Development of a Novel Clinical Decision Support System for Exercise Prescription Among Patients With Multiple Cardiovascular Disease Risk Factors

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Abstract

Cardiovascular disease (CVD) risk factors cluster in an individual. Exercise is universally recommended to prevent and treat CVD. Yet, clinicians lack guidance on how to design an exercise prescription (ExRx) for patients with multiple CVD risk factors. To address this unmet need, we developed a novel clinical decision support system to prescribe exercise (prioritize personalize prescribe exercise [P3-EX]) for patients with multiple CVD risk factors founded upon the evidenced-based recommendations of the American College of Sports Medicine (ACSM) and American Heart Association. To develop P3-EX, we integrated (1) the ACSM exercise preparticipation health screening recommendations; (2) an adapted American Heart Association Life’s Simple 7 cardiovascular health scoring system; (3) adapted ACSM strategies for designing an ExRx for people with multiple CVD risk factors; and (4) the ACSM frequency, intensity, time, and time principle of ExRx. We have tested the clinical utility of P3-EX within a university-based online graduate program in ExRx among students that includes physicians, physical therapists, registered dietitians, exercise physiologists, kinesiologists, fitness industry professionals, and kinesiology educators in higher education. The support system P3-EX has proven to be an easy-to-use, guided, and time-efficient evidence-based approach to ExRx for patients with multiple CVD risk factors that has applicability to other chronic diseases and health conditions. Further evaluation is needed to better establish its feasibility, acceptability, and clinical utility as an ExRx tool.

Cardiovascular disease (CVD) is the leading cause of death and disability in the United States and the world. The five major CVD risk factors of hypertension, diabetes mellitus, dyslipidemia, obesity, and physical inactivity cluster in an individual. Because of its many health benefits, leading health care experts from all over the world recognize exercise as the most efficient, cost-effective, and accessible “poly pill” to prevent and treat more than 35 chronic diseases and health conditions that include CVD and its major risk factors. Yet, 82% of adults in the United States do not engage in the recommended amounts of exercise to achieve these health benefits. Unfortunately, despite exercise being recognized as a poly pill to improve health, only 30% of primary care physicians recommend exercise to their patients when a physician’s recommendation to exercise is a strong incentive for their patients to exercise. Physicians and other health care professionals do not recommend exercise because they lack the tools, training, and time to do so. Clinical decision support systems have become essential devices for health care providers to streamline information processing, recommend next steps for treatment, and avoid adverse treatment effects. Yet, to the best of our knowledge, there is no evidenced-based, time-efficient, guided tool for clinicians to prescribe exercise to their patients. This is a critically important unmet need to address given that exercise is
universally recommended to prevent, treat, and control CVD along with its major risk factors.\textsuperscript{2-8}

The American College of Sports Medicine (ACSM) exercise preparticipation health screening recommendations no longer include CVD risk factor profiling.\textsuperscript{15,16} This omission has created confusion in clinicians’ minds of how to design an exercise prescription (ExRx) for patients with multiple CVD risk factors.\textsuperscript{12,17} In parallel, the American Heart Association (AHA) tracks the cardiovascular health (CVH) in the United States with a tool known as Life’s Simple 7 via assessment of physical activity levels and the biomarkers of blood lipids, blood pressure (BP), blood glucose (BG), and body mass index (BMI) that represent the five major CVD risk factors of physical inactivity, dyslipidemia, hypertension (HTN), diabetes mellitus, and obesity, respectively.\textsuperscript{18,19} Integrating the industry-standard recommendations set forth by the ACSM\textsuperscript{15,16} and an adapted version of the AHA Life’s Simple 7 cardiovascular health (AHA\textsubscript{7}CVH) scoring system\textsuperscript{18,19} we present a novel, evidence-based clinical decision support system (prioritize, personalize, prescribe exercise [P3-EX]) for clinicians to design an ExRx for patients with multiple CVD risk factors who also may have other chronic diseases and health conditions.

THE P3-EX CLINICAL DECISION SUPPORT SYSTEM FOR EXERCISE PRESCRIPTION

The purpose of P3-EX is to provide physicians and other health care professionals with guidance that is evidenced-based and time-efficient on how to design an ExRx\textsubscript{P} for patients with multiple CVD risk factors who may have other chronic diseases and health conditions.\textsuperscript{12,17} To develop P3-EX, we integrated: (1) the ACSM exercise preparticipation health screening recommendations\textsuperscript{15,16}; (2) an adapted AHA\textsubscript{7}CVH scoring system\textsuperscript{18,19}; (3) adapted ACSM strategies for designing an ExRx\textsubscript{P} for people with multiple CVD risk factors who may have other chronic diseases and health conditions\textsuperscript{20}; and (4) the ACSM frequency, intensity, time, and time (FITT) principle of ExRx\textsubscript{P}.\textsuperscript{20} We now introduce P3-EX for designing a FITT ExRx\textsubscript{P} for patients with multiple CVD risk factors who may have other chronic diseases or health conditions.

Step 1. Complete the ACSM Exercise Preparticipation Health Screening

The purpose of the ACSM exercise preparticipation health screening is to identify individuals who may be at elevated risk for acute exercise-related sudden cardiac death and/or myocardial infarction during and for some time after exercising.\textsuperscript{15,16} The ACSM exercise preparticipation health screening is based upon the three primary factors that account for an acute exercise-related cardiovascular event that include the: (1) current level of physical activity; (2) presence of signs or symptoms suggestive of or having CVD or metabolic (ie, diabetes mellitus) or renal disease; and (3) desired exercise intensity. These three factors frame the ACSM exercise preparticipation health screening recommendations and determine if medical clearance is needed before exercise participation. The algorithm is depicted in Figure 1 and overviewed below. Furthermore, we developed an easy-to-use checklist for determining the presence of signs and symptoms suggestive of CVD or metabolic or renal disease (see Table 1).

Regularly physically active asymptomatic patients without known CVD or metabolic or renal disease may continue their exercise program without medical clearance and progress gradually as tolerated according to the ACSM FITT ExRx\textsubscript{P} guidelines. Physically active asymptomatic patients with known CVD or metabolic or renal disease whose health care provider has cleared them to exercise within the last year do not need to consult with their health care provider to continue with a moderate-intensity exercise program unless they develop resting or exertional symptoms suggestive of CVD or metabolic or renal disease, or experience a change in health status. Physically active patients who develop signs or symptoms suggestive of CVD or metabolic or renal disease should discontinue exercise and obtain medical clearance before resuming their exercise program.

Physically inactive but otherwise healthy asymptomatic patients may begin a light-to-moderate-intensity exercise program without medical clearance, and in the absence of symptoms, can progress gradually as recommended by the ACSM FITT ExRx\textsubscript{P} guidelines. Physically inactive patients with known CVD or...
metabolic or renal disease, and/or those with signs or symptoms suggestive of these diseases, should obtain medical clearance before starting an exercise program.

**Step 2. Identify the CVD Risk Factors**

A significant departure in the current ACSM exercise preparticipation health screening recommendations from past recommendations was removal of CVD risk factors. Reasons for doing so was that their predictive value for an acute exercise-related cardiac event was low, and including them resulted in excessive referrals to a health care provider to obtain clearance before exercise participation, which is a deterrent to adopting and maintaining an exercise program. Nonetheless, the ACSM scientific roundtable expert members acknowledged identifying CVD risk factors should remain an important part of designing the FITT ExRx for disease prevention and management. Table 2 contains the CVD risk factors and their defining criteria. To perform step 2, the presence or absence of metabolic or renal disease, and/or those with signs or symptoms suggestive of these diseases, should obtain medical clearance before starting an exercise program.

**FIGURE 1.** The ACSM exercise preparticipation health screening logic model. Exercise participation is defined as performing planned, structured physical activity at least 30 minutes at moderate intensity on at least 3 days per week for at least the last 3 months. **Cardiac, peripheral vascular, or cerebrovascular disease. ***Type 1 or 2 diabetes mellitus. ^Medical clearance is defined as approval from a health care professional to engage in exercise. þLight intensity exercise is defined as an intensity that causes slight increases in HR and breathing. þþModerate intensity exercise is defined as an intensity that causes noticeable increases in HR and breathing. þþþVigorous intensity exercise is defined as an intensity that causes substantial increases in HR and breathing. ACSM = American College of Sports Medicine; CV = cardiovascular; HR = heart rate. ††Adapted from ACSM’s Guidelines for Exercise Testing and Prescription. [15,16]
| Signs/symptoms suggestive of disease | Description of the signs/symptoms suggestive of disease | Yes | No |
|-----------------------------------|--------------------------------------------------------|-----|----|
| **Dizziness**                     | Dizziness may be a sign of disease when in combination with stumbling or difficulty walking, fainting, a blackout, numbness or weakness, SOB, a sudden or severe headache, chest pain or an irregular heart rate, a very stiff neck, vomiting, or seizures; or if dizziness is recurrent and prolonged. Difficulty breathing lying down (orthopnea) and is relieved with sitting or standing. |     |    |
| **Forceful or fast heartbeat**     | Forceful or fast heartbeat (palpitations or tachycardia; heart rate >100 beats/min). Unpleasant awareness of a rapid heart rate at rest that may be associated with SOB, lightheadedness, rapid pulse rate, chest pain, or fainting. |     |    |
| **Ankle or limb pain or swelling** | Swelling of the foot, ankle, and/or limb (ankle edema). May appears as puffiness, stretched or shiny skin, skin that retains a dimple (pits) after being pressed, or increased abdominal size. |     |    |
| **Chest related pain or discomfort** | Pain/discomfort in the chest/neck/arm/other area that may result from an reduced oxygen supply to the heart (myocardial ischemia). Feeling of squeezing, constricting, burning, or “heaviness” behind/below/ across the chest, in the front of the body, in one or both arms or the shoulders; in the neck, cheeks or teeth; or in the forearms or fingers, and/or interscapular region of the back. Provoked by exertion, excitement, other forms of stress, the cold weather, or after meals. Pain in the legs that is due to an inadequate blood supply (intermittent claudication). Symptoms are brought on by exercise and do not occur with standing or sitting. Pain often described as a burning or cramp which disappears within 1-2 minutes after stopping exercise. |     |    |
| **Shortness of breath**           | SOB at rest or with mild exertion; and/or unusual fatigue during regular daily activities is abnormal if occurs at a level of exertion not expected to evoke symptoms. |     |    |
| **Murmur or heart sound**         | Murmur may be a sign of cardiovascular disease when combined with blue skin especially in the fingertips and lips, swelling and sudden weight gain, SOB, enlarged neck veins, chest pain, dizziness, or fainting. |     |    |

*SOB = shortness of breath.

*These signs or symptoms must be interpreted within the clinical context in which they occur because they are not all specific for cardiovascular, metabolic, or renal diseases.

*If the answer is yes to any sign or symptom medical clearance is required.

*May be used in combination with the Questionnaire for Exercise Professionals from ACSM’s Guidelines for Exercise Testing and Prescription (p 36).†

Adapted from ACSM’s Guidelines for Exercise Testing and Prescription (pp 26-27).†
the CVD risk factor is denoted, and the number of CVD risk factors is totaled (see Table 2).

### Step 3. Prioritize the CVD Risk Factor to Design the FITT ExRx

Prioritizing the CVD risk factor consists of two parts as shown in Figure 2 and is described below.

### Step 3a. Score the CVD Risk Factors With the AHA7CVH

Using the AHA7CVH in Figure 2, the CVD risk factors identified in step 2 are scored in Table 2 as ideal (2 points), intermediate (1 point), or poor (0 points) CVH if the patient is untreated or being treated with medication for the major CVD risk factors of obesity (ie, BMI, and if not available, waist circumference), dyslipidemia (ie, low-density

| TABLE 2. The Cardiovascular Disease Risk Factors and Defining Criteria<sup>a,b</sup> |
|---------------------|-------------|-----------------|----------|
| Risk factors       | Defining criteria                                                                                     | AHA CVH score |
| Age, years         | Men ≥45; women ≥55                                                                                     | Yes or No     |
| Family history     | Myocardial infarction, coronary revascularization, or sudden death before 55 years old in father or other male first-degree relative or before 65 years old in mother or other female first-degree relative. | Yes or No     |
| Cigarette smoking  | Current cigarette smoker or those who quit within the previous 6 months or exposure to environmental tobacco smoke. | Yes or No     |
| Physical inactivity| Not participating in at least 30 minutes of moderate intensity physical activity on at least 3 days of the week for at least 3 months. | Yes or No     |
| Obesity            | BMI ≥30 kg/m² or waist girth >102 cm (40 in) for men and >88 cm (35 in) for women.                      | Yes or No     |
| Hypertension       | Systolic ≥130 mm Hg and/or diastolic ≥80 mm Hg, confirmed by measurements on at least two separate occasions, or on antihypertensive medication. | Yes or No     |
| Dyslipidemia       | LDL-C ≥130 mg/dL (3.37 mmol/L) or HDL-C <40 mg/dL (1.04 mmol/L) or on lipid-lowering medication. If total serum cholesterol is all that is available, use ≥200 mg/dL (5.18 mmol/L). | Yes or No     |
| Diabetes           | Fasting BG ≥126 mg/dL (7.0 mmol/L) or 2-hour plasma glucose values in oral glucose tolerance test ≥200 mg/dL (11.1 mmol/L) or HbA1C ≥6.5%. | Yes or No     |
| Negative risk factor | HDL-C ≥60 mg/dL (1.55 mmol/L)                                                                  | Yes or No     |
| Total number of cardiovascular disease risk factors |                                                                                                   | Yes or No     |

<sup>a</sup>AHA = American Heart Association; BG = blood glucose; BMI = body mass index; BP = blood pressure; CVH = cardiovascular health; HbA1C = hemoglobin A1C; HDL-C = high-density lipoprotein cholesterol; LDL-C = low-density lipoprotein cholesterol.

<sup>b</sup>If the presence or absence of a cardiovascular disease risk factor is not disclosed or is not available, that cardiovascular disease risk factor should be counted as a risk factor.

<sup>c</sup>High HDL-C is considered a negative risk factor. For individuals having high HDL-C ≥60 mg/dL (1.55 mmol/L), for these individuals one positive risk factor is subtracted from the sum of positive risk factors.

Adapted from ACSM’s Guidelines for Exercise Testing and Prescription (p 48).<sup>16</sup>
The strategy chosen should be based on the CVD risk factor and/or chronic disease and health condition. The CVH scoring system has been adapted from its original version to accommodate: (1) adjustments in scoring for the inverse association between AHA Life’s Simple 7 ideal metrics and the incidence of myocardial infarction, stroke, coronary heart disease; (2) the 2017 AHA/American College of Cardiology blood pressure guidelines. See Table 3 and the ACSM’s Guidelines for Exercise Testing and Prescription for the FITT ExRx and special considerations for each CVD risk factor and/or chronic disease and health condition.

### FIGURE 2. A clinical decision support system for prioritizing the cardiovascular risk factor or chronic disease or health condition to design the FITT ExRx.

1. Identify and note any other chronic diseases or health conditions.
2. Identify and score the patient/client’s CVD risk factors (i.e., CVH biomarkers) using the CVH scoring system adapted from AHA’s Life’s Simple 7.
3. Use the CVH score cut-offs for waist circumference (WC) based on ACSM’s Guidelines for Exercise Testing and Prescription (p 70).
4. If 2 CVH biomarkers scored the lowest and the patient/client has no other chronic diseases or health conditions, begin with the FITT ExRx for this CVH biomarker, while considering the patient/ client’s preferences, goals, and special considerations.
5. If 2 CVH biomarkers scored the lowest and/or the patient/client has other chronic diseases or health conditions, use Third, Third, Strategy A. B. C. or C to determine which CVH biomarker or chronic disease or health condition to design the FITT ExRx.
6. If ≥ 2 CVH biomarkers scored the lowest and/or the patient/client has other chronic diseases or health conditions, use Third, Third, Strategy A. B. C. or C to determine which CVH biomarker or chronic disease or health condition to design the FITT ExRx.

#### Table 3: Cardiovascular health scoring system adapted from the American heart association’s life’s simple 7

| CVH biomarker | CVH score | Ideal (2 pts) | Intermediate (1 pt) | Poor (0 pt) |
|---------------|-----------|---------------|---------------------|------------|
| BMI (kg/m²) or WC (cm) | <25 kg/m² | 25-29.9 kg/m² Independent of treatment | ≥30 kg/m² or WC >102 cm (40 in) for men and >88 cm (35 in) for women Independent of treatment |
| LDL-C or TC (mg/dL) | <100 mg/dL | 100-159 mg/dL | ≥200 mg/dL Treated | ≥160 mg/dL | 210 mg/dL |
| SBP/DBP (mmHg) | <120 & <80 mmHg | 120-129 & <80 mmHg Un-treated | ≥130 & <80 mmHg Treated | ≥130 mmHg or 280 mmHg Independent of treatment |
| Fasting glucose (mg/dL) | <100 mg/dL | 100-125 mg/dL Un-treated | ≥126 mg/dL Treated | ≥126 mg/dL (Diabetes) Independent of treatment |

#### Strategies

**Strategy A.** Begin with the FITT ExRx for the CVH biomarker or chronic disease or health condition that is the most limiting regarding activities of daily living, quality of life, and/or starting or maintaining an exercise program, while considering the patient/ client’s preferences, goals, and special considerations.

**Strategy B.** Begin with the most conservative FITT ExRx regarding intensity and/or volume for the patient/client’s CVH biomarker or chronic disease or health condition, while considering the patient/client’s preferences, goals, and special considerations.

**Strategy C.** Begin with the FITT ExRx for the CVH biomarker or chronic disease or health condition that encompasses the FITT ExRx, for the other CVH biomarker(s) or chronic disease(s) or health condition(s), while considering the patient/client’s preferences, goals, and special considerations.

The strategy should be based on the CVD risk factor and/or chronic disease and health condition with the FITT ExRx that best fits that strategy’s description, while considering the patient’s preferences, goals, and special considerations. There is a strong, inverse association between AHA Life’s Simple 7 ideal metrics and the incidence of myocardial infarction, stroke, coronary heart disease, and other cardiovascular outcomes, as well as noncardiovascular conditions such as depression, cognitive function, and cancer. The CVH scoring system has been adapted from its original version to accommodate: (1) adjustments in scoring for resting values that are being treated by medication, as any CVD risk factor that is being treated by medication is regarded as having a lower value; and (2) the 2017 AHA/American College of Cardiology blood pressure guidelines. See Table 3 and the ACSM’s Guidelines for Exercise Testing and Prescription for the FITT ExRx and special considerations for each CVD risk factor and chronic disease and health condition.
CVD risk factor or chronic disease or health condition to focus the FITT ExRx.\textsuperscript{20}

**Step 3b. Apply the ACSM Strategies.** The adapted ACSM strategies for designing an ExRx for people with multiple CVD risk factors and/or chronic diseases and health conditions are shown in Figure 2 and described below.\textsuperscript{20} It is possible that more than one strategy may be used to prioritize the CVD risk factor to design the FITT ExRx. In that case, the purpose of P3-EX is to guide the clinician in deciding which CVD risk factor to focus the FITT ExRx. However, P3-EX is not meant to replace good clinical judgement on which strategy is best to use. Furthermore, to maximize safety and therapeutic benefit, the FITT ExRx should be delivered in collaboration with a properly credentialed exercise professional with a focus on transitioning to ongoing self-managed exercise.

**ACSM Strategy A.** Begin with the CVD risk factor tied for the poorest AHA\textsubscript{7}CVH score that is the most limiting regarding performing activities of daily living, quality of life, and/or starting or maintaining an exercise program, while considering the patient’s preferences, goals, and special considerations.\textsuperscript{20} An example for which strategy A would be used to prioritize the CVD risk factor to design the FITT ExRx is a patient who has diabetes-related neuropathy with a fasting BG of 136 mg/dL and LDL-C of 162 mg/dL, both of which receive a score of 0 on the AHA\textsubscript{7}CVH. For this patient, the FITT ExRx for diabetes mellitus would be recommended as outlined in step 4 based upon strategy A because of the limitations imposed by diabetes-related neuropathy in performing activities of daily living.

In some cases, other chronic diseases and health conditions could take precedent over CVD risk factors to design the FITT ExRx based on strategy A. For example, for a patient with fibromyalgia, regardless of the number of CVD risk factors and AHA\textsubscript{7}CVH scores, the FITT ExRx for fibromyalgia would be recommended based on strategy A because of the very conservative nature of the FITT ExRx for fibromyalgia in terms of exercise intensity, volume, and total time.

**ACSM Strategy B.** Begin with the CVD risk factor tied for the poorest AHA\textsubscript{7}CVH score whose FITT ExRx is the most conservative in terms of exercise intensity, volume and/or total time, while considering the patient’s preferences, goals, and special considerations.\textsuperscript{20} An example for which strategy B would be used to prioritize the CVD risk factor for the FITT ExRx is a patient who is physically inactive and has a BMI of 32 kg/m\textsuperscript{2} and BG of 128 mg/dL confirmed on two occasions, both of which receive a score of 0 on the AHA\textsubscript{7}CVH. For this patient, the FITT ExRx for diabetes mellitus would be recommended as outlined in step 4 based on strategy B because the FITT ExRx for diabetes mellitus is more conservative in terms of exercise intensity, volume, and total time than is the FITT ExRx for obesity.\textsuperscript{16}

In some cases, other chronic diseases and health conditions could take precedent over CVD risk factors to design the FITT ExRx based on strategy B. For example, for a patient with fibromyalgia, regardless of the number of CVD risk factors and AHA\textsubscript{7}CVH scores, the FITT ExRx for fibromyalgia would be recommended based on strategy B because of the very conservative nature of the FITT ExRx for fibromyalgia in terms of exercise intensity, volume, and total time.

**ACSM Strategy C.** Begin with the CVD risk factor tied for the poorest AHA\textsubscript{7}CVH score whose FITT ExRx encompasses the FITT ExRx for the other CVD risk factor(s) in terms of exercise intensity, volume, and/or total time while considering the patient’s other chronic diseases or health conditions, preferences, goals, and special considerations.\textsuperscript{20} An example for which strategy C would be used to prioritize the CVD risk factor for the FITT ExRx is a patient who has a BMI of 31 kg/m\textsuperscript{2} and BP of 136/88 mm Hg, both of which receive a score of 0 on the AHA\textsubscript{7}CVH. For this patient, the FITT ExRx for obesity would be recommended as outlined in step 4 based on strategy C because the FITT ExRx for obesity encompasses the FITT ExRx for HTN in terms of exercise intensity, volume, and time.\textsuperscript{16} In addition, obesity is a major CVD risk factor for HTN and targeting obesity would favorably impact HTN.\textsuperscript{25}

In some cases, other chronic diseases and health conditions could take precedent over the CVD risk factors to design the FITT ExRx based on strategy C. For example, for a
TABLE 3. The ACSM FITT ExRx for Diabetes Mellitus, Dyslipidemia, Hypertension, and Obesity

| Condition         | Aerobic | Resistance | Flexibility | Neuromotor |
|-------------------|---------|------------|-------------|------------|
| **Diabetes mellitus** |         |            |             |            |
| Frequency, days/week | 3-7     | A minimum of 2 nonconsecutive days/week, but preferably 3. | ≥2-3       | ≥2-3       |
| Intensity         | Moderate (40%–59% VO₂R or 11-12 RPE rating) to vigorous (60%–89% VO₂R or 14-17 RPE rating). | Moderate (50%-69% of 1-RM) to vigorous (70%-85% of 1-RM). | Stretch to the point of tightness or slight discomfort. | Not determined. |
| Time              | T1DM: 150 min/wk at moderate intensity, or 75 min/wk at vigorous intensity, or combination. T2DM: 150 min/wk at moderate to vigorous intensity. | At least 8 to 10 exercises with 1-3 sets of 10-15 repetitions to near fatigue per set early in training. Gradually progress to heavier weights using 1-3 sets of 8-10 repetitions. | Hold static stretch for 10-30 s; 2-4 repetitions of each exercise. | ≥20-30 min/d. |

| **Dyslipidemia** |         |            |             |            |
| Frequency, days/week | ≥5 to maximize caloric expenditure. | 2-3 | ≥2-3 | ≥2-3 |
| Intensity         | 40%-75% VO₂R or HRR. | Moderate (50%-69% of 1-RM) to vigorous (70%-85% of 1-RM) to improve strength; <50% 1RM to improve muscle endurance. | Stretch to the point of tightness or slight discomfort. | Not determined. |
| Time              | 30–60 min/d. To promote or maintain weight loss, 50-60 min/d or more of daily exercise is recommended. | 2-4 sets, 8-12 repetitions for strength; ≤ 2 sets, 12-20 repetitions for muscular endurance. | Hold static stretch for 10-30 s; 2-4 repetitions of each exercise. | ≥20-30 min/d. |

| **Hypertension** |         |            |             |            |
| Frequency, days/week | 2-3 d/wk | 2-3 d/wk | ≥2-3 d/wk | ≥2-3 d/wk |
| Intensity         | Moderate intensity, (i.e., 40% - 59% VO₂R or HRR; RPE 12-13 (on a 6–20 scale) to Vigorous (i.e., 60% - 80% VO₂R or HRR; RPE 14-16 (on a 6–20 scale).) | 60% - 70% 1-RM, may progress to 80% 1-RM. For older individuals and novice exercisers begin with 40-50% 1RM. | Stretch to the point of feeling tightness or slight discomfort. | Low to Moderate |
| Time              | ≥ 30 min/d of continuous or accumulated exercise. If intermittent exercise performed, begin with a minimum of 10 min bouts. | 2-4 sets of 8-12 repetitions for each of the major muscle groups. | Hold static stretch for 10-30 s; 2-4 repetitions of each exercise. | ≥20-30 min/d |

| **Obesity** |         |            |             |            |
| Frequency, days/week | ≥ 5     | 2-3       | ≥2-3       | ≥2-3       |
| Intensity         | Initial intensity should be moderate (40%-59% VO₂R or HRR); Progress to vigorous (≥60% VO₂R or 60%-70% of 1 RM; Gradually increase to enhance strength and muscle mass. | Stretch to the point of feeling tightness or slight discomfort. | Not determined. |
healthy older adult who has multiple CVD risk factors regardless of their score on the AHA7CVH, the FITT ExRx for healthy older adults could be recommended because this FITT ExRx encompasses the FITT ExRx for any CVD risk factors that this older adult may encounter.

**Step 4. Design the FITT ExRx**

Once the CVD risk factor or chronic disease or health condition has been prioritized with the AHA7CVH and ACSM strategies in Figure 2, the ACSM FITT ExRx for that prioritized CVD risk factor and/or chronic disease or health condition is then recommended. The ACSM FITT ExRx for the major CVD risk factors of diabetes mellitus, dyslipidemia, hypertension, and obesity is detailed in Table 3. The reader is referred to other resources for additional information on the FITT ExRx for these CVD risk factors and other chronic diseases and health conditions.

Please see the Supplemental Material (available online at http://mcpiqojournal.org) that shows how P3-EX is applied to a case study of a patient with multiple CVD risk factors. After applying the ACSM FITT ExRx for the prioritized major CVD risk factor or chronic disease or health conditions, the patient’s special considerations including medication use and side effects are compiled and the FITT ExRx is adjusted. A description of the special considerations for the major CVD risk factors and/or chronic diseases and health conditions to adjust the FITT ExRx is beyond the scope of this report. The reader is referred to other resources for detailed information on special considerations in ExRx for these major CVD risk factors.

**CONCLUSION**

With the release of the Physical Activity Guidelines for Americans, 2nd Edition, there is now a call to action for physicians and health care providers to recommend physical activity to their patients because physical activity is the “best buy” for our health. The US Department of Health and Human Services recommends clinicians provide patients with regular counseling on physical activity and promote physical activity as one of the singularly most effective preventive health...

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**TABLE 3. Continued**

| Exclusion | Time | Frequency (F) | Intensity (I) | Type (T) | Time | Time | Time | Time | Time |
|-----------|------|--------------|--------------|----------|------|------|------|------|------|
| Obesity   | ≥30-30 mVd | ≥1-3 | 0.5-0.8 | ≥1-2 | ≥1-3 | ≥1-3 | ≥1-3 | ≥1-3 | ≥1-3 |
| 2.4 repetitions of each of the major muscle groups. | | | | | | | | | |
| Heart rate reserve (HRR) for greater health benefits. | 30 mVd | 1-3 | 0.5-0.8 | ≥1-2 | ≥1-3 | ≥1-3 | ≥1-3 | ≥1-3 | ≥1-3 |
| 2-4 sets of 8-12 repetitions for each of the major muscle groups. | | | | | | | | | |
| Hold static stretch for 10-30 s; 2-4 repetitions of each exercise. | | | | | | | | | |

**ACSM** = American College of Sports Medicine; **FITT** = frequency, intensity, time, and type; **ExRx** = exercise prescription; **HRR** = heart rate reserve; **1-RM** = one repetition maximum; **RPE** = rating of perceived exertion; **T1DM** = type 1 diabetes mellitus; **T2DM** = type 2 diabetes mellitus; **VO2R** = oxygen uptake reserve.

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**Supplemental Material**

Please see the Supplemental Material (available online at http://mcpiqojournal.org) that shows how P3-EX is applied to a case study of a patient with multiple CVD risk factors. After applying the ACSM FITT ExRx for the prioritized major CVD risk factor or chronic disease or health conditions, the patient’s special considerations including medication use and side effects are compiled and the FITT ExRx is adjusted. A description of the special considerations for the major CVD risk factors and/or chronic diseases and health conditions to adjust the FITT ExRx is beyond the scope of this report. The reader is referred to other resources for detailed information on special considerations in ExRx for these major CVD risk factors.

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interventions available. Yet, to the best of our knowledge, a clinical decision support system for clinicians to use to prescribe exercise to their patients does not exist. To address this critical unmet need we have developed an evidenced-based, guided, and time-efficient tool for clinicians to use to prescribe exercise for patients with multiple CVD risk factors who may have other chronic diseases and health conditions founded upon industry standard recommendations of the AHA and ACSM (ie, P3-EX). Future directions include continued testing of P3-EX within a university-based online graduate program as well as further investigation to better establish its feasibility, acceptability, and clinical utility as an ExRx tool.

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SUPPLEMENTAL ONLINE MATERIAL

Supplemental material can be found online at http://mcpiqojournal.org. Supplemental material attached to journal articles has not been edited, and the authors take responsibility for the accuracy of all data.

Abbreviations and Acronyms: ACSM = American College of Sports Medicine; AHA = American Heart Association; AHA_ACHV = American Heart Association Life’s Simple 7 cardiovascular health scoring system; BG = blood glucose; BMI = body mass index; BP = blood pressure; CVD = cardiovascular disease; CV = cardiovascular; CVH = cardiovascular health; DBP = diastolic blood pressure; Ex Rm = exercise prescription; FITT = frequency, intensity, time, and type; HDL-C = high-density lipoprotein cholesterol; HTN = hypertension; HR = heart rate; HRR = heart rate reserve; LDL-C = low-density lipoprotein cholesterol; 1-RM = one repetition maximum; P3-EX = prioritize personalize prescribe exercise clinical decision support system; PNF = proprioceptive neuromuscular facilitation; RPE = rating of perceived exertion; SBP = systolic blood pressure; T1DM = type 1 diabetes mellitus; TC = total cholesterol; T2DM = type 2 diabetes mellitus; SOB = shortness of breath; VO2R = oxygen uptake reserve; WC = waist circumference

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