This PowerPoint file is a supplement to the video presentation. Some of the educational content of this program is not available solely through the PowerPoint file. Participants should use all materials to enhance the value of this continuing education program.

Diabetes Management Strategies

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Goals

- Recognize macronutrients and how each affect the blood glucose
- Identify various meal plans for diabetes management
- Examine medical and alternative treatments for diabetes management
- Discover tools for empowering management in patients with diabetes

Oral Medications for Diabetes

Biguanides

- Used to treat insulin resistance
- Decrease hepatic glucose secretions
- Increase glucose absorbed by muscle cells
- Decrease body's need for insulin
- First line medication at diagnosis of type 2 diabetes

Biguanides

- May promote some weight loss
- Very low risk of hypoglycemia
- Some studies suggest that metformin may lower hemoglobin A1c by 1.0-2.0%
- Doses
  - 500-2500mg
    - typically BID (2x/day) with a meal
- Generic name: metformin
- Brand name: Glucophage®
- Long-acting metformin
  - extended release (XR)
  - Glucophage XR®
  - Glumetza®
  - Fortamet®
- Liquid metformin
  - Riomet®
Side Effects of Biguanides

• Common side effects
  – initial nausea and/or diarrhea which is usually temporary
  – loss of appetite
  – increased abdominal gas
  – metallic taste

• Other possible side effects
  – hives
  – lactic acidosis causing:
    • trouble breathing
    • excessive sweating
    • cool and clammy skin
    • sweet-smelling breath
    • stomach pain
    • nausea or vomiting
    • Confusion
  – swelling of face, lips, tongue, or throat
  – possible B12 reduction over time

Biguanides Contraindications

• Renal disease or renal dysfunction
  – serum creatinine levels ≥1.5mg/dl (males), ≥1.4mg/dl (females) or abnormal creatinine clearance
    • may also result from conditions such as:
      – cardiovascular collapse (shock)
      – acute myocardial infarction
      – septicemia

• Known hypersensitivity

• Acute or chronic metabolic acidosis

• Should be temporarily discontinued in patients undergoing radiologic studies involving intravascular administration of iodinated contrast materials
  – can cause acute alteration of renal function

• Alcohol can potentiate effect on lactate metabolism
Sulfonylureas

- Increases amount of insulin produced by the pancreas for those who do not make enough insulin or are insulin resistant
- Prescribed for type 2 diabetes when healthy meal plan, weight loss, and exercise is not successful in achieving target blood glucose
- Studies suggest that sulfonylureas lower hemoglobin A1c 1.0-2.0%
- Generic name: chlorpropamide; brand name: Diabinese®
- Generic name: glimepiride; brand name: Amaryl®
- Generic name: glipizide; brand names: Glucotrol®, Glucotrol XL®
  - dosing glipizide: 2.5-40mg
  - dosing Glucotrol XL®: 2.5-20mg
- Generic name: glyburide; brand names: DiaBeta™, Glynase® Pres Tab®, Micronase®
  - dosing Micronase®, DiaBeta™: 1.25-20mg
  - dosing Glynase®: 0.75-12mg
- Generic name: tolazamide
- Generic name: tolbutamide

Side Effects of Sulfonylureas

- Common side effects
  - hypoglycemia
  - hunger
  - weight gain
- Other side effects to consider
  - difficulty breathing
  - swelling of face, lips, tongue, or throat
  - hives
  - seizures

Contraindications of Sulfonylureas

- Pregnancy
- Known hypersensitivity
Dipeptidyl Peptidase-4 (DPP-4) Inhibitors

- Incretin is a hormone responsible for communicating to the pancreas to release insulin
  - DPP-4 removes incretin from the body
  - DPP-4 inhibitor allows the incretin to remain in the body longer
- Works to decrease blood glucose
  - very low risk of hypoglycemia
  - does not cause weight gain
- Delays gastric emptying
- Some studies suggest that DPP-4 inhibitors lower hemoglobin A1c by 0.5-0.8%
- Generic name: alogliptin; brand name: Nesina®
  - dosing: 25mg daily eliminated via kidney
- Generic name: linagliptin; brand name: Tradjenta®
  - dosing: 5mg daily eliminated via feces
- Generic name: saxagliptin; brand name: Onglyza®
  - dosing: up to 5mg daily eliminated via kidney, feces
- Generic name: sitagliptin; brand name: Januvia®
  - dosing: 100mg daily eliminated via kidney

DPP-4 Inhibitor Side Effects

- Common side effects
  - signs of upper respiratory tract infection (stuffy or runny nose or sore throat)
  - signs of urinary tract infection
  - any other type of infection
  - headache
- Possible other side effects
  - trouble breathing
  - swelling of face, lips, tongue, throat
  - hives

DPP-4 Inhibitor Contraindications

- Pregnancy
- Type 1 diabetes
- Renal insufficiency receiving 50mg/day sitagliptin had a slightly greater increase in serum creatinine (0.05mg/dl)
Sodium-Glucose Transporter 2 (SGLT2) Inhibitors

- Have nothing to do with insulin
- SGLTs prevent glucose from entering the urine
- SGLT2 inhibits SGLTs causing glucose to be filtered through the kidney into the urine
- May promote some weight loss – usually about 5 to 10 pounds in 6 to 12 months
- May also lose sodium which may be beneficial for blood pressure
- Generic name: dapagliflozin; brand name: Invokamet®, Invokana®
  - dosing: 100-300mg 1x/day
- Generic name: dapagliflozin; brand name: Farxiga®, Xigduo®
  - dosing: 5-10mg 1x/day
- Generic name: empagliflozin; brand name: Jardiance®
  - dosing: 10-25mg 1x/day

SGLT-2 Inhibitor Side Effects

- Women have higher risk of yeast infections
- Uncircumcised men may have foreskin infections
- Contraindicated in elderly patients who have kidney disease and those taking diuretics due to possible dehydration

SGLT-2 Contraindications

- Canagliflozin
  - hypersensitivity
  - severe renal impairment
    - glomerular filtration rate (GFR) <45mL/min
  - end stage renal disease
  - patient on dialysis
- Dapagliflozin
  - hypersensitivity
  - severe renal impairment: GFR <60mL/min
  - end stage renal disease
  - patient on dialysis
- Empagliflozin
  - hypersensitivity
  - severe renal impairment: GFR <45mL/min
  - end stage renal disease
  - patient on dialysis
Thiazolidinediones (TZDs)

- Thomas Buchanan, MD, professor of medicine at the University of Southern California led the Troglitazone in Prevention of Diabetes (TRIPOD) study
  - treated women at risk of developing type 2 diabetes with TZDs
  - 235 Hispanic women who had previously had gestational diabetes were treated with TZD, Rezulin® (troglitazone), and Actos®
  - beta-cell function was stabilized
  - 55% reduction in diabetes compared to placebo group
  - effects continued after discontinued use
- Exact mechanism not fully understood
- Activates receptor common in fat cells called nuclear peroxisomal proliferator-activated receptors-gamma (PPAR-gamma)
- Affects how glucose and fats are metabolized
- Once activated, uptake or absorption of fat cell increases and stimulates metabolism of glucose decreasing liver’s production of new glucose

TZDs

- May also prevent cardiovascular disease
  - unrelated to effects on beta cells
  - lowers free fatty acids in bloodstream
- Not as potent as sulfonylureas or metformin when used as a monotherapy
- High cost
- Studies suggest that TZDs decrease hemoglobin A1c 0.5-1.0%
- Generic name: pioglitazone; brand name: Actos®
  - dosing: 15-45mg daily
- Generic name: rosiglitazone; brand name: Avandia®
  - dosing: 4-8mg daily
Side Effects of TZDs

• FDA in 2000 asked manufacturer of Rezulin® to withdraw it after reports of severe and fatal liver poisoning
• Actos® and Avandia® have not shown same risks
• Associated with weight gain
• Some studies have demonstrated risk of edema
• Risk of congestive heart failure

TZDs Contraindications

• Congestive heart failure
• Patients with osteoporosis or at risk of bone fractures

Glucosidase Inhibitors

• Aids in slowing digestion of complex carbohydrates, but not simple carbohydrates
• Taken with first bite of food
• No risk of hypoglycemia unless used with other oral medications
• Some studies suggest that glucosidase inhibitors lower hemoglobin A1c 0.5-0.8%
• Generic name: acarbose; brand name: Precose®
  – dosing: 25-100mg with meals
• Generic name: miglitol; brand name: Glyset™
  – dosing: 300mg maximum daily dose
• Dosing should begin slowly at 4-8 week intervals to decrease GI effects
• Caution should be taken with liver and kidney problems
Side Effects of Glucosidase Inhibitors

- Common side effects
  - flatulence
  - feeling bloated
  - abdominal pain
  - diarrhea
- Other possible side effects
  - trouble breathing
  - swelling of face, lips, tongue, or throat
  - hives
  - yellow eyes
  - yellow skin

Glucosidase Inhibitors Contraindications

- Hypersensitivity
- Renal dysfunction with serum creatinine >2mg/dl
- Cirrhosis
- Diabetic ketoacidosis
- Inflammatory bowel disease
- Intestinal obstruction or predisposition
- Colon ulceration
- Other disorders of digestion or absorption
Dopamine Receptor Agonists

- Timed bromocriptine administration within 2 hours of awakening may promote low hypothalamic dopamine levels and inhibit excessive sympathetic tone within central nervous system
  - results in reduction of post meal plasma glucose due to enhanced suppression of hepatic glucose production
- Reduces fasting and post meal plasma free fatty acids and triglyceride levels
- In double blind, placebo controlled study of 52 patients with type 2 diabetes, bromocriptine reduced composite cardiovascular end point by 40%
  - mechanism unknown at this time
- Generic name: bromocriptine mesylate – quick release (QR); brand name: Cycloset®
  - dosing: 1.6-4.8mg daily
  - each tablet contains 0.8mg
- Studies suggest that bromocriptine may reduce hemoglobin A1c 0.6-0.9%

Side Effects of Dopamine Receptor Agonists

- Nausea
- Headache
- Fatigue
- Hypotension
- Syncope
- Somnolence
Meglitinides

- Increases rapid output of insulin
- Taken immediately before a meal
- Used for those who have found that exercise and eating plan is not enough to control blood glucose sufficiently
- Some studies suggest meglitinides reduce hemoglobin A1c 1.0-2.0%
- Generic name: nateglinide; brand name: Starlix™
  - dosing: 60-120mg with meals eliminated via kidney
- Generic name: repaglinide; brand name: Prandin®
  - dosing: 0.5-4mg with meals metabolized in liver
- Combination: repaglinide and metformin (PrandiMet®)
  - aids in reducing rapid rise in blood glucose levels occurring immediately after a person consumes a meal

Side Effects of Meglitinides

- Common side effects
  - hypoglycemia
  - joint pain
- Other possible side effects
  - trouble breathing
  - swelling of face, lips, tongue, or throat
  - seizures
  - hives
  - cold symptoms such as cough, runny nose, stuffy nose, or sore throat

Meglitinides Contraindications

- Hypersensitivity
- Diabetic ketoacidosis
- Type 1 diabetes
- Pregnancy
Insulin Dosing

- Range: 0.5-1.0 units/kg body weight/day
- Discard opened insulin vials after 28 days

Insulin Side Effects

- Hypoglycemia
- Weight gain

Bolus

- Decreases postprandial glucose
- Rapid-acting analogs
  - aspart (NovoLog®)
    - onset: 5-15 minutes
    - peak: 30-90 minutes
    - effective duration < 5 hours
  - lispro (Humalog®)
  - glulisine (Apidra®)

Bolus

- Short acting
  - regular
    - onset: 30-60 minutes
    - peak: 2-3 hours
    - effective duration: 5-8 hours
  - regular concentrated insulin 500 units/mL regular insulin “U-500”
    - onset: 30-60 minutes
    - peak: 2-3 hours
    - effective duration: up to 24 hours
Basal

- Controls blood glucose between meals and nighttime
- Fasting blood glucose reflects efficacy
- Intermediate
  - neutral protamine hagedorn (NPH)
    - onset: 2-4 hours
    - peak: 4-10 hours
    - effective duration: 10-16 hours
- Long acting
  - detemir (Levemir®)
    - onset: 3-8 hours
    - peak: no peak
    - effective duration: 10-16 hours
  - glargine (Lantus®)
    - onset: 2-4 hours
    - peak: no peak
    - effective duration: 24 hours

Basal

- Long acting
  - glargine (Toujeo®)
    - concentrated insulin
    - 300 units/mL in 1.5mL pen
    - onset: 6 hours
    - peak: no peak
    - effective duration: 24 hours
Basal + Bolus

- Intermediate + short
  - 70/30 = 70% NPH + 30% regular
  - 50/50 = 50% NPH + 50% regular
  - onset: 5-15 minutes
  - peak: dual peaks
  - effective duration: 10-16 hours
- Intermediate + rapid
  - NovoLog® mix: 70/30
    - onset: 30-60 minutes
  - Humalog® mix: 75/25 or 50/50
    - onset: 5-15 minutes
  - peak: dual peaks
  - effective duration: 10-16 hours

Inhaled Insulin

- Bolus: rapid-acting
- Only inhaled insulin on market is Afrezza®
- Taken at mealtimes
- Available in 4-unit and 8-unit cartridges that are placed in a small gadget
- Onset: 15 minutes
- Peak: 1 hour
- Duration: 3 hours
- Lung function should be assessed before starting
- Should be avoided in chronic lung disease
  - acute bronchospasm risk

Inhaled Insulin Side Effects

- Hypoglycemia
- Cough
- Throat irritation
Injectables That Lower Glucose

• Increases insulin release with food
• Slows gastric emptying
• Promotes satiety
• Suppresses glucagon
• Studies suggest that these medications lower hemoglobin A1c 0.5-1.6%
• Weight loss results of approximately 3 lbs.
• Side effects for all:
  – nausea
  – vomiting
  – weight loss
  – injection site reaction
  – acute pancreatitis
    • severe abdominal pain
    • vomiting

Injectables That Lower Glucose

• Black box warning
  – thyroid c-cell tumor warning for liraglutide, exenatide XR, albiglutide, and dulaglutide
  – should be completely avoided in patients who have family history of medullary thyroid cancer
  – healthcare provider should be notified when hoarseness and throat lump occurs
• GLP-1 agonist
  – exenatide (Byetta®)
    • dose range: 5mcg or 10mcg BID (renally excreted)
  – exenatide XR (Bydureon®)
    • 2mg 1x/week (renally excreted)
  – liraglutide (Victoza®)
    • dose range: 0.6-1.8mg daily
Injectables That Lower Glucose

• Amylin mimetic
  – slows gastric emptying
  – suppresses glucagon
  – promotes satiety
  – some studies suggest amylin reduces hemoglobin A1c 0.5-1%
  – pramlintide (Symlin®)
    • dose range:
      – type 1: 15-60mcg
      – type 2: 60-120mcg
      – immediately before a major meal

Insulin Pumps and CGMs

• Insulin pumps have been constructed to mimic the pancreas’ activity
  – basal insulin
  – bolus insulin
• Some insulin pumps allow patient to adjust for:
  – exercise
  – high-fat meals
  – stress
Insulin Pumps and CGMs

- Continuous glucose monitoring (CGM)
  - Test blood glucose approximately every 5 minutes and alerts patients of hyperglycemia trends and hypoglycemia trends
  - Now available in conjunction with the insulin pump

Alpha Lipoic Acid

- Mitochondrial fatty acid involved in energy metabolism and multi-enzyme complexes
- Supplements have shown benefit against various forms of oxidation and inflammation
- Essential component of mitochondrial respiratory enzymes
- Clinically used in treatment of diabetic neuropathy and degenerative neuronal disease due to aging, and atherosclerosis as well as liver diseases
- Usually taken with L-Carnitine
- Water soluble in gut even though it is a fatty acid and does not have to be ingested with other fatty acids
- Consumption of raw egg whites can negate benefits
- Not advised to take with medium chain triglycerides because of the competition for absorption
- Dosing
  - 300-600mg
- Some studies show that diabetic neuropathy had notable effects
- Other studies show that symptoms of intermittent claudication also had notable results
- Blood flow, HbA1c, inflammation, lipid peroxidation, weight, and nerve repair were only rated as having minor effects according to review of literature
Chromium

- Essential mineral
- Regulates glucose metabolism and insulin sensitivity
- When supplemented in people with normal or elevated chromium levels, no reliable effect is shown
  - no diabetes-related biomarkers are improved
- Mechanism directly related to chromodulin, a protein which normally enhances signaling of insulin receptors
- Benefits were shown to aid in fighting depression and snacking associated with binge eating
  - further research is needed
- Dosing
  - 1,000mcg of chromium picolinate
  - should be supplemented with meal containing carbohydrate

Omega 3 Fatty Acids

- Eicosapentaenoic acid (EPA)
- Docosahexaenoic acid (DHA)
- Usually found in fish, animal products, and phytoplankton
- Fish oil signals molecules primarily through eicosanoids
  - proper ratio of omega 3 to omega 6 fatty acids influences which eicosanoids are released in response to stress
- Found to have a strong correlation in studies to reduce triglycerides
- Can raise cholesterol
- Dosing
  - 250mg is minimum dose
  - American Heart Association recommends 1g daily
  - an increase of 200mg/day for pregnant women of DHA as long as there is no risk of elevated mercury levels
- Studies have found that omega 3s may also aid in depression
- Only minor effects were found in studies reducing blood pressure, raising HDL, decreasing inflammation, and decreasing LDL
Polyphenols

- Found in a variety of plant-based foods
  - especially dark chocolate, green tea, coffee, and extra virgin olive oil
- Researchers found that they lowered blood glucose
- Researchers also found that there were improvements in the function of the pancreas
- Resveratrol in particular aids in preventing insulin resistance, aids in reducing inflammation (preventing oxidation of LDL), and may protect nerve cells from damage as well as buildup of amyloid plaque that can lead to Alzheimer’s

Cinnamon

- Reduces rate of glucose uptake
- Reduces fasting blood glucose over time
- May reduce cholesterol
- Warning
  - contains a liver toxin called coumarin
  - using Cassia cinnamon can expose individuals to high levels of hepatotoxic and carcinogenic phytochemical coumarin when super loaded
- Ceylon (Indonesian) should always be used in the supplement form
- Dosing
  - 1-6g per day taken with carbohydrate containing meals
Foot Care

- Feet should be inspected every day for bruising or injury
  - healthcare provider should be contacted immediately if there are cuts or breaks in the skin or an ingrown nail
  - patient should also report any changes in color, shape, or change in sensitivity
- Foot exam should be performed annually by healthcare provider
- Patient should consult with healthcare provider regarding appropriate exercise
- Toenails should be trimmed straight across and filed on edges with emery board
- Shoes and socks should be worn at all times with appropriate fitting socks and shoes
- Feet should be protected from hot and cold
- Patients should not cross their legs for long period and should elevate feet when sitting

Dialysis

- Hemodialysis
  - artificial kidney (dialyzer) used to filter blood
  - uses semipermeable membrane to filter out urea, creatinine, potassium, and extra fluid
  - conducted in hospital or dialysis center
  - conducted 3x/week for a duration of ~4 hours each visit
  - dialysis diet is required to increase protein intake and limit potassium, phosphorus, sodium, and fluid
  - requires vascular access
    - arteriovenous (AV) fistula
      - directly connects artery and vein usually in the arm
      - patient taught to exercise by squeezing a rubber ball to allow fistula to mature for use allowing the vein to increase in size and strength taking 6 weeks to 4 months
Dialysis

- requires vascular access
  - arteriovenous (AV) fistula
    - advantages
      » lower risk of infections
      » lower risks of forming clots
      » allows greater blood flow
      » lasts longer, sometimes even decades
    - disadvantages
      » appearance of bulging veins at access site
      » may require several months to mature
      » some do not mature
  - AV graft
    - connects artery and vein under skin with manmade tubing ½ inch in diameter made of Teflon® or Gore-Tex® material
    - transplanted animal or human vessels may also be used as grafts
    - usually placed in arm but can be placed in thigh

Dialysis

- requires vascular access
  - AV graft
    - advantages
      » does not require as much time to mature because they do not need to enlarge before using
      » can usually use within 2-6 weeks after placement
    - disadvantages
      » issues with clotting
      » infections
Dialysis

- Peritoneal dialysis
  - continuous ambulatory peritoneal dialysis (CAPD)
    - machine free
    - patient places ~2qts of cleaning fluid into tube in abdominal area then drains this fluid later in the day by gravity
    - complete 3, 4, or 5 times in a 24 hour period while awake and during normal activities
    - each exchange takes 30-40 minutes
  - automated peritoneal dialysis (APD)
    - similar to CAPD except machine delivers and drains cleansing fluid
    - usually done at night while sleeping

Dialysis

- Peritoneal dialysis
  - advantages
    - fluid is easier to control
    - may reduce stress on the heart and blood vessels
    - food consumption is not as strict
    - patient uses fewer medications
    - freedom in daily activities and travel
  - disadvantages
    - may be contraindicated in morbidly obese individuals or with multiple prior abdominal surgeries
    - peritonitis (infection of abdomen)
    - daily treatment
Macronutrients

- **Protein**
  - little to no effect on blood glucose as long as there is adequate insulin

- **Fats**
  - no significant effect on blood glucose
  - high-fat content may increase insulin resistance
  - longer time to metabolize could lead to higher blood glucose hours later

- **Carbohydrates**
  - major source of fuel for the body and directly related to increase in blood glucose
  - non-starchy vegetables
  - reading food label

Saturated Fat and Cardiovascular Disease

- **History of the low fat diet**
  - 1940's research suggested that there might be a correlation between fat and heart disease
  - 1960's ideology of low fat diet was recommended for high risk heart disease patients
  - 1980's ideology of low fat diet was embraced

Does the research support low fat diet?

- Review of 72 separate studies on heart risk and intake of fatty acids found no evidence to support guidelines stating that saturated fat consumption should be lowered to reduce risk of developing heart disease
- Also found that impact of omega-3 fatty acids varied within same family of fatty acids

Education Strategies for Meal Plan

- **Food Exchange System**
  - based on calorie count

- **My Food Guide Pyramid**

- **Food Plate**

- **Carbohydrate Counting**
Sugar Alcohols

• Reduced calorie sweetener
• Examples:
  – erythritol
  – glycerol
  – hydrogenated starch hydrolysates
  – isomalt
  – lactitol
  – maltitol
  – mannitol
  – sorbitol
  – xylitol
• Calculating carbohydrates with sugar alcohols
  – sugar alcohols are incompletely absorbed
  – divide the sugar alcohols by 2 then subtract from total carbohydrates

Artificial Sweeteners

• Some studies have linked non-caloric sweetener use to obesity and diabetes
• Other studies show a protective effect or no effect at all
• One study found significant correlations between non-nutritive sweetener consumption and several metabolic-syndrome related clinical parameters
  – increased weight
  – waist-to-hip ratio
  – higher fasting blood glucose
  – glycosylated HbA1c%
  – elevated serum alanine aminotransferase
Stevia

- Refers to the plant *stevia rebaudiana*
  - sweetest of the stevia species of plants
- Sweetness derived from glycoside (bound to sugar) compounds of steviol
- Confers pharmacological activity
- Low doses appear to have anti-inflammatory and anti-oxidative effects
- Higher doses appear to be linked to infertility (animal studies)
- Dosing should not exceed 8mg/kg (540mg for a 150lb individual)

Alcohol

- Important that patient discusses alcohol intake with healthcare provider
  - alcohol may interfere with other medications
- Recommended portions
  - 12 oz beer
  - 5 oz wine
  - 1 ½ oz distilled spirits (rum, whiskey, gin, etc.)
- Risk of hypoglycemia
  - liver takes 1-1 ½ hours to process alcohol
  - liver’s release of glucose into the bloodstream is inhibited
  - can cause hypoglycemia up to 24 hours after drinking
Alcohol

- Important considerations for alcohol
  - patient should always wear medical ID
  - patient should know signs and symptoms of hypoglycemia
  - patient should carry glucose tablets or other source of carbohydrate appropriate for treating hypoglycemia
  - patient should test blood glucose often, especially if patient has hypoglycemic unawareness
  - glucagon should be readily available and not out of date
  - alcohol should not be consumed on an empty stomach

Physical Activity

- Increases insulin sensitivity
- Muscle contraction stimulates mechanisms that increase glucose uptake in moderate exercise
  - insulin is decreased
  - translocation of GLUT4 glucose transporters are initiated
  - increased peripheral blood flow augments total insulin delivery to muscle, compensating in part for decreased plasma insulin concentrations
  - effect counteracts catecholamines which usually inhibit muscle glucose uptake
- Intense exercise in type 1 individuals may increase glucose if no insulin is present or if blood glucose is >250mg/dl
- Overall recommendations for diabetes are 150 minutes a week of moderate to vigorous aerobic exercise over at least three days per week with no more than two consecutive days between days of activity
Recommendations for Exercise for Type 1

- Monitoring glucose is crucial before and after exercise
- Insulin may need to be lowered before exercise begins to prevent hypoglycemia
  - if blood glucose is trending downward before exercise, a carbohydrate snack is recommended
- Blood glucose may increase during or after exercise, particularly when participating in high-intensity exercise that increases stress hormones
- If blood glucose is high before exercise, monitoring of urine ketones is important
  - vigorous exercise should be avoided if ketones are positive
  - if ketones are negative, exercise should be okay but blood glucose should be taken after exercise with monitoring of ketones if blood glucose is high

Diabetes Management Strategies

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