Care of the Patient with Diabetes

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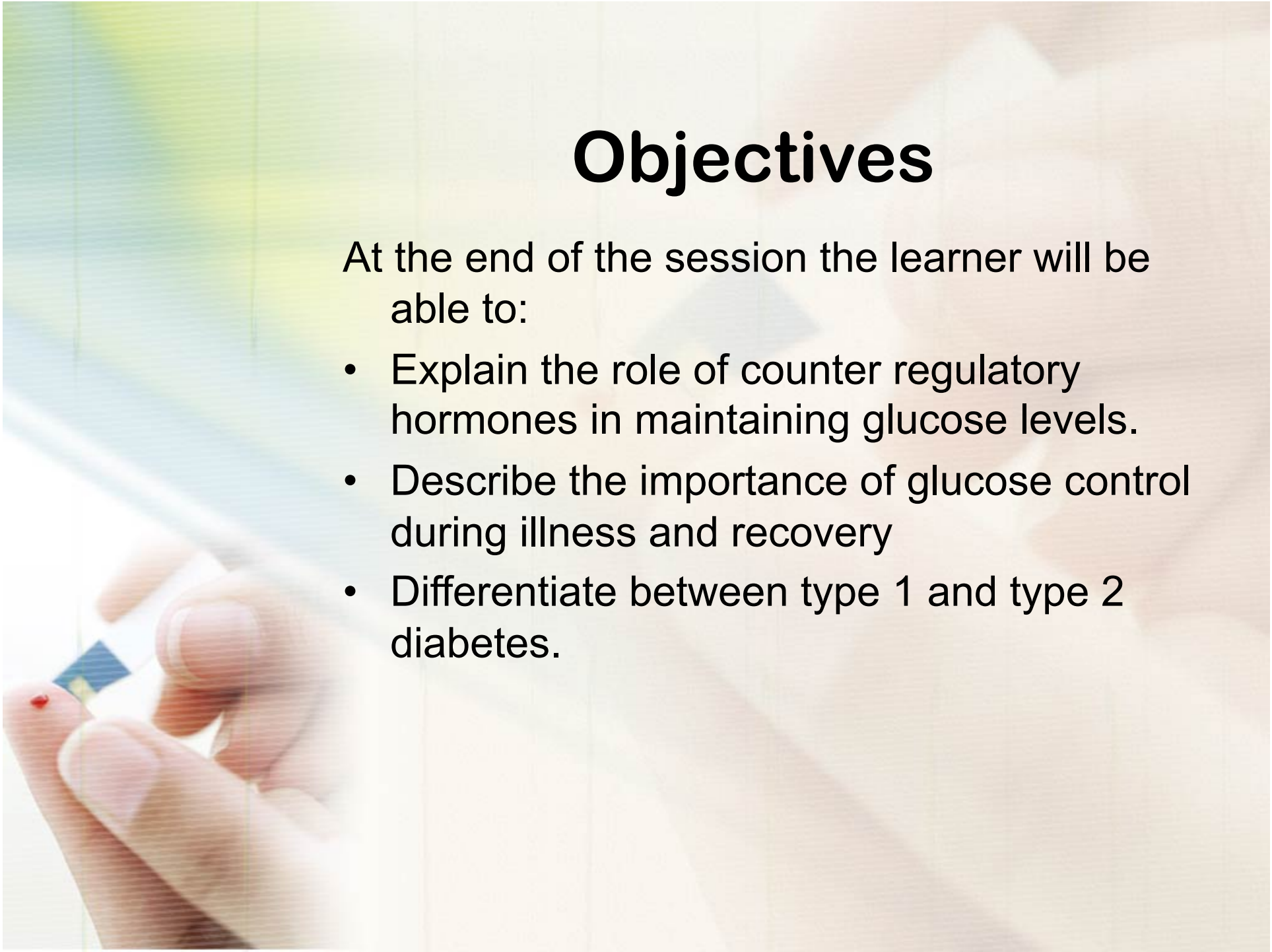
Objectives

At the end of the session the learner will be able to:

- Explain the role of counter regulatory hormones in maintaining glucose levels.
- Describe the importance of glucose control during illness and recovery
- Differentiate between type 1 and type 2 diabetes.

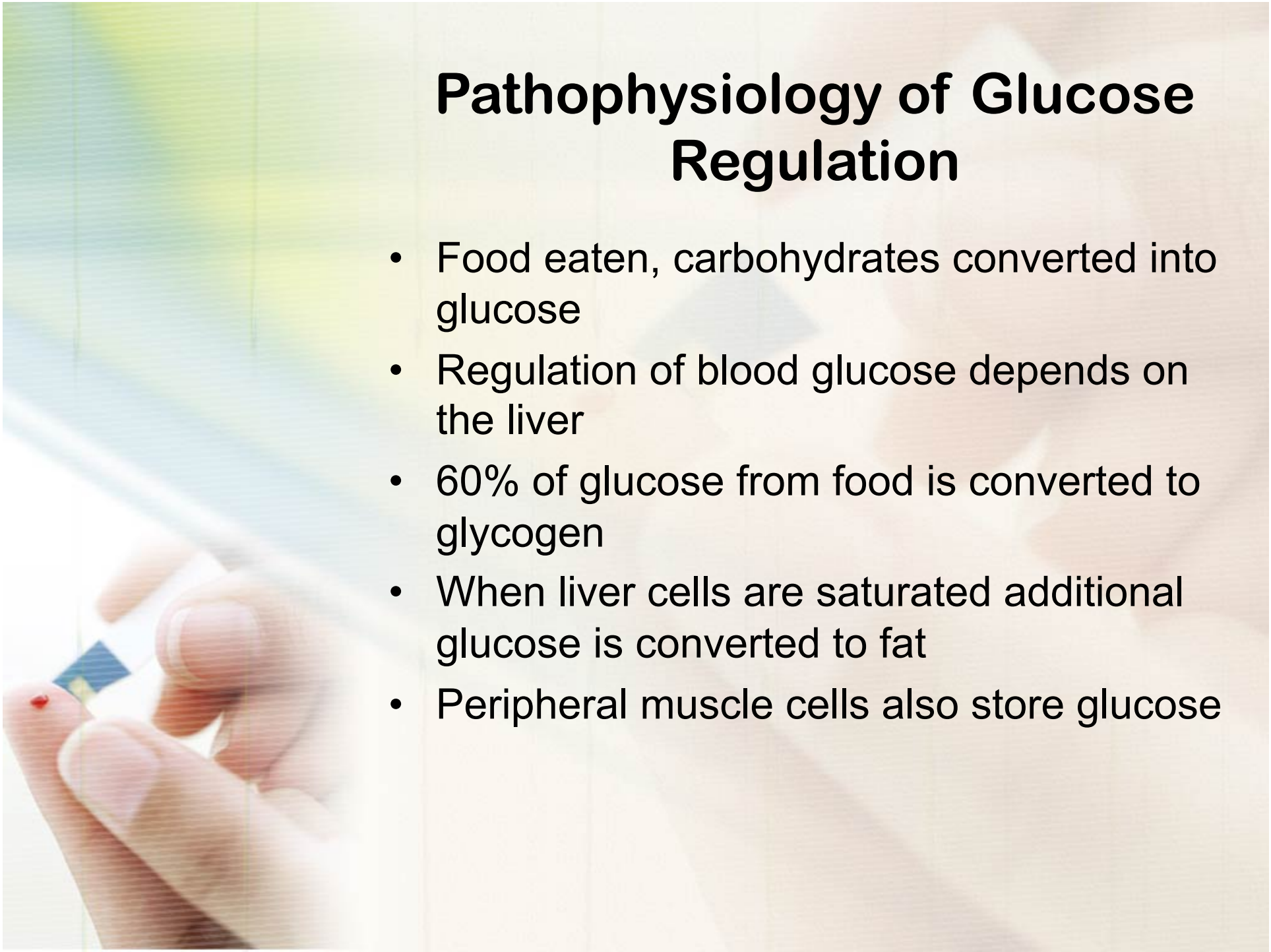


Prevalence of Diabetes

- National Statistics
  - Among people greater than 18 years of age in the US in 2007, 8% were diagnosed with diabetes.
  - In comparison, in Haiti diabetes affects 7.4% in men and 11.1% in women.
  - In the US diabetes is expected to increase 60% in the next 22 years

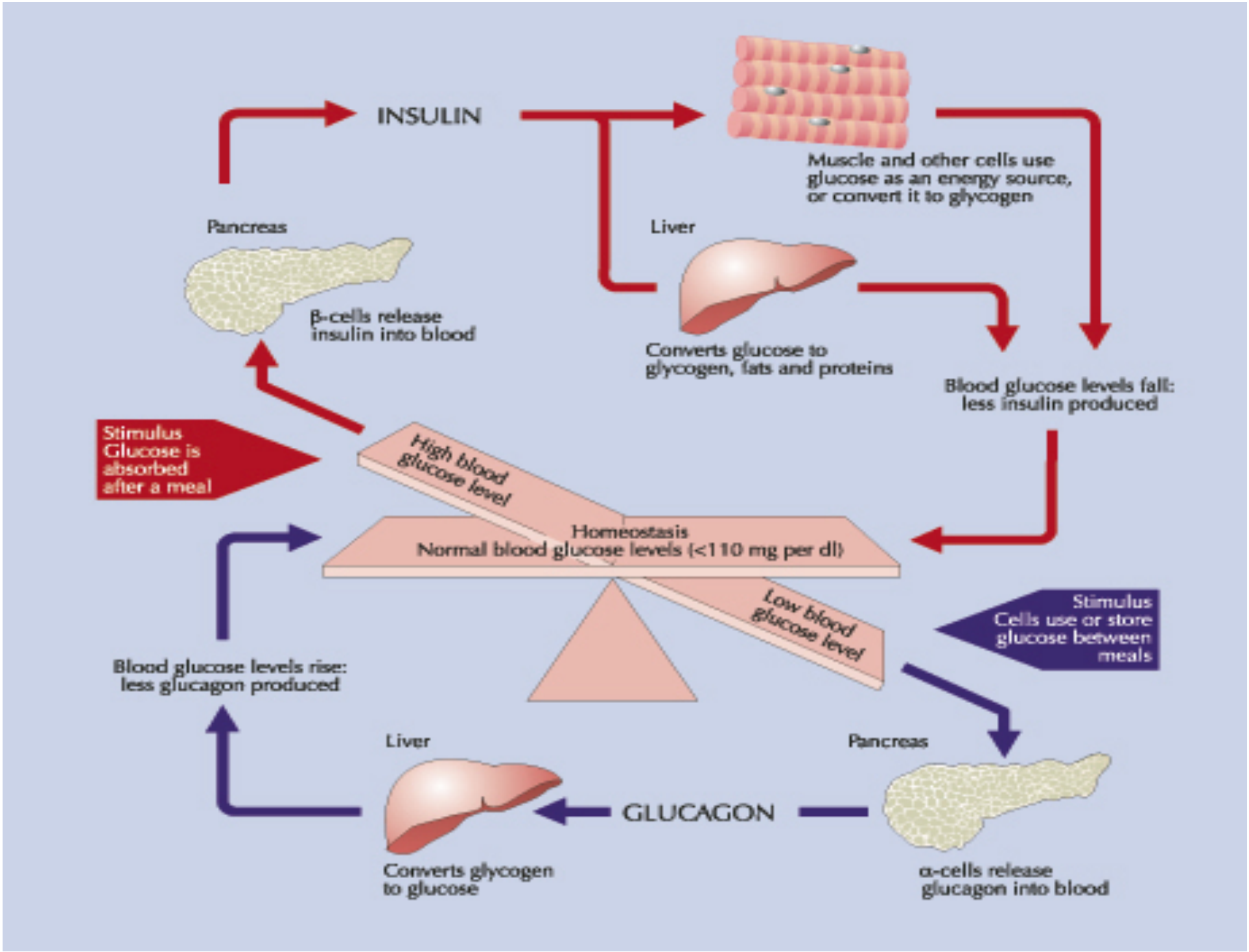
Baptiste, ED, et. al. (2006). Glucose intolerance and other cardiovascular risk factors in Haiti. *Diabetes Metabolism*; 32: 443-451.
Wild S, Roglie G, Greene A, Sicree R, King H. (2006) Global prevalence of diabetes; estimates for the year 2000 and projections for 2030. *Diabetes Care.* 27(5): 1047-1053.

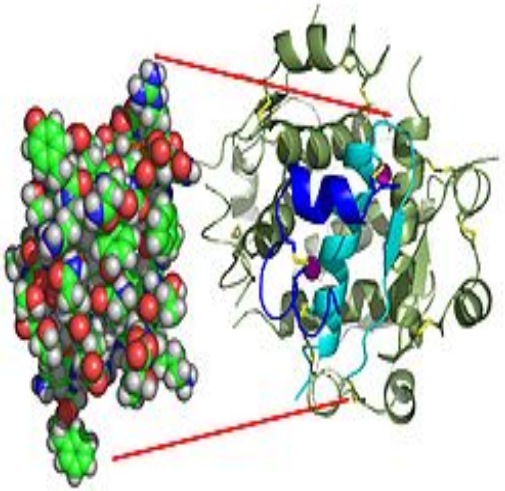
What is Diabetes?



Pathophysiology of Glucose Regulation

- Food eaten, carbohydrates converted into glucose
- Regulation of blood glucose depends on the liver
- 60% of glucose from food is converted to glycogen
- When liver cells are saturated additional glucose is converted to fat
- Peripheral muscle cells also store glucose

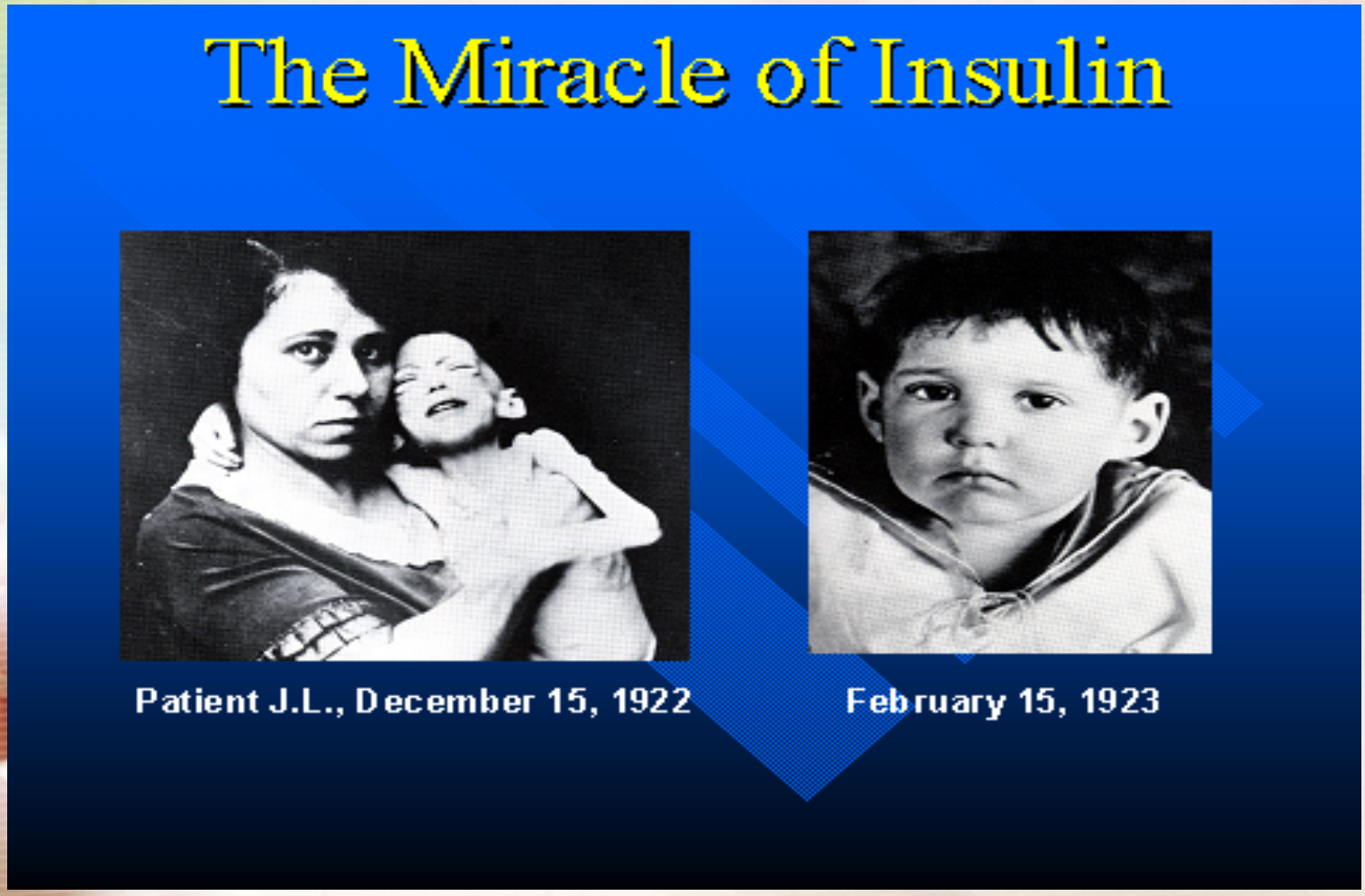

INSULIN
Muscle and other cells use glucose as an energy source, or convert it to glycogen
Pancreas
β-cells release insulin into blood
Liver
Converts glucose to glycogen, fats and proteins
Blood glucose levels fall: less insulin produced
Stimulus Glucose is absorbed after a meal
High blood glucose level
Homeostasis
Normal blood glucose levels (<110 mg per dl)
Low blood glucose level
Stimulus Cells use or store glucose between meals
Blood glucose levels rise: less glucagon produced
Liver
Converts glycogen to glucose
GLUCAGON
Pancreas
α-cells release glucagon into blood



History of Insulin

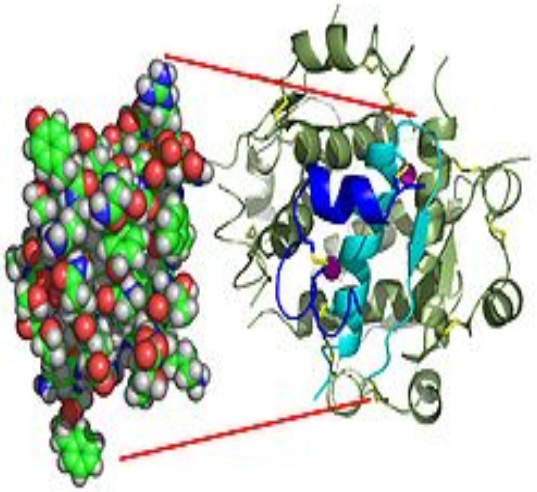
- 1921 Nicolae Paulescu first to isolate insulin (pancrein)
- Spring 1921 Banting traveled to Toronto
- Banting and Best isolated beta cells from dogs, producing isletin (insulin).
- Took 6 weeks to extract isletin
- Went to using fetal calf pancreas
- Next Banting invited James Collip (biochemist) to purify the extract.
- January 11, 1922, Leonard Thompson was given first injection of insulin.
- Collip improved the extract and the second dose was given on January 23, 1922
- April 1922 Eli Lilly combined efforts with Banting
- Won Nobel Prize in 1923

Insulin…the impact



Important Functions of Insulin

- Insulin allows glucose into the cell
- Enhances uptake of glucose by the liver
- Prevents the breakdown of stored glycogen back to glucose.

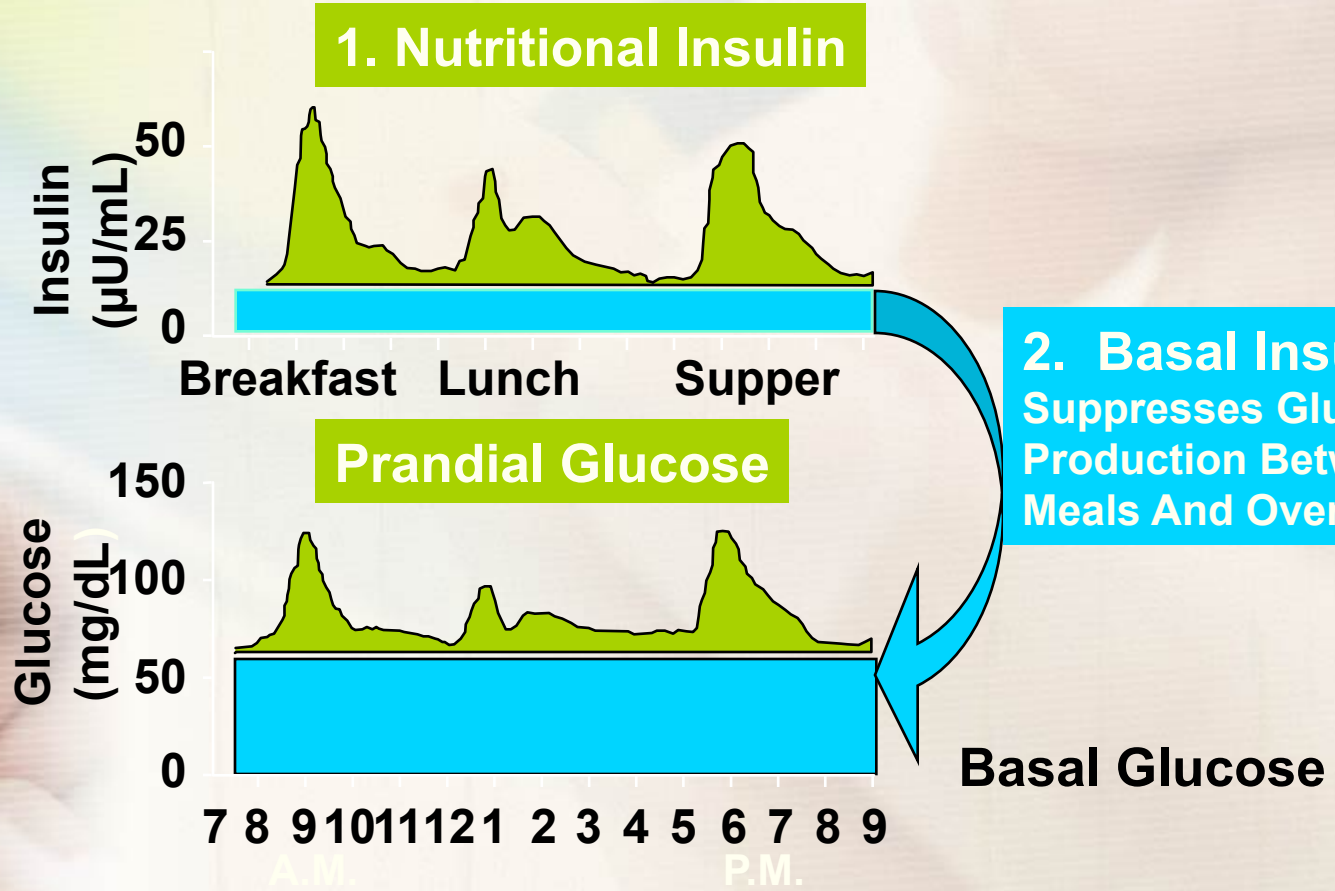


Important Functions of Insulin

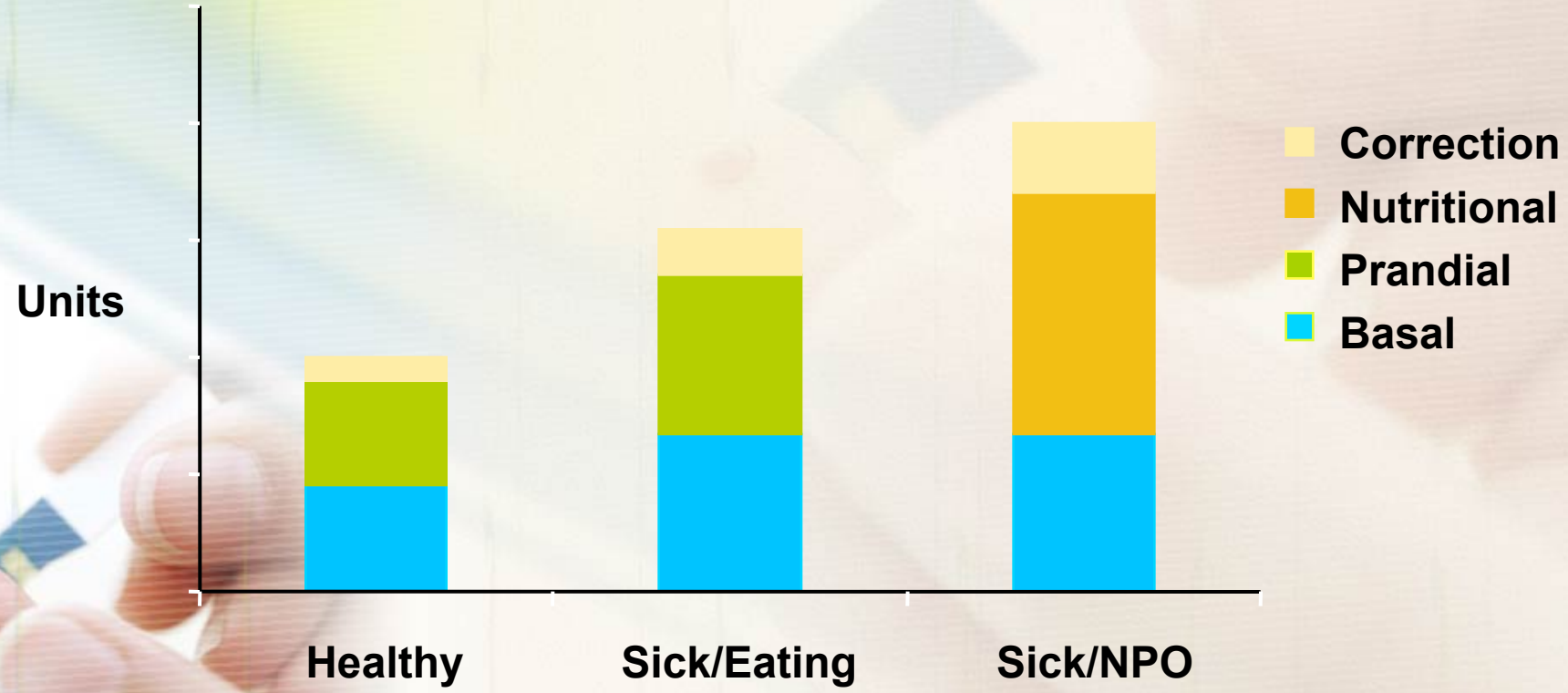
- Insulin secreted continuously is the **basal rate.**
- Insulin response after a meal is a **bolus.**
- Insulin affects protein and mineral metabolism
- Enhances fat storage and prevents fats from being used for energy

Physioloic Insulin Secretion

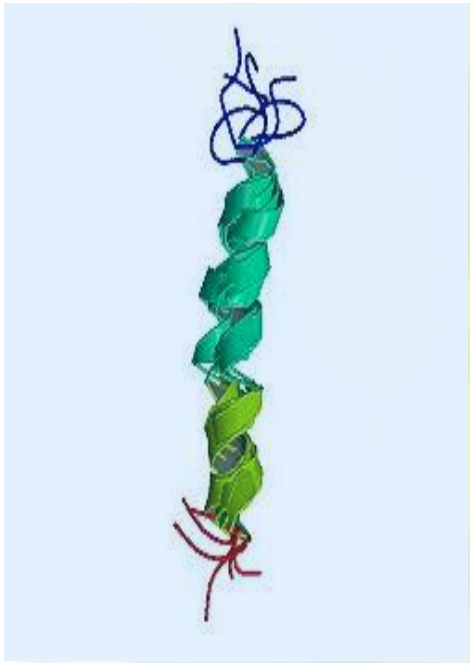
Normal 24-Hour Profile



Insulin Requirements in Health and Illness

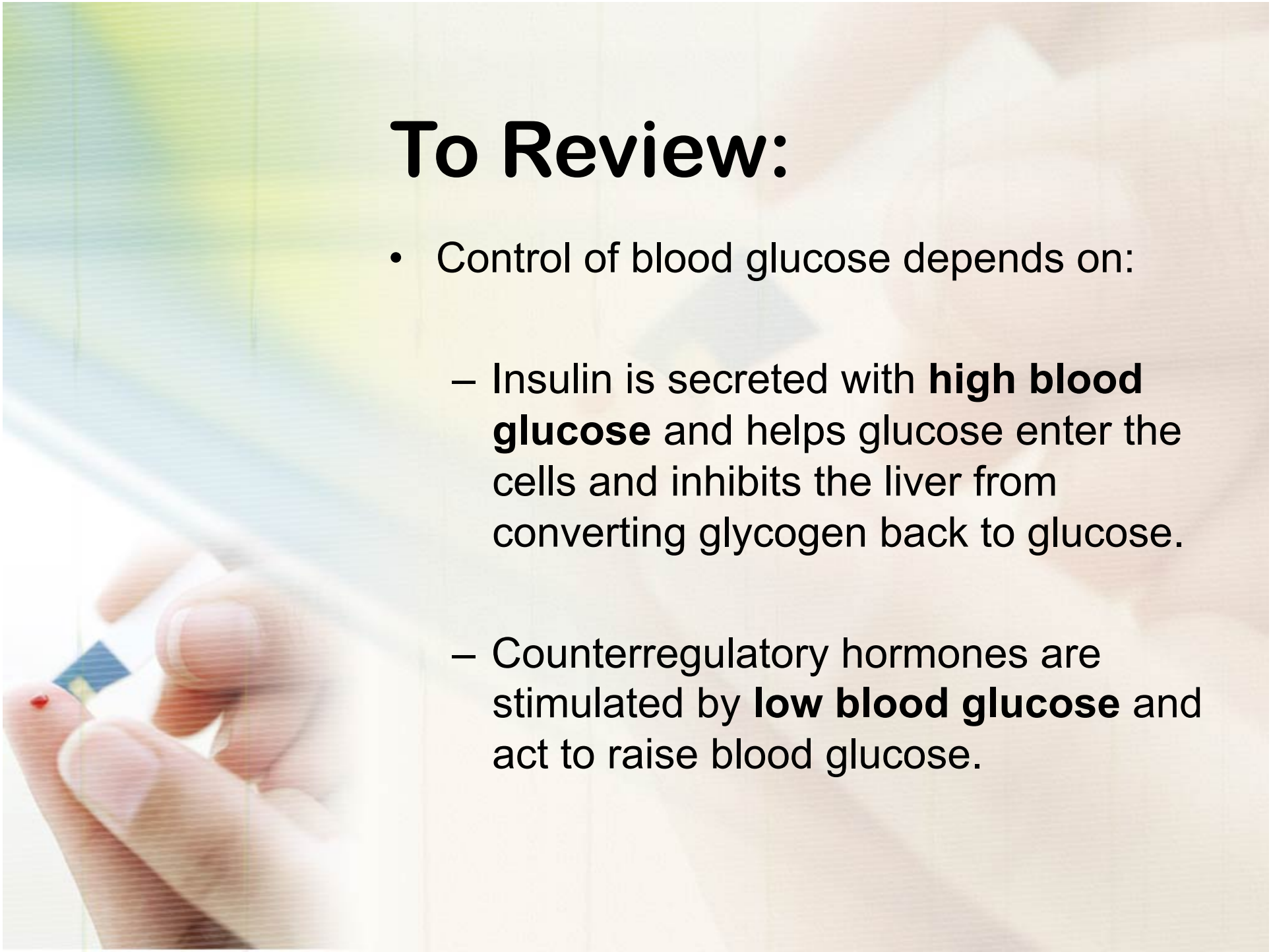


Clement S, et al. *Diabetes Care.* 2004;27:553–591.



Counterregulatory Hormones

Raises Blood Sugar	Source	Action of Hormone
Glucagon	pancreas' alpha cells	Stimulates glycogenolysis gluconeogenosis
Epinephrine	Adrenal gland's medulla	Causes rapid rise in blood glucose in times of stress
Cortisol	Adrenal gland's cortex	Maintains blood glucose levels during fasting and stress
Growth Hormone	Pituitary gland	Causes slow rise in blood glucose



To Review:

- Control of blood glucose depends on:
  - Insulin is secreted with **high blood glucose** and helps glucose enter the cells and inhibits the liver from converting glycogen back to glucose.
  - Counterregulatory hormones are stimulated by **low blood glucose** and act to raise blood glucose.


FIGHT
—or—
FLIGHT
Swerdlow

Physiology of the Stress Response

Stress is anything that activates the body's mechanism's to adapt

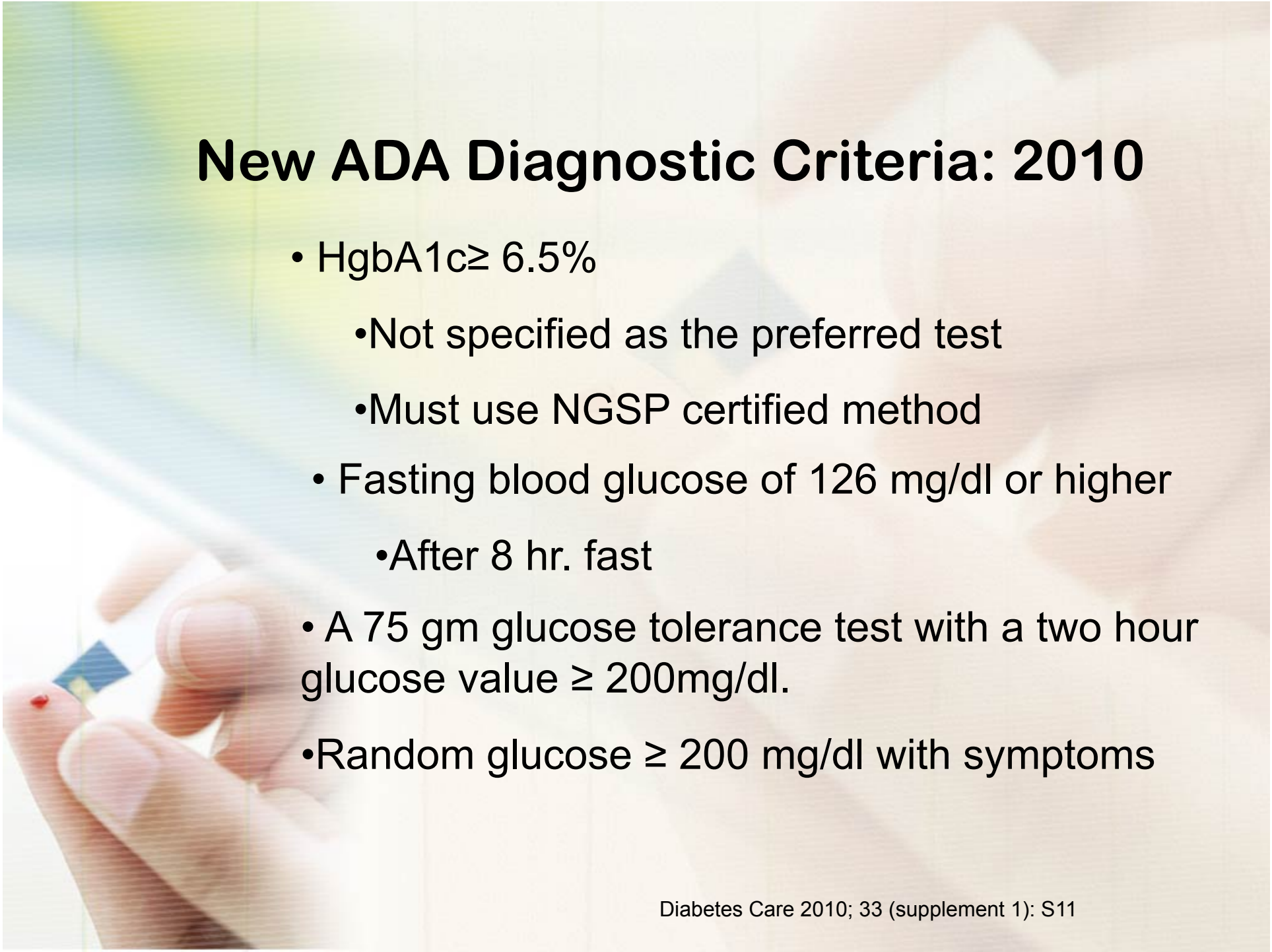
- Emotional stress
- Physical stress
  - Illness
  - Infection
  - Surgery
  - Trauma

- Stress Response
  - How bodies have adapted to help survive **sudden danger.**
  - Increased secretion of counterregulatory hormones.
    - Increase oxygen availability and delivery.
    - Contribute to release of glucose from the liver
    - Oppose the action of insulin

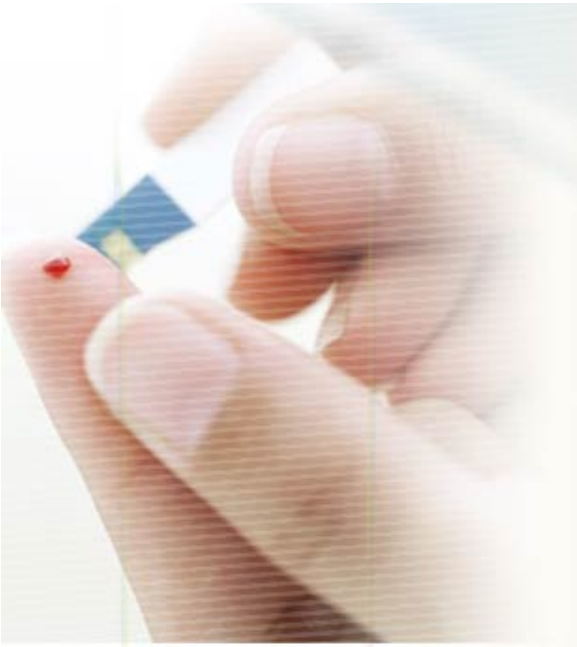
Diagnosis of Diabetes

New ADA Diagnostic Criteria: 2010

- HgbA1c≥ 6.5%
  - Not specified as the preferred test
  - Must use NGSP certified method
- Fasting blood glucose of 126 mg/dl or higher
  - After 8 hr. fast
- A 75 gm glucose tolerance test with a two hour glucose value ≥ 200mg/dl.
- Random glucose ≥ 200 mg/dl with symptoms



Diabetes Care 2010; 33 (supplement 1): S11



Pathophysiology of Diabetes

Type 1 Diabetes

- 5-10% of population
- Beta cells are destroyed by autoimmune response
- Some genetic predisposition but low compared to type 2
- Usually those that develop are young peak age between 12 and 14, but…….
- S/S develop abruptly and are due to high blood glucose which leads to osmotic pressure.

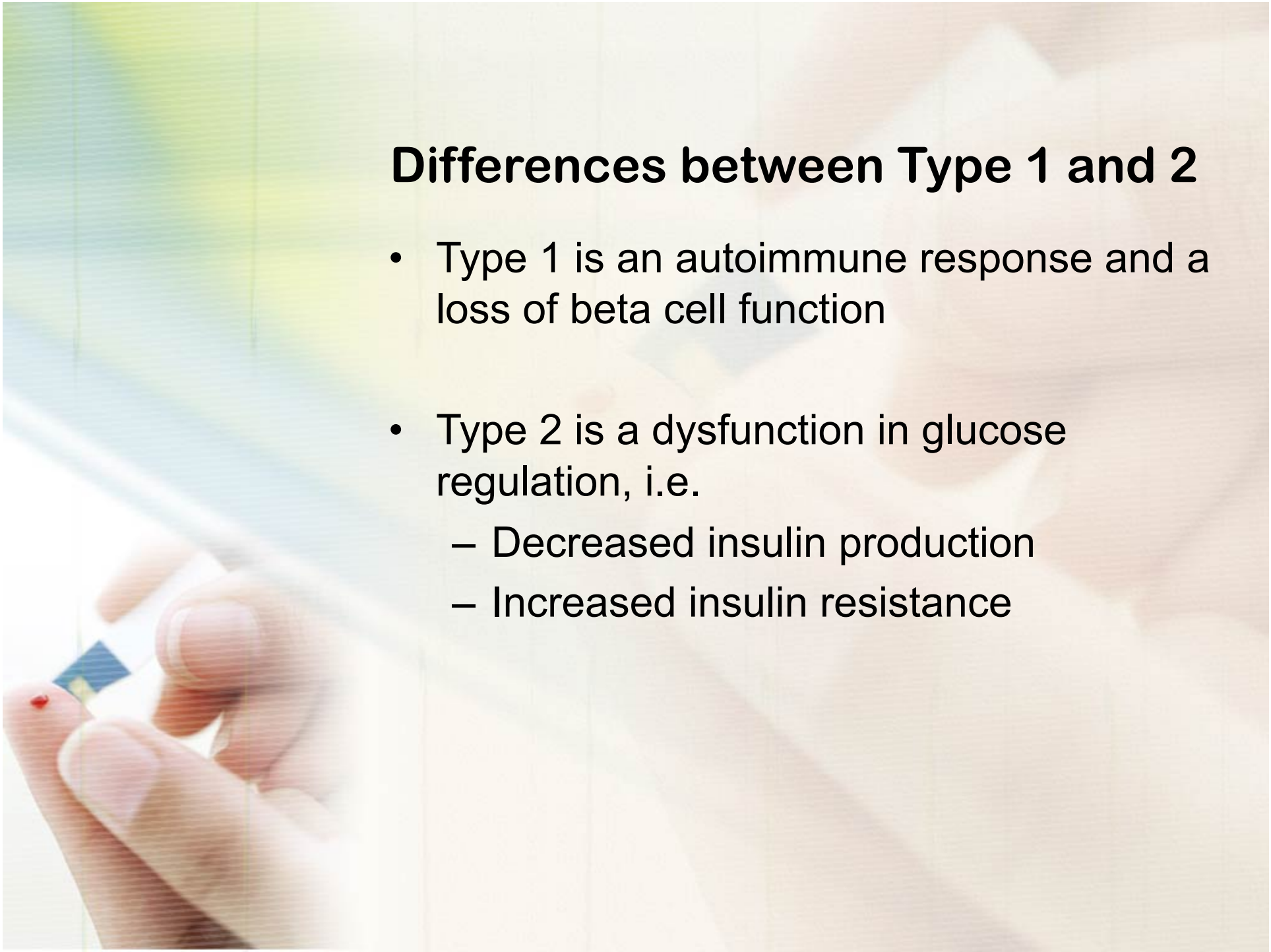
Signs and Symptoms of Type 1

- Weight loss
- Polyphagia
- Polydipsia
- Polyuria
- Lack of energy and sleepiness
- Blurred vision

Pathophysiology of Diabetes

Type 2 Diabetes

- 90% of the population
- More common in those over 40 but…..
- Overweight or obese
- Sedentary
- Strong genetic predisposition
- Greater amongst certain ethnicities, i.e. African Americans, Native Americans, Latinos, and Pacific Islanders
- Women who have a Hx of Gestational Diabetes



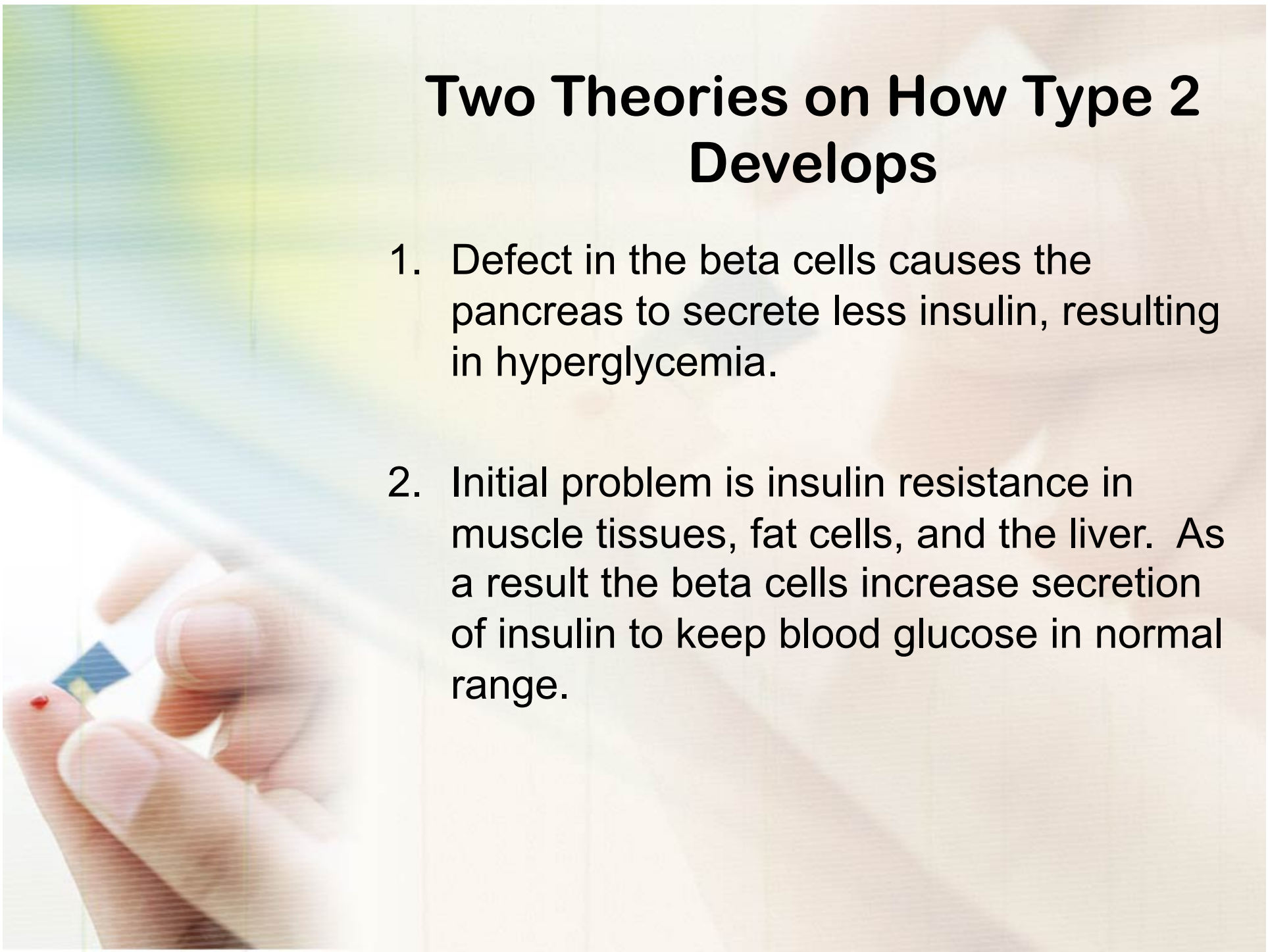
Differences between Type 1 and 2

- Type 1 is an autoimmune response and a loss of beta cell function
- Type 2 is a dysfunction in glucose regulation, i.e.
  - Decreased insulin production
  - Increased insulin resistance

Two Theories on How Type 2 Develops

1. Defect in the beta cells causes the pancreas to secrete less insulin, resulting in hyperglycemia.

2. Initial problem is insulin resistance in muscle tissues, fat cells, and the liver. As a result the beta cells increase secretion of insulin to keep blood glucose in normal range.



Signs and Symptoms of Type 2

- Polyphagia
- Polydipsia
- Polyuria
- Blurred vision
- Fatigue
- Frequent infections
- Slow wound healing


Serious
Complications of
Diabetes

Serious Consequences of Type 1

Ketoacidosis

- hyperglycemia over 300 mg/dL
- low bicarbonate level (<15 mEq/L)
- acidosis (pH <7.30)
- ketonemia and ketonuria
- Nausea/ vomiting
- difficulty breathing (Kussmaul's breathing)
- fruity odor on breath
- confusion

Serious Consequences of Type 2

Hyperosmolar Hyperglycemic state (HHS)

- Plasma glucose level of 600 mg/dL or greater
- Effective serum osmolality of 320 mOsm/kg or greater
- Profound dehydration (8-12 L) with elevated serum urea nitrogen (BUN)-to-creatinine ratio
- Small ketonuria and absent-to-low ketonemia
- Bicarbonate concentration greater than 15 mEq/L
- Some alteration in consciousness

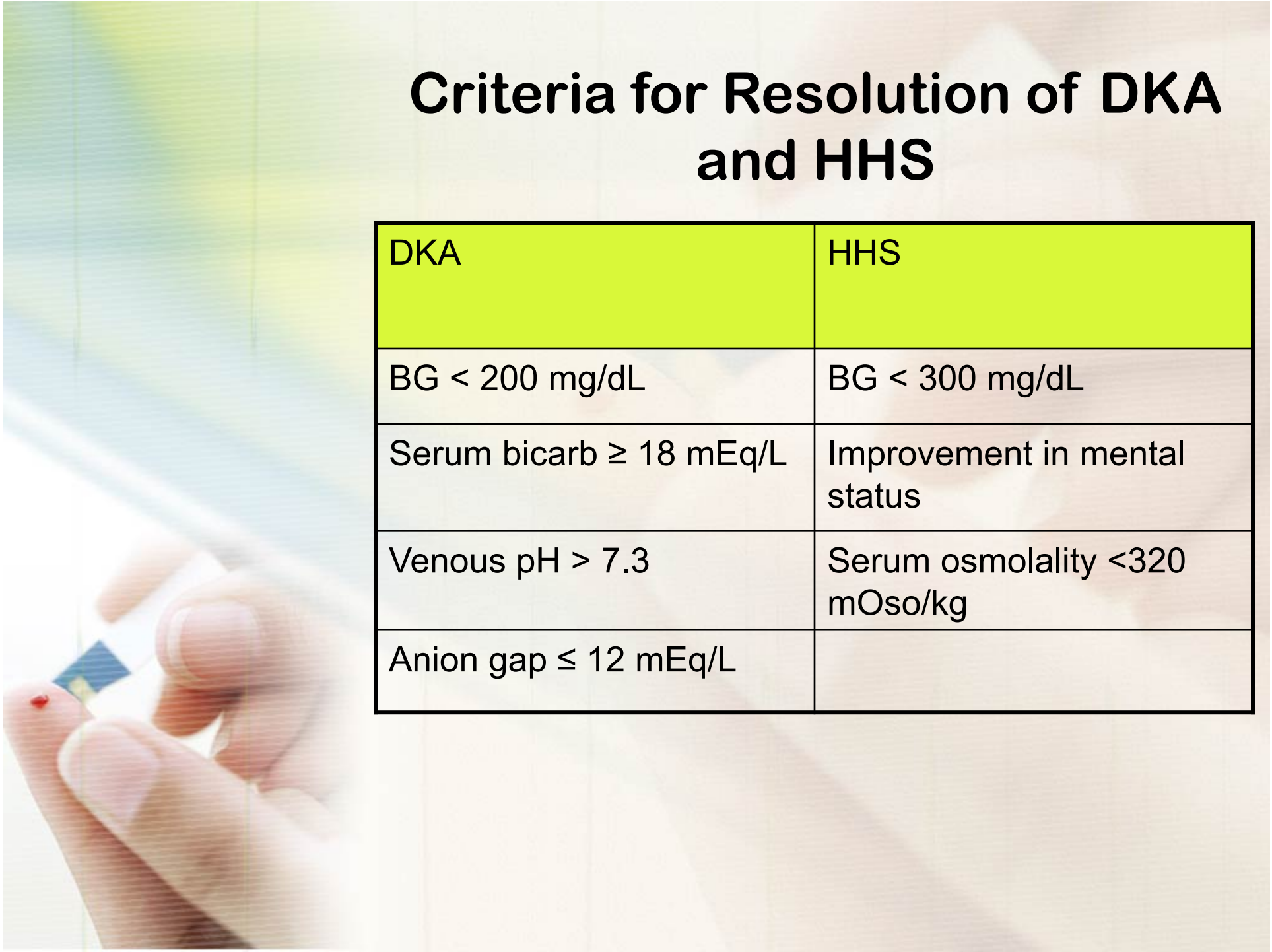
Comparison of DKA and HHS

	DKA			HHS
	Mild	Moderate	Severe	
Plasma Glucose (mg/dL)	>250	>250	>250	>600
Arterial ph	7.25-7.30	7.00-<7/24	<7.00	>7.30
Serum bicarbonate (mEq/L)	15-18	10-<15	<10	>15
Urine Ketones	Positive	Positive	Positive	Small
Serum Ketones	Positive	Positive	Positive	Small
Effective Serum Osmolality	Variable	Variable	Variable	>320 mOso/kg
Anion Gap	>10	>12	>12	<12
Alteration in Sensorium or mental obdundation	Alert	Alert/drowsy	Stuperous/coma	Stuperous/coma

Umpierrez, GE et.al. Diabetic Ketoacidosi and Hyperglycemic Hyperosmolar Syndrome. 2002 Diabetes Spectrum. 15 (1) 28-36

Criteria for Resolution of DKA and HHS

DKA	HHS
BG < 200 mg/dL	BG < 300 mg/dL
Serum bicarb ≥ 18 mEq/L	Improvement in mental status
Venous pH > 7.3	Serum osmolality <320 mOso/kg
Anion gap ≤ 12 mEq/L	



Effects of Hypoglycemia

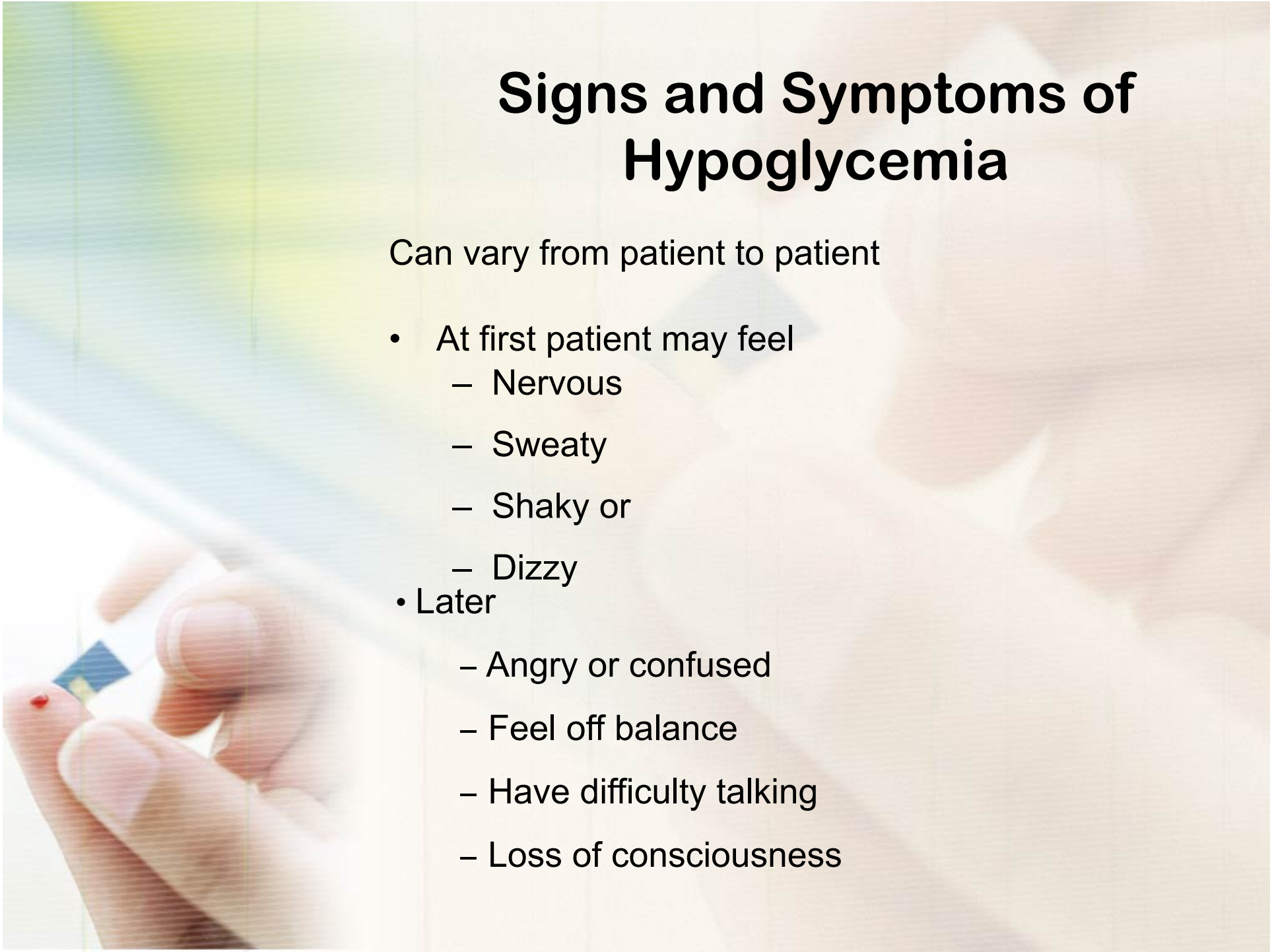
- Early phases alpha cells release glucagon
- Glucagon stimulates hepatocytes
- Glycogen to glucose
- Hepatic gluconeogenesis
- Lead to a rise in blood glucose

Lien L.F et.al. (eds) *Glycemic Control in the Hospitalized Patient*. Springer Science+Business Media, LLC: New York; 2011.

Signs and Symptoms of Hypoglycemia

Can vary from patient to patient

- At first patient may feel
  - Nervous
  - Sweaty
  - Shaky or
  - Dizzy
- Later
  - Angry or confused
  - Feel off balance
  - Have difficulty talking
  - Loss of consciousness



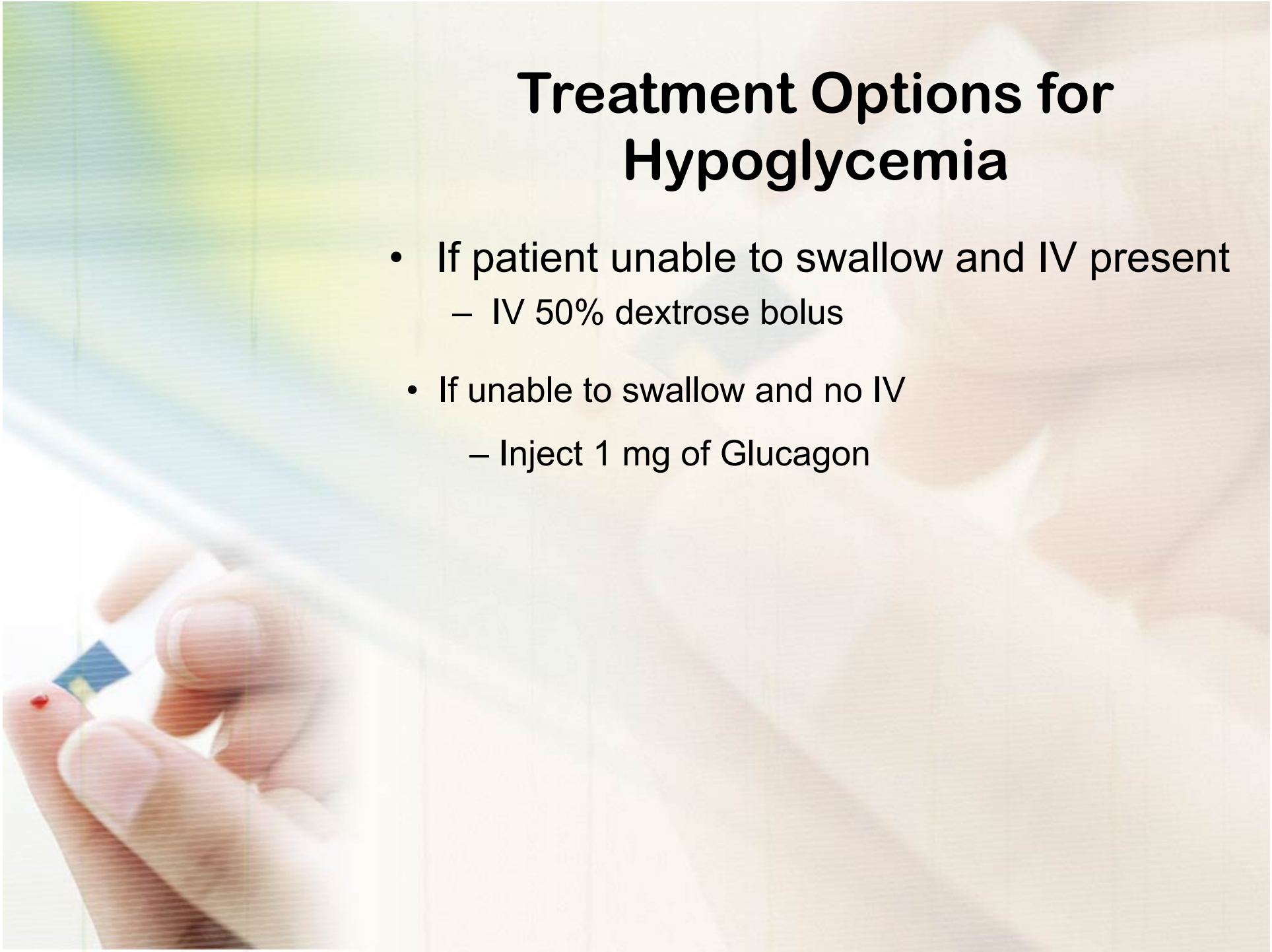
Treatment Options for Hypoglycemia

- Rule of 15 s
  - 15 grams of carbohydrate
  - Will raise blood glucose 15 mg/dl
  - In about 15 minutes

- Examples of 15 grams of oral carbohdyrate
  - 4 ounces of regular juice or soda
  - 3 to 4 hard candies
  - box of raisins
  - 3-4 teaspoons of sugar
  - 1 teaspoon of jelly

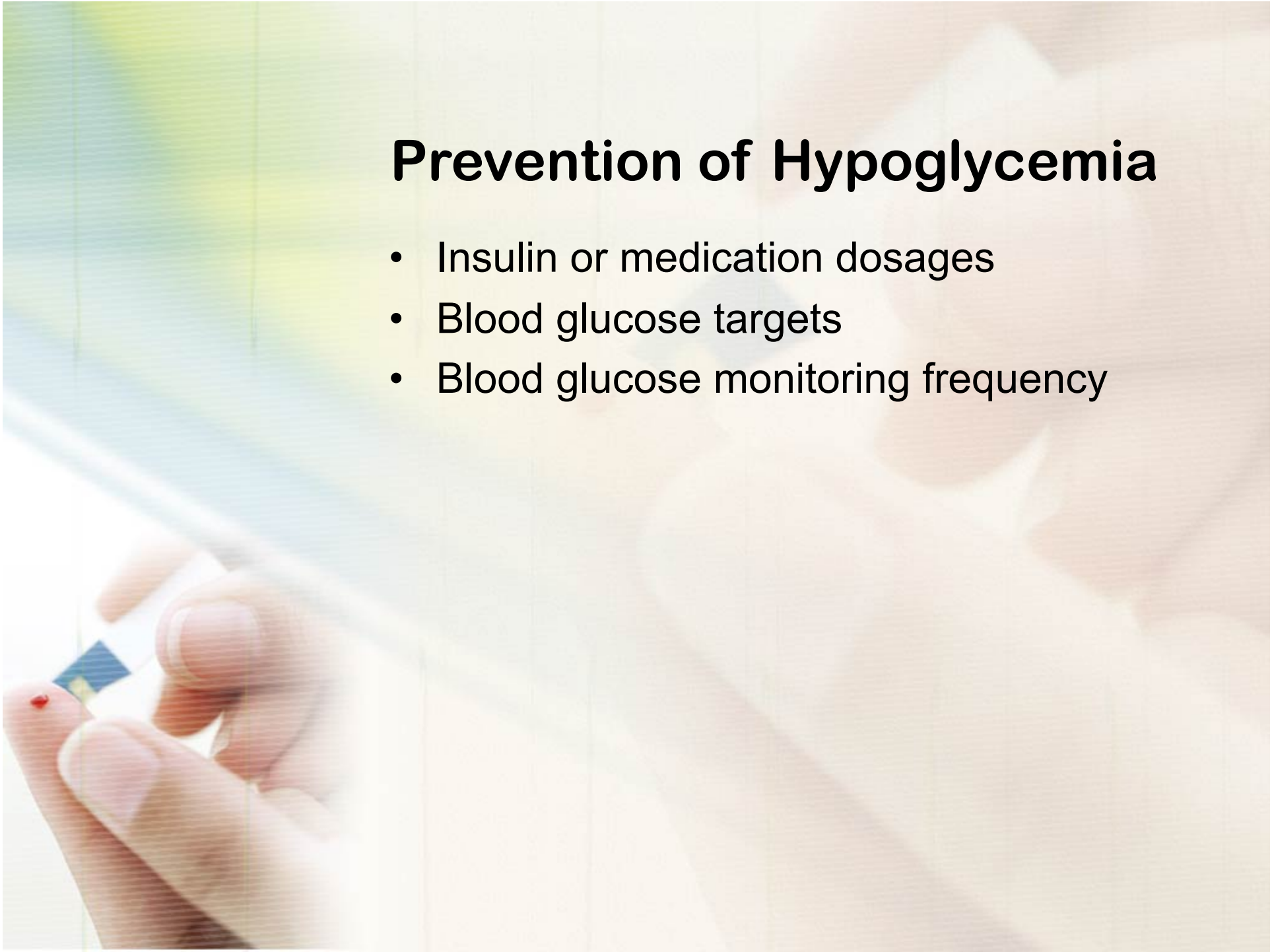
Treatment Options for Hypoglycemia

- If patient unable to swallow and IV present
  - IV 50% dextrose bolus
- If unable to swallow and no IV
  - Inject 1 mg of Glucagon



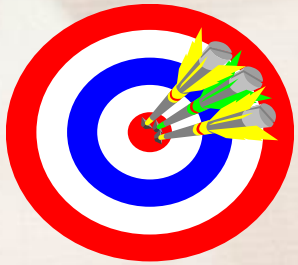
Prevention of Hypoglycemia

- Insulin or medication dosages
- Blood glucose targets
- Blood glucose monitoring frequency



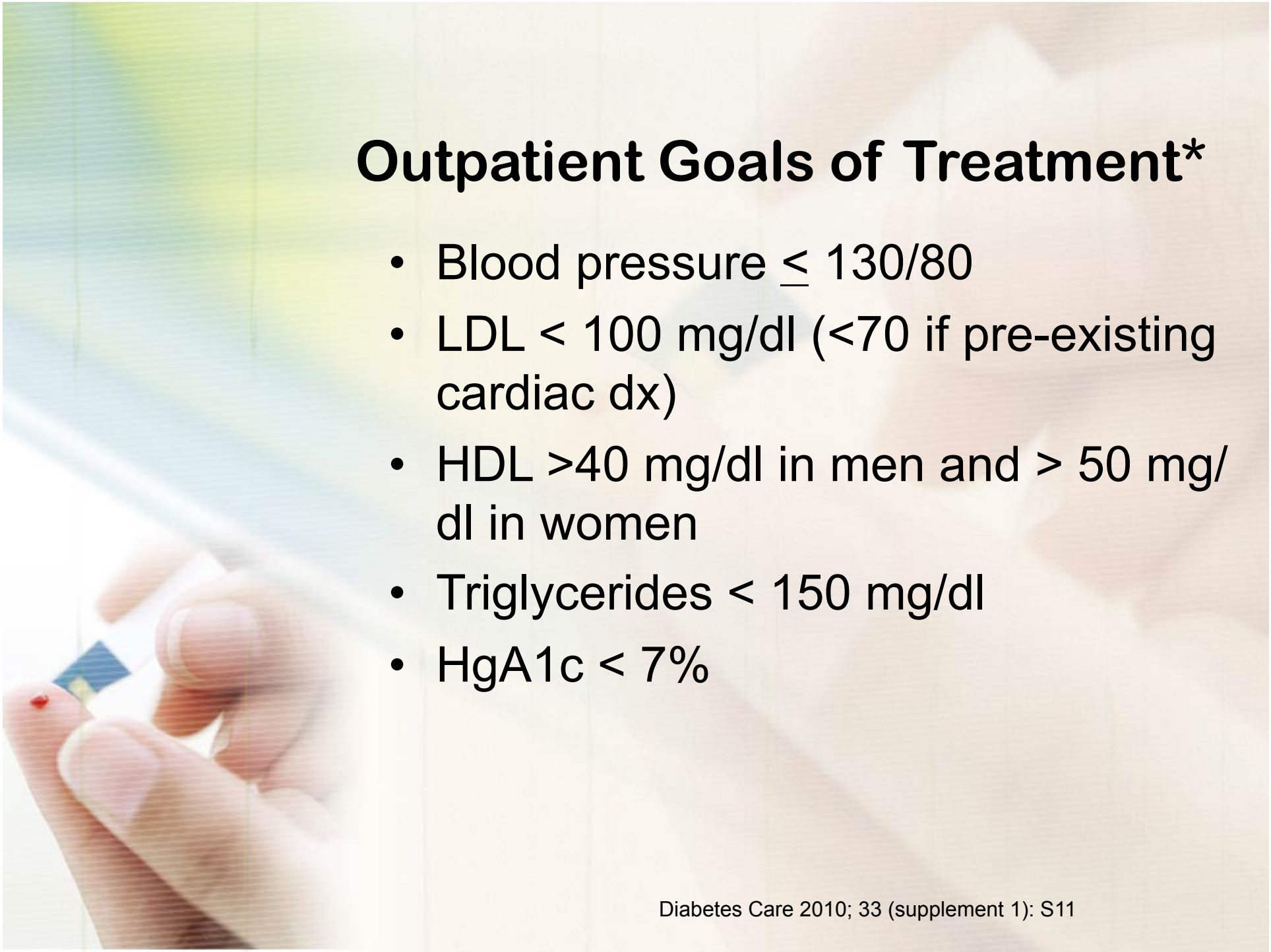
How do we care for people diagnosed with Diabetes?

Inpatient Glycemic Goals



	ICU	Non-ICU Preprandial	Non-ICU Maximal
AACE/ADA	140 mg/dL-180 mg/dL	< 140 mg/dL	< 180 mg/dL

Moghissi, E.S. et. al. American Association of Clinical Endocrinologists and American Diabetes Association Consensus Statement on Inpatient Glycemic Control *Endocrine Practice.* 2009:15 (4): 1-17.



Outpatient Goals of Treatment*

- Blood pressure ≤ 130/80
- LDL < 100 mg/dl (<70 if pre-existing cardiac dx)
- HDL >40 mg/dl in men and > 50 mg/dl in women
- Triglycerides < 150 mg/dl
- HgA1c < 7%

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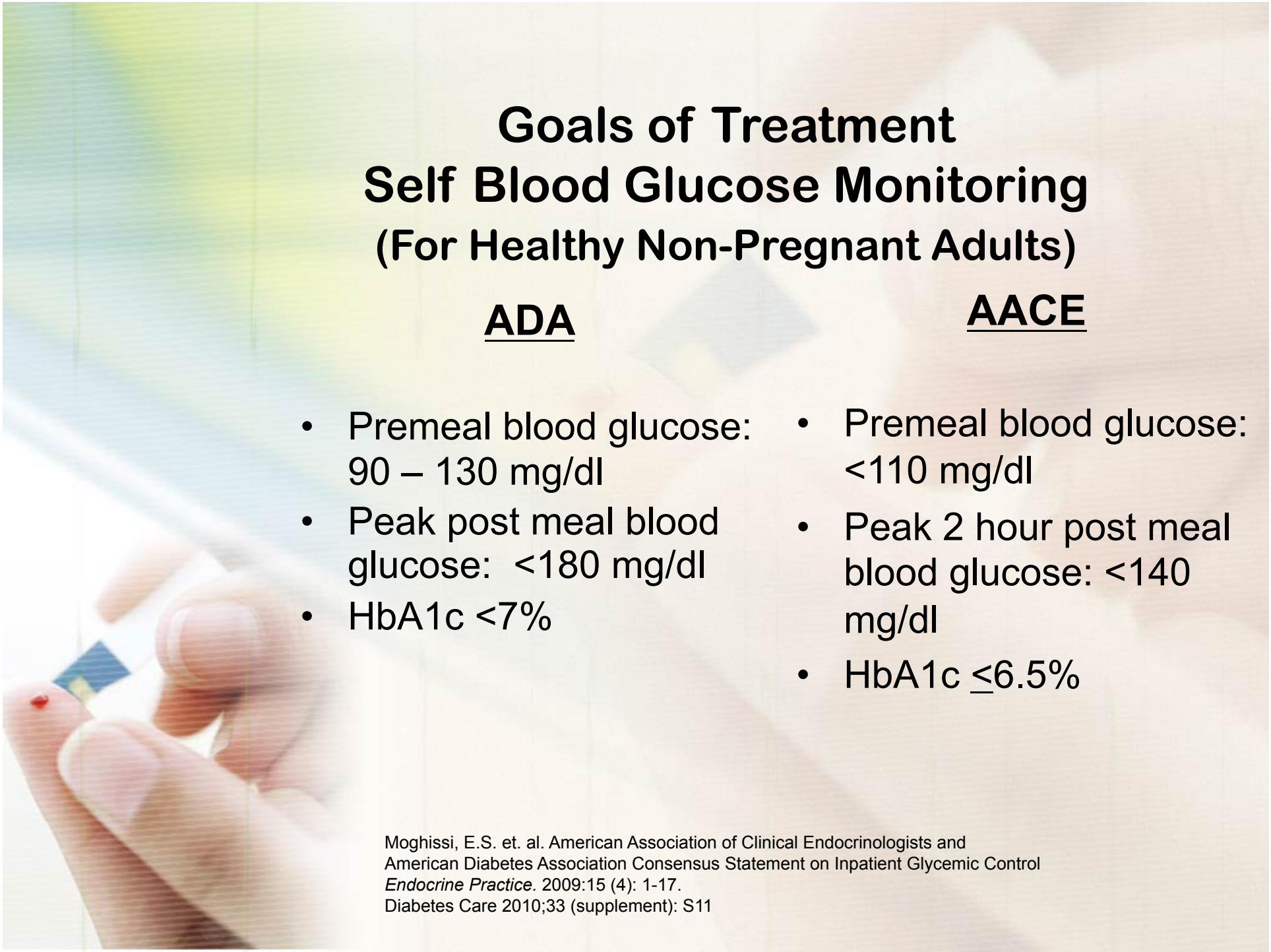
Goals of Treatment
Self Blood Glucose Monitoring
(For Healthy Non-Pregnant Adults)



ADA

- Premeal blood glucose: 90 – 130 mg/dl
- Peak post meal blood glucose: <180 mg/dl
- HbA1c <7%

AACE

- Premeal blood glucose: <110 mg/dl
- Peak 2 hour post meal blood glucose: <140 mg/dl
- HbA1c ≤6.5%

Moghissi, E.S. et. al. American Association of Clinical Endocrinologists and American Diabetes Association Consensus Statement on Inpatient Glycemic Control *Endocrine Practice.* 2009:15 (4): 1-17.
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Goals of Treatment SBGM*

Higher target goals for those with:

- Advanced complications
- Life-limiting comorbid illness
- Cognitive or functional impairments
- Hypoglycemic unawareness
- Young children
- Lower goals for pregnant women

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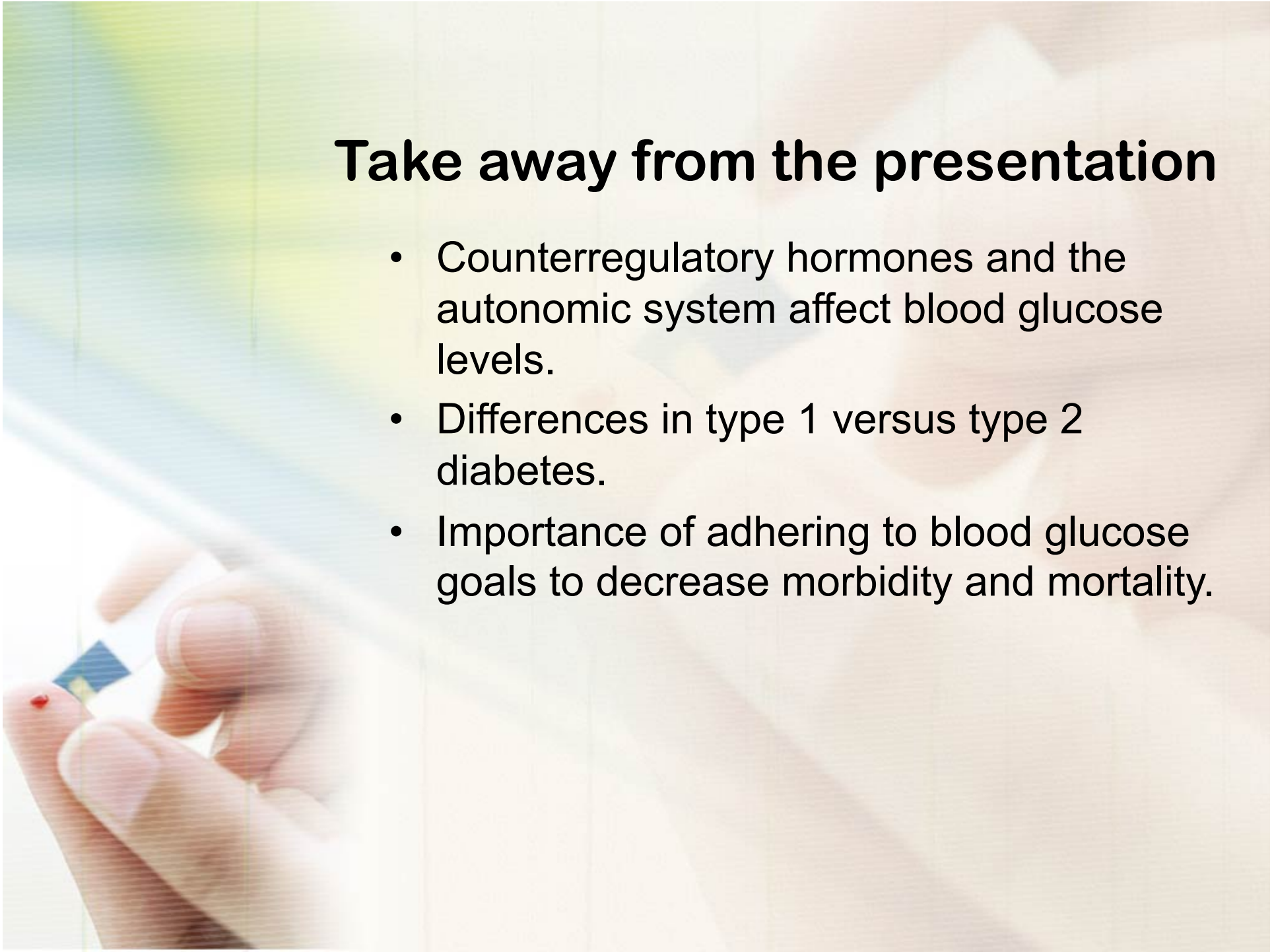
Take away from the presentation

- Counterregulatory hormones and the autonomic system affect blood glucose levels.
- Differences in type 1 versus type 2 diabetes.
- Importance of adhering to blood glucose goals to decrease morbidity and mortality.



Thank you


Questions