- Diabetes Mellitus is combination of two Latin words
  - Diabetes means "to flow through"
  - Mellitus means "honey like"
- Diabetes mellitus (DM) is a group of diseases characterized by high levels of blood glucose resulting from defects in insulin production, insulin action, or both.
- The term diabetes mellitus describes a metabolic disorder of multiple etiologies characterized by chronic hyperglycemia with disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action, or both.
- The effects of diabetes mellitus include long–term damage, dysfunction and failure of various organs.

Diabetes Long Term Effects

- The long–term effects of diabetes mellitus include progressive development of the specific complications of retinopathy with potential blindness, nephropathy that may lead to renal failure, and/or neuropathy with risk of foot ulcers, amputation, Charcot joints, and features of autonomic dysfunction, including sexual dysfunction.

- People with diabetes are at increased risk of cardiovascular, peripheral vascular and cerebrovascular disease.

Burden of Diabetes

- The development of diabetes is projected to reach pandemic proportions over the next 10 years.
- International Diabetes Federation (IDF) data indicate that by the year 2025, the number of people affected will reach 350 million – 90% of these people will have Type 2 diabetes.
- In most Western societies, the overall prevalence has reached 4- 6%, and is as high as 10-12% among 60-70-year-old people.
- The annual health costs caused by diabetes and its complications account for around 6-12% of all health-care expenditure.

Crude prevalence (%)

- 9.0 and above
- 6.8 to 8.9
- 4.9 to 6.7
- 2.6 to 4.8
- Less than 2.5
- No data available
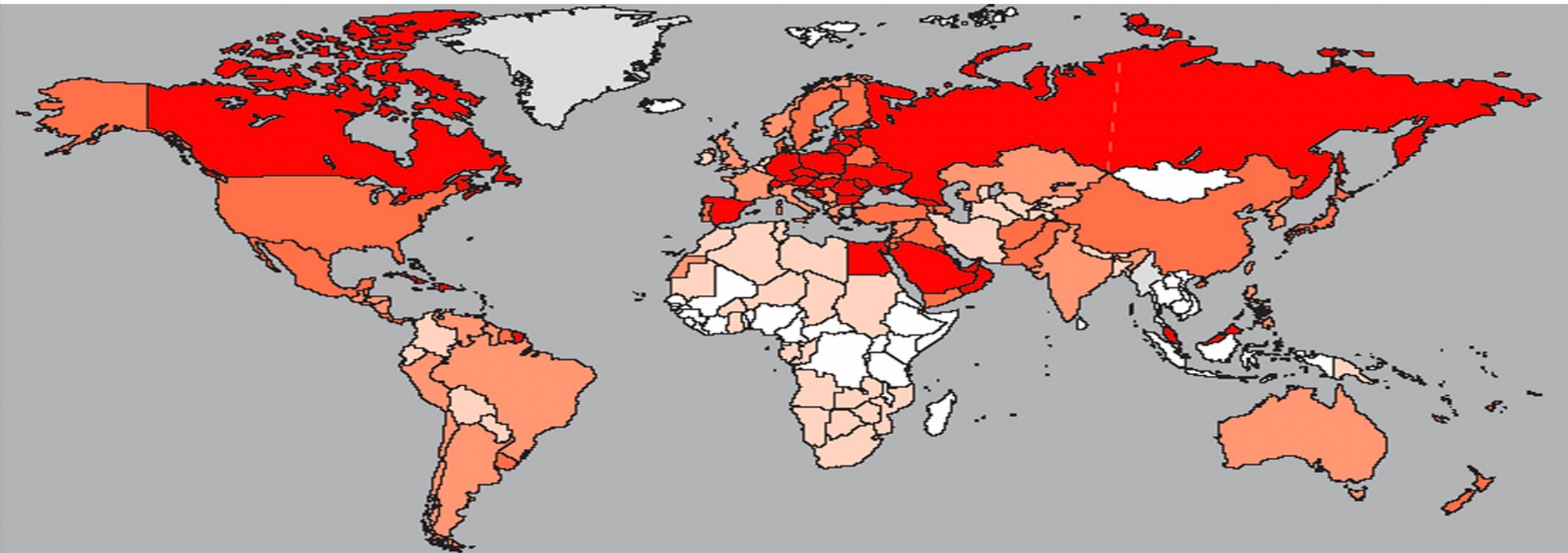
Diabetes Mellitus

- **Definition: metabolic disorder** characterized by hyperglycemia due to an absolute or relative lack of insulin or to a cellular resistance to insulin

- **Major classifications**
    1) Type 1 Diabetes
    2) Type 2 Diabetes
    3) Gestational Diabetes
    4) Pre Diabetes
    5) Secondary Diabetes

There are 5 Major Types of Diabetes

Type 1 Diabetes

- Usually diagnosed in childhood
- Affected by hereditary
- Sometimes there are no symptoms
- Imperative to inject insulin daily because the body makes little or no insulin
- Often called 'insulin- dependent' group
- Patients with type 1 diabetes need insulin daily to survive

Type 2 Diabetes

- Most common
- Usually occurs in adulthood but diagnosis is increasing in the younger generation
- Affects many children
- Body is incapable of responding to insulin
- Rates rising due to increased obesity and failure to exercise and eat healthy

Gestational Diabetes

- Blood sugar levels are high during pregnancy in women

- Women who give birth to children over 9 lbs.

- High risk of type 2 diabetes and cardiovascular disease

- A form of glucose intolerance that is diagnosed in some women during pregnancy.

- Gestational diabetes occurs more frequently among African Americans, Hispanic/Latino Americans, and American Indians. It is also more common among obese women and women with a family history of diabetes.

- During pregnancy, gestational diabetes requires treatment to normalize maternal blood glucose levels to avoid complications in the infant.

- After pregnancy, 5% to 10% of women with gestational diabetes are found to have type 2 diabetes.

- Women who have had gestational diabetes have a 20% to 50% chance of developing diabetes in the next 5-10 years.

Pre-Diabetes

- At least 79 million people are diagnosed with pre-diabetes each year

- Above average blood glucose levels, not high enough to be classified under type 1 or type 2 diabetes

- Long-term damage to body, including heart and circulatory system

- Starts with unhealthy eating habits & inadequate exercise

Secondary Diabetes Mellitus

- Secondary causes of Diabetes mellitus include
  - Acromegaly
  - Cushing syndrome
  - Thyrotoxicosis
  - Pheochromocytoma
  - Chronic pancreatitis
  - Cancer
  - Drug induced hyperglycemia

- **Drug induced hyperglycemia:**
  - Atypical Antipsychotics - Alter receptor binding characteristics, leading to increased insulin resistance.
  - Beta-blockers - Inhibit insulin secretion.
  - Calcium Channel Blockers - Inhibits secretion of insulin by interfering with cytosolic calcium release.
  - Corticosteroids - Cause peripheral insulin resistance and gluconeogensis.
  - Fluoroquinolones - Inhibits insulin secretion by blocking ATP sensitive potassium channels.
  - Naicin - They cause increased insulin resistance due to increased free fatty acid mobilization.
  - Phenothiazines - Inhibit insulin secretion.
  - Protease Inhibitors - Inhibit the conversion of proinsulin to insulin.
  - Thiazide Diuretics - Inhibit insulin secretion due to hypokalemia. They also cause increased insulin resistance due to increased free fatty acid mobilization.

Diabetes Mellitus - Impact on Health

- Sixth leading cause of death due to cardiovascular effects resulting in atherosclerosis, coronary artery disease, and stroke

- Leading cause of end stage renal failure

- Major cause of blindness

- Most frequent cause of non-traumatic amputations

- Diabetes affects estimated 15.7 million people
  - (10.3 million are diagnosed; 5.4 million are undiagnosed)

- Increasing prevalence of Type 2 Diabetes in older adults and minority groups
 - (African American, American Indian and Hispanic populations)

Diabetes Mellitus - Diabetes Type 1

- Definition - Diabetes Mellitus Diabetes Type 1
  - Metabolic condition in which the beta cells of pancreas no longer produce insulin
- Characterized by hyperglycemia, breakdown of body fats and protein and development of ketosis
- Accounts for 5 – 10 % of cases of diabetes
- Most often occurs in childhood or adolescence
- Formerly called Juvenile-onset diabetes or insulin-dependent diabetes (IDDM)
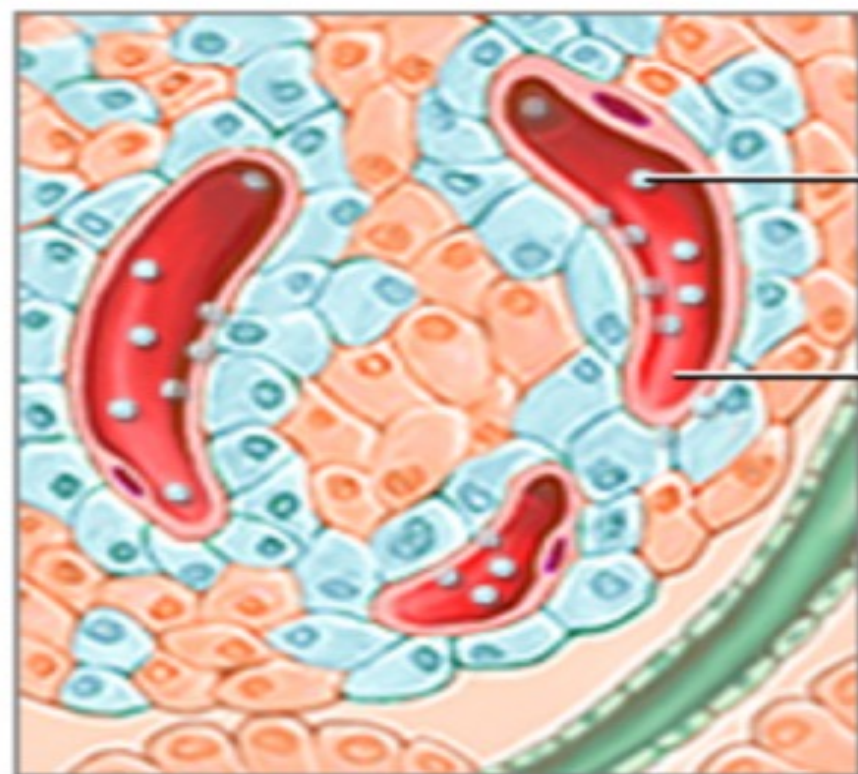
Insulin secreted into bloodstream

Blood capillary
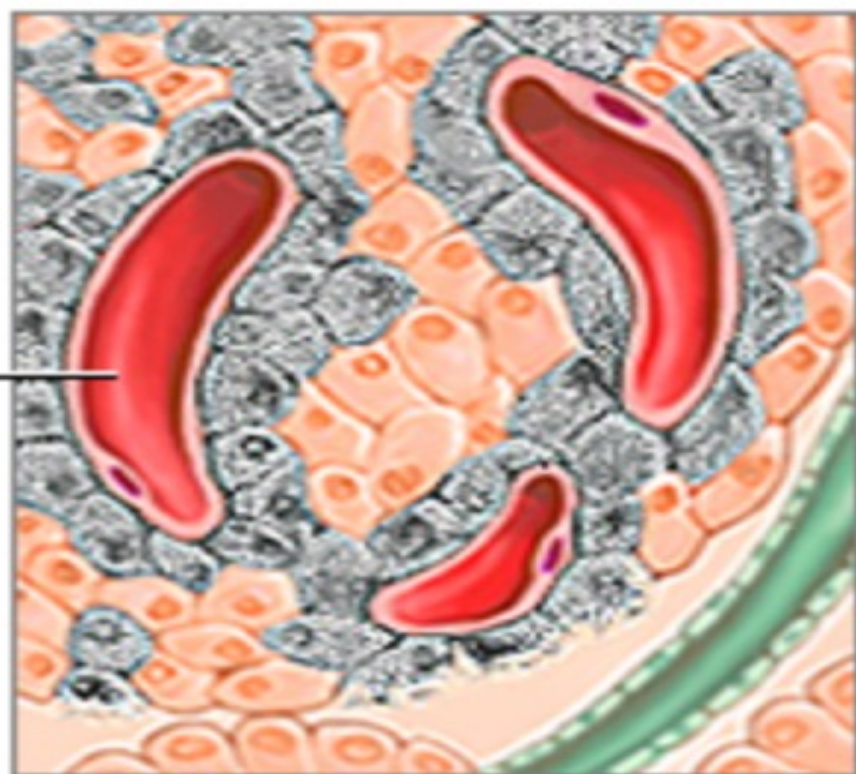
Insulin-producing cells

Insulin-producing cells destroyed

A.D.A.M.

Pathophysiology - Type 1

- Autoimmune reaction in which the beta cells that produce insulin are destroyed
- Alpha cells produce excess glucagon causing hyperglycemia

Risk Factors - Type 1

- Genetic predisposition for increased susceptibility
  - HLA linkage
- Environmental triggers stimulate an autoimmune response
  - Viral infections (mumps, rubella, coxsackievirus B4)
  - Chemical toxins

DIABETES
TYPE 1

CHI Health

Type 1 Diabetes

8,5 mg/dL

INSULIN

SYMPTOMS

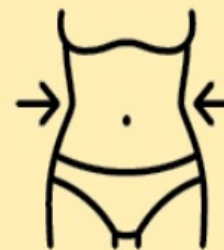| Frequent urination | Excessive thirst | Extreme hunger | Extreme fatigue | Blurred vision | Sudden weight loss | Irritability |

Diabetes Mellitus Manifestations

- Process of beta cell destruction occurs slowly
- Hyperglycemia occurs when 80 – 90% is destroyed; often trigger stressor event (e. g. illness)
- **Hyperglycemia leads to**
  - ==Polyuria== (hyperglycemia acts as osmotic diuretic)
  - Glycosuria (renal threshold for glucose: 180 mg/dL)
  - ==Polydipsia== (thirst from dehydration from polyuria)
  - ==Polyphagia== (hunger and eats more since cell cannot utilize glucose)
  - Weight loss (body breaking down fat and protein to restore energy source)
  - Malaise and fatigue (from decrease in energy)
  - Blurred vision (swelling of lenses from osmotic effects)

Diabetes Symptoms

- High blood levels of glucose
- Blurry vision
- Fatigue
- Thirst
- Painful urination
- Frequent urination
- Sores that do not heal
- Nausea
- Vomiting
- Weight loss
- Hunger
- In some cases...there are no symptoms at all!!
- Diabetes type 1 and type 2 symptoms are closely similar, although, type 1 is often worse in severity

Diabetes Type 1 - Diagnosis

- Patient is symptomatic plus
    - Casual plasma glucose (non-fasting) is 200 mg/dl OR
    - Fasting plasma glucose of 126 mg/dl or higher OR
    - Two hour plasma glucose level of 200 mg/dl or greater during an oral glucose tolerance test

Testing for Diabetes
FPG (Fasting Plasma Glucose Test)

- Patient must fast for eight hours

- Doctor will mix blood with other liquids to determine the amount of sugar or glucose in the blood

- This is measured in mg/dl

- Blood glucose range for pre-diabetics will be in the 100-125 mg/dl range.

- Type 2 diabetes will have blood sugar results in the range of 126 mg/dl and above

- These levels can increase the risk of heart disease and stroke

Testing for Diabetes 1
OGTT (Oral Glucose Tolerance Test)

- Doctor measures how well your body reacts to average dose of sugar
- Patient will be drawn blood two hours before and after he/she drinks pre-mixed beverage with the sugar
- Blood glucose levels are measured to see how the body reacted
- Blood glucose range for pre- diabetics will be between 140-199 mg/dl.
- For those with type 2 diabetes, the range will start at 200 mg/dl and continue to peak.

Diagnostic Tests - Type 1

- Blood glucose greater than 250 mg/dL
- Blood pH less than 7.3
- Blood bicarbonate less than 15 mEq/L
- Ketones present in blood
- Ketones and glucose present in urine
- Electrolyte abnormalities (Na, K, Cl)
- Serum osmolality < 350 mosm/kg (normal 280-300)

Values of Diagnosis of Diabetes Mellitus

Values for diagnosis of diabetes mellitus and other categories of hyperglycaemia

	Glucose concentration, mmol l^{-1} (mg dl^{-1})		
	Whole blood		Plasma*
	Venous	Capillary	Venous
Diabetes Mellitus:			
Fasting	≥ 6.1 (≥ 110)	≥ 6.1 (≥ 110)	≥ 7.0 (≥ 126)
or			
2-h post glucose load	≥ 10.0 (≥ 180)	≥ 11.1 (≥ 200)	≥ 11.1 (≥ 200)
or both			
Impaired Glucose Tolerance (IGT):			
Fasting (if measured)	< 6.1 (< 110)	< 6.1 (< 110)	< 7.0 (< 126)
and			
2-h post glucose load	≥ 6.7 (≥ 120) and < 10.0 (< 180)	≥ 7.8 (≥ 140) and < 11.1 (< 200)	≥ 7.8 (≥ 140) and < 11.1 (< 200)
Impaired Fasting Glycaemia (IFG):			
Fasting	≥ 5.6 (≥ 100) and < 6.1 (< 110)	≥ 5.6 (≥ 100) and < 6.1 (< 110)	≥ 6.1 (≥ 110) and < 7.0 (< 126)
and (if measured)			
2-h post glucose load	< 6.7 (< 120)	< 7.8 (< 140)	< 7.8 (< 140)

Test or Exam	Frequency
Glycated HB	Every 6 months
Fundoscopy	1 x per year
Foot exam	Every 4 months
Lipid profile	1-2 x per year
S-creatinine	1 x per year
Microalbuminuria	1 x per year
Blood pressure	Daily
BMI	Every 4 months
ECG	Every 6 months

Treatment of Type 1 Diabetes

- Requires immediate medical attention and usually admission to hospital

- Frequent measurement of blood glucose and treat according to glucose levels with regular insulin (mild ketosis, subcutaneous route; severe ketosis with intravenous insulin administration)

- Restore fluid balance: initially 0.9% saline at 500 – 1000 mL/hr.; regulate fluids according to client status; when blood glucose is 250 mg/dL add dextrose to intravenous solutions

Type 2 Diabetes

- Definition: condition of fasting hyperglycemia occurring despite availability of body's own insulin

- Often called non-insulin dependent diabetes or adult onset diabetes

- Both are misnomers, because it can be found in children and type II DM may require insulin

Type 2 Diabetes

Pathophysiology

- Sufficient insulin production to prevent Diabetic Keto Acidosis

- But insufficient to lower blood glucose through uptake of glucose by muscle and fat cells

- Cellular resistance to insulin increased by obesity, inactivity, illness, age, some medications
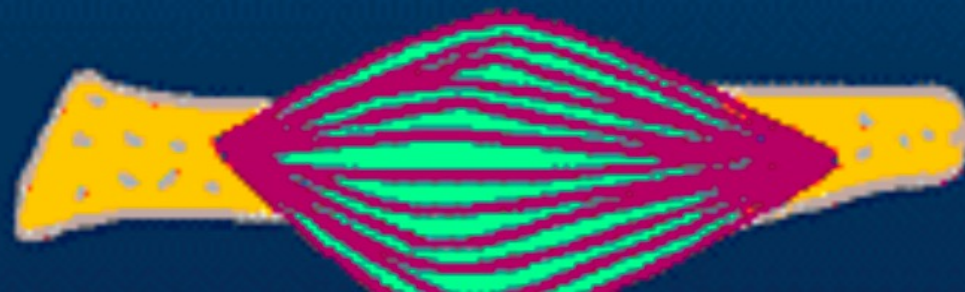
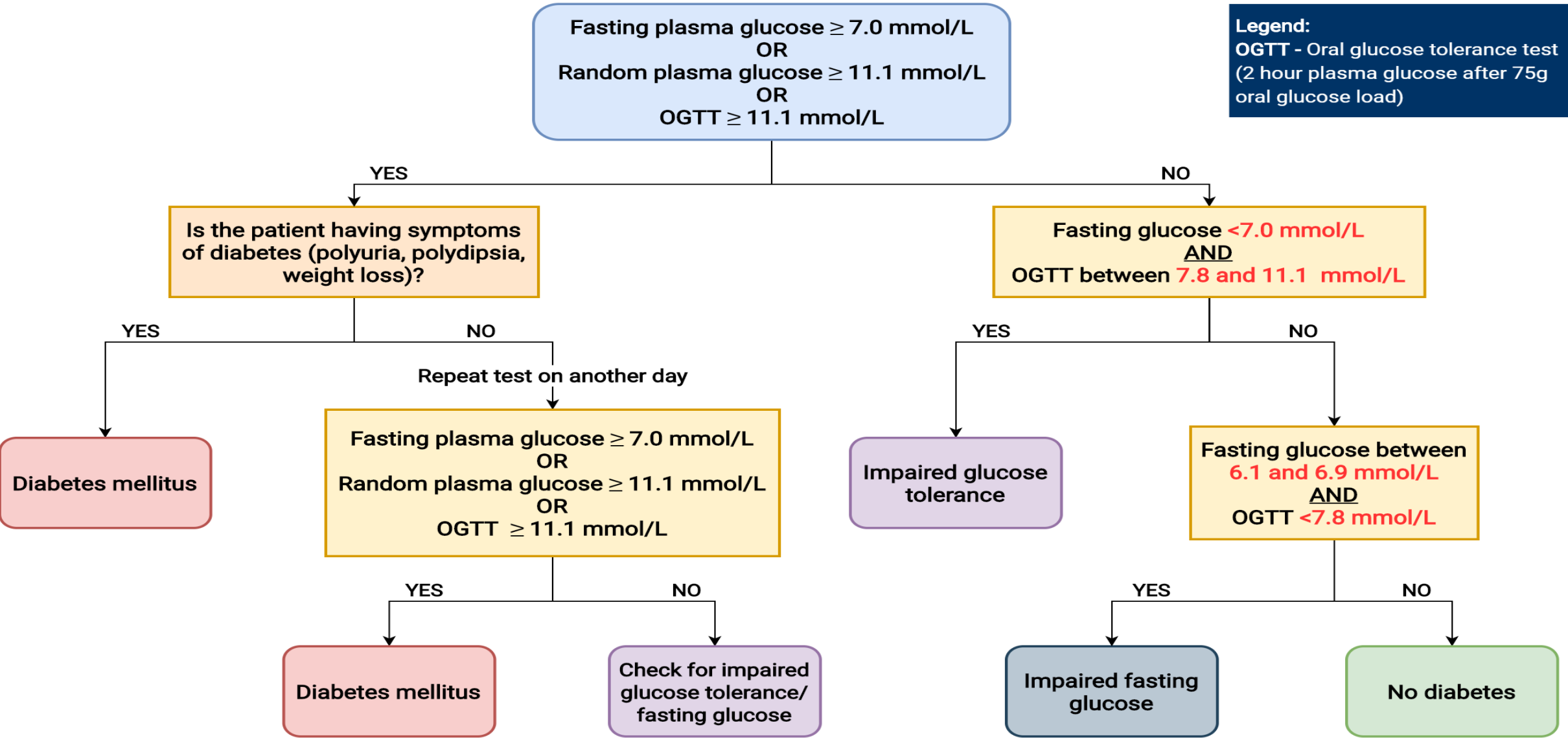Reduced/altered insulin secretion

Hyperglycemia

Inappropriate endogenous
glucose production

Impaired insulin-mediated
glucose disposal

Diagnostic Criteria for Diabetes mellitus

Fasting plasma glucose ≥ 7.0 mmol/L
OR
Random plasma glucose ≥ 11.1 mmol/L
OR
OGTT ≥ 11.1 mmol/L

YES

Is the patient having symptoms of diabetes (polyuria, polydipsia, weight loss)?

YES

Diabetes mellitus

NO

Repeat test on another day

Fasting plasma glucose ≥ 7.0 mmol/L
OR
Random plasma glucose ≥ 11.1 mmol/L
OR
OGTT ≥ 11.1 mmol/L

YES

Diabetes mellitus

NO

Check for impaired glucose tolerance/ fasting glucose

NO

Fasting glucose <7.0 mmol/L
AND
OGTT between 7.8 and 11.1 mmol/L

YES

Impaired glucose tolerance

NO

Fasting glucose between 6.1 and 6.9 mmol/L
AND
OGTT <7.8 mmol/L

YES

Impaired fasting glucose

NO

No diabetes

GRAM PROJECT

Diagnostic Tests to Monitor Diabetes Type 1 Management

- **Fasting Blood Glucose** (normal: 70 – 110 mg/dL)
- **Glycosylated Hemoglobin** (c) (Hemoglobin A1C)
  - Considered elevated if values above 7%
  - Blood test analyzes excess glucose attached to hemoglobin.
  - Since rbc lives about 120 days gives an average of the blood glucose over previous 2 to 3 months
  - Not a fasting test, can be drawn any time of the day
  - % of glycated (glucose attached) hemoglobin measures how much glucose has been in the bloodstream for the past 3 months

Diagnostic Tests to Monitor Diabetes Type 1 Management

- **Urine glucose and ketone levels** (part of routine urinalysis)
  - Glucose in urine indicates hyperglycemia (renal threshold is usually 180 mg/dL)
  - Presence of ketones indicates fat breakdown, indicator of DKA; ketones may be present if person not eating

- **Urine albumin** (part of routine urinalysis)
  - If albumin present, indicates need for workup for nephropathy
  - Typical order is creatinine clearance testing

Diagnostic Tests to Monitor Diabetes Type 1 Management

- **Cholesterol and Triglyceride Levels**
  - Recommendations
    - LDL < 100 mg/dl
    - HDL > 45 mg/dL
    - Triglycerides < 150 mg/dL
  - Monitor risk for atherosclerosis and cardiovascular complications
  - Serum electrolytes in clients with DKA or HHNS
    - Diabetic Keto Acidosis
    - Hyperglycemic hyperosmolar nonketotic syndrome

# Hyperglycemic Hyperosmolar Nonketotic Syndrome

- Hyperglycemic hyperosmolar nonketotic syndrome (HHNS) is also known as hyperglycemic hyperosmolar syndrome (HHS).

- It involves very high blood sugar levels and can be life threatening.

- HHNS can happen to anyone, but it's **more common in older people who have type 2 diabetes**.

- HHNS is an emergency caused by **very high blood sugar, often over 600 mg/dL.**

- Kidneys try to get rid of the extra blood sugar by putting more sugar into the urine.

- This makes you urinate more, and you lose too much body fluid, causing dehydration.

Diabetic Medications - Insulin

- Sources: standard practice is use of human insulin prepared by alteration of pork insulin or recombinant DNA therapy
- Clients who need insulin as therapy:
  - All type 1 diabetics since their bodies essentially no longer produce insulin
  - Some Type 2 diabetics, if oral medications are not adequate for control (both oral medications and insulin may be needed)
  - Diabetics enduring stressor situations such as surgery, corticosteroid therapy, infections, treatment for DKA, HHNS
- Women with gestational diabetes who are not adequately controlled with diet
- Some clients receiving high caloric feedings including tube feedings or parenteral nutrition

- Injection sites
  - Abdominal areas is the most preferred because of rapid absorption
  - Injection sites are rotated
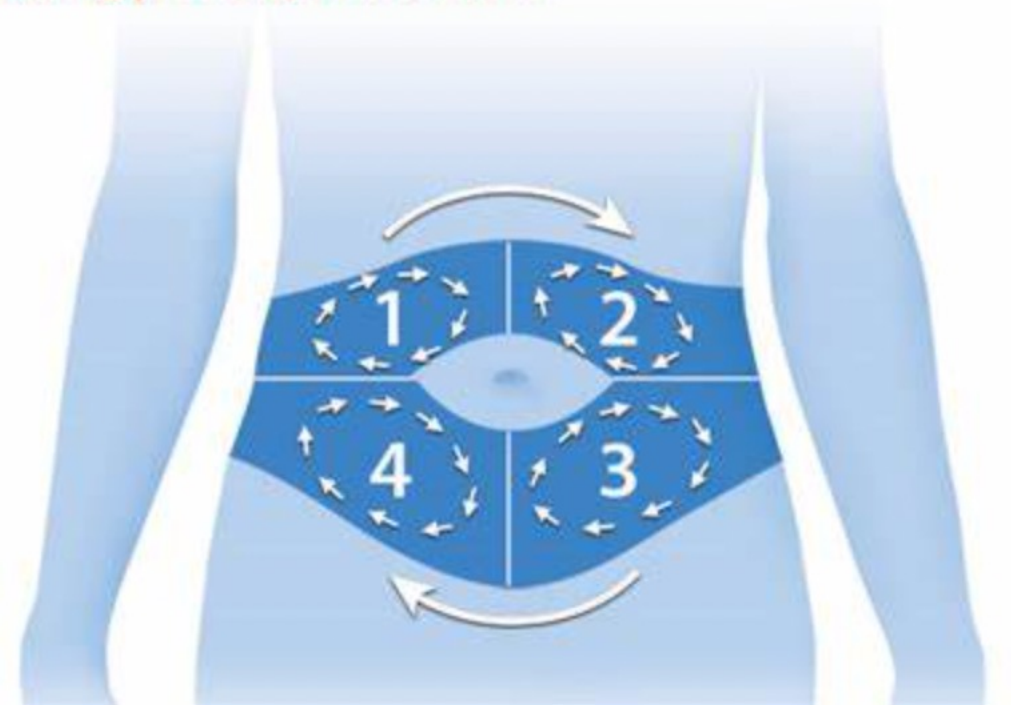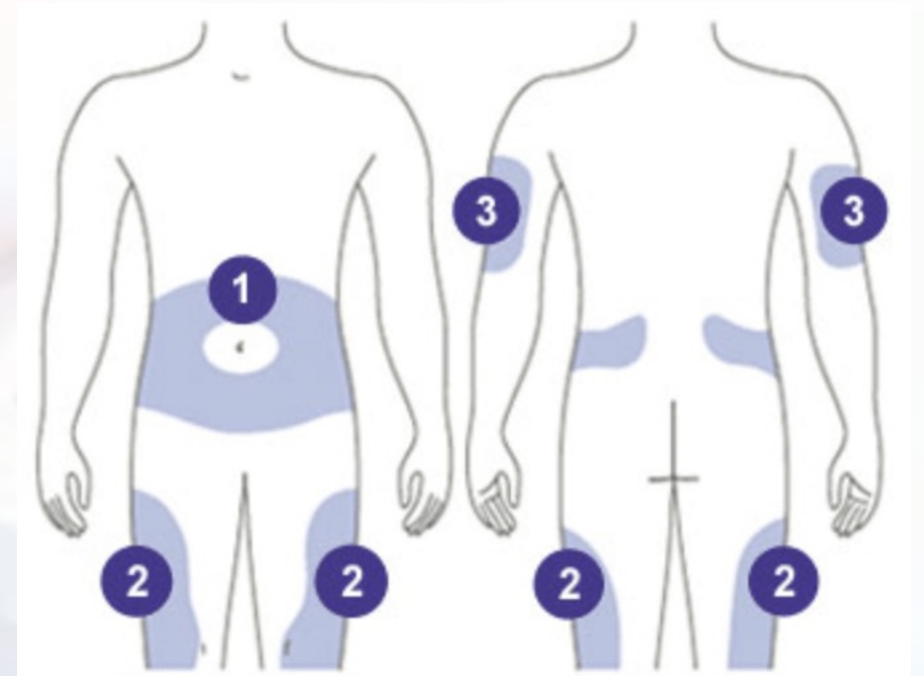
		BEFORE BREAKFAST	BEFORE LUNCH	BEFORE DINNER	AT BEDTIME
NPH dose		12 units		6 units	
Regular insulin dose if fingerstick glucose is (mg/dl) [mmol/L]:					
70-100	**[3.9-5.5]**	4 units		4 units	
101-150	**[5.6-8.3]**	5 units		5 units	
151-200	**[8.4-11.1]**	6 units		6 units	
201-250	**[11.2-13.9]**	7 units		7 units	
251-300	**[14.0-16.7]**	8 units	1 unit	8 units	1 unit
>300	**[>16.7]**	9 units	2 units	9 units	2 units

Type 2 Medications
Oral Hypoglycemic Agents

- Used to treat Diabetes Type 2

- Client must also maintain prescribed diet and exercise program; monitor blood glucose levels

- Not used with pregnant or lactating women

- Several different oral hypoglycemic agents and insulin may be prescribed for the client

- Specific drug interactions may affect the blood glucose levels

- Must have some functioning beta cells

Classifications & Action of Medications
Sulfonylureas

- Action: Stimulates pancreatic cells to secrete more insulin and increases sensitivity of peripheral tissues to insulin
- Used to treat non-obese Type 2 diabetics
- Examples: Glipizide(Glucotrol), Chlorpropamide (Diabinese), Tolazamide (Tolinase)

Classifications & Action of Medications

Meglitinides

- Action: stimulates pancreatic cells to secret more insulin
- Taken just before meals, rapid onset, limited duration of action
- Major adverse effects is hypoglycemia
- <mark>Used in non-obese diabetics</mark>
- Examples: Repaglinide (Prandin), Nateglinide (Starlix)

Classifications & Action of Medications

Biguanides

- Action: decreases overproduction of glucose by liver and makes insulin more effective in peripheral tissues

- Used in obese diabetics

- Does not stimulate insulin release

- Metabolized by the kidney, do not use with renal patients

- Example: Metformin (Glucophage)

Classifications & Action of Medications

Alpha-Glucoside Inhibitors

- Action: Slow carbohydrate digestion and delay rate of glucose absorption

- Take with first bite of the meal or 15 min. after

- Adjunct to diet to decrease blood glucose levels

- Example: Acarbose (Precose), Miglitol (Glyset)

Classifications & Action of Medications

Thizaolidinediones (Glitazones)

- Action: Sensitizes peripheral tissues to insulin

- Used in obese diabetics

- Inhibits glucose production

- Improves sensitivity to insulin in muscle and fat tissue

- Examples: Rosiglitazone(Avandia), Pioglitazone (Actos)

Classifications & Action of Medications

- Patients with Type 2 DM who are obese have insulin resistance, they produce enough insulin
  - Should use Glucophage, Actos or Avandia
  - Enhances insulin secretion in tissue, but does not increase amount of insulin secreted
- Patients with Type 2 DM who are thin do not produce enough insulin, they are not insulin resistant
  - Need sulfonylurea agents like Diabinese, Tolinase, Glucotrol, Diabeta

Role of Diet in Diabetic Management

Goals for diabetic therapy include

- Maintain as near-normal blood glucose levels as possible with balance of food with medications

- Obtain optimal serum lipid levels

- Provide adequate calories to attain or maintain reasonable weight

Role of Diet in Diabetic Management

Goals for diabetic therapy include

- Diet Composition
  - Carbohydrates: 60 – 70% of daily diet
    - Carbohydrates convert quickly to sugars
  - Advice patient to consume a similar amount of carbs at each meal
  - Medications can work on a consistent glucose response from foods
- Protein: 15 – 20% of daily diet
- Fats: No more than 10% of total calories from saturated fats

Role of Diet in Diabetic Management

- Fiber: 20 to 35 grams/day; promotes intestinal motility and gives feeling of fullness

- Sodium: recommended intake 1000 mg per 1000 kcal

- Sweeteners approved by FDA instead of refined sugars

- Limited use of alcohol: potential hypoglycemic effect of insulin and oral hypoglycemics

Nursing and Health Care Plans

- Assessment, planning, implementation with client according to type and stage of diabetes

- Prevention, assessment and treatment of complications through client self-management and keeping appointments for medical care

- Client and ==family teaching for diabetes management==

- Health promotion includes ==education of healthy life style, and lowering risks== for developing diabetes for all clients.

- Blood glucose screening at 3-year intervals starting at age 45 for persons in high risk groups
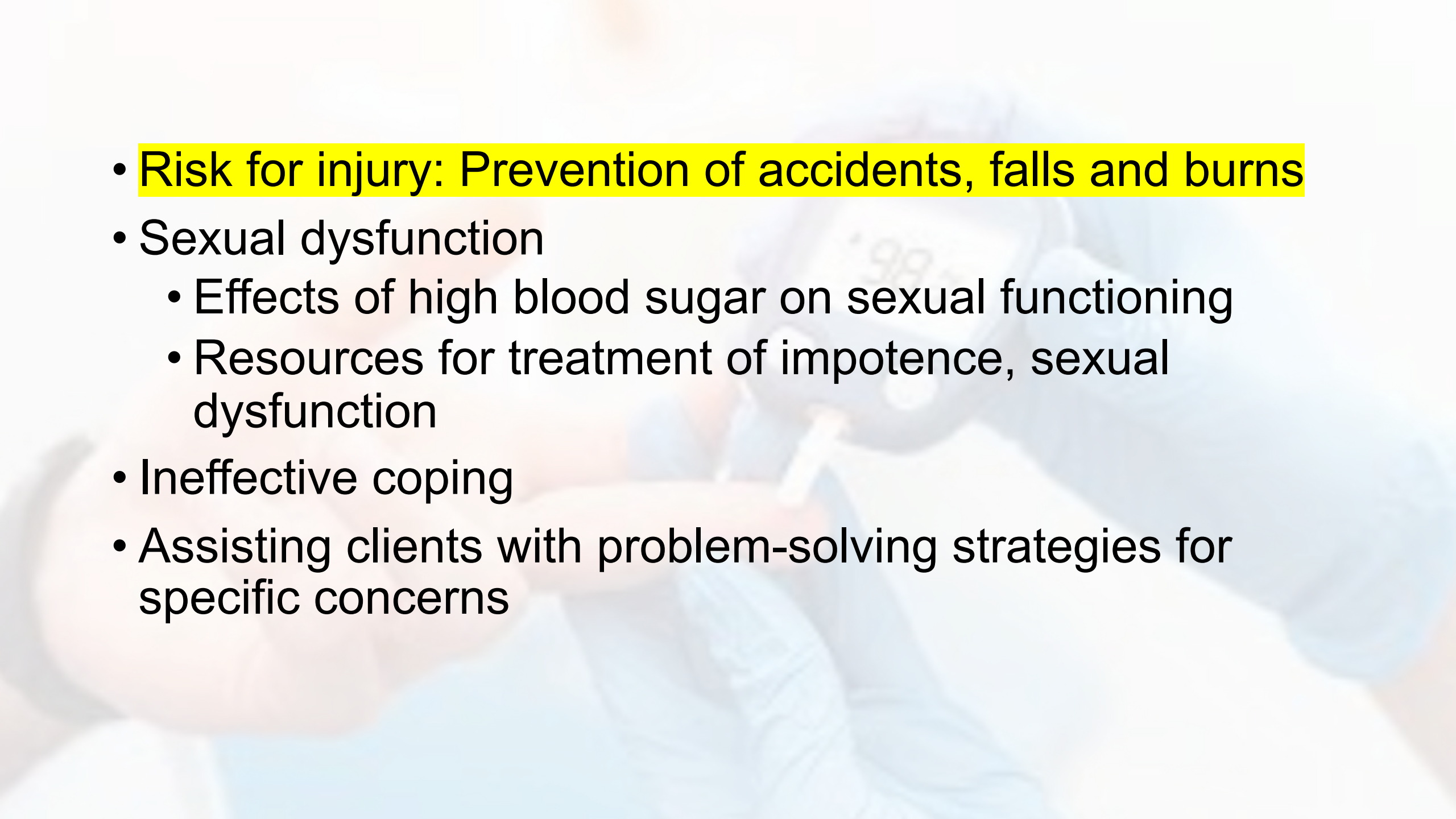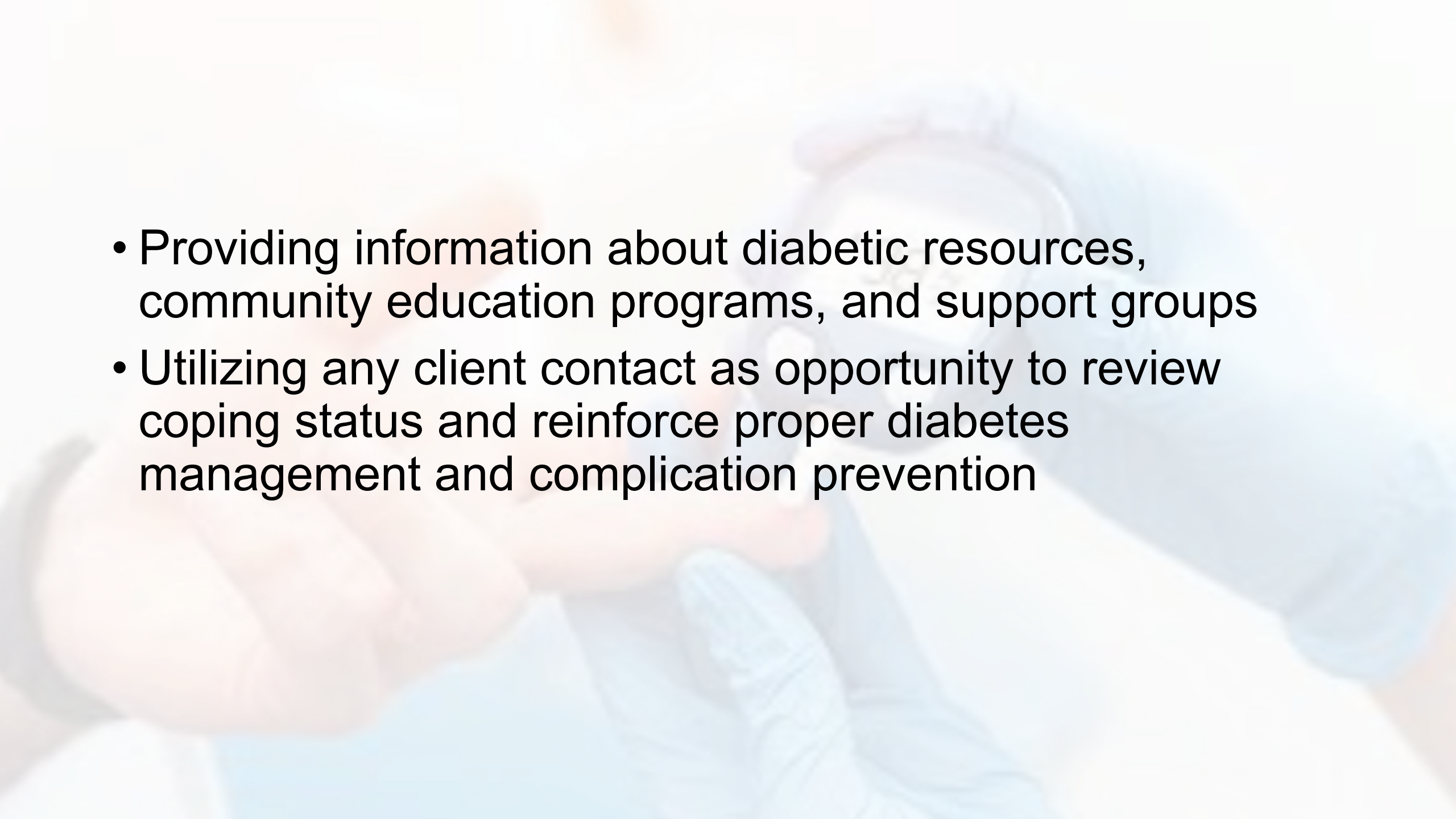
Specific Teaching Interventions

- <mark>Risk for impaired skin integrity</mark>: Proper foot care
  - Daily inspection of feet
  - Checking temperature of any water before washing feet
  - Need for lubricating cream after drying but not between toes
  - Patients should be followed by a podiatrist
  - Early reporting of any wounds or blisters

Specific Teaching Interventions

- <mark>Risk for infection</mark>
  - Frequent hand washing
  - Early recognition of signs of infection and seeking treatment
  - Meticulous skin care
- Regular dental examinations and consistent oral hygiene care

- <mark>Risk for injury: Prevention of accidents, falls and burns</mark>
- Sexual dysfunction
  - Effects of high blood sugar on sexual functioning
  - Resources for treatment of impotence, sexual dysfunction
- Ineffective coping
- Assisting clients with problem-solving strategies for specific concerns

- Providing information about diabetic resources, community education programs, and support groups
- Utilizing any client contact as opportunity to review coping status and reinforce proper diabetes management and complication prevention

How to prevent & control diabetes

- Prevention all starts with a better lifestyle
- Eating healthier
- Being active
- Taking medicine as directed
- Taking care of your body
- Check feet to make sure there is no nerve damage or interruption of blood
- flow

How to prevent & control diabetes

- Take care of teeth
- Control blood pressure and high
- No smoking!
- Check in with your doctor at least once a month
- Have your blood sugar checked along with weight, blood pressure, and feelings
- Check blood sugar levels daily by using home monitoring device