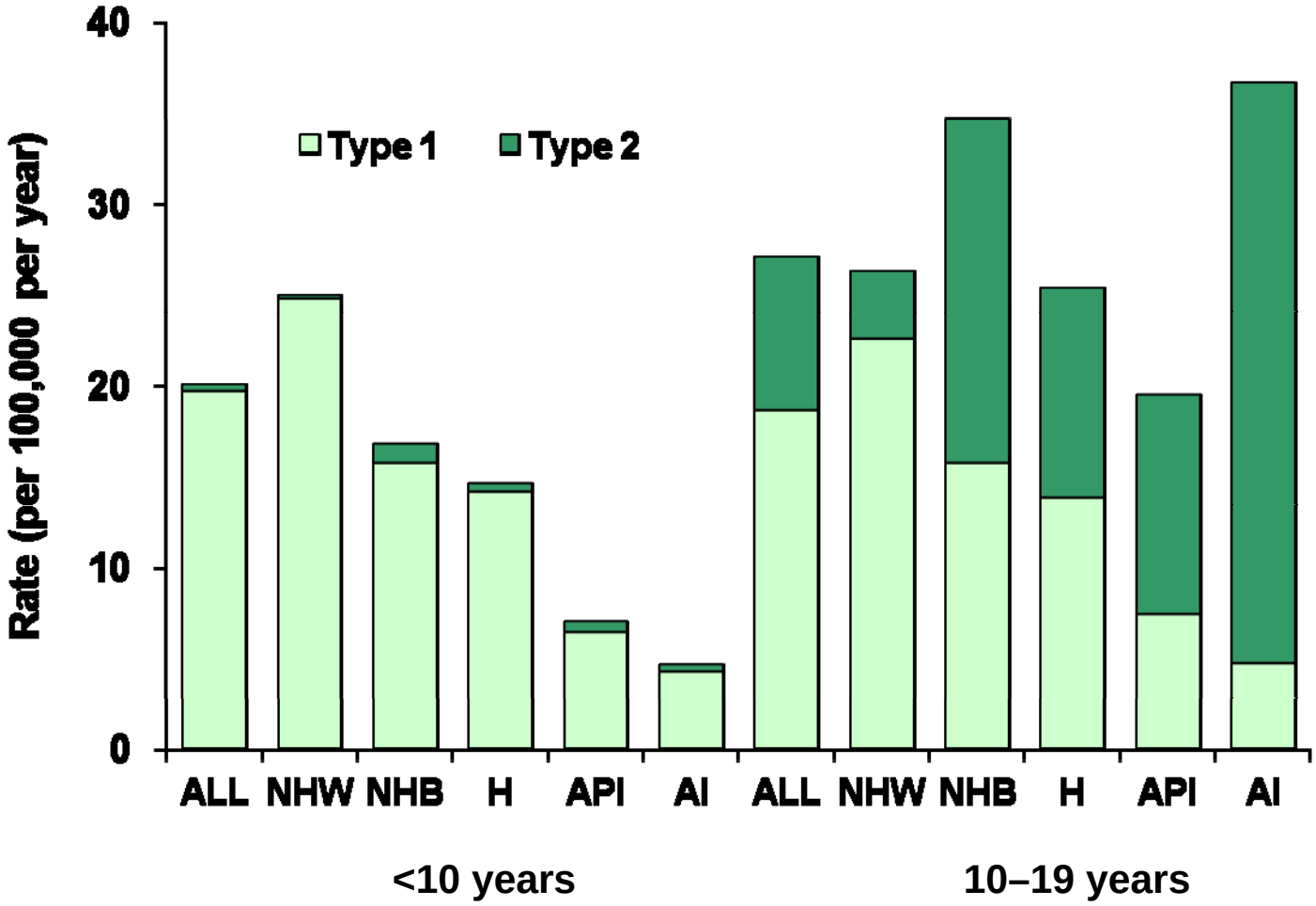
tableau

American Diabetes Association 2004 - 2007



Rate of new cases of type 1 and type 2 diabetes among youth aged <20 years, by race/ethnicity, 2002–2005



Source: SEARCH for Diabetes in Youth Study
NHW=non-Hispanic whites; NHB=non-Hispanic blacks; H=Hispanics; API=Asians/Pacific Islanders; AI=American Indians


www.StrangeCosmos.com

Treatment of type I diabetes: insulin

Type	Starts working	Duration of effect
Short acting: Regular: Lispro (Humalog) Aspart (Novalog)	 30 minutes 5 – 15 minutes	 5 – 8 hours 2 – 4 hours
Intermediate acting: NPH	 2 hours	 12 – 18 hours
Long acting: glargine (Lantus), detimir (Levimir)	 2 hours	 20 – 24 hours

Treatment of diabetes (type II)

Nonpharmacologic treatment: weight loss and exercise.

Pharmacologic treatment:

Biguanides: metformin (Glucophage). Contraindicated in kidney disease

Sulfonylureas: glipizide (Glucotrol), glyburide (Micronase)

TZDs: pioglitazone (Actos), rosiglitazone (Avandia)

Amino acid derivatives: nateglinide (Starlix)

Incretin mimetics: exenatide (Byetta)

Meglitinides: repaglinide (Prandin)

Dipeptidyl peptidase 4 inhibitors: saxigliptin (Onglyza), sitagliptin (Januvia)

Alpha glucosidase inhibitors: acarbose (Precose), migitol (Glyset)

Insulin

Tight glucose control vs. looser glucose control in diabetes

Tight control

Lower risk of complications (including kidney disease)

Many more hypoglycemic reactions

Weight gain

Looser control

Potentially higher risk of complications

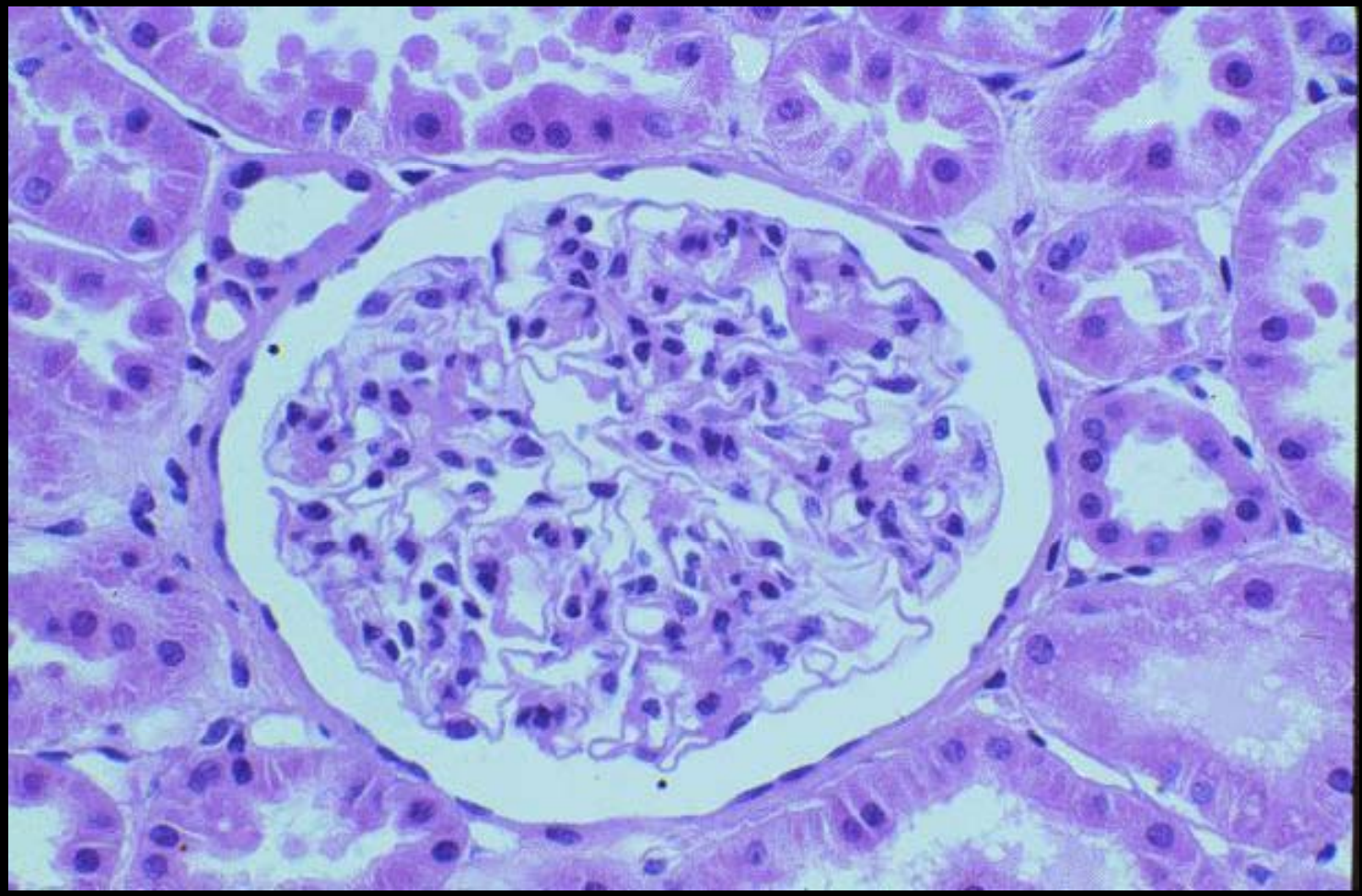
Many fewer hypoglycemic reactions

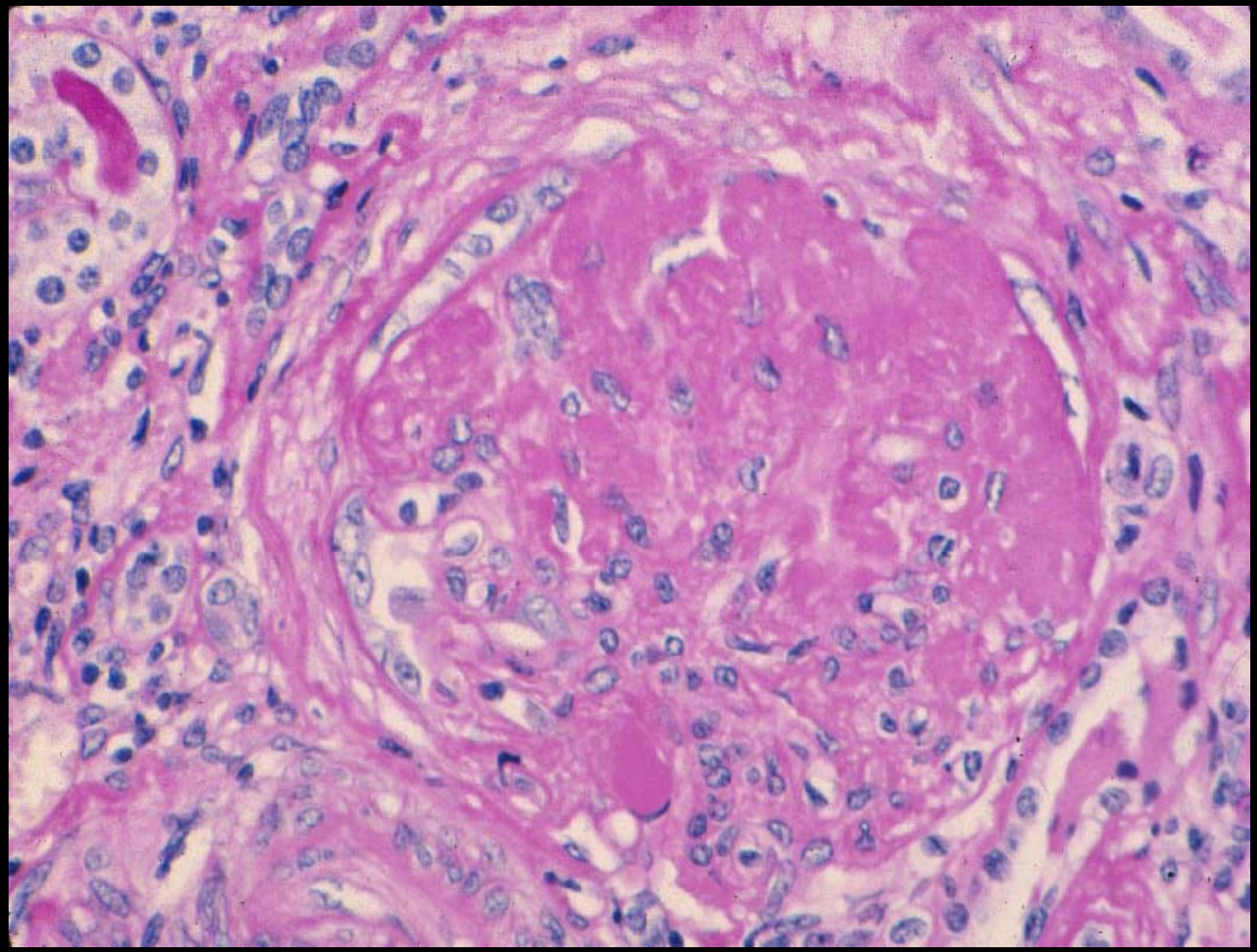
Complications of Diabetes

- Nephropathy (kidney disease)
- Neuropathy (diseases of the peripheral nerves)
- Retinopathy and blindness
- Gastropathy
- Macrovascular and microvascular disease: coronary artery disease and increased risk of heart attacks, cerebrovascular disease and increased risk of stroke, peripheral vascular disease and increased risk of amputation

Cardiovascular disease and diabetes

- 2 – 4 times greater risk of myocardial infarction (heart attack)
- 2 – 4 times greater risk of CVA (stroke)
- 60 % of all amputations of extremities are performed in diabetics





Natural history of diabetic nephropathy

Time	
Onset	
5 years	microalbuminuria
10 years	macroalbuminuria (> 200 μg/min)
	once macroalbuminuria occurs, GFR drops by a mean of 10 ml/min/year
15 years	azotemia/decreased GFR
20 years	stage V CKD (GFR < 15 ml/min)
	with initiation of dialysis or transplant

About 30 % of diabetics will get diabetic kidney disease

Risks for worsening kidney function are:

Obesity/inactivity (in type II diabetes)

Uncontrolled hyperglycemia

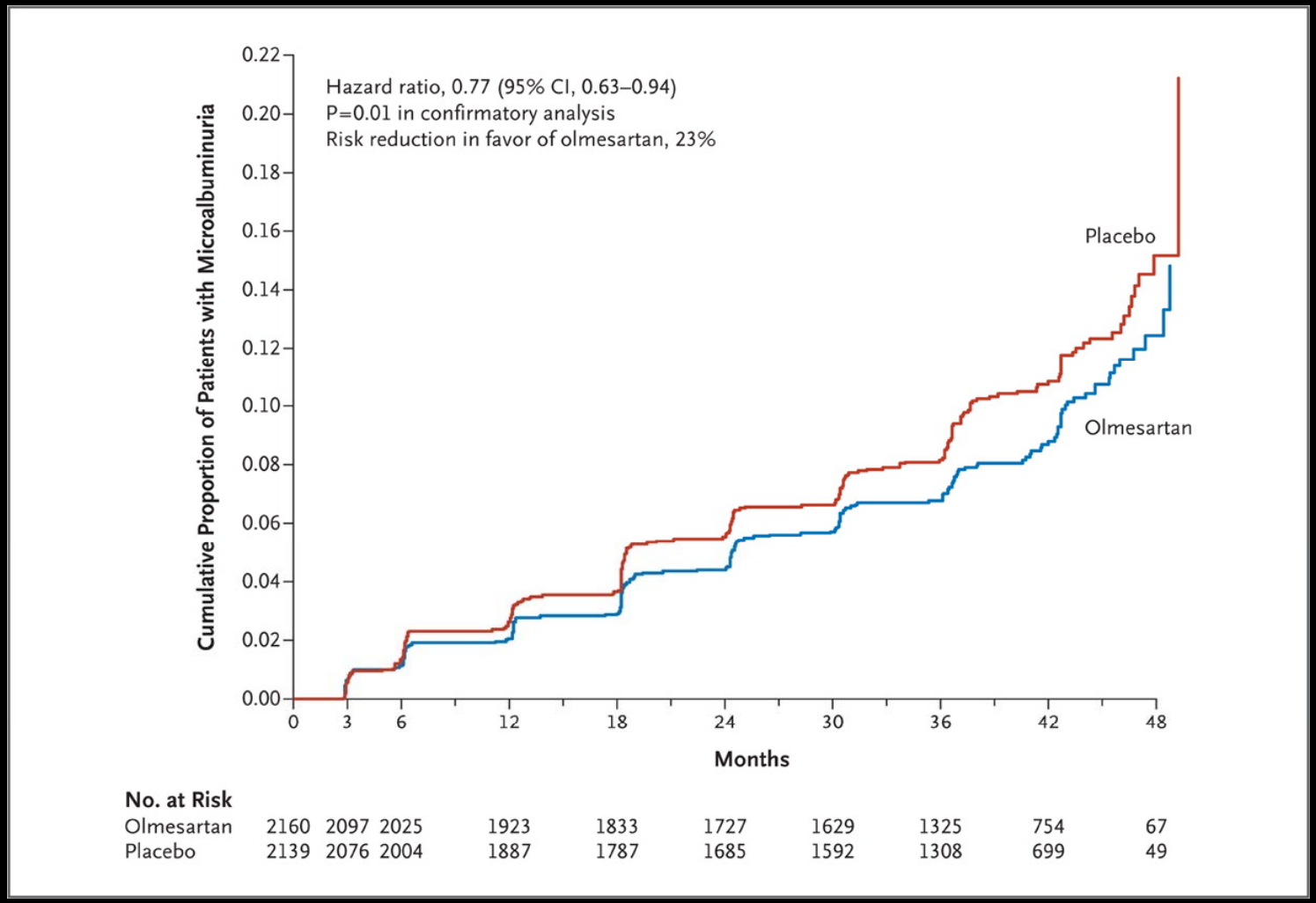
Uncontrolled blood pressure

Smoking

Frequent urinary tract infections

Hereditary factors: more common in African Americans, Native Americans

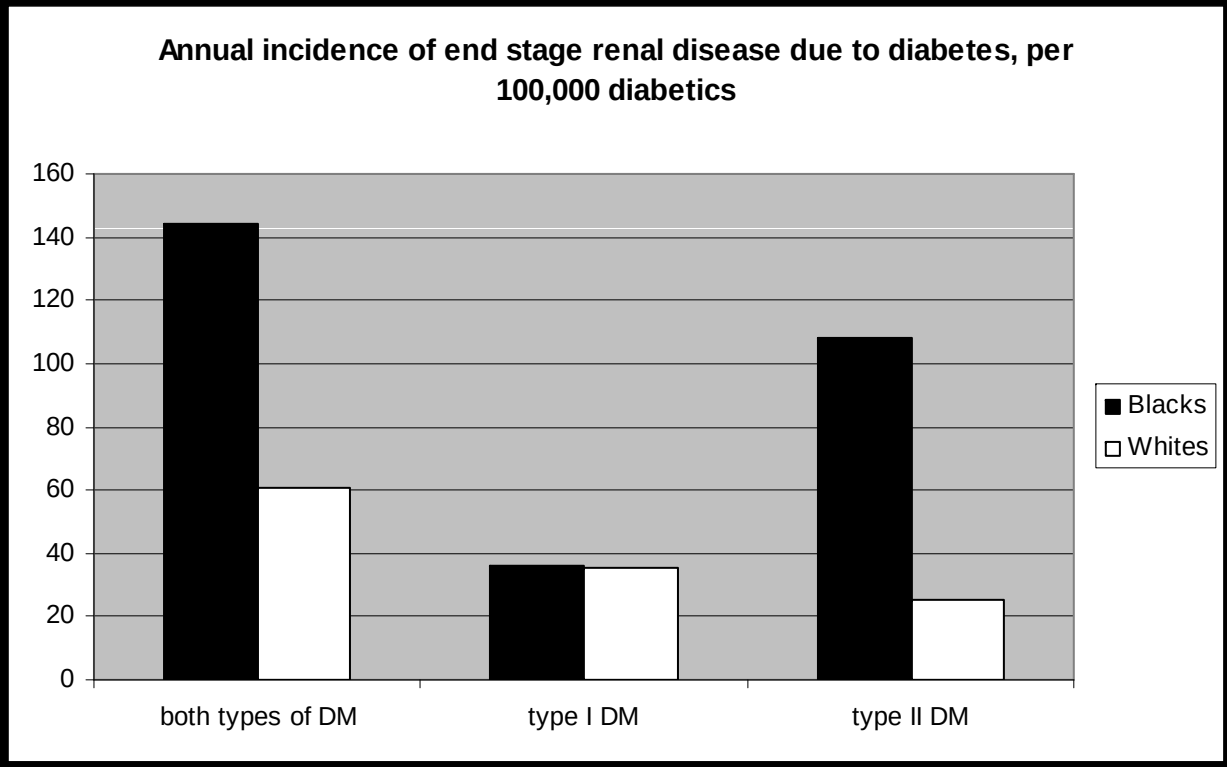
Occurrence of Microalbuminuria during the 48-Month Follow-up Period in the Two Study Groups.



Haller H et al. N Engl J Med 2011;364:907-917.

The NEW ENGLAND JOURNAL of MEDICINE

Much higher rate of diabetic kidney disease in African Americans (Cowie, AJKD 1989)



Diabetes and the Kidney

Diabetes is, in the United States, the leading cause of kidney disease. Per the USRDS:

53 % of incident dialysis patients had diabetes in 2006 (up from 28 % in 1980).

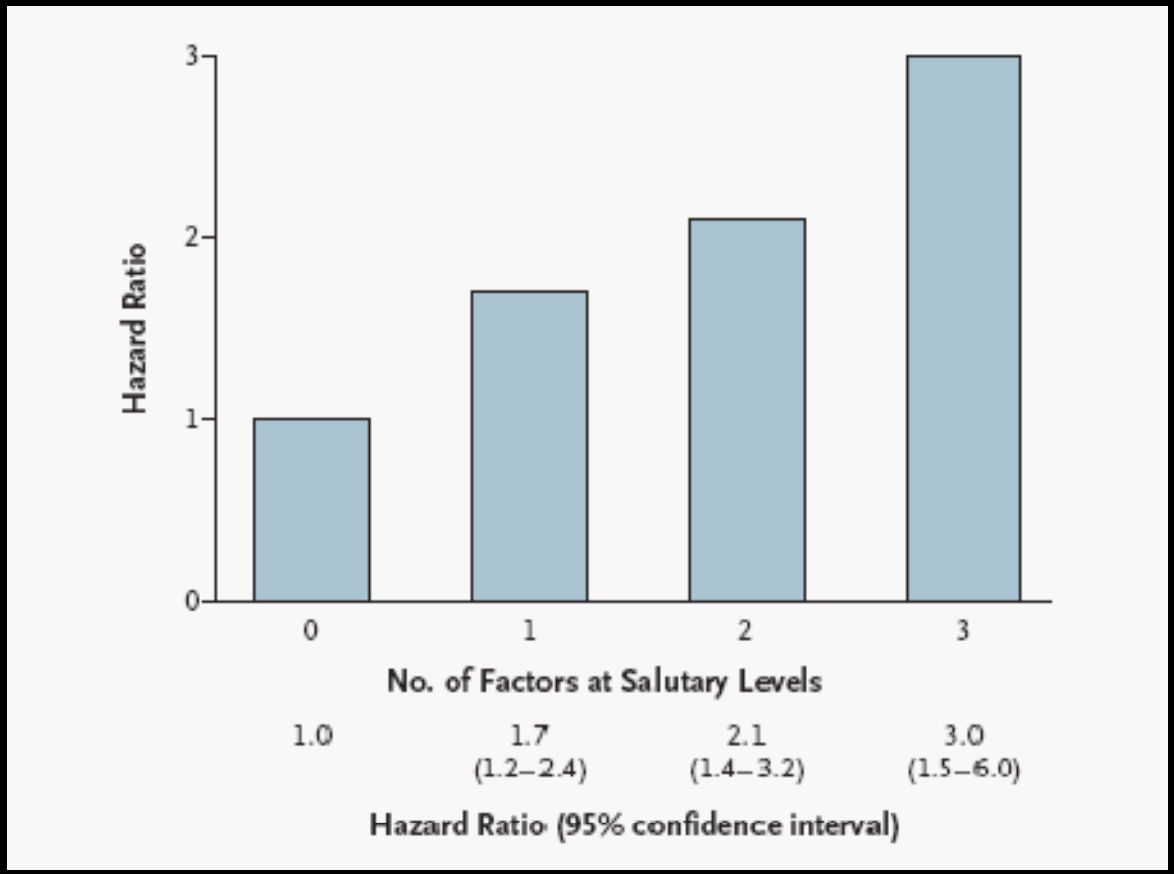
45 % of the prevalent dialysis patients have diabetes (up from 18 % in 1980).

Annual mortality rate in diabetic nephropathy (in dialysis patients) is 33 %.

Diabetic kidney disease may be able to be prevented (or progression to ESRD can be slowed down

1. Good control of glucose
2. Good control of blood pressure (target blood pressure 130/80 or below)
3. Use of medications in the ACE inhibitor/angiotensin receptor blocker categories
4. Avoidance of smoking
5. Weight loss (if obese or overweight) and exercise

Sometimes, early diabetic kidney disease can return to normal: related to good control of HgbA1C (< 8 %), total cholesterol (< 198 mg/dL) and absence of smoking
Perkins, NEJM 2003

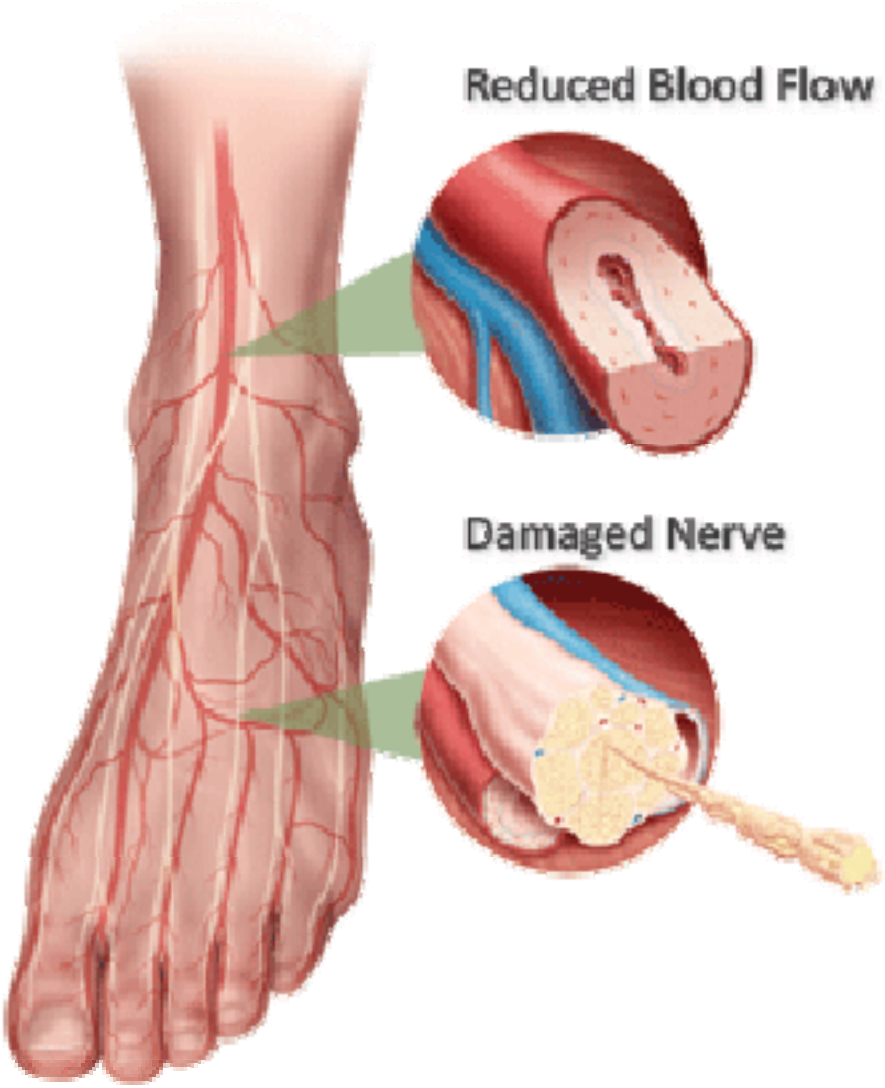


When diabetes progresses to end stage kidney disease

1. Best treatment is living related kidney transplant (for individuals under age of 65 without infection or malignancy
2. Hemodialysis and peritoneal dialysis probably equally effective: peritoneal dialysis involves use of dextrose containing solutions (which may worsen glucose control), but intraperitoneal insulin can be used to effectively lower glucose levels
3. Pancreatic transplants helpful in selected patients

Special problems associated with diabetes in the dialysis unit

1. Infection
2. Visual and neurological problems
3. Hyperglycemia and hypoglycemia


Reduced Blood Flow
Damaged Nerve

Dialysis catheter exit site infection

Photo courtesy of ZJ Twardowski

In diabetics on dialysis, how can infections be avoided?

1. Good control of glucose levels
2. Complete avoidance of smoking
3. Regular foot checks, referrals to podiatrist if abnormalities seen
4. Change socks every day, keep feet moist with lotions, treat fungal infections aggressively, no walking around barefoot

Visual and neurological problems in diabetes

1. Diabetes is the leading cause of blindness in adults in the United States, due to disease of the retina.
2. Presents gradually, begins with blurry and then decreased vision
3. Can be treated with aggressive opthalmalogic care
4. Neuropathy tends to affect the peripheral nerves (hands and feet): numbness, “pins and needles” feeling, pain, decreased hand and finger dexterity

Hypoglycemia

1. Symptoms may be present when glucose is < 70 mg/dL
2. Symptoms are almost always present when glucose is < 45 mg/dL
3. Symptoms include anxiety, restlessness, sweating, tachycardia, diminished mental status, may proceed to coma

Hypoglycemia

1. Occurs with too high a dose of insulin or a hypoglycemic agent, or inadequate carbohydrate intake, or both.
2. Patients on HD are, to some degree protected, because of dextrose in the dialysate bath
3. Treatment is oral or IV glucose, followed by a carbohydrate (which will release glucose over time)

Hyperglycemia

1. Most patients are completely asymptomatic unless glucose level is > 300 mg/dL. Some patients may have increased thirst.
2. Associated with inadequate dose of insulin or hypoglycemic agents, excess carbohydrate intake, or both, but can be an early sign of infection, heart attack.
3. Treatment is rapid glucose lowering, usually with insulin or increasing oral hypoglycemic dose.

Take home points

1. Diabetes is due to a defect in insulin production (type I) or an inability of insulin to act on cells (type II).
2. Type II diabetes is progressively more common in the United States, related to the epidemic of obesity and inactivity and may affect close to 1 in 10 Americans. The CDC predicts that this number may increase to 1 in 3 by 2050.
3. It causes heart and vascular disease, blindness, neuropathy, and it is the leading cause of kidney disease in the United States.

What can you do in the dialysis unit with your diabetic patients

1. Encourage diet, weight loss, and exercise, especially for type II diabetes
2. Encourage compliance with medication, empower patients to advocate for themselves regarding side effects of medications
3. Recognize signs of hypoglycemia and hyperglycemia during treatments. Be on the lookout for visual difficulties among your patients.
4. Help patients avoid infections: encourage foot checks. Fistula first; discourage permcaths