In the United States, the prevalence of high cholesterol, hypertension, and cigarette smoking together with age-adjusted cardiovascular deaths has declined over the last several decades. On the other hand, the prevalence of diabetes has risen steadily, largely because of an epidemic of obesity and adiposity and our increasingly inactive lifestyle (see also Chapters 1 and 5). These trends will likely mitigate further reductions in cardiovascular mortality and even reverse the decline in cardiovascular disease (CVD) incidence.

Using 2010 as the baseline, the estimated direct and indirect costs of CVD are expected to triple by the year 2030, making this a critical medical and societal issue. These sobering projections and other recent data suggest that effective preventive strategies are needed if we are to limit the growing burden of CVD (see also Chapters 5 and 6). The current reactive-based health care model, in which patients are seen when they become ill, typically during outpatient visits or hospitalizations, often fails to proactively improve health, because so many health outcomes are explained by individual behaviors and the lifestyle choices people make on a daily basis.

Unfortunately, many patients as well as individuals in the medical community continue to rely on costly coronary revascularization procedures and/or cardioprotective medications as a first-line strategy to stabilize or favorably modify established risk factors and the course of coronary heart disease (CHD). However, these therapies do not address the root of the problem, that is, the most proximal risk factors for CHD, including poor dietary practices, physical inactivity, and cigarette smoking, as shown in Figure 12-1. Unhealthy lifestyle habits strongly influence not only conventional risk factors (e.g., blood pressure, lipid and lipoprotein levels, glucose-insulin homeostasis) but also novel or emerging risk factors such as endothelial function, inflammation (e.g., C-reactive protein), thrombosis and coagulation, arrhythmias, and other disease modulators (e.g., psychosocial stressors), even among users of lipid-lowering and antihypertensive medications. Collectively, these data suggest it is time to change our emphasis from disease management to disease prevention, focusing on the foundational causes of CVD by reengineering prevention into the U.S. health care system.

This chapter emphasizes the role of lifestyle interventions in the prevention and treatment of CVD in patients with diabetes, with specific reference to weight management and energy balance, dietary intake and cardiometabolic risk, smoking cessation, exercise and physical activity, cardiorespiratory fitness, and research-based psychosocial...
interventions (e.g., readiness for changes, motivational interviewing, counseling strategies) to support cardioprotective lifestyle change in this at-risk patient subset (see also Chapter 5).

WEIGHT MANAGEMENT AND ENERGY BALANCE

Obesity is an independent risk factor for hypertension, dyslipidemia, and CVD, increasing the risk of cardiovascular events and mortality in patients with type 2 diabetes. Distribution of body fat also plays a role in cardiometabolic risk; individuals with central adiposity, as evidenced by increased waist measurement or "apple" body shape, have higher risk. Elevated waist circumference is defined as greater than 100 cm (40 inches) for North American men and greater than 88 cm (35 inches) for North American women. The proposed Diabetes Federation cut points for other geographical areas and countries are somewhat lower. Most individuals with type 2 diabetes are overweight or obese and/or have an elevated waist circumference. Therefore weight reduction is commonly indicated for patients with type 2 diabetes.

Increased waist measurement is a surrogate marker for visceral adiposity, which is fat tissue within the peritoneal cavity surrounding the intra-abdominal organs. Visceral adiposity is metabolically active, secreting a number of cytokine-like factors, referred to as adipokines. Adipokines promote inflammation and a prothrombotic state and are associated with development of atherogenic dyslipidemia (hypertriglyceridemia, low high-density lipoprotein [HDL] cholesterol [HDL-C] level, and an elevated subfraction of small, dense low-density lipoprotein [LDL] cholesterol [LDL-C] level), insulin resistance, dysglycemia and elevated blood pressure. Inflammation, as measured by serum level of high-sensitivity C-reactive protein, is also associated with type 2 diabetes and CVD. Modest weight reduction of 5% total body weight in individuals with type 2 diabetes is associated with decreased visceral adiposity and improvement in serum lipid concentrations, insulin action, and fasting blood glucose, as well as reductions in blood pressure, serum markers of inflammation, and the need for diabetes medication(s). In some patients, substantial weight loss can lead to clinical resolution of type 2 diabetes (see also Chapters 2, 9, and 10).

Weight loss occurs when energy intake is lower than energy expenditure. An energy deficit of 500 to 1000 kcal/day (3500 to 7000 kcal/wk) usually results in a weight loss of 1 to 2 lb/wk. Rate of weight loss can vary, however, depending on genetic factors, age, fidgeting, amount of lean body mass, and habitual physical activity. Older individuals tend to lose weight more slowly than younger persons because metabolic rate declines by approximately 2% each decade. A higher lean body mass is associated with greater energy expenditure and therefore a higher rate of weight loss. Most overweight or obese adults will lose weight if they comply with a diet of 1000 to 1200 kcal/day for women or 1200 to 1600 kcal/day for men. An alternative approach to determining prescribed calorie content is based on current total body weight and is divided into five weight categories (Table 12-1).

Investigators have attempted to define the dietary macro-nutrient composition that is optimal for weight reduction, improvement in cardiometabolic risk factors, and long-term weight maintenance in overweight and obese individuals, as well as patients with type 2 diabetes (see also Chapter 5). Overall, it appears that lower-carbohydrate diets (<40% of total calories) may result in greater short-term weight loss, improvement in hypertriglyceridemia, and possibly improvement in insulin resistance and glycosylated hemoglobin, but degree of weight loss and improvement in cardiometabolic
risk factors is similar to that seen with low-fat or high-protein diets at 1 to 2 years. Of note, however, is that many participants have difficulty maintaining the macronutrient composition of their assigned diet after 6 to 12 months, so the true impact of differing macronutrient composition dietary intake in the long term is not known. It is likely that the optimal macronutrient composition varies for different individuals with regard to long-term compliance. Therefore, dietary guidance should be individualized to the patient’s lifestyle, preferences, and culture. According to the American Diabetes Association (ADA) 2013 Position Statement, the mix of carbohydrate, protein, and fat may be adjusted to meet the metabolic goals and individual preferences of the person with diabetes.

The ADA, the Obesity Society, and the American Society for Nutrition recommend a 500- to 1000-kcal/day deficit through a diet that meets guidelines for reducing risk of comorbidities with obesity. Specifically, these organizations recommend that the dietary macronutrient content and nutritional quality be based on guidelines from the ADA, the American Heart Association (AHA), and the National Cholesterol Education Program—Adult Treatment Panel (Box 12-1). These are evidence-based dietary interventions that have been shown to improve selected cardiovascular risk factors, including hypertension and LDL-cholesterol level, and therefore are appropriate for patients with type 2 diabetes. According to the 2013 ADA Position Statement, individuals who have prediabetes or diabetes should receive individualized medical nutritional therapy (MNT) as needed to achieve treatment goals, preferably provided by a registered dietitian familiar with the components of diabetes MNT. The ADA statement recognizes that for weight loss, low-carbohydrate, low-fat, calorie-restricted, or Mediterranean diets may be effective in the short term (up to 2 years). However, for patients on low-carbohydrate diets, it is recommended to monitor lipid profiles, renal function, and protein intake (for those with nephropathy) and adjust hypoglycemic pharmacotherapy as needed.

Prepackaged meal replacements in the form of liquid shakes, bars, and entrees are a useful tool to simplify a prescribed diet and minimize errors with portion control and high-caloric-density food choices. Meal replacement diets can enhance weight loss, improve cardiovascular risk factors, and have shown durable weight loss for periods of 4 to 5 years. A meal replacement weight loss diet typically consists of replacing two food meals and two snacks with four approximately 110- to 200-kcal shakes or bars, plus one food meal consisting of lean protein, low-starch vegetables, a fruit serving, and a starch serving. Total daily caloric intake often ranges from 900 to 1300 kcal/day. For weight maintenance, individuals typically have two food meals and replace a third meal and one to two snacks per day with shakes and/or bars. In a study of 119 patients with type 2 diabetes, use of prepackaged meal replacements, compared with calorie-equivalent usual-care diet, resulted in greater weight loss (−3.0 ± 5.4 kg versus −1.0 ± 3.8 kg), improved glycemic control with lower hemoglobin A1c (HbA1c) levels, improved quality of life, and better compliance with dietary recommendations after 1 year. Another study found that the use of liquid meal replacements for 12 weeks in patients with type 2 diabetes resulted in significantly greater weight losses and reductions in fasting blood sugar compared with a conventional diet with the same calorie goal.

With the prescription of a meal replacement diet, care must be taken to lower or discontinue medications that can lead to significant hypoglycemia, such as sulfonylureas, insulin secretagogues, and insulin. Required medication adjustments are based on the patient’s current glycemic control, the prescribed dietary carbohydrate content, and the anticipated rate of weight loss based on calorie deficit. Patients should monitor blood glucose on a scheduled basis, and assessment for further medication adjustments should be completed daily to weekly for the first 3 to 4 weeks on the diet and then at intervals of 2 to 4 weeks during weight loss.

Recently, the Look AHEAD (Action for Health in Diabetes) study examined whether cardiovascular morbidity and mortality in persons with type 2 diabetes were reduced through an intensive lifestyle intervention aimed at achieving and maintaining at least a 10% loss of body weight over 4 years. This large randomized controlled trial of 5145 participants included moderate-intensity exercise with a goal of 200 min/wk, a healthy diet that included portion-controlled foods, and behavior modification, versus a usual-care control group (diabetes support and education). The primary outcome was a composite of death from cardiovascular causes, or hospitalization for angina pectoris for up to 13.5 years. One-year results showed an average 8.6% weight loss, significant reduction of glycosylated hemoglobin, and reduction in several cardiovascular risk factors in the intervention group. Other important health benefits included improvement in obstructive sleep apnea, reduction in diabetes medications, maintenance of physical mobility, and improvement in quality of life. However, despite these numerous health improvements, the intensive lifestyle intervention did not reduce the rate of cardiovascular events and the trial was halted early.
The ADA MNT goals include achieving and maintaining blood glucose levels in the normal range or as close to normal as safely possible, a lipid and lipoprotein profile that reduces the risk for CVD, and blood pressure levels in the normal range or as close to normal as possible. In type 2 diabetes, there is evidence that more intensive treatment of glycemia, particularly in newly diagnosed diabetes, may reduce long-term CVD events. The glycosylated hemoglobin goal according to ADA guidelines is below 7.0% but should be individualized based on factors such as age and life expectancy, comorbid conditions, and hypoglycemia unawareness. MNT has been shown to reduce glycosylated hemoglobin levels by 1% to 2% in type 2 diabetes, depending on duration of diabetes. Lowering of LDL-C to a target of less than 100 mg/dL has been shown to decrease cardiovascular risk in type 2 diabetes; and for high-risk individuals with overt CVD, an LDL-C goal of below 70 mg/dL is recommended. There is also evidence that lowering blood pressure to below 140 mm Hg systolic and below 80 mm Hg diastolic in individuals with type 2 diabetes reduces cardiovascular events. Accordingly, the ADA guidelines recommend a systolic blood pressure target of below 140 mm Hg and a diastolic blood pressure target of below 80 mm Hg.

Dietary carbohydrate intake is the major determinant of postprandial blood glucose levels, which in turn have a significant impact on overall diabetes control and glycosylated hemoglobin level. Therefore, the impact of carbohydrate intake on blood sugars with regard to carbohydrate amount, type, glycemic index, and glycemic load has been the focus of several investigations. Glycemic index is a measure that compares postprandial blood glucose responses to constant amounts of different carbohydrate-containing foods. Glycemic load is calculated by multiplying the glycemic index of the food by the amount of carbohydrate. Fiber, lactose, fructose, and fat tend to lower glycemic index. Examples of carbohydrate foods with a lower glycemic index include oats, barley, bulgur, lentils, apples, oranges, milk, and yogurt. High–glycemic index foods include items such as white bread, most white rice, potato, pretzels, cornflakes, and extruded breakfast cereals. A meta-analysis of the effects of low–glycemic index diets on blood sugar control found a 0.4% reduction in glycosylated hemoglobin in comparison with high–glycemic index diets. In addition to the modest benefit of low–glycemic index diets on glycosylated hemoglobin, many low–glycemic index foods have higher nutritional quality with regard to fiber, vitamins, and minerals. The ADA recommends a diet that includes carbohydrates from fruits, vegetables, whole grains, legumes, and low-fat milk, which are lower–glycemic index foods.

The total amount of carbohydrate in a meal also affects postprandial blood glucose levels. The recommended daily allowance for carbohydrate intake is 130 g/day, which is the average minimum requirement. There are no large randomized long-term trials that evaluate outcomes of low–carbohydrate diets specifically in individuals with diabetes. One small weight loss trial reported improvement in fasting glucose among a subset with diabetes after 1 year on a low–carbohydrate diet (120 g/day) compared with a higher–carbohydrate diet (230 g/day), but no significant change in glycosylated hemoglobin. Because of lack of long-term data on the safety of low–carbohydrate diets in patients with diabetes as well as minimal evidence of benefit, it is recommended that clinicians focus on the nutritional quality of carbohydrates rather than the quantity of carbohydrates. Therefore, counseling diabetic patients to consume most or all of their carbohydrates from fruits, vegetables, whole grains, legumes, and low-fat milk is preferred.

Dietary strategies associated with reducing blood pressure in individuals with diabetes include the DASH (Dietary Approaches to Stop Hypertension) diet and moderation of alcohol intake. The DASH diet is high in fruit and vegetables, moderate in low–fat dairy products, and low in animal protein and includes a substantial intake of plant protein from legumes and nuts. This diet, which is promoted by the National Heart, Lung and Blood Institute for the prevention and treatment of hypertension, substantially reduces both systolic and diastolic blood pressure. Additional sodium restriction in combination with DASH results in even greater blood pressure lowering. The ADA recommends a reduced–sodium diet (e.g., 2300 mg/day) for normotensive and hypertensive individuals with diabetes. The DASH diet has also been shown to reduce LDL-C. A large prospective cohort study from the Nurses’ Health Study found that adherence to the DASH–style diet was associated with a lower risk of CHD and stroke among middle–aged women during 24 years of follow–up.

Chronic excessive alcohol intake is associated with increased risk of hypertension, whereas light–to–moderate alcohol intake is associated with reductions in blood pressure. Therefore it is recommended that adults with diabetes who choose to drink alcohol should limit consumption to an amount, defined as 1 drink or less per day for women and 2 drinks or less per day for men, ideally with meals.

Findings from large trials on dietary fat intake and cardiovascular outcomes in individuals with diabetes are not available. Because patients with diabetes have similar cardiovascular risk as those with preexisting CVD, the same dietary goals are recommended. These include limiting saturated fat intake to less than 7% of total calories, minimizing trans fatty acids, and limiting cholesterol intake to less than 200 mg daily. Saturated and trans fatty acids are the main dietary determinants of LDL–C, and reduction of dietary intake of these fats has been shown to decrease plasma total cholesterol and LDL–C. Dietary n–3 polyunsaturated fatty acids appear to have beneficial effects on plasma lipid concentrations, lowering plasma triglycerides in individuals with hypertriglyceridemia and type 2 diabetes. Both fish and fish oil supplements contain n–3 polyunsaturated fatty acids, and consumption from either source may reduce adverse CVD outcomes. Other recent analyses, however, have reported no additional cardioprotective benefit from omega–3 fatty acid supplementation. The ADA guidelines recommend two or more servings of fish per week (with the exception of commercially fried fish files).
Smoking is associated with cardiovascular risk factors including elevated serum total cholesterol and LDL-C levels, low serum HDL-C levels, and insulin resistance. In addition, smoking is associated with poorer glycemic control. In patients with type 1 diabetes, smokers have higher levels of intracellular adhesion molecule-1, which is a marker of endothelial dysfunction, compared with nonsmokers.

Given the greatly increased cardiovascular risk associated with smoking in those with diabetes as well as the near elimination of increased risk 10 years after quitting, smoking cessation is an important lifestyle change target for cardiovascular risk reduction in individuals with diabetes. The ADA recommends including smoking cessation counseling and other forms of treatment as routine components of diabetes care. A number of large randomized controlled trials demonstrate that even brief counseling on smoking cessation, including the use of quit dates, can be efficacious and cost-effective. For the patient who is motivated to quit, pharmacologic therapy in addition to counseling is more effective than either treatment alone. There is also evidence that smoking cessation programs are cost-effective and successful in patients with diabetes. One proposed strategy for clinicians managing smoking in diabetic patients is the five A’s strategy:

1. Ask every patient about tobacco use.
2. Advise the patient about the importance of smoking cessation at every visit, in a brief, clear, and unambiguous manner.
3. Assess the patient’s willingness to quit smoking within the next 30 days.
4. Assist the patient who is interested in quitting by offering self-help material, setting a quit date, offering referral to a local support group, and considering nicotine replacement therapy.
5. Arrange follow-up with those patients who are ready to quit, and give positive reinforcement during the first year after cessation.

EXERCISE AND PHYSICAL ACTIVITY IN THE PREVENTION AND TREATMENT OF TYPE 2 DIABETES MELLITUS

There is a pathophysiologic cascade by which physical inactivity predisposes to a cluster of cardiometabolic diseases, including type 2 diabetes mellitus. With an increasingly inactive lifestyle, skeletal muscle downregulates its capacity to convert nutritional substrates to adenosine triphosphate. Inactive skeletal muscle’s impaired ability to oxidize glucose and fatty acids is presumably mediated by several mechanisms, including decreased mitochondrial concentration and oxidative enzymes; a reduced ability to remove glucose from blood because of fewer capillaries and diminished glucose transporter; and an attenuated capacity to hydrolyze blood triglycerides to free fatty acids, secondary to decreased lipoprotein lipase activity. Collectively, these metabolic perturbations reduce the somatic capacity to burn fuel, resulting in hyperinsulinemia, insulin resistance, and hyperglycemia, and ultimately increased cardiovascular risk. On the other hand, regular moderate-to-vigorous leisure-time physical activity, structured aerobic exercise, or both, can often reverse these adverse sequelae. A significant increase in physical activity and daily energy expenditure also improves insulin action in obesity, with or without a concomitant reduction in body weight and fat stores. This is an important (and often overlooked) salutary effect, suggesting that physical activity is as efficacious in preventing insulin resistance as losing body weight.

Several recent randomized controlled trials in patients with type 2 diabetes have investigated the effects of moderate-to-vigorous aerobic exercise and resistance training on cardiopulmonary fitness, modifiable cardiovascular risk factors, and arterial stiffness, with specific reference to changes in body weight and fat stores. Compared with the control group and/or counseling alone, supervised exercise produced significant improvements in cardiorespiratory fitness, upper and lower body strength, HbA1c, systolic and diastolic blood pressure, total serum cholesterol, HDL-C and LDL-C, body mass index (BMI), waist circumference, insulin resistance, inflammation (high-sensitivity C-reactive protein), leptin, and CHD risk scores, independent of body weight losses. Structured exercise durations exceeding 150 min/wk were associated with greater HbA1c declines than those of 150 min/wk or less (0.89% and 0.36% reductions, respectively). On the other hand, large-artery elasticity, assessed by measuring pulse wave velocity, did not improve. A systematic review and meta-analysis of the relevant literature from 1970 to 2009 revealed that combined aerobic exercise and resistance training, as well as aerobic exercise alone, were related to statistically significant declines in HbA1c, triglyceride levels, waist circumference, and systolic blood pressure among individuals with type 2 diabetes. In contrast, the meta-analysis found little support for the benefits of resistance training alone on cardiovascular risk factors, including changes in HbA1c or resting systolic blood pressure, in patients with diabetes. Others, however, have reported that resistance training alone is associated with reductions in HbA1c as compared with a control group of patients with type 2 diabetes.

Compared with overweight and obese individuals, those with a normal weight at the time of diabetes diagnosis have higher mortality rates, even after adjustment for potential confounding variables. Because these data extend the “obesity paradox” to patients with diabetes, other potential modulators of survival, including body composition, fat distribution, regular physical activity, and cardiopulmonary fitness, beyond the measurement of BMI, may help the medical community clarify the relationships among obesity, morbidity, and mortality in adults with diabetes.

Numerous investigations and systematic reviews have examined the relationships among habitual physical activity, cardiopulmonary fitness, diabetes, BMI, and mortality. The risk for all-cause and/or cardiovascular mortality is lower among overweight and obese individuals with good aerobic fitness than in individuals with normal BMI and low fitness. This finding has also been reported in a study of African American and Caucasian veterans with diabetes, in whom the obesity paradox was observed along with an independent association between poor exercise capacity and mortality within BMI categories. Others have reported that higher levels of cardiopulmonary fitness are associated with a substantial reduction in health risk for a given level of visceral and subcutaneous fat, and that increased physical activity and/or cardiopulmonary fitness is inversely associated with all-cause and cardiovascular mortality in persons with diabetes. Collectively, these data and other recent reports strongly support the role of structured exercise, regular moderate-to-vigorous physical activity, or both, in interventions designed to prevent and treat type 2 diabetes, regardless of the patient’s BMI.
Walking: “Exercise is Medicine” for Patients with Diabetes

Epidemiologic studies and clinical trials have consistently demonstrated the survival benefits of regular exercise, especially walking, in the prevention and treatment of type 2 diabetes mellitus (see also Chapter 5). In epidemiologic studies, brisk walking for at least 30 min/day has been associated with a 30% to 40% reduction in the risk of developing type 2 diabetes in women. Two clinical trials demonstrated that regular walking or other moderate exercise in conjunction with dietary changes and modest weight losses resulted in a 58% reduction in the development of diabetes in overweight patients with impaired fasting glucose, as compared with usual-care control groups. In the Diabetes Prevention Program, drug therapy with metformin reduced the risk by only 31%.

In a nationally representative sample (n = 2896) of Americans with diabetes aged 18 years or older, regular walking was associated with significant reductions in all-cause and cardiovascular mortality, up to 39% and 54% for walking at least 2 hr/wk and 3 to 4 hr/wk, respectively. The inverse association held in multivariable analyses after potential confounding variables (e.g., risk factors, BMI, comorbid conditions) were controlled for. Walking at moderate-intensity levels was associated with the greatest reduction in mortality rates. The authors concluded that “1 death per year may be preventable for every 61 people who could be persuaded to walk at least 2 hours per week.” These findings are consistent with previous studies conducted among younger and healthier populations with diabetes. In the Nurses’ Health Study, in which baseline CVD and cancer patients were eliminated, moderate and vigorous levels of physical activity were associated with reduced rates of overall cardiovascular events among diabetic women aged 30 to 55 years. Similarly, the Aerobics Center Longitudinal Study reported that men with type 2 diabetes who had a low fitness level and were physically inactive had higher mortality rates during follow-up than did their counterparts who were active and fit. The clinical and public health implications of these data are enormous, because the survival benefits of moderate- to vigorous-intensity exercise, often achieved by brisk walking alone, may be even greater than those achieved by contemporary pharmacologic therapies to manage diabetes.

Cardioprotective Effects of Regular Exercise

Two meta-analyses have now shown that regular exercise participation can decrease the overall risk of cardiovascular events by up to 50%, presumably from multiple mechanisms, including antiatherosclerotic, anti-ischemic, antiarrhythmic, anti-thrombotic, and psychological effects (Fig. 12-2). As noted earlier, aerobic exercise, with and without resistance training, has favorable effects on the diabetic patient’s cardiovascular risk factor profile, as well as on coagulability, fibrinolysis, and coronary endothelial function. Because more than 40% of the risk reduction associated with exercise training cannot be explained by changes in conventional risk factors, a cardioprotective “vascular conditioning” effect, including enhanced nitric oxide vasodilator function, improved vascular reactivity, altered vascular structure, or combinations thereof, has been proposed. Decreased vulnerability to threatening arrhythmias and increased resistance to ventricular fibrillation have also been postulated to reflect exercise-related adaptations in autonomic control. As a result of endurance training, sympathetic drive at rest is reduced and vagal tone and heart rate variability are increased. Moreover, ischemic preconditioning before coronary occlusion, at least in animal models, can reduce subsequent infarct size and/or the potential for malignant ventricular arrhythmias.

PHYSICAL ACTIVITY, EXERCISE PROGRAMMING, AND PRESCRIPTION

In many patients with type 2 diabetes, adequate glycemic control can often be achieved by dietary changes, regular physical activity, structured exercise, and weight reduction. The exercise program should generally follow contemporary guidelines for the treatment of excessive body weight and fat stores, and other risk factors associated with this common metabolic condition (i.e., dyslipidemia, hypertension, inflammatory markers, fibrinolytic factors, waist circumference). Overall, individuals with type 2 diabetes have an increased risk of morbidity and mortality from CVD as compared with their age- and gender-matched counterparts without this comorbidity. Accordingly, a physical examination and a careful preliminary cardiovascular assessment, including peak or symptom-limited exercise testing, with estimated or directly measured peak oxygen consumption (Vo2 peak), should be considered before beginning a vigorous (≥60% Vo2 reserve) exercise training program, where

\[
\text{Vo2 reserve} = \% \text{ intensity} \times (\text{Vo2 peak} - \text{Vo2 rest}) + \text{Vo2 rest}
\]

With this formula, Vo2 is generally expressed in mL O2/kg/min or in metabolic equivalents (METs), where 1 MET = 3.5 mL O2/kg/min. Both the AHA and the American College of Sports Medicine (ACSM) guidelines for exercise testing and prescription recommend that peak or symptom-limited exercise testing be considered before initiation of vigorous exercise training in individuals with known or suspected CVD, including patients with diabetes mellitus.

Type of Exercise

Aerobic (or endurance) exercise has been the most frequently studied mode of physical conditioning, and the resultant increases in cardiorespiratory fitness in patients with type 2 diabetes have been consistently associated with improvements in modifiable cardiovascular risk factors, independent of weight loss. The most effective exercises for the endurance phase use large muscle groups, are maintained continuously, and are rhythmic in nature, such as walking, jogging, elliptical training, stationary or outdoor cycling, swimming, rowing, stair climbing, and combined arm-leg ergometry. Other exercise modalities commonly used in structured exercise training programs for patients with type 2 diabetes include calisthenics, particularly those involving sustained total-body movement, recreational activities (e.g., golf, doubles tennis, pickleball), and resistance training. The last is a particularly important option, because traditional aerobic-conditioning regimens often fail to accommodate participants who require improved muscle strength or endurance to perform occupational or leisure-time activities. Moreover, studies have now shown that muscular strength is inversely associated with all-cause mortality, independent of cardiorespiratory fitness levels.
Because of the high prevalence of underlying ischemic heart disease, and the heightened risk for exertion-related cardiovascular events and orthopedic injuries, adoption of a moderate intensity (e.g., walking), rather than a vigorous physical activity program (e.g., jogging, running) may be more appropriate for diabetic patients, especially those who are middle-aged and older. Walking has several advantages over other forms of exercise during the initial phase of a physical conditioning program, including inherent neuromuscular limitations on the speed of walking (and therefore the rate of energy expenditure). Brisk walking programs can significantly increase aerobic capacity and reduce body weight and fat stores, particularly when the walking duration exceeds 30 minutes. Additional advantages of a walking program include accessibility, social companionship, lack of special equipment (other than a pair of well-fitted athletic shoes), an easily tolerable exercise intensity, and fewer musculoskeletal and orthopedic problems of the legs, knees, and feet than with jogging or running. Walking in water, with a backpack, or with a weighted vest are options for those who seek to progressively increase the exercise intensity and associated energy expenditure.

The Rule of 2 and 3 Miles per Hour (mph)

Because most diabetic patients, many of whom are overweight or obese, prefer to walk at moderate intensities, it is helpful to recognize that walking on level ground at 2 and 3 mph approximates 2 and 3 METs, respectively. For patients who prefer the slower walking pace (2 mph; 3.2 km/h), each 3.5% increase in treadmill grade adds approximately 1 MET to the gross energy cost. Therefore, patients who desire to walk at a 2-mph pace, but require a 4-MET workload for training, would be advised to add 7.0% grade to this speed. For patients who can negotiate the faster walking speed (3 mph; 4.8 km/h), each 2.5% increase in treadmill grade adds an additional 1 MET to the gross energy expenditure. Accordingly, a workload of 3 mph, 7.5% grade, would approximate an aerobic requirement of 6 METs. Use of this practical rule can be helpful to clinicians in prescribing treadmill exercise workloads for their diabetic patients, without the need for consulting tables, nomograms, or metabolic formulas or calculations.

Resistance Training

Although resistance exercise has generally been considered to be less effective in preventing and treating type 2 diabetes, some reviews suggest that it provides independent and additive benefits to an aerobic exercise program for virtually the entire cluster of associated cardiovascular risk factors. For example, numerous studies show that resistance training improves insulin sensitivity, significantly decreases HbA1c and blood pressure in diabetic and hypertensive adults, respectively, and reduces body fat stores and visceral adipose tissue in both men and women. In addition, the maintenance or enhancement of lean body mass from chronic resistance training is associated with a modest increase in basal metabolic rate, which over time may facilitate greater reductions in body weight than can be achieved with increased physical activity and/or structured exercise. Weight-training-induced attenuation of the hemodynamic response to lifting standardized loads has also been reported, which may decrease cardiac demands during daily activities such as carrying packages or lifting moderate to heavy objects. There are also intriguing data to suggest that strength training can increase endurance capacity without an accompanying increase in cardiorespiratory fitness.

Although the traditional weight-training prescription has involved performing each exercise three times (e.g., three sets of 10 to 15 repetitions per set), it appears that one set provides similar improvements in muscular strength and endurance, at least for the novice exerciser. Consequently, single-set programs performed at least two times a week are recommended rather than multiset programs, because they are highly effective, less time-consuming, and less likely to cause musculoskeletal injury or soreness. Such regimens should include 8 to 10 different exercises involving the trunk and upper and lower extremities at loads that permit 8 to 15 repetitions per set. At least 60 minutes of resistance training should be completed each week (e.g., two 30-minute sessions).
Lifestyle Physical Activity
Despite contemporary exercise guidelines and the much-heralded Surgeon General’s report, the traditional model for getting people to be more physically active (i.e., a regular or structured exercise program) has been only marginally effective. Randomized clinical trials have now shown that a lifestyle approach to physical activity among previously sedentary adults has similar effects on cardiorespiratory fitness, body composition, and coronary risk factors as a structured exercise program. These findings have important implications for public health, suggesting an alternative approach to sedentary people who, for one reason or another, are not ready to integrate a formal exercise commitment into their daily schedule. The skyrocketing prevalence of overweight and obesity and related sequela (e.g., type 2 diabetes, metabolic syndrome) suggests the need for “real world” interventions designed to circumvent and attenuate barriers to achieving an adequate daily energy expenditure. Accordingly, physicians and allied health professionals should counsel patients to integrate multiple short bouts of physical activity into their lives. The Activity Pyramid, analogous to the U.S. Department of Agriculture (USDA) Food Guide Pyramid, has been suggested as a model to facilitate public and patient education for adoption of a progressively more active lifestyle. This schematic presents a tiered set of weekly goals to promote improved cardiorespiratory fitness and health, building on a base that emphasizes the importance of accumulating at least 30 minutes of moderate-intensity activity on 5 or more days per week.

Intensity and Duration
There is some controversy regarding the most appropriate exercise intensity and duration that are needed to optimally condition patients with insulin resistance syndrome. Different risk factors associated with this condition may respond more favorably to different exercise dosages and intensities. For example, a randomized, controlled trial of previously inactive, overweight men and women with abnormal lipoprotein profiles compared the effectiveness of three different exercise regimens versus controls: high-amount, high-intensity exercise; low-amount, high-intensity exercise; and low-amount, moderate-intensity exercise. Although all exercise groups demonstrated improved responses on a variety of lipid and lipoprotein variables as compared with the control group, the most beneficial changes were noted in the high-amount, high-intensity exercise regimen. Because type 2 diabetes has been associated with increased body weight and fat stores, a sedentary lifestyle, and a low level of cardiorespiratory fitness, the initial exercise intensity should approximate at least 40% of the VO2 or heart rate reserve or 55% of the maximal heart rate, at a rating of perceived exertion (6 to 20 category scale) of 11 (fairly light) or higher, for a minimum accumulated duration of 30 min/day. Over time, in the absence of adverse signs and symptoms, the exercise intensity should be gradually increased, generally corresponding to a rating of perceived exertion up to 14 (somewhat hard to hard), to provide the stimulus to improve cardiorespiratory fitness.
and facilitate a progressive overload (i.e., attainment of goal energy expenditure).

The exercise intensity recommendation can be achieved with a combination of moderate and vigorous physical activity, which approximates 40% to 59% and 60% to 84% of \( \dot{V}O_2 \) or heart rate reserve, respectively. The ACSM recommends that most adults engage in moderate-intensity exercise training for at least 30 min/day on at least 5 days of the week for a total of more than 150 min/wk, or vigorous exercise training for at least 20 min/day on at least 3 days of the week for a total of more than 75 min/wk, or a combination of moderate and vigorous-intensity exercise to achieve a total energy expenditure of more than 500 to 1000 MET/min/wk.\(^1\) When a combination is used, it has been suggested that the vigorous-intensity exercise time can be multiplied by 1.7 to allow this to be added to the moderate-intensity time.\(^1\) For example, in 1 week a diabetic patient could exercise on 3 days for 40 minutes at a moderate intensity and on another day for 20 minutes at a vigorous intensity, approximating 154 minutes of moderate-intensity activity \((120 + [20 \times 1.7])\). Thus, this combination of moderate and vigorous exercise meets the minimum recommended weekly moderate-intensity exercise dosage \((\geq 150 \text{ minutes})\). The 1.7 multiplication factor is derived from recommendations that 150 minutes of moderate-intensity exercise is equivalent to approximately 90 minutes of vigorous physical activity (a ratio of 1:1.7), and is compatible with a recent position statement from the ACSM and ADA.\(^1\)

**Frequency**

The frequency of exercise is an important consideration when structured exercise and/or increased lifestyle physical activity are used to treat the abnormalities associated with type 2 diabetes, especially insulin sensitivity and glucose use. Although even twice-weekly exercise sessions may favorably influence glycemic control, patients with type 2 diabetes should exercise at least 3 days each week with no more than 2 consecutive days without training,\(^1\) because increases in insulin sensitivity decline markedly by 48 hours after exercise.\(^1\) Nevertheless, more frequent exercise (i.e., at least 5 days/wk) may serve to maximize both the acute glucose-lowering effect and the effect on cardiovascular risk reduction.\(^1\)

A summary of exercise prescription and physical activity guidelines for patients with type 2 diabetes mellitus is shown in Table 12-2, with specific reference to the type of exercise, major goals and objectives, and the recommended intensity, frequency, and duration. It should be emphasized, however, that if these recommended levels of exercise are deemed by the patient to be unrealistic or excessive, the patient should be encouraged to achieve more moderate exercise dosages or intensities, because the primary

| TABLE 12-2  Exercise Recommendations for Patients with Type 2 Diabetes Mellitus |
|----------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|
| **TYPE OF EXERCISE** | **MAJOR GOALS AND OBJECTIVES** | **INTENSITY, FREQUENCY, DURATION** |
| Aerobic (large muscle activities)—for example, walking, jogging, stationary or outdoor cycling, swimming | Increase \( \dot{V}O_2 \) peak; ADLs | \( 40\%-84\% \dot{V}O_2 \) or HRR; 55\%-89\% HR max; RPE 11-16 (6-20 scale) |
| | Improve glycemic control and coronary risk factors | No more than 2 consecutive days without exercising; four to five sessions per week (or more) may be needed to reduce body weight and fat stores |
| | Decrease rate-pressure product during submaximal exercise | \( \geq 150 \text{ min/wk or } \geq 90 \text{ min/wk for moderate-intensity or vigorous-intensity exercise, respectively; } \geq 20 \text{ min per session} \) |
| | Induce other cardioprotective benefits (e.g., enhanced nitric oxide vasodilator function, improved vascular reactivity, altered vascular structure, increased resistance to ventricular tachycardia and fibrillation) | For moderate-intensity activity \(( \leq 59\% \dot{V}O_2 \) or HRR and/or \( \leq 69\% \) HR max and/or RPE \( \leq 13 \)), multiple shorter periods of exercise \((10\text{-}15 \text{ min exercise bouts})\) accumulated throughout the day may elicit similar (or even greater) reductions in body weight and fat stores than a single bout of the same duration |
| | Complement structured exercise with an increase in daily lifestyle activities (walking breaks at work, gardening, household activities); move more, sit less | |
| Resistance training (multijoint exercises, large muscle groups, progressive) | Increase muscle strength and endurance | 8-10 different exercises that work major muscle groups; weight loads gradually increased over time |
| | Increase ability to perform leisure and occupational activities and ADLs | \( \geq 2 \text{ times/wk} \) |
| | Decrease the rate-pressure product at any given resistance (e.g., during lifting or carrying objects) | Moderate to vigorous intensity; one to four sets of 8-10 reps at a weight that cannot be lifted more than 8-10 times,\(^1\) or 12-15 reps at a weight that cannot be lifted more than 12-15 times (for patients with known CHD), with 1- to 2-min rest periods between sets |
| | Assist in the maintenance of basal metabolic rate by maintaining or increasing lean body mass over time | |
| Flexibility and stretching (upper and lower body ROM activities) | Improve balance and agility | Static stretches: hold for 10-30 sec |
| | Decrease risk of musculoskeletal and orthopedic injury | 2-3 days/wk |

ADLs = Activities of daily living; HR max = maximal heart rate; HRR = heart rate reserve; ROM = range of motion; RPE = rating of perceived exertion (6-20 scale); \( \dot{V}O_2 \)R = \( \dot{V}O_2 \) reserve.\(^\#\)

* Aerobic exercise should be preceded by a warm-up (approximately 10 minutes) and followed by a cool-down (5-10 minutes) at a reduced exercise intensity (e.g., slow walking). Stretching (5-10 minutes) may be incorporated before or after the endurance exercise phase.

\( \dot{V}O_2 \) rest formula = \((\dot{V}O_2 \) peak − \( \dot{V}O_2 \) rest) \times 40\%-84\% \text{ intensity} + \( \dot{V}O_2 \) rest, where \( \dot{V}O_2 \) values are expressed in METs.

\(^1\)Approximates 70\%-84\% of one repetition maximum.
The Structured Exercise Session: Special Considerations for Exercisers with Diabetes

Structured exercise training sessions should include a preliminary aerobic warm-up (approximately 10 minutes), a conditioning phase (>20 minutes of vigorous-intensity or ≥30 minutes of moderate-intensity exercise), a cool-down (5 to 10 minutes), and ideally an optional recreational game. Stretching (5 to 10 minutes) may be incorporated before or after the conditioning or endurance exercise phase. The warm-up facilitates the transition from rest to the conditioning phase by stretching postural muscles and increasing blood flow. A gradual warm-up may also reduce the likelihood of exercise-induced ischemic responses, which can occur with sudden strenuous exertion. A walking cool-down enhances venous return during recovery, decreasing the possibility of hypotension and related sequelae, and ameliorates the potential, deleterious effects of the post-exercise rise in plasma catecholamines. In addition, it facilitates more rapid removal of lactic acid than stationary recovery.

For patients with diabetes and adequate blood glucose control or those who are mildly hyperglycemic, regular physical activity acutely decreases blood glucose levels and, in some patients with diabetes treated with insulin, actually reduces insulin requirements. This is because of the insulin-like effect of aerobic exercise. However, physical activity can also result in a hypoglycemic state that is the most common problem experienced by exercising patients with diabetes treated with insulin or, to a lesser extent, oral hypoglycemic drugs. Recommendations and precautionary measures to reduce the potential for exercise-related complications in patients with diabetes are shown in Box 12-2.

**Box 12-2 Preventive Strategies for Exercisers with Diabetes**

- Wear proper footwear and practice good foot hygiene. Patients with diabetes, especially those with impaired nerve conduction in their feet, should use cushioned shoes (gel or air soles) and avoid high-impact activities such as running or jumping. Such activities are more likely to traumatize the feet in patients with peripheral neuropathy and precipitate vitreous hemorrhage or tractional retinal detachment in patients with active diabetic retinopathy.

- Recognize that exercise in excessive heat or humidity may exacerbate the risk of heat injury in patients with diabetes with autonomic neuropathy. Associated abnormalities of the nervous system can alter cardiovascular, skin blood flow, and sweating responses to exercise in hot and humid environments, increasing the risk of heat stroke. As a general guideline, patients with diabetes should curtail outdoor exercise when the temperature exceeds 90°F, when the relative humidity exceeds 60%, or both.

- Consider that diabetes increases the risk of cardiovascular events by approximately threefold (or more in women) and is associated with a higher prevalence of exertion-related myocardial ischemia, typically manifesting as angina pectoris and/or significant ST-segment depression, which can be highly arrhythmogenic. Beta blockers, in particular, may attenuate the rate-pressure product and associated cardiac demands, camouflaging or preventing signs or symptoms of myocardial ischemia. Monitor blood glucose before, during, and after physical activity when starting an exercise program. Exercise at approximately the same time each day; a good practice is to take advantage of the acute glucose-lowering effect of physical activity by timing the session at approximately 1 hour after a meal (to coincide with the peak postprandial rise in glucose).

- Inject insulin in body areas where muscles are not actively recruited by exercise. For example, an inactive injection area like the abdomen should be used before walking, jogging, or stationary or outdoor bicycling. The response to structured exercise and/or moderate-to-vigorous physical activity in the patient with diabetes taking insulin depends on a number of variables, including the adequacy of control by exogenous insulin. Accordingly, diabetes must be under adequate control before the patient begins an exercise program. A blood glucose concentration above 300 mg/dL or above 240 mg/dL with urinary ketone bodies is considered a relative contraindication to exercise participation. In patients taking insulin, consideration should be given to the ingestion of 20 to 30 g of additional carbohydrate before exercise when the preexercise blood glucose is below 100 mg/dL.

- Exercising during the evening hours increases the risk of nocturnal hypoglycemia, which may occur up to 4 to 6 hours after an exercise bout. To decrease the likelihood of this response during the night (or day), the patient with diabetes may need to reduce his or her insulin dose or increase carbohydrate intake before or after exercise.

- Recognize the signs and symptoms of hypoglycemia. These include heart palpitations, confusion, weakness, and visual disturbances. If hypoglycemia is left untreated, it could lead to unconsciousness or convulsions. To reduce the likelihood of complications, patients with diabetes should always carry a form of fast-acting carbohydrate (e.g., juice, candy, glucose tablets), exercise with a partner, and wear a diabetes identification tag.

- Monitor for symptoms of hyperglycemia. These include excessive thirst; frequent urination; blurred vision; itchy, dry skin; and a fruity odor or breath. Hyperglycemia can lead to diabetic coma.

**Psychosocial Interventions to Support Lifestyle Change**

Psychosocial and counseling interventions that are recommended to support lifestyle change and reduce cardiovascular risk in patients with diabetes include self-management education, screening for traits that negatively affect health behaviors, skill training targeted toward improved self-monitoring and development of coping strategies, evidence-based mind-body therapies for stress reduction, assessing readiness for change, and motivational interviewing. The literature suggests varied results when lifestyle change interventions have been used in treating patients with diabetes and CVD, ranging from minimal to modest effects. Accordingly, the ADA recommends interventions aimed at self-management and behavior change.

Although the aforementioned interventions can assist in reducing health risk and mortality, this section focuses primarily on interventions that can be incorporated into day-to-day clinical practice with patients, including assessment of readiness for change, motivational interviewing, and evidence-based mind-body therapies for stress reduction.

**Readiness for Change**

One approach that can guide healthcare providers’ interventions with patients when personal choice and behavior are key to determining outcomes is the transtheoretical model, originally proposed by Prochaska and DiClemente. This model is often referred to as the *health-related behavior change model*. Health-related behavior change includes behaviors that patients commonly engage in to maintain or improve their health. As Figure 12-4 demonstrates, there are seven stages in the model. Although it is enticing to perceive the model as linear or circular, it is actually far more complex. It is possible for patients to move through varied behavioral stages in a nonlinear fashion.
it is important to understand the components of each of the stages and how to determine at which stage patients are functioning to most appropriately intervene.

**Stages of the Transtheoretical Model**

**Precontemplation**
Patients are not thinking about making a behavioral change and likely do not even think that they have an unhealthy lifestyle and/or risk factors. The goal for healthcare providers at this stage is to help patients recognize the need for lifestyle change(s) and move them into the contemplation stage. There are several barriers for patients in this stage, which may include lack of knowledge regarding their current status or the risks for future health problems, a limited sense of self-efficacy in relation to making positive lifestyle changes, or simply feeling content with their current weight, health status, or lifestyle choices.126,130

**Contemplation**
Patients are beginning to think about making a lifestyle change but are ambivalent; they remain unsure about whether the inconvenience of changing longstanding behaviors truly outweighs the potential risk of maintaining the status quo. The goal for healthcare providers at this stage is to help patients explore the ambivalence they feel, help to solidify their desire to make a change, and move them into the preparation stage. In addition to the barriers that exist in the precontemplation stage, which may persist, a sense of indecisiveness may also be present. At this stage, patients often find it difficult to decide between continuing to engage in the same behaviors or making substantive changes that will ultimately lead to a healthier lifestyle.126,130

**Preparation**
Patients have decided to change their behavior and are planning to do so within the coming month. There are two goals for healthcare providers at this stage. The first is to help patients move into the action stage. To achieve this, healthcare providers need to help patients design an action plan that is reasonable for them. The second goal is to help patients identify barriers to making lifestyle changes. Barriers at this stage often involve the decision-making process itself. Some patients find it challenging to remain committed to making a change because they are still actively engaged in their former behaviors. Others may feel overwhelmed by the behavioral options. Healthcare providers can help patients explore these and decide which ones are most appropriate for them. It is important to remind patients that the process of behavior change is dynamic and different options can be subsequently chosen as replacement behaviors or as complementary to the behaviors recently adopted.126,130

**Action**
During the action stage, patients have begun to make lifestyle changes toward meeting an identified goal. The objectives for healthcare providers are to help patients optimize their plans for success in the short and long terms and to help them maintain the changes to create habits. There are several barriers for patients in this stage, which may include disillusionment with the process of change, a sense of failure, or a sense of overconfidence—the patient’s belief that change has occurred and that potential barriers can be easily overcome. This can lead to unnerving experiences for patients when an unexpected barrier arises and they do not know how to handle it. The patient is in the action stage often for at least 6 months, and sometimes longer. Behavior change is difficult, and patients may need to be reminded that persistence regarding the target behavior is more important for long-term success than is perfection.126,130

**Maintenance**
New behaviors have become well learned and newly formed habits for patients. The goal for healthcare providers at this stage is to help ensure that patients’ newly formed behaviors are stable and have become integrated into their lifestyle. Barriers within the maintenance stage arise when patients have not reached their original goal or experience major losses or stresses that can lead to resumption of previous unhealthy habits or behaviors.126,130

**Relapse**
Sometimes patients resume previous unhealthy habits or behaviors. Relapse does not occur only after patients fail maintenance, but can occur at any point during the change process. The goals for healthcare providers when relapse occurs is to identify the relapse, as well as possible triggers for it, and then reframe the "slip" or "off-target behavior" as an opportunity to learn. Patients can use relapses to identify barriers and formulate plans to address them in the future. Healthcare providers can help patients design a modified or improved plan of action in response to the relapse with the goal of overcoming the barrier and moving, once again, toward the original goal.126,130

**Exit**
Once maintenance of the new target behaviors is fully established and stable, exit occurs. At this point in time, relapse is unlikely. Patients now find themselves in a stage of precontemplation regarding the previous unhealthy behaviors. In other words, they cannot imagine wanting to go back to their former lifestyle and the unfavorable outcome(s) that were associated with their previous behaviors.126,130

**Assessment of Stages of Change**
How do healthcare providers determine the stage of change that patients are in? Engaging in a dialogue with patients and demonstrating a genuine interest in their perspective is the first step. Asking questions that are respectful, specific, and open-ended, without being judgmental, is critical. Taking time to listen to the responses carefully and then asking follow-up questions to clarify key issues from the
patients’ perspective helps develop a mutual understanding of the issue and the level of interest patients have regarding behavior change. Table 12-3 provides an overview of the stages of change, typical patient beliefs or characteristics at each stage, and methods of intervening, which healthcare providers can use to support movement through the stages and eventual behavior change.

**Motivational Interviewing**

The effectiveness of motivational interviewing as a therapeutic approach to address diabetes, cardiovascular health, and other clinically relevant lifestyle changes has yielded varying results, from strong evidence for to low levels of sustained behavior change. Nevertheless, there remains enthusiasm for motivational interviewing within healthcare provider–patient interactions in a variety of settings.

Motivational interviewing is based on the notion that all behavior is motivated, including the ambivalence that people experience when deciding whether to engage in a particular behavior or not. It does not focus on the action of change itself, but rather on the motivation to make change(s). This type of talk therapy was initially developed as a method to treat patients with addictive behaviors and, once it was shown to be effective, was expanded to address other health-related behaviors. The underlying power of this therapeutic approach is that patients talk themselves into changing behavior, rather than having it suggested or advised by others. Although motivational interviewing is not a particular method of interacting with patients, the spirit, principles, and skills it promotes offers healthcare providers a way of focusing on building rapport with patients and collaborating with them to identify, examine, and reduce or resolve the ambivalence they may have in relation to behavior change through a variety of techniques.

**“Spirit” of Motivational Interviewing**

**Collaboration**

To establish a partnership, it is important to develop a genuine, comfortable environment in which patients do not feel judged. This approach requires more listening than talking, and restating what the healthcare provider hears from the patient, so that the patient feels that his or her perspective is valued. The therapeutic process is focused on developing a mutual understanding, which may not always include agreement.

**Evocation**

Drawing out the patients’ beliefs and motivations regarding behavior change is key to setting the stage for long-term change. The role of healthcare providers is to draw out patients’ motivations and skills for behavior change.

**Autonomy**

Emphasizing the right of patients to make their own decisions but also empowering them to maintain responsibility for implementing behavior change is critical, but sometimes
overwhelming. When multiple changes may be necessary to reach an identified health goal (e.g., control of diabetes signs and symptoms, weight loss), it often helps if patients determine which behavior to focus on first.127,131,140

**Principles of Motivational Interviewing**

**Express Empathy**
It is important to be able to express understanding in a manner that enables patients to feel heard and understood, in a nonjudgmental manner that reflects the viewpoints and experiences of the patient.127,131,140,141

**Support Self-Efficacy**
Motivational interviewing is a strengths-based approach that operates from the perspective that patients have within themselves the capability to change behaviors successfully. Healthcare providers support self-efficacy by focusing on previous successes and highlighting skills and strengths that patients already possess. To this end, healthcare providers can suggest skills and strengths that can be used or built on, as change is being considered, planned, and implemented. In addition, allowing patients to set their own agenda for change will support self-efficacy. For example, when considering multiple lifestyle changes that might be necessary for successful management of diabetes (e.g., self-monitoring of glucose levels, changing eating habits, increasing physical activity, reducing stress), allowing patients to determine which change to make first empowers them and increases the likelihood of the behavior change being sustained over time.127,131,140–142

**Roll with Resistance**
Resistance is not a part of the personality or character of patients. Instead, it is a manifestation of the process going on between providers and patients, as well as the ambivalence that is felt or experienced by patients when they contemplate making behavioral changes. When patients argue against, challenge, or discount information presented by providers or interrupt and/or talk over providers, they are likely demonstrating resistance to hearing or truly accepting the need for change. Resistance also presents itself in the form of denial, when patients deny they have lifestyle deficiencies, blame others for the problem, or minimize the potential negative impact of the habit at hand. Finally, resistance may occur when patients overly ignore what providers say, do not respond, or sidetrack, discussing issues unrelated to the information that was provided.131

**Interviewing Skills and Strategies**
Motivational interviewing uses varied interviewing skills and strategies that are taught as basic communication skills for developing strong healthcare provider–patient relationships. The acronym OARS can cue healthcare providers to implement the most commonly used skills and strategies, including open-ended questions, affirmations, reflections, and summaries.140

- **Open-ended questions**: Asking questions that cannot be answered easily with a “yes/no” or limited response can lead to obtaining useful information from patients that allows healthcare providers to develop a better understanding of their concerns and perspectives. Open-ended questions encourage patients to talk and provide personal viewpoints. These types of questions often begin with what, how, why, or could.

- **Affirmations**: Statements that highlight patient strengths can be a useful tool to support behavior change. Pointing out positive traits or characteristics to patients empowers them to build on existing skills and strengths. Affirmations may include complimenting effort, acknowledging small successes, or stating appreciation.131,140,141

- **Reflections**: Reflective listening involves recognizing key words or feelings expressed by patients and using them to paraphrase what was heard. The main ideas or concepts reflected back to patients should represent their point of view, not those of the healthcare provider. Reflective listening accomplishes two goals: first, it enables providers to express empathy and demonstrate understanding of patients’ perspectives; second, healthcare providers can use reflective listening to identity ambivalence regarding behavior change and guide patients toward resolving their uncertainty.131,140,141

- **Summaries**: Recapping what has occurred in healthcare provider–patient interactions communicates interest and understanding and can lead to movement away from previous unhealthy behaviors.131,140,141

In addition to OARS, other skills are also useful within the context of motivational interviewing. Establishing structure, or setting an agenda for the visit, helps providers to focus on readiness for change and appropriate behavior change processes.127 The recommended structure is to ask a question that determines readiness for change, listen to patients’ responses, and provide information that might help patients move along the change continuum. Once healthcare providers have shared information with patients, they can then ask patients to share their understanding or interpretation of the information that was provided.131

Other important strategies when engaged in motivational interviewing include assessing the importance of the change being discussed, along with the confidence level of patients in their ability to make the change, and finally attempting to increase patients’ motivation for change.127,151 Readiness to change is influenced by how important individuals perceive change to be, as well as how confident they are that they can make the change.

For healthcare providers, assessing importance and confidence regarding a mutually agreeable change goal are necessary. For example, “On a scale of 1 to 10, with 10 being the highest, how important is it for you to keep your blood sugar level within the normal range each day?” In
assessing the level of importance for making a change, it is common for resistance to arise. If a patient rates the level of importance below 7, it suggests that the healthcare provider may be moving too quickly in the approach.

Once an importance level has been established, it is also possible to use the rating to increase the patient’s motivation level to engage in change by asking him or her to elaborate on why he or she rated the importance at the particular level that was chosen. Whether the rating is higher or lower in the range, questions can be asked to solidify or shift the rating upward. For example, “Although you indicated that you want to pay closer attention to the fluctuation in your blood sugar throughout the day, when I asked you to rate the importance of monitoring your blood sugars daily, you rated the importance as 6. What would it take to increase the importance level to a 7 or 8?”

Similar methods can be used to determine patients’ confidence level for making a behavioral change. Once again, a confidence rating below 7 suggests the need to determine what would be necessary to increase the level of confidence that change can be made successfully. Without a higher confidence level, patients are likely to fail in their effort to change behaviors.

Using Change Talk in Motivational Interviewing
Change talk includes statements made by patients that suggest consideration of change, motivation for change, or commitment to change. The acronym DARN CAT can help healthcare providers to remember the different types of statements and their meanings. The first four types of change talk, represented by DARN, reflect precommitment to change (desire, ability, reason, need). There may be conflict or ambivalence noted between statement types, which are often paired together with the connector word but. For example, “I want to [desire], but I can’t [ability].” The last three types of change talk, represented by CAT, reflect commitment to change (commitment, activation, taking steps).

In summary, motivational interviewing offers healthcare providers a therapeutic approach to health-related behavior change issues that allows for increased mutual understanding regarding patients’ perceptions and experience, as well as methods to increase importance, confidence, and motivation regarding making behavioral changes and developing an action plan to achieve long-term success.

Table 12-4 combines the transtheoretical model of stages of change and motivational interviewing strategies to illustrate how the two models can be used in conjunction with each other. Weight loss goals are used as examples for interventions for all stages.

Evidenced-Based Mind-Body Therapies
Research demonstrates reduction in risk for both cardiovascular events and mortality when stress reduction techniques are used by patients. Yet traditional medicine often falls short in offering integrative approaches for stress reduction. Healthcare providers can recommend options such as meditation, yoga, mindfulness-based stress reduction, pet ownership, guided imagery, biofeedback, and tai chi, or combinations thereof, all of which are associated with significant reductions in stress and stress-related illnesses. Many of these methods can be taught by healthcare providers, learned in settings identified by healthcare providers, and offered to patients at risk, including those with diabetes.

SUMMARY
The treatment of CVD has evolved from simple lifestyle modifications in the 1960s, largely focused on a “prudent diet” and regular exercise, to an array of costly medical and revascularization interventions that too often fail to address the underlying causes—poor dietary habits, physical inactivity, and cigarette smoking. The INTERHEART
study examined the risk factors associated with first acute myocardial infarction in 52 countries, including 15,152 patients and 14,820 controls. Risk factors (abnormal lipids, smoking, hypertension, diabetes mellitus, abdominal obesity) accounted for approximately 80% of the population attributable risk in men and women. Similarly, Khot and colleagues suggested that a more rigorous focus on these risk factors would promote them to have great potential to reduce the burden of atherosclerotic CVD. Added benefits include a reduction in angina symptoms, decreases in exercise-induced signs or symptoms of myocardial ischemia, fewer recurrent cardiac events, an improved quality of life, and diminished need for coronary revascularization.

The issue is not information but methods, motivation, and behavioral changes. Accordingly, patients with diabetes should be directed toward comprehensive programs designed to change behavior and facilitate cardiovascular risk reduction, with use of individually tailored interventions to circumvent or attenuate barriers to participation and adherence. The challenge is yours!

References