This presentation will:

• Present the biological and environmental factors contributing to the obesity epidemic

• Discuss the lifestyle modification therapy for patients with obesity, prediabetes, and diabetes

• Outline the model for care of the overweight or obese patient, based on the AACE comprehensive diabetes algorithm

• Explain the implications of lifestyle modification on the prevention of prediabetes and diabetes

AACE = American Association of Clinical Endocrinologists
Number of People with Diabetes by IDF Region

Number of Cases 2013

IDF = International Diabetes Federation

IDF Diabetes Atlas: Diabetes Prevalence

- 415 million people worldwide have diabetes

- By 2040, this number will rise to 642 million (521-829 million)

AFR = Africa; EUR = Europe; IDF = International Diabetes Federation; MENA = Middle East and North Africa; NAC = North America and Caribbean; SACA = South and Central America; SEA = South-East Asia; WP = Western Pacific.

Age-Adjusted Prevalence of Obesity and Diagnosed Diabetes Among U.S. Adults

**Obesity (BMI ≥30 kg/m²)**

<table>
<thead>
<tr>
<th>Year</th>
<th>No Data</th>
<th>&lt;14.0%</th>
<th>14.0%–17.9%</th>
<th>18.0%–21.9%</th>
<th>22.0%–25.9%</th>
<th>&gt;26.0%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>No Data</td>
<td>&lt;4.5%</td>
<td>4.5%–5.9%</td>
<td>6.0%–7.4%</td>
<td>7.5%–8.9%</td>
<td>&gt;9.0%</td>
</tr>
<tr>
<td>2000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

BMI = body mass index; CDC = U.S. Center for Disease Control and Prevention.

Obesity directly and indirectly promotes and/or causes adverse health consequences.

Current evidence indicates that obesity must be treated as a chronic, relapsing disease.
Identification and Screening: BMI Is the Starting Point

• 2013 AHA/ACC/TOS Obesity Guidelines—identify patients who need to lose weight
  – Measure height and weight and calculate BMI at annual visits or more frequently for all patients
  – Use BMI cut points to classify patients with overweight or obesity
    • BMI is used as an estimate of increased adverse health consequences

ACC = American College of Cardiology; AHA = American Heart Association; BMI = body mass index; TOS = The Obesity Society.

The Role of the Physician

• >50% of visits no BMI measured

• If BMI data available >70% of obese patients were not diagnosed

• If obesity diagnosed >63% received no counseling (even with risk factors)

BMI = body mass index.

Obesity Classification: BMI

Patients with overweight/obesity = increased body fat (adiposity)

Overweight and obesity classification: body mass index (BMI) in kg/m²

- Normal weight (18.5–24.9)
- Overweight (25.0–29.9)
- Class I obesity (30.0–34.9)
- Class II obesity (35.0–39.9)
- Class III obesity (≥40.0)

ACTION ITEM:
For all patients, calculate BMI at annual visits or more frequently and identify body weight classification.

BMI = body mass index.

Obesity Classification: Waist Circumference (WC)

Patients with overweight/obesity = increased body fat (adiposity)

Overweight and obesity classification: waist circumference (WC)

Men abdominal obesity
≥40 in. (≥102 cm)*

Women abdominal obesity
≥35 in. (≥88 cm)*

ACTION ITEM:
Measure WC at annual visits or more frequently in patients with overweight or obesity.

WC = waist circumference.

*Different WC abdominal obesity cutoff points may be appropriate for different races, such as ≥90 cm for Asian men and ≥80 cm for Asian women.

Medical Complications of Obesity

**Pulmonary disease**
- abnormal function
- obstructive sleep apnea
- hypoventilation syndrome

**Nonalcoholic fatty liver disease**
- steatohepatitis
- cirrhosis

**Gall bladder disease**

**Gynecologic abnormalities**
- abnormal menses
- infertility
- polycystic ovarian syndrome

**Osteoarthritis**

**Skin**

**Gout**

**Idiopathic intracranial hypertension**

**Stroke**

**Cataracts**

**Coronary heart disease**

**Diabetes**

**Dyslipidemia**

**Hypertension**

**Severe pancreatitis**

**Cancer**
- breast, uterus, cervix
- colon, esophagus, pancreas
- kidney, prostate

**Phlebitis**
- venous stasis
# Adverse Health and Social Consequences Associated with Obesity

<table>
<thead>
<tr>
<th>PHYSICAL</th>
<th>PSYCHOSOCIAL</th>
<th>FUNCTIONAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cancer</td>
<td>Depression</td>
<td>Absenteeism from school or work</td>
</tr>
<tr>
<td>Cardiovascular disease</td>
<td>Discrimination</td>
<td>Disability</td>
</tr>
<tr>
<td>Cholestasis</td>
<td>Low self-esteem</td>
<td>Disqualification from active military/fire/police services</td>
</tr>
<tr>
<td>Dyslipidemia</td>
<td>Negative body image</td>
<td>Low physical fitness level</td>
</tr>
<tr>
<td>Gallbladder disease</td>
<td>Negative stereotyping</td>
<td>Mobility limitations</td>
</tr>
<tr>
<td>Glucose intolerance and insulin resistance</td>
<td>Social marginalization</td>
<td>Reduced academic performance</td>
</tr>
<tr>
<td>Hepatic steatosis</td>
<td>Teasing and bullying</td>
<td>Reduced productivity</td>
</tr>
<tr>
<td>Hypertension</td>
<td></td>
<td>Unemployment</td>
</tr>
<tr>
<td>Hyperuricemia and gout</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Menstrual abnormalities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orthopedic problems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduction of cerebral blood flow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sleep apnea</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T2DM</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

T2DM = type 2 diabetes mellitus.

Treatment: Modest Weight Loss = Major Health Benefits

≥5% weight loss
• T2DM prevention
• With T2DM: better glycemic control/medication reduction
• Improvement in urinary stress incontinence, mobility, joint pain, weight-related QOL
• Improvements in CVD risk factors (HDL-C, TG, BP)

≥10% weight loss
• Previous improvements
• Sleep apnea
• Diabetes remission?

≥15% weight loss
• Previous improvements
• CVD mortality
• All-cause mortality and reduction in cancer risk (with surgical weight loss)

ACTION ITEM:
Consider the benefits that a 5% to 10% weight loss will have on your patients with overweight or obesity.

BP = blood pressure; CVD = cardiovascular disease; HDL-C = high density lipoprotein-cholesterol; QOL = quality of life; T2DM = type 2 diabetes mellitus; TG = triglycerides.
Reduction in Mortality with Modest Weight Loss

Effects of Weight Loss in Type 2 Diabetes

- Every kg of weight loss is associated with 3 to 4 months of improved survival

- In a prospective analysis of 5000 people with type 2 diabetes, 35% reported intentional weight loss; this subgroup experienced a 25% reduction in mortality over 12 years

- Alternately, a 5-kg weight gain increases coronary heart disease risk by 30%

Cause of Obesity: Abnormal Energy Balance

Body Weight

Increase
- Energy intake
  - Ingestion of:
    - Proteins
    - Fats
    - Carbohydrates

Decrease
- Energy expenditure
  - Basal metabolic rate
  - Physical activity
  - Energy to metabolized food

Human being: biological and behavioral interface
Regulation of Body Weight

- **Genes** confer the potential for obesity

- **Environment** determines whether the potential is realized, and to what extent
Thrifty Genes Contribute to Morbid Obesity

• Genetic factors account for 80% of a person’s tendency to develop obesity

• “Thrifty genes” are designed to protect us from starvation by allowing us to store large amounts of energy in the form of fat when food is abundant

• This is the first time in human history that food has been so abundant

• The age-old advantage of thrifty genes has been influenced by our unique environment to cause disease

Determinants of Body Weight

**Genes**
- Protective and at risk alleles for weight gain
- Race (ancestral admixture)
- Gene-gene interactions

**Environment**
- Food availability
- Food quality
- Built environment
- Socioeconomic status
- Education

**Biological factors**
- *In utero* environment
- Birthweight
- Gender
- Age
- Concurrent diseases

**Behavior**
- Dietary preferences
- Physical activity
- Psychological factors
- Cultural factors
- Diurnal life patterns
In Obesity, Biology Protects Against Weight Loss and Maintains a High Body Weight

Equilibrium Weight
Baseline weight 250 lbs

Weight Loss

- ↑ Ghrelin
- ↓ Leptin, PYY, CCK, amylin
- ↓ Resting energy expenditure
- ↑ Hunger
- ↑ Calorie-dense food preferences

Increased appetite
Decreased energy out
Increased energy in

Weight Gain

CCK = cholecystokinin; PYY = peptide YY.

Dietary Changes
We all know what to eat and not to eat but we still don’t lose weight!
Lifestyle Modification: Diet Guidelines and Recommendations

- Goal of 5% to 15% weight loss
- Caloric deficit of ~500 to 750 kcal/day (kcal = ~10x BW in lbs)
- Balanced, healthful diet with 50% to 55% carb, ≤30% fat, 15% protein

BW = body weight.

The “Toxic Environment”

High-Calorie Food is...

- Highly palatable
- Near-ubiquitous
- Heavily advertised
- Supersized

Effect of Low-fat and Low-carbohydrate Diet on Weight Over 2 Years

Adults with Obesity
(N=307)

Sedentary Lifestyles
Lifestyle Modification: Physical Activity Guidelines and Recommendations

• Talk about physical activity (not “exercise”)
• Some is better than none
• ≥150 min/wk of moderate intensity activity
• Both aerobic (endurance) and strengthening (resistance) activity are beneficial
Sedentary Lifestyles – Examples

Physical activity is...

• To be avoided
• Nearly unnecessary
• Limited by infrastructure
### “But Doc, I Can’t Walk Too Far”

<table>
<thead>
<tr>
<th></th>
<th>Recommend low-impact exercise: stationary bicycle, swimming, elliptical machine, stairstepper, treadmill, low-impact aerobics, weight-lifting machine</th>
</tr>
</thead>
<tbody>
<tr>
<td>All patients</td>
<td></td>
</tr>
<tr>
<td>Foot disease, peripheral vascular disease, arthritis</td>
<td>Swimming, water aerobics, upper body resistance training</td>
</tr>
<tr>
<td>Orthostatic conditions</td>
<td>Semi-recumbent chair and weight lifting, semi-recumbent cycling, water exercise</td>
</tr>
<tr>
<td>Elderly</td>
<td>Stretching while sitting, movement exercise (eg, tai chi, hatha yoga)</td>
</tr>
</tbody>
</table>

Anything is better than nothing
Is It Possible to Delay the Onset of T2DM?

DPP = Diabetes Prevention Program; DREAM = Diabetes Reduction Assessment with Ramipril & Rosiglitazone Medication; STOP-NIDDM = Study to Prevent Non-Insulin-Dependent Diabetes Mellitus; T2DM = type 2 diabetes mellitus; TRIPOD = Troglitazone in the Prevention of Diabetes; XENDOS = XEnical in the Prevention of Diabetes in Obese Subjects.

# Prediabetes

<table>
<thead>
<tr>
<th><strong>Impaired Fasting Glucose (IFG):</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>FPG 100-125 mg/dL (5.6-6.9 mmol/l)</td>
</tr>
<tr>
<td>or</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Impaired Glucose Tolerance (IGT):</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>2-h plasma glucose in the 75-g OGTT</td>
</tr>
<tr>
<td>140-199 mg/dL (7.8-11.0 mmol/l)</td>
</tr>
<tr>
<td>or</td>
</tr>
</tbody>
</table>

**A1C 5.7-6.4%**

A1C = glycated hemoglobin; FPG = fasting plasma glucose; IFG = impaired fasting plasma glucose; IGT = impaired glucose tolerance; OGTT = oral glucose tolerance test.

AACE Diabetes Algorithm, American Association of Clinical Endocrinologists.
ADA Recommendations for Diabetes Screening

- A1C ≥5.7%, impaired glucose tolerance (IGT), or impaired fasting glucose (IFG) on previous testing
- Polycystic ovary syndrome (PCOS)
- Other conditions associated with insulin resistance such as severe obesity or acanthosis nigricans
- Overweight children >10 years old (or after puberty onset if earlier) with family history of type 2 diabetes
- Signs of insulin resistance or conditions associated with insulin resistance (acanthosis nigricans, hypertension, dyslipidemia, or PCOS)
- Maternal history of diabetes or gestational diabetes
- Ethnic groups at increased risk

Test every 1-2 years if prediabetes is diagnosed and every 3 years if glucose tolerance is normal

A1C = glycated hemoglobin; ADA = American Diabetes Association; IFG = impaired fasting plasma glucose; IGT = impaired glucose tolerance; PCOS = polycystic ovary syndrome.

What Are the Health Risks Associated with Prediabetes?

- Progression to diabetes: on average, 11% of people with prediabetes develop type 2 diabetes each year (DPP)
- Other studies: majority with prediabetes develop type 2 diabetes in 10 years
- Presence of microvascular complications at onset of diabetes
- 50% higher risk of CVD, CAD and stroke


CAD = coronary artery disease; CVD = cardiovascular disease; DPP = Diabetes Prevention Program.
Intensive Lifestyle Intervention Prevents Progression from IGT to T2DM

Diabetes Prevention Program (N=3234)

*Goal:* 7% reduction in baseline body weight through low-calorie, low-fat meal plan and ≥150 min/week moderate intensity physical activity.

IGT = impaired glucose tolerance; T2DM = type 2 diabetes mellitus.

How Much Weight Loss Is Needed to Prevent Type 2 Diabetes? The DPP Experience

DPP = Diabetes Prevention Program.

Lifestyle Intervention: Long-Term Effects
Cumulative 20-Year T2DM Incidence

Da Qing Diabetes Prevention Study

6-year intervention hazard rate ratio 0.49 (95% CI 0.33-0.73)
20-year follow-up hazard rate ratio 0.57 (95% CI 0.41-0.81)

Number at risk
Control  135  105  69  48  40  37  34  27  27  23  14
Intervention 428  387  314  250  230  206  192  161  147  136  114

T2DM = type 2 diabetes mellitus.

Lifestyle Change and Weight Loss Reduces Long-Term Incidence of T2DM

Finnish Diabetes Prevention Study (N=522)

Kaplan-Meier estimate of probability of remaining free of diabetes

Follow-up Time (Years)

Log-rank test \( P=0.0001 \)

Hazard ratio: 0.57 (95% CI 0.43-0.76)

Goal: 5% reduction in body weight with moderate-intensity physical activity for ≥30 minutes/day plus meal plan consisting of <30% calories from fat, <10% calories from saturated fat, and ≥15 mg fiber.


T2DM = type 2 diabetes mellitus.
Diabetes Progression Reduction

Diabetes Prevention Program (DPP)

Figure 2. Cumulative Incidence of Diabetes According to Study Group.

The diagnosis of diabetes was based on the criteria of the American Diabetes Association. The incidence of diabetes differed significantly among the three groups (P<0.001 for each comparison).

DPP = Diabetes Prevention Program.

Intensive Lifestyle Intervention Effectively Prevents T2DM as Populations Age

Diabetes Prevention Program (DPP) (N=3234)

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Placebo</th>
<th>Metformin</th>
<th>Lifestyle</th>
</tr>
</thead>
<tbody>
<tr>
<td>25-44</td>
<td>11.6</td>
<td>6.7</td>
<td>48%</td>
</tr>
<tr>
<td>45-59</td>
<td>10.8</td>
<td>7.6</td>
<td>59%</td>
</tr>
<tr>
<td>≥60</td>
<td>10.8</td>
<td>9.6</td>
<td>71%</td>
</tr>
</tbody>
</table>

* Goal: 7% reduction in baseline body weight through low-calorie, low-fat meal plan and ≥150 min/week moderate intensity physical activity.

DPP = Diabetes Prevention Program; T2DM = type 2 diabetes mellitus.

How Do We Use Available Treatment Modalities for Overweight and Obese Patients?

- Balance efficacy, safety, and cost
- Optimize benefit: risk ratio
- Achieve best outcomes
- Cost-effectiveness of care
Motivational Interviewing

• Encourage **collaboration**
  • “Let’s put our heads together and review the options.”

• **Support autonomy** and problem-solving; remember, 99% of outcomes are the patient’s

• **Develop motivation** by eliciting **change** talk

• **Ask open-ended, motivational questions**
  • “What do you want to accomplish in this visit today?”
  • “What is the most important concern to you about your diabetes right now?”

# NHLBI Obesity Treatment Guidelines

## A Guide to Selecting Treatment

<table>
<thead>
<tr>
<th>BMI Category (kg/m²)</th>
<th>Treatment</th>
<th>25–26.9</th>
<th>27–29.9</th>
<th>30–34.9</th>
<th>35–39.9</th>
<th>≥40</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diet, physical activity, and behavior</td>
<td>Appropriate NHLBI Guidelines</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Pharmacotherapy</td>
<td>No</td>
<td>With comorbidities</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Surgery*</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>LAGB only</td>
<td>With comorbidities</td>
<td>+</td>
</tr>
</tbody>
</table>

*Bariatric surgeries require lifestyle medical follow-up.

¹FDA approved gastric band surgery for patients with BMI ≥30 and one weight related medical condition (February 2011).

BMI = body mass index; FDA = U.S. Food and Drug Administration; LAGB = laparoscopic adjustable gastric banding; NHLBI = National Heart, Lung, and Blood Institute.

Diabetes Remission in the Swedish Obese Subjects Bariatric Surgery Study

Incidence of Diabetes After Bariatric Surgery: UK Population-Based Matched* Cohort Study

*Matched for BMI, age, gender, index year, A1C, # banding>bypass>sleeve

A1C = glycated hemoglobin; BMI = body mass index; UK = United Kingdom.

Conditions for Success

• Engagement with other health team members
• Support at home (and at work)
• Patience
• Persistence
• Set realistic goals
  – The weight treatment goal is to lose 5 to 10% of current body weight over the next 6 to 12 months.
  – Perpetual goal until BMI is 18.5 to 24.9 kg/m²

BMI = body mass index.
Summary

• Lifestyle intervention effectively prevents diabetes and adverse cardiovascular outcomes
  – Lifestyle alone is less effective in more obese populations

• Weight loss with lifestyle change is difficult to maintain long-term
  – Ongoing behavioral support from healthcare team and/or structured support group can help patients maintain weight loss
  – Benefits of initial weight loss are sustained even with weight regain

• Medical interventions are more effective when combined with lifestyle change

• Healthcare professionals should work with patients to set realistic goals and encourage adherence to weight loss/maintenance behaviors
Set Realistic Goals with Your Patient

Goal: decrease risk of complications and improve long-term outlook

Ask patient: What are your goals?

Patients often want to lose ~30% of body weight
(a loss of “only” 7% to 10% or less may be equated with failure)

Advise patients to accept steady, incremental progress and emphasize that improved health—not necessarily reduced weight—is the goal

- Short-term weight loss goal (for most patients): 7% to 10% loss at 6 months
  - Increase in muscle mass may be more important than decrease in fat mass
- Interim goal: maintenance
- Long-term goal (if desired): additional energy deficit recalculated for next weight loss goal

Remind patients that reducing caloric intake and increasing physical activity are key to achieving and maintaining weight loss
Motivational Interviewing

• Ask permission before giving advice
  • Ask: “May I propose a plan?” or “What about...?”
  • Avoid: “You should eat less and walk more.”

• Approach with curiosity or invitation
  • Say: “I wonder...” or “One option could be...”
  • Invite: “How about week or so trial of...?” or “Some people with diabetes have found...”

Motivational Empowerment

Focus on:

• **Optimism:** “I think you’re onto something.”

• **Strengths:** “What are your strongest areas in managing your diabetes?” “What are you most comfortable with?”

• **Legitimizing experiences:** “I know what you mean about shopping when hungry. If I stop at the store on my way home from work, I always buy too much.”

Two-Track Approach to Reduce Risk of Diabetes Development

(1) Lower glucose to prevent microvascular complications and progression to diabetes
- Lifestyle intervention
- Pharmacotherapy in high-risk patients

(2) Address CV disease risk factors
- Lifestyle intervention
- Blood pressure goals: <130/80 mm Hg
- Calculate CV risk

CV = cardiovascular.
Components of Therapeutic Lifestyle Change

• Nutrition
  – Reduced calorie diet
  – Healthy eating
• Sufficient physical activity
• Avoidance of tobacco products
• Limited alcohol consumption
• Sufficient sleep
• Stress reduction (including behavioral therapy as necessary)
# Nutritional Components

<table>
<thead>
<tr>
<th>TOPIC</th>
<th>RECOMMENDATION</th>
</tr>
</thead>
</table>
| Carbohydrate| • Understand health effects of the 3 types of carbohydrates: sugars, starch, and fiber  
• Target 7-10 servings per day of healthful carbohydrates (fresh fruits and vegetables, pulses, whole grains)  
• Lower-glycemic index foods may facilitate glycemic control:* multigrain bread, pumpernickel bread, whole oats, legumes, apple, lentils, chickpeas, mango, yams, brown rice |
| Fat         | • Eat healthful fats: low-mercury/low-contaminant-containing nuts, avocado, certain plant oils, fish  
• Limit saturated fats (butter, fatty red meats, tropical plant oils, fast foods) and trans fats  
• Use no- or low-fat dairy products                                                                                                                                 |
| Protein     | • Consume protein from foods low in saturated fats (fish, egg whites, beans)  
• Avoid or limit processed meats                                                                                                                                                                               |
| Micronutrients| • Routine supplementation not necessary except for patients at risk of insufficiency or deficiency  
• Chromium; vanadium; magnesium; vitamins A, C, and E; and CoQ10 not recommended for glycemic control                                                                                                          |

*Insufficient evidence to support a formal recommendation to educate patients that sugars have both positive and negative health effects

Macronutrient Diet Composition

- Diets enriched in the following are associated with a decrease in insulin sensitivity
  - Total fat
  - Saturated fat
  - Trans-fat
  - Refined grains

- Diets enriched in the following are associated with an increase in insulin sensitivity
  - Fiber
  - Fruits/vegetables
  - Polyunsaturated fats
  - Monounsaturated fats
  - Whole grain

AACE Physical Activity Recommendations

Patients

• ≥150 minutes per week of moderate-intensity exercise
  – Strength training
  – Aerobic exercise (e.g., walking, stair climbing)
• Increase as tolerated
  – Use community engagement or professional trainer to help with motivation

Healthcare Professionals

• Exude positive attitude
• Evaluate for contraindications and/or limitations to increased physical activity before patient begins or intensifies exercise program
• Develop exercise recommendations according to individual goals and limitations
  – Set realistic goals and schedules

AACE = American Association of Clinical Endocrinologists; HR = heart rate.
Advice for Exercise

- Drink fluids (18 ounces) 1-2 hours before exercise
- Stretch
- Include warm-up and cool-down periods of 5-10 min each
- Wear silica gel or air midsoles and polyester seamless socks
- Check for blisters before and after activity
- Wear ID bracelet
- Aerobic or resistance training beneficial
  - Light weights and high repetitions

ID = identification.
How Much Exercise Is Enough?

- **Intensity**
  - Moderate, “conversational” exercise (: should be able to talk comfortably )
  - Heart rate at 70% of maximum (max HR = 220 – age)

- **Frequency**
  - 3-4 times per week
  - Maintain regular schedule with realistic goals

- **Motivation**
  - Cross-train (ie, walk, ride, swim)
  - Use exercise partner or professional trainer or attend organized programs
  - Reward self

- **Health care professional team must exude positive attitude regarding importance of exercise**

HR = heart rate.
Intensive Lifestyle Intervention Reduces Blood Pressure

Diabetes Prevention Program (N=3234)

Blood Pressure Change

Hypertension Prevalence

## Therapeutic Weight Loss

<table>
<thead>
<tr>
<th>OBESITY COMPLICATION</th>
<th>% weight loss required for therapeutic benefit</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes Prevention</td>
<td>3% to 10%</td>
<td>Maximum benefit 10%</td>
</tr>
<tr>
<td>Hypertension</td>
<td>5% to &gt;15%</td>
<td>BP still decreasing &gt;15%</td>
</tr>
<tr>
<td>Dyslipidemia</td>
<td>3% to &gt;15%</td>
<td>TG still decreasing at &gt;15%</td>
</tr>
<tr>
<td>A1C</td>
<td>3% to &gt;15%</td>
<td>A1C still decreasing at &gt;15%</td>
</tr>
<tr>
<td>NAFLD</td>
<td>10%</td>
<td>Improves steatosis, inflammation, mild fibrosis</td>
</tr>
<tr>
<td>Sleep Apnea (AHI)</td>
<td>10%</td>
<td>Little benefit at ≤ 5%</td>
</tr>
<tr>
<td>Dyslipidemia</td>
<td>5%-10%</td>
<td>Improves symptoms and joint stress mechanics</td>
</tr>
<tr>
<td>A1C</td>
<td>5%-10%</td>
<td></td>
</tr>
<tr>
<td>NAFLD</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>Sleep Apnea (AHI)</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>Osteoarthritis</td>
<td>5%-10%</td>
<td></td>
</tr>
<tr>
<td>Stress Incontinence</td>
<td>5%-10%</td>
<td></td>
</tr>
<tr>
<td>GERD</td>
<td>5%-10% women</td>
<td></td>
</tr>
<tr>
<td>PCOS</td>
<td>5%-15% (&gt;10% optimal)</td>
<td>Lowers androgens, improves ovulation, increases insulin sensitivity</td>
</tr>
</tbody>
</table>

A1C = glycated hemoglobin; BP = blood pressure; GERD = gastroesophageal reflux disease; NAFLD = nonalcoholic fatty liver disease; PCOS = polycystic ovary syndrome; TG = triglycerides.

Progression of NAFLD

NAFLD = nonalcoholic fatty liver disease.
Diabetes Prevention Program Conclusions

• **Lifestyle modification** was most effective for individuals ≥60 years of age and for those with lower baseline BMI

• **Metformin** reduced the risk of developing type 2 diabetes most effectively in patients <60 years of age, and in those with a baseline BMI >35 kg/m²

• **Early intervention** resulted in the greatest rate of diabetes prevention/delay in all groups

BMI = body mass index.

5 Keys to Successful Diabetes Self-Management

• Know your metabolic targets (A1C, blood pressure, lipids)
• Know how to attain your metabolic targets by practicing lifestyle intervention (healthy nutritional choices and daily exercise)
• Take your medications (be adherent to the prescribed treatment program)
• Do not smoke
• Make certain your health care provider is knowledgeable about intensive diabetes management

A1C = glycated hemoglobin.

Unger, J. Diabetes Management in Primary Care. 2nd Ed. Lippincott. 2012.
Preventing Type 2 Diabetes

Screening: High-risk Patients

IFG = impaired fasting plasma glucose; IGT = impaired glucose tolerance.
**PREDIABETES ALGORITHM**

IFG (100–125) | IGT (140–199) | METABOLIC SYNDROME (NCEP 2001)

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**LIFESTYLE THERAPY**

(Including Medically Assisted Weight Loss)

- TREAT ASCVD RISK FACTORS
- WEIGHT LOSS THERAPIES

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**ASCVD RISK FACTOR MODIFICATIONS ALGORITHM**

- DYSLIPIDEMIA ROUTE
- HYPERTENSION ROUTE

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**NORMAL GLYCEMIA**

Progression

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**OVERT DIABETES**

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**TREAT HYPERGLYCEMIA**

FPG > 100 | 2-hour PG > 140

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**1 PRE-DM CRITERION**

- Intensify Weight Loss Therapies
- Low-risk Medications
  - Metformin
  - Acarbose

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**MULTIPLE PRE-DM CRITERIA**

- Consider with Caution
  - TZD
  - GLP-1 RA

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**LEGEND**

Orlistat, lorcaserin, phentermine/topiramate ER, naltrexone/bupropion, liraglutide 3 mg, or bariatric surgery as indicated for obesity treatment

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**PROCEED TO HYPERGLYCEMIA ALGORITHM**

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If glycemia not normalized
COMPLICATIONS-CENTRIC MODEL FOR CARE OF THE PATIENT WITH OVERWEIGHT/OBESEITY

STEP 1  EVALUATION FOR COMPLICATIONS AND STAGING

CAR디奥林匹克DISEASE | BIOMECHANICAL COMPLICATIONS

BMI < 25

NO OVERWEIGHT OR OBESITY

BMI ≥ 25

OVERWEIGHT OR OBESITY

COMPLICATIONS

BMI ≥ 25

MILD TO MODERATE
SEVERE

STAGE 0
STAGE 1
STAGE 2

STEP 2  SELECT:

Therapeutic targets for improvement in complications + Treatment modality + Treatment intensity based on staging

Lifestyle Therapy:

Physician/RD counseling, web/remote program, structured multidisciplinary program

Medical Therapy (BMI ≥ 27):

Individualize care by selecting one of the following based on efficacy, safety, and patients’ clinical profile: phentermine, orlistat, lorcaserin, phentermine/topiramate ER, naltrexone/bupropion, liraglutide 3 mg

Surgical Therapy (BMI ≥ 35):

Gastric banding, sleeve, or bypass

STEP 3

If therapeutic targets for complications not met, intensify lifestyle, medical, and/or surgical treatment modalities for greater weight loss. Obesity is a chronic progressive disease and requires commitment to long-term therapy and follow-up.
Weight loss (means ± SEM) during 4 years of treatment with orlistat plus lifestyle changes or placebo plus lifestyle changes in obese patients

XENDOS = XEnical in the Prevention of Diabetes in Obese Subjects.

XEnical in the Prevention of Diabetes in Obese Subjects

IGT = impaired glucose tolerance.

Dose-Response for Weight Loss and Diabetes Prevention Due to Phentermine/Topiramate ER Treatment: SEQUEL

Weight Loss Induced by Phentermine/Topiramate ER Prevents Diabetes in Patients with Metabolic Syndrome and/or Prediabetes: SEQUEL Study


PHEN = phentermine; TPMER = topiramate ER.
Strategies for Maintaining Weight Loss

- From the Academy of Nutrition and Dietetics Evidence Analysis Library:
  - Reduced calorie diet
  - Distribute calories throughout day
  - Portion control
    - Avoid large meals, especially later in day
    - Meal replacements can be helpful

- Other Strategies:
  - Increasing fruits, vegetables, and low-fat dairy effective in the Weight Loss Maintenance Clinical Trial
  - National Weight Control Registry promotes eating breakfast, physical activity (1.5 hr/day) and self-monitoring
Look AHEAD (Action for Health in Diabetes) Study

- Any type of glucose-lowering medication allowable
- No more than 30% of enrolled participants could be receiving insulin
- Included patients with and without a history of cardiovascular disease

- Two groups of patients (N=5145; mean age 59 years) were randomly assigned:
  1. Intensive Lifestyle Intervention (ILI)
     - Goal = attain weight loss of 7% and maintain it
     - Lowering caloric intake and increase physical activity
  2. Control Group
     - Diabetes support and education only

- Any medication changes were made by patients’ own care providers

AHEAD = Action for Health in Diabetes; ILI = intensive lifestyle intervention.

Look AHEAD Study

• **Primary Endpoint**
  - First occurrence of a cardiovascular (CV) outcome
    • Death from CV cause
    • Nonfatal myocardial infarction (MI)
    • Nonfatal stroke
    • Hospitalization for angina

• **Secondary Endpoints**
  - Death from: CV cause, nonfatal MI, or nonfatal stroke
  - Death from: Any cause, MI, stroke
  - Hospitalization for: Angina, coronary artery bypass surgery, percutaneous coronary intervention, heart failure, or peripheral vascular disease

AHEAD = Action for Health in Diabetes; CV = cardiovascular; MI = myocardial infarction.
Look AHEAD Study

Change in Weight and Fitness: 10 Years of Follow Up

AHEAD = Action for Health in Diabetes.

Look AHEAD Study
One Year Weight Loss Success Factors

(5,145 M&F w/ Type 2 Diabetes; Randomized to Intensive Lifestyle Intervention or Control)

AHEAD = Action for Health in Diabetes; ILI = intensive lifestyle intervention; MR = meal replacements.


A1C = glycated hemoglobin; AHEAD = Action for Health in Diabetes.
Look AHEAD Study

• Outcomes in ILI group:
  – Weight Loss
    • First year: Lost 8.6% of body weight
    • Average weight loss at end of trial, 6%
  – Improved A1C
  – CKD risk decreased by 31%
  – Over 9.6 years of follow up, there was no significant difference between the intensive ILI group and the control group in terms of CV morbidity and mortality

A1C = glycated hemoglobin; AHEAD = Action for Health in Diabetes; CKD = chronic kidney disease; CV = cardiovascular; ILI = intensive lifestyle intervention.

Look AHEAD Study

Conclusions:

• Look AHEAD found no significant difference in CV outcomes between the ILI and control groups
• However, the ILI intervention group had greater reductions in weight, A1C, and greater initial improvements in multiple other domains:
  – Reductions in rates of urinary incontinence, sleep apnea and depression
  – Improvements in quality of life, physical functioning, and mobility

A1C = glycated hemoglobin; AHEAD = Action for Health in Diabetes; CV = cardiovascular; ILI = intensive lifestyle intervention.

Defining Interventional Criteria for Pre-Diabetes

**Impaired fasting plasma glucose (IFG)** = 100-125 mg/dL (5.5-6.9 mmol/L)

**Impaired glucose tolerance (IGT)** = 140-199 mg/dL (7.7-11 mmol/L)

**Metabolic Syndrome** diagnosed by National Cholesterol Education Program (NCEP) criteria should be considered a pre-diabetes equivalent

- Predicts future diabetes better than IFG
- 3 of 5 criteria of the metabolic syndrome are sufficient for diagnosis

**A1C** = 5.5%-6.4%

- In the absence of unequivocal hyperglycemia, this result should be confirmed by repeat testing

A1C = glycated hemoglobin; IFG = impaired fasting plasma glucose; IGT = impaired glucose tolerance; NCEP = National Cholesterol Education Program.
Relationship Between BMI and Risk of T2DM

BMI = body mass index; T2DM = type 2 diabetes mellitus.

Interventions to Reduce the Risks Associated with Prediabetes

• Intensive lifestyle management is the cornerstone of all prevention efforts

• No pharmacologic agents are currently approved for the management of prediabetes

  – Pharmacotherapy targeted at glucose may be considered in high-risk patients after individual risk:benefit analysis
Weight Loss Reduces Cardiometabolic Risk Factors in Patients with Type 2 Diabetes

Randomized, controlled trial; n = 5145; Patients with type 2 diabetes, age >18 y; Mean ± SE
Intensified lifestyle intervention (n = 2496) vs. diabetes support and education (n = 2463) therapy; *P<0.001 between groups

A1C = glycated hemoglobin; HDL = high density lipoprotein.
Physical Activity

• Adults with T2DM should be advised to perform at least 150 min/week of moderate-intense aerobic activity (50%-70% of maximum heart rate) spread over 3 days with no more than 2 consecutive days without exercising

• In the absence of contraindications, resistance training should be performed at least twice weekly

• Providers should use “clinical judgment” when deciding whether to screen asymptomatic patients for silent coronary artery disease

• High-risk patients should be encouraged to start with short periods of low intensity exercise and progress slowly

T2DM = type 2 diabetes mellitus.

Acanthosis Nigricans: A Sign of Insulin Resistance

- Velvety, light-brown-to-black discoloration usually on the neck, back, axilla, groin, and dorsum of hands may point to PCOS in females
- Insulin sensitivity decreases by 30% at puberty with compensatory increase in insulin secretion

PCOS = polycystic ovary syndrome.

Feasibility of Preventing Type 2 Diabetes

• There is a long period of **glucose intolerance** that precedes the development of diabetes
• **Screening tests** can identify persons at high risk
• There are safe, potentially effective interventions that can address **modifiable risk factors**:
  – Obesity
  – Body fat distribution
  – Physical inactivity
  – High blood glucose
