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Diabetes: screening and diagnosis

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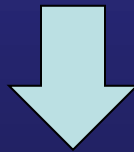
Session objectives

- Recognize the criteria for screening for diabetes

- Describe the available screening tests for diabetes

- Identify the diagnostic criteria for diabetes and

  prediabetes

- Explain the health and economic impacts of diabetes

What's in a name?

What does "Diabetes Mellitus" mean?

Diabetes = To pass

Mellitus = Honey

Passing honey

Classification of diabetes mellitus

1) Type 1 diabetes

2) Type 2 diabetes

3) Gestational diabetes

4) Specific types of diabetes due to other causes:

  Examples:

  - MODY (maturity onset diabetes of the young)

  - Diseases of the exocrine pancreas (cystic fibrosis)

  - Drug- induced (steroids or after organ transplantation)

Screening for diabetes in adults

1. All persons age ≥ 35 years

2. Persons with risk factors (next slide)

3. Ladies with prior gestational DM

4. Persons with HIV

5. History of pancreatitis

6. Cystic fibrosis

7. Use of high-risk medications

8. After organ transplantation

Screening for diabetes

Adults with BMI ≥25 with any of the following risk factors:

- Physical inactivity
- First-degree relative with diabetes
- Hypertension
- Cardiovascular disease
- High-risk race/ethnicity (e.g. African American, Latino, Native American,)

- HDL cholesterol <0.9 mmol (35 mg)
- Triglyceride >2.8 mmol (250 mg)
- Polycystic ovary syndrome
- Other clinical conditions associated with insulin resistance (e.g. morbid obesity, acanthosis nigricans)

Calculating BMI

Body mass index (BMI) → Weight (kg) ÷ height (m)^2

Weight (kg) ÷ height (m) ÷ height (m)

Example: weight 82, height 165 cm
BMI = 82 ÷ 1.65 ÷ 1.65= 30.1

30 or more → **Obesity**

25 to 29.9 → **Overweight**

18.5-24.9 → **Normal**

Less than 18.5 → **Underweight**

Screening for diabetes in adults

5) History of pancreatitis

- Acute pancreatitis: within 3-6 months then every year

- Chronic pancreatitis: every year

6) Cystic fibrosis:

- Every year starting at age 10 years

Screening for diabetes in adults

7) Use of high-risk medications:

- Corticosteroids, 2nd generation antipsychotics, statins, PCSK-9 inhibitors, some HIV medications, thiazides

- Screen at baseline, after 3 months then every year

Screening for diabetes in children

♦ Starting at age 10 or after puberty (which ever is earlier) with overweight (≥85th percentile) or obesity (≥95th percentile) and **any** of the following:

- Maternal history of DM
- GDM during the child's gestation
- Family history of type 2 DM (1st or 2nd degree relative)
- High-risk race/ethnicity (e.g. African American, Latino,..)
- Hypertension
- Dyslipidemia
- Small-for-gestational age birth weigh
- Polycystic ovary syndrome

Screening for diabetes: frequency

If results are normal, testing should be repeated at least at every 3 years

American Diabetes Association. Diabetes Care 2023;46 (suppl 1):S19

Screening for diabetes: which test?

- The American diabetes association recommends that any of the following tests can be used:

    A) Fasting plasma glucose

    B) HbA1c

    C) 2-hour plasma glucose after 75-gram oral glucose tolerance test

American Diabetes Association. Diabetes Care 2024;47 (suppl 1):S20

Fasting plasma glucose

Patient preparation:

- Fasting at least 8 hours

- Water is allowed

Plasma glucose: which units?

mmol or mg?

1 mmol glucose = 18 mg
mg = mmol × 18

Example: 10 mmol = 180 mg

Fasting plasma glucose

- **<u>Normal</u>**:

  - <5.6 mmol (100 mg)

- **<u>Diabetes</u>**:

  - $\geq$7 mmol (126 mg)

- **<u>Impaired fasting glucose (IFG) [Prediabetes]</u>**:

  - 5.6 to 6.9 mmol (100-125 mg)

Precaution

Capillary glucose should **not** be used for the diagnosis of diabetes

75-g OGTT

75-gram

Oral **G**lucose **T**olerance **T**est

When to do 75-g OGTT?

- Pregnancy (screening for GDM)

- Screening for DM after delivery with GDM

- Screening for post-transplantation DM

- Diagnosis of cystic fibrosis-related DM

- To confirm the diagnosis of DM (optional)

- Screening for DM (optional)

How to do 75-gram OGTT (in non-pregnant)?

Fasting and 2-hour glucose

2-hour plasma glucose after 75-gram OGTT

Normal

Impaired Glucose Tolerance (IGT) [Prediabetes]

Diabetes

< 7.8 mmol (140 mg)

7.8-11 mmol (140-199 mg)

≥ 11.1 mmol (200 mg)

American Diabetes Association. Diabetes Care 2024;47 (suppl 1):S20
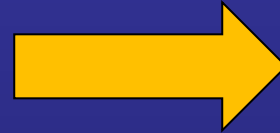
Interpretation of A1c

Diabetes ➡ ≥6.5

Prediabetes ➡ 5.7-6.4

Normal ➡ <5.7

Why is prediabetes important?

- High risk of type 2 DM

- High risk of cardiovascular disease

- Associated with obesity, HTN, dyslipidemia

- Number or persons with prediabetes is more than

  those with DM

Management of prediabetes

Diabetes prevention program

Persons with prediabetes

- Group on lifestyle changes:

  - Weight loss of at ≥7%
  - Structured exercise program
    [moderate intensity]
    (150 min./week)

→ Risk of DM ↓ by **58 %**

Group on Metformin → Risk of DM ↓ by **31 %**

Diabetes Prevention Program Research Group. N Engl J Med 2002;346:393.

Management of prediabetes

- Lifestyle changes:

  – Refer to lifestyle change behavior program

  – Aim for weight loss of at least 7%

  – Physical activity:

    • Moderate intensity (such as brisk walking)

    • Duration: at least 150 minutes/week

American Diabetes Association. Diabetes Care 2024;47 (suppl 1):S43

Management of prediabetes

- Screen and treat CVD risk factors: HTN, dyslipidemia
- Metformin (especially for):
    - **BMI ≥35**
    - **Fasting glucose ≥6.1 mmol (110 mg)**
    - **HbA1c ≥6%**
    - **Prior gestational diabetes**
- Metformin was not effective for age ≥60 years
- Self-management education & support
- Testing for diabetes **yearly**

How to diagnose DM?

Fasting plasma glucose ≥ 7 mmol (126 mg)

OR

HbA1c ≥ 6.5

OR

2-hour plasma glucose post 75-g OGTT ≥ 11.1 mmol (200 mg)

OR

Symptoms of diabetes and
random plasma glucose ≥ 11.1 mmol (200 mg)

American Diabetes Association. Diabetes Care 2024;47 (suppl 1):S20

Confirming the diagnosis of DM

If 1 test is abnormal ➡ - Repeat same test
- Or do a different test

Symptoms of DM & random glucose $\geq$ 11.1 mmol (200 mg) ➡ Diagnosis is confirmed

If 2 tests are discordant
(Example:
 Fasting PG 7.5 mmol (135 mg)
 A1c 6.3 ➡ Repeat the test showing DM
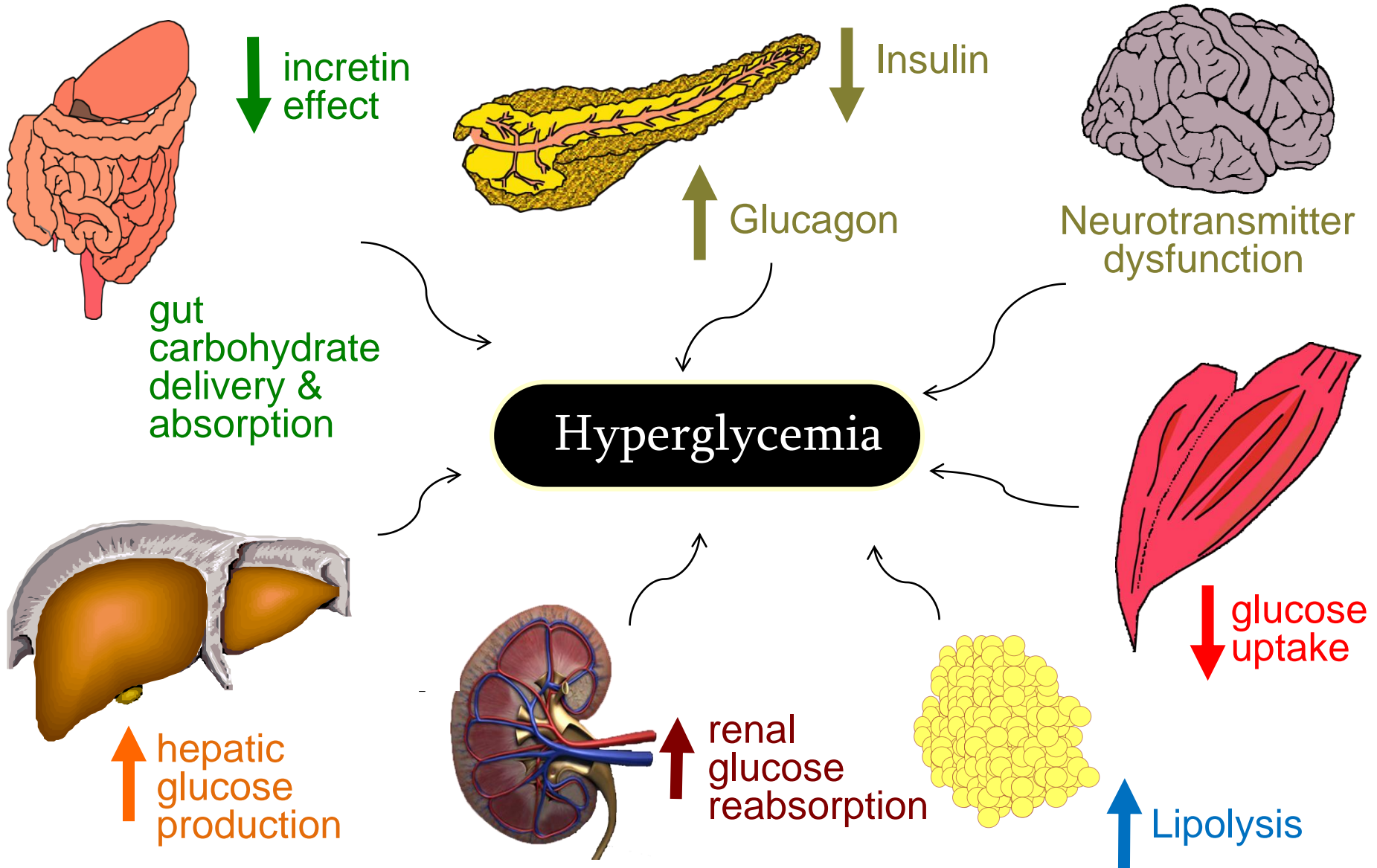(fasting plasma glucose here)

Type 1 diabetes

- Destruction of Beta cells causing insulin deficiency
- Cause ?? Autoimmune, genetic, viral, environmental
- Types:
    - Autoimmune: antibodies present
    - Idiopathic: no antibodies
- < 10 % of all cases of diabetes
- Children & young adults
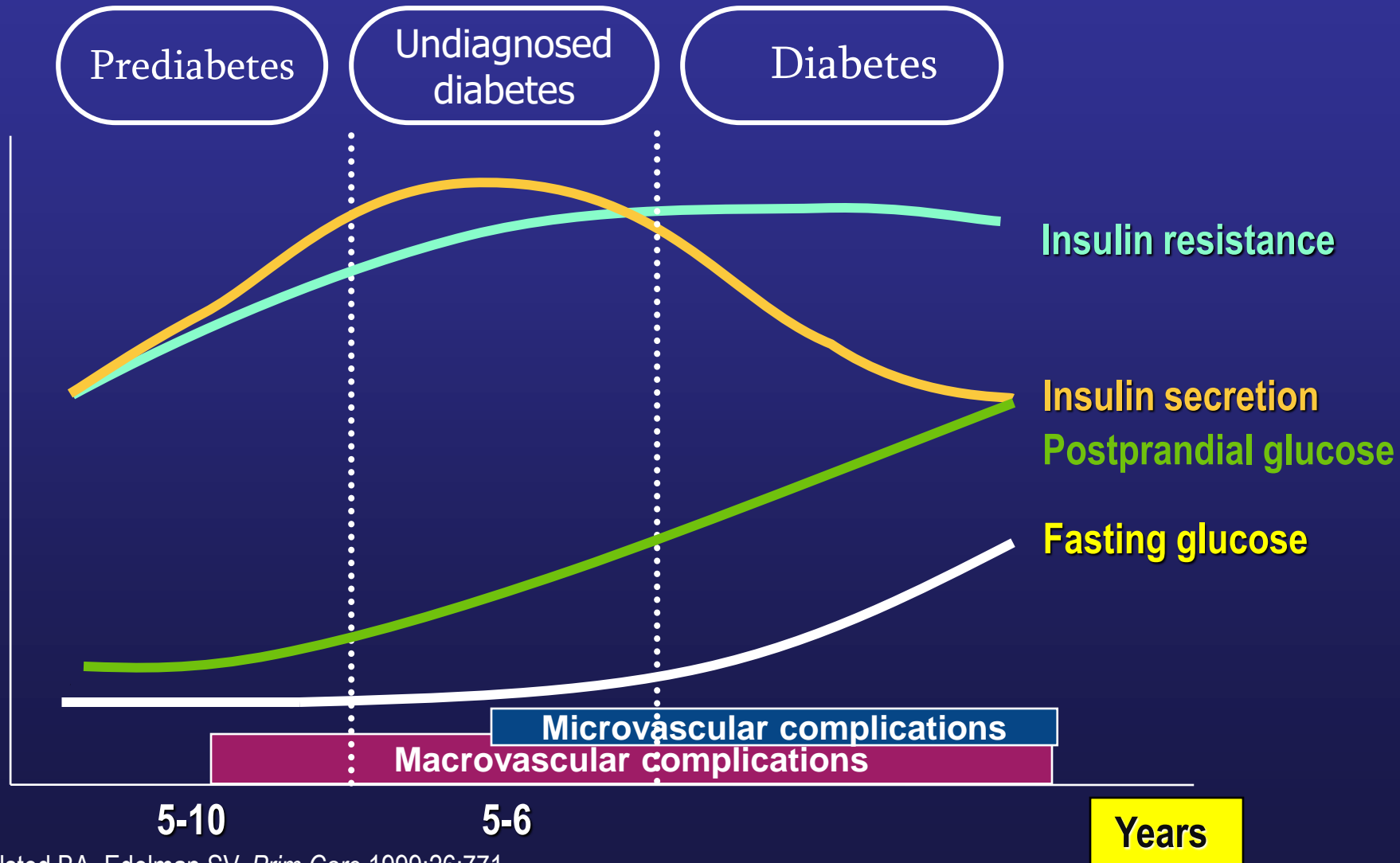- Insulin is the only treatment

Type 2 diabetes

- Diabetes remains undiagnosed for 4-7 years

- About 30-50% of people with diabetes do

  not know that they have the disease

- About 25% have complications at the time

  of diagnosis

Pathophysiology of type 2 DM

↓ incretin effect

gut carbohydrate delivery & absorption

↓ Insulin

↑ Glucagon

Neurotransmitter dysfunction

Hyperglycemia

↑ hepatic glucose production

↑ renal glucose reabsorption

↑ Lipolysis

↓ glucose uptake

Natural history of type 2 DM

Ramlo-Halsted BA, Edelman SV. *Prim Care* 1999;26:771

Prevalence of diabetes
(age adjusted 20-79 years)

Prevalence

25 —

24.9%

20 —

20.9 %

19.5 %

19%

15 —

10 —

10.7%

5 —

6.3 %

UK   **USA**   **Malaysia**   **Qatar**   **Egypt**   **Kuwait**
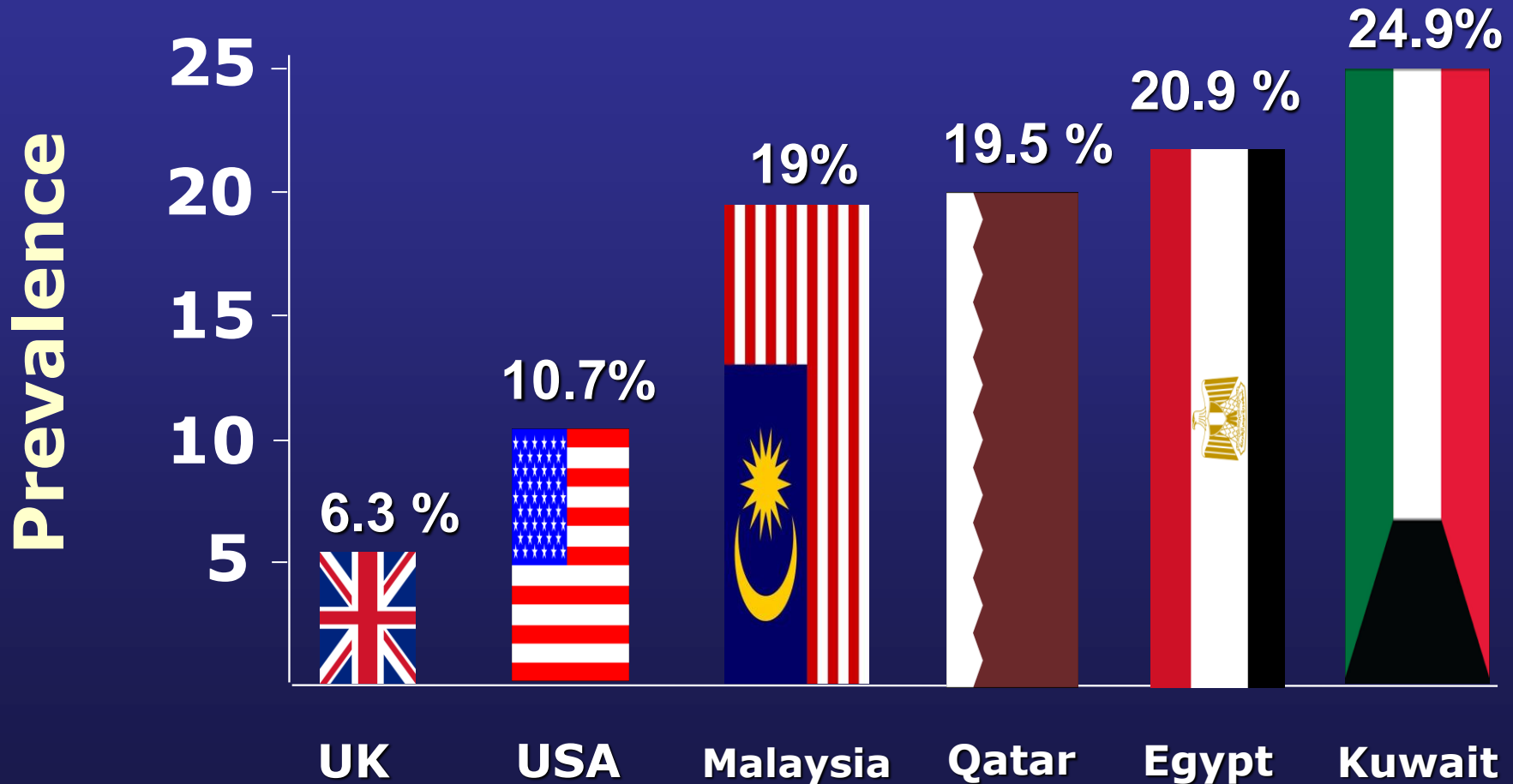
Diabetes: why care?

- $\uparrow$ Risk of cardiovascular disease (CAD, stroke, PAD)

- # 1 cause of chronic kidney disease and dialysis

- # 1 cause of non-traumatic limb amputations

- # 1 cause of blindness in adults

- High risk of hypertension, dyslipidemia & depression

- Major cause of disability and work absenteeism

American Diabetes Association. Diabetes Care 2024;47 (suppl 1):S20
Peters S, et al. Lancet 2014;383:197; Center for disease control & prevention www.cdc.gov

Complications of diabetes

Macrovascular

"Macro" = large

Disease of the large vessels

Microvascular

"Micro" = small

Disease of the small vessels

Complications of diabetes

Stroke

Eye disease

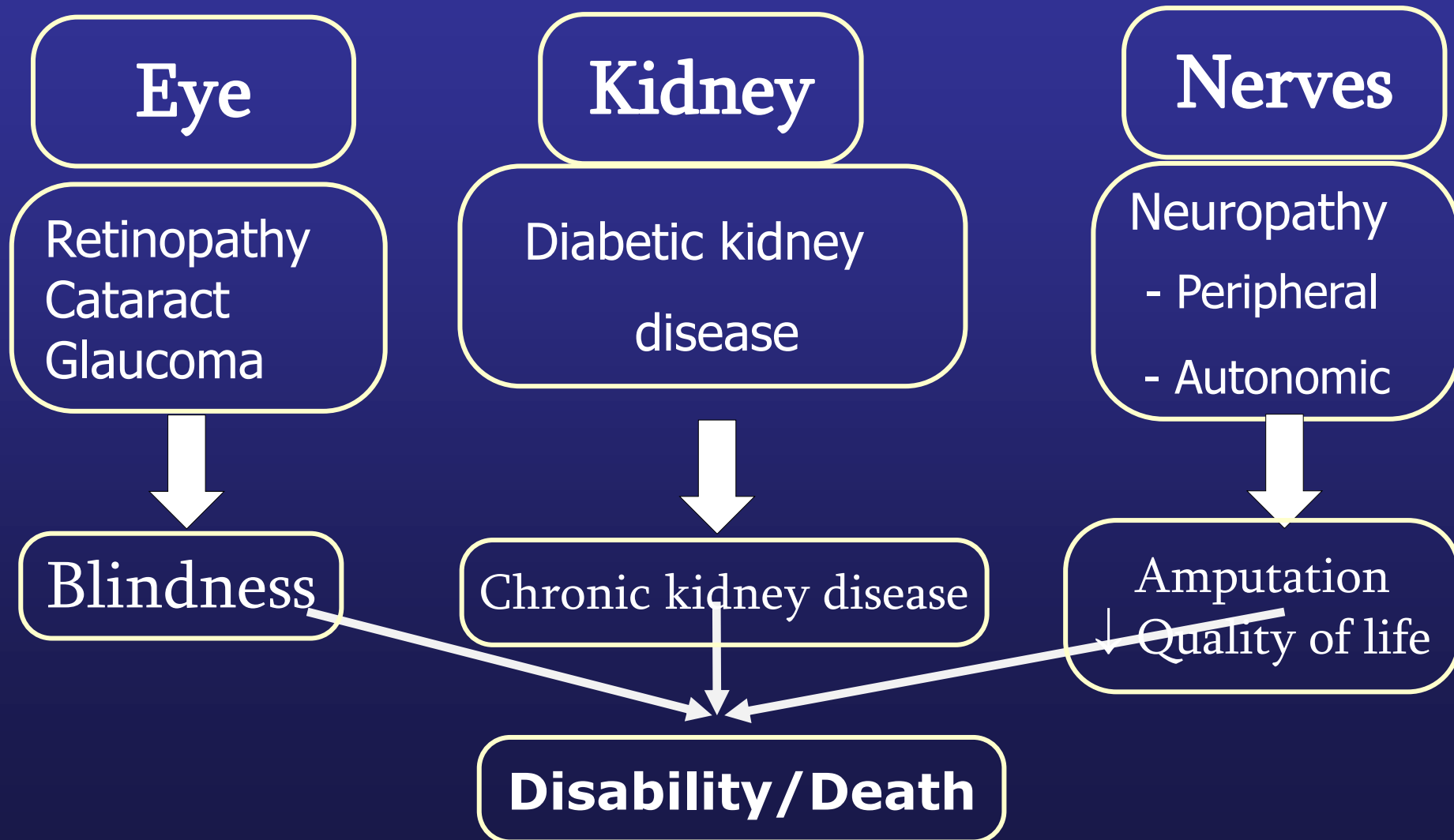Coronary artery disease

Kidney disease

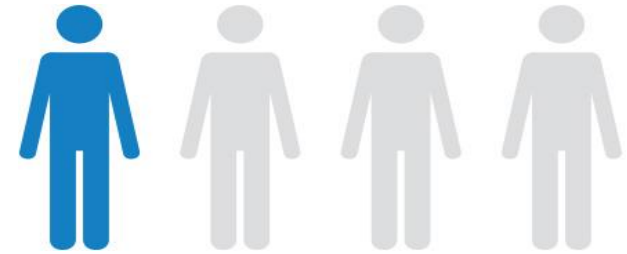Peripheral arterial disease

Nerve disease
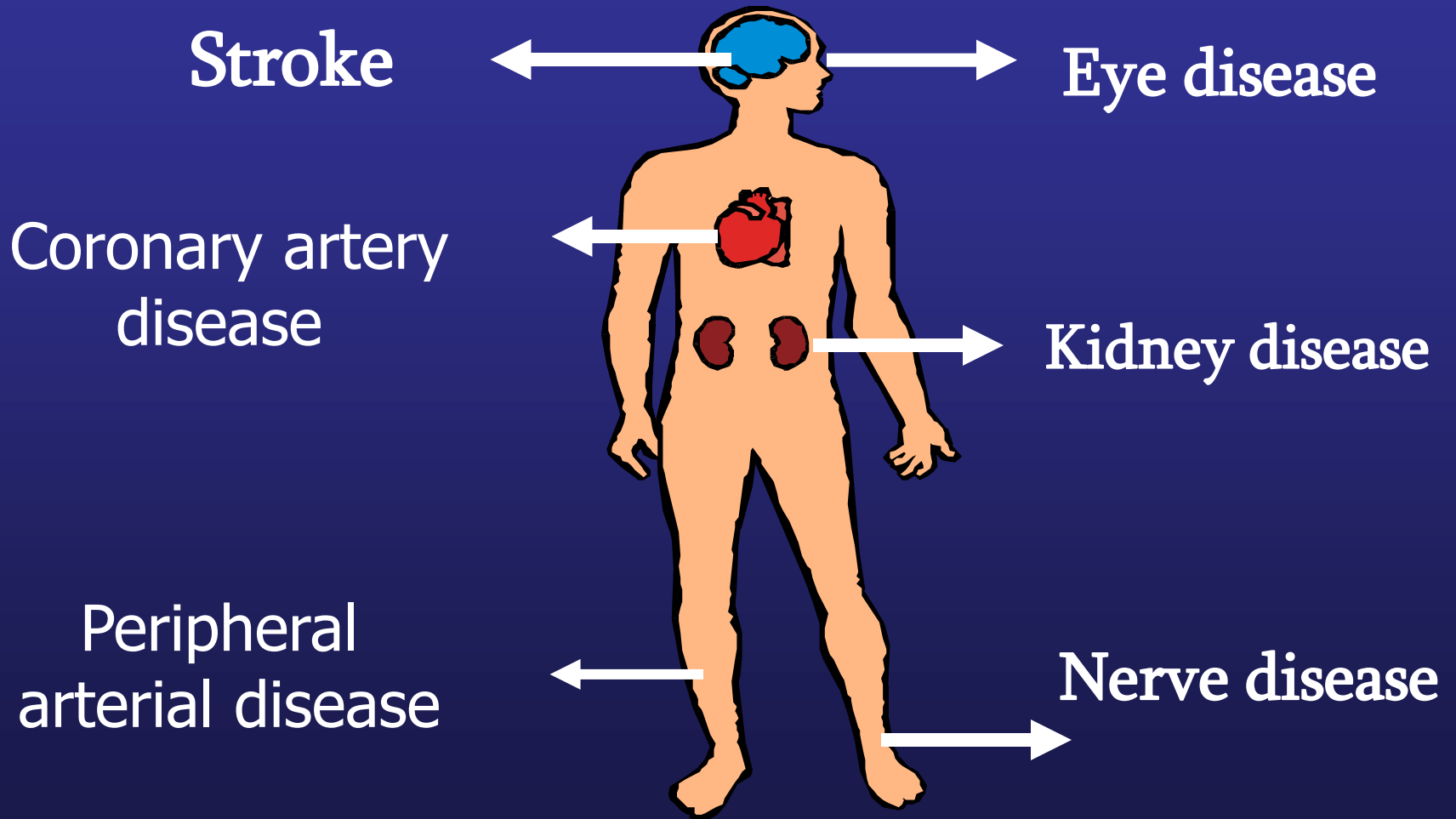
DM & cardiovascular disease

- ↑ Risk of coronary artery disease 200-400%

- ↑ Risk of ischemic stroke

- ↑ Rate of heart failure hospitalization

- ↑ Risk of peripheral artery disease

- ↑ Short- & long-term mortality after acute coronary syndrome

- ↑ Post-MI complications (recurrent ischemia, failure, shock)

- CVD is the main cause of death (~ 80%) in DM

McAllister DA, et al. Circulation 2018;138(24):2774; Peters S, et al. Lancet 2014;383:1973

Microvascular complications of DM

Eye

Retinopathy
Cataract
Glaucoma

↓

Blindness

Kidney

Diabetic kidney disease

↓

Chronic kidney disease

Nerves

Neuropathy
- Peripheral
- Autonomic

↓

Amputation
↓Quality of life

Disability/Death

Cost of diabetes (in USA)

Estimated cost $327 Billion

25% of health care expenditure

2.3 times compared
to no diabetes

American Diabetes Association. Diabetes Care 2018;41:917-928

Summary

- Screen for DM: age ≥35, prior GDM, risk factors

- Can use fasting glucose, A1c or 75-g OGTT

- Criteria to diagnose DM:

  ♦ Fasting glucose: ≥7 mmol (126 mg)

  ♦ A1c: ≥6.5%

  ♦ 2-hour post 75-g OGTT: ≥11.1 mmol (200 mg)

- Diabetes has a huge impact on health and economy

Tripoli, Libya