Women and Heart Disease

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- Complete the questions at the end of the course.
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Faculty

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Faculty Disclosure

Contributing faculty, Margo A. Halm, RN, PhD, NEA-BC, has disclosed no relevant financial relationship with any product manufacturer or service provider mentioned.

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Division Planner Disclosure

The division planner has disclosed no relevant financial relationship with any product manufacturer or service provider mentioned.

Audience

This course is designed for all nurses in family practice or medical/surgical areas, especially critical care or cardiac units.

Accreditations & Approvals

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Course Objective

The purpose of this course is to identify the unique challenges that face women with heart disease, including prevention, diagnosis, and treatment.

Learning Objectives

Upon completion of this course, you should be able to:

1. Describe the morbidity and mortality associated with heart disease, especially in women.
2. Describe how female cardiac anatomy and physiology differs from men's.
3. Discuss the role that traditional risk factors play in the development of heart disease in women.
4. List gender-specific risk factors for heart disease in women.
5. Identify reasons heart disease is more complex to diagnose in women.
6. Compare and contrast the efficacy of noninvasive and invasive cardiac diagnostic tests in women.
7. Describe the basic types and variations of angina and their prevalence in women.
8. Compare and contrast the usual clinical course of women with angina versus myocardial infarction (MI).
9. Discuss common complications seen in women post-MI.
10. Discuss clinical outcomes of medical treatment options in women with heart disease.
11. Discuss the preoperative status of women undergoing coronary artery bypass surgery and the implications this status may have on postoperative outcomes.
12. Describe the research base related to the clinical outcomes of women who participate in formal cardiac rehabilitation programs.
13. Identify nursing diagnoses and appropriate nursing interventions that are applicable to women with heart disease during the acute phase.
14. Discuss primary and secondary prevention strategies for women.
15. Identify at least two reasons why women were formerly excluded from clinical trials related to the diagnosis and treatment of heart disease.
16. Identify areas where further research is needed in relation to heart disease and women.

Sections marked with this symbol include evidence-based practice recommendations. The level of evidence and/or strength of recommendation, as provided by the evidence-based source, are also included so you may determine the validity or relevance of the information. These sections may be used in conjunction with the course material for better application to your daily practice.

INTRODUCTION

More than one in three women in the United States suffers from heart disease [1]. This fact has stimulated the lay and scientific communities, and heart disease has gained recognition as a significant health issue for women. The purpose of this course is to discuss the realities and uncertainties about heart disease in women. Progress has been made in defining both the incidence of heart disease in women and how women and men differ in regard to cardiac anatomy and physiology. In addition, both traditional and gender-specific coronary risk factors have been studied, along with the reliability of conventional cardiac diagnostic tests in women. However, many uncertainties remain because, for many years, women have largely been excluded from research on the diagnosis and treatment of heart disease. In particular, cardiac symptomatology of women may differ from the classic textbook cases seen in men. Clinical outcomes of women receiving standard medical and surgical treatments remain another area of uncertainty. Healthcare professionals who participate in this course will be able to identify the unique challenges that face women, from prevention and diagnosis to treatment issues. Patients will benefit from this advanced knowledge base as healthcare providers strengthen their roles as patient advocates and educators. This will help women to receive appropriate and timely treatment, as well as preventive and follow-up care.

OVERVIEW OF WOMEN AND HEART DISEASE

Heart disease remains a major health problem in the United States, but only in the last few decades has there been an increased focus on the incidence of heart disease in women. This section will discuss the morbidity and mortality associated with heart disease in women compared to that seen in men. Factors that influence these differences will be discussed, including the unique cardiovascular system features seen in women and the significance of cardiovascular risk factors in women, including both traditional and gender-specific risk factors. Techniques to help women determine their level of risk for heart disease will be discussed based on assessing certain cardiovascular parameters, risk factors, and lifestyle choices.

MORBIDITY

Statistics have shown that women are at considerable risk for heart disease, contrary to previous belief. An estimated 44 million women in the United States are affected by some form of cardiovascular disease [2]. The prevalence is 31.9% in non-Hispanic white women, 48.3% in non-Hispanic black women, and 32.5% in Mexican American women [1]. In 2010, cardiovascular disease was the first-listed diagnosis of 2.8 million women discharged from short-stay hospitals [1].

Overall, the incidence of coronary heart disease in women increases with increasing age [3]. In women younger than 65 years of age, heart disease usually manifests itself about 10 years later than it does in men. By about 65 years of age, however, a woman's risk is approximately equal to a man's and the outcomes are frequently worse [1]. In women 75 to 84 years of age, the morbidity from heart disease increases 40-fold compared to women 35 to 44 years of age [4].

Coronary disease most commonly presents in the form of angina in women, compared to myocardial infarction (MI) and sudden death in men; however, women tend to report chest pain less frequently than men, which may result in either a delayed diagnosis or a misdiagnosis. Women also are frequently further along the disease trajectory than men when presenting with cardiac symptoms [1; 5]. Even women who are at risk for cardiovascular disease may not be referred for diagnostic tests that are considered routine in men [1]. Therefore, screening is the key, with early detection focused on improving clinical outcomes and reducing the costs associated with hospitalization. Additionally, a symptomatic woman should interact with her physician and persist until a correct diagnosis is obtained.

The elderly population is changing the demography of coronary heart disease in the United States. In 2015, 14.9% of the U.S. population was 65 years of age and older [6]. This number is projected to grow to 20% of the U.S. population (approximately 72 million people) by 2030 [7]. Individuals who are 85 years of age and older are the most rapidly growing subgroup of elderly. Approximately 6.3 million people in the United States are 85 years of age and older, with a projected increase to more than 19 million expected by 2060 [8; 9]. These trends will clearly influence the diagnosis and treatment of heart disease in women. For the year 2013, the total economic cost of this health problem in the United States was estimated to be $312.6 billion [4]. Given the fact that the incidence of heart disease in women increases with age, coupled with the projected increase in the elderly population, this economic burden will certainly continue to grow.

MORTALITY

Each year since 1984, the number of deaths for women from cardiovascular disease (CVD) has exceeded the number for men. In 2013, CVD was the cause of death in 398,086 women. Women represented 49.7% of all deaths from CVD [1; 10].

Heart disease is the second leading cause of death in American women older than 75 years of age [11]. Although the risk of breast cancer has been the focus of intense media coverage for several years, heart disease kills more than twice as many women in the United States each year as do all forms of cancer, including breast cancer [4; 11].

Despite these gloomy statistics, the mortality rates for women from heart disease have been on the decline in the United States. Since 1979, the age-adjusted heart disease mortality rates have declined significantly for all major race and sex groups. From 2002–2013, the rate of death from heart disease declined 6.2% for women of all ages and races. It declined 6.4% for non-Hispanic white women; 4.7% for non-Hispanic black women; 5.4% for Hispanic women; 1.8% for American Indian/Alaska Native women; and 4.2% for Asian/Pacific Islander women [11]. This decline is most likely due to improved medical care and increased emphasis on the reduction of cardiovascular risk factors [12; 13; 14].

THE FRAMINGHAM HEART STUDY

The Framingham Heart Study was one of the first longitudinal studies conducted to investigate gender differences in the prevalence and manifestations of heart disease. The study enrolled equal numbers of men and women with a total sample size of 5,127 subjects. After 26 years, the findings demonstrated that of all documented coronary events, 40% occurred in women. In addition, the study suggested that women with angina have a better prognosis than men [12]. The clinical outcomes documented in this study are shown in ***Table 1***.

FRAMINGHAM HEART STUDY CARDIAC OUTCOMES		
Outcomes	**Percent of Women**	**Percent of Men**
Suffered a more serious coronary event	17%	44%
Remained survival free of MI for eight years	80%	71%
Had an uncomplicated course post-MI	86%	66%
Source: [12]		*Table 1*

It is important to note that these early findings suggested that, for women, a diagnosis of heart disease was not a serious health matter. In the Framingham Study, the symptom of chest pain was used to define the presence of heart disease. As a result, many women who suffered chest pain attributable to a noncardiac cause were still enrolled in the study, thus explaining their significantly longer survival when compared to men. These findings, which suggested that heart disease in women was not serious, led to an under-recognition of the significance of cardiovascular risk factors and manifestations in women. This has been referred to as a treatment, referral, and research bias [15]. For instance, women remain on medical management longer than men before undergoing invasive diagnostic testing and revascularization by either percutaneous coronary intervention (PCI) (also referred to as percutaneous transluminal coronary angioplasty [PTCA]) or coronary artery bypass graft (CABG) procedures. This delay may be due to the physician's reluctance to refer women to a procedure that may be associated with complications (e.g., age and other risk factors), as well as the patient's desire to forgo these types of procedures [16; 17].

CARDIOVASCULAR RISK PROFILE IN WOMEN

CARDIAC ANATOMIC PROFILE IN WOMEN

Several anatomic and physiologic differences exist in the cardiovascular system of women compared to men. Because women's bodies are generally smaller in stature, the female heart and thoracic cavity are smaller and lighter. A woman's heart weighs approximately 229 grams; a man's heart weighs about 56 grams more. The female heart also has smaller coronary arteries than a man's heart. The right coronary artery appears to be more dominant in women [1; 18; 19; 20; 21].

In addition to anatomic differences in male and female cardiovascular systems, research indicates that women may deposit plaque differently than men. The Women's Ischemia Syndrome Evaluation (WISE) Study, supported by the National Heart, Lung, and Blood Institute, evaluated gender differences in the presentation and treatment of ischemic heart disease [22; 23]. Researchers found that women's atherosclerotic plaque deposition was more diffuse than men's. This physiologic difference results in scalloping or artery irregularities, rather than the large, obstructive blockages that are commonly associated with heart disease and MI. Furthermore, microvessels and vasodilator response appear to be impaired more frequently in the female population. These less obvious changes are more difficult to detect from a traditional angiogram and may result in different symptoms.

PHYSIOLOGIC PROFILE OF WOMEN COMPARED TO MEN	
Physiologic Characteristic	**Female Tendencies**
Body size	Smaller in size
Heart and thoracic cavity	Smaller and lighter in size Smaller cardiac muscle fibers
Coronary arteries	Smaller in diameter Right coronary artery dominance
ECG	Higher resting heart rates Shorter PR and QRS intervals Smaller amplitude of R, S, and T waves
Stroke volume	Higher
Resting ejection fraction (EF)	Higher
Left ventricular end-diastolic pressure and volume	Lower
Hematology	Lower hematocrit and blood volumes Lower oxygen-carrying capacity Natural estrogens in premenopausal women that protect from effects of ischemic heart disease Higher cholesterol levels beginning at 55 years of age
Body fat percentage and distribution	Increased body fat percentage and different fat distribution

Source: [18; 20; 21; 25; 26; 27] *Table 2*

This may partially account for the differences in presentation and subsequent treatment of heart disease in women.

On the electrocardiogram (ECG), resting heart rate is higher, PR and QRS intervals tend to be shorter, and the amplitude of the R, S, and T waves across the precordium are smaller in women. Left ventricular end-diastolic pressure and volume are also lower in women, yet stroke volume and resting ejection fractions (EF) tend to be higher in women than in men. Up to 30% of women with normal coronary arteries do not have an increase in EF with exercise, a finding that has important implications for exercise testing [1; 18; 20; 24; 25; 26].

Hematologic differences also exist between men and women. Women's hematocrit and blood volumes tend to be lower, along with their oxygen-carrying capacity. Cholesterol levels tend to rise in women around 55 years of age; however, the natural estrogens of perimenopause are believed to provide protection against heart disease by conferring beneficial effects to the lipid profile. It has also been suggested that estrogen receptors located within the walls of blood vessels may affect the proliferation of smooth muscle cells, reduce platelet aggregation, and alter the degradation of collagen and elastin [23; 27; 28].

The last anatomic and physiologic difference between men and women is body fat percentage (which is higher in women) and the distribution of body fat. Women who have a large waist, also referred to as abdominal obesity or central adiposity, tend to have an increased risk of an MI at an earlier age [20; 21; 27]. Studies have suggested that, in particular, waist-to-hip ratio measures of abdominal adiposity may be strong indicators of mortality in women [29; 30]. Other studies have indicated that waist-to-height ratio may be an accurate predictor of heart disease in women [31; 32]. Patterns of fat distribution and associated cardiovascular health risks will be discussed in further detail in the following section on traditional coronary risk factors. ***Table 2*** summarizes how women's physiologic profile differs from men's.

TRADITIONAL RISK FACTORS

Certain risk factors increase the likelihood of the development of heart disease. These are known as the traditional cardiovascular risk factors, and they are shared equally between males and females. However, the weight given to these traditional risk factors may not be the same between men and women, and the traditional diagnostic tests, which generally focus on obstructive disease, are not as effective in women as compared to men [22]. At comparable levels of cardiovascular risk factors, the risk of a cardiac event in a premenopausal woman is 50% the risk level for a man the same age. The relative protection of women from heart disease may be due to better tolerance of cardiovascular risk factors, as well as hormonal and metabolic differences [22; 33].

The traditional risk factors may be further categorized as nonalterable and alterable factors. While recognition of both sets of risk factors is important, patient care should include an emphasis on those factors that can be altered or changed.

Nonalterable Factors

Age

As men and women age, they become progressively more likely to develop heart disease. Men's heart problems tend to peak earlier than women's; however, the incidence in women tends to catch up to that in men around 65 years of age. Until that time, estrogen produced during the premenopausal years provides some protection. As a result, heart disease usually manifests itself approximately 10 years later in women compared to men. Women are also more likely to have other age-related health problems, such as diabetes, hypertension, or arthritis [34; 35].

Family History

Family history is also a significant traditional risk factor for heart disease. If members of a woman's family have a history of heart disease, she is more likely to develop it. A paternal history of MI prior to 60 years of age appears to carry a greater risk for both men and women than does MI at older ages. However, it has been suggested that any maternal history of MI prior to 50 years of age may be an important risk factor [27; 36; 37].

Ethnic Background

Like family history and age, ethnic background is a factor that cannot be modified. For example, non-Hispanic black women are at higher risk of developing serious heart disease and dying from it when compared to non-Hispanic white and Mexican American women [38; 39]. This increased risk has been attributed to a higher incidence of uncontrolled hypertension, obesity, and sedentary lifestyle in this population. Differences in access to and utilization of healthcare services, as well as the need for risk reduction interventions targeted at specific socioeconomic status, may also be contributing factors [38; 40; 41].

Alterable Factors

Again, alterable cardiovascular risk factors require the most attention when counseling female patients. These factors include smoking, hypertension, hyperlipidemia, diabetes, obesity, metabolic syndrome, sedentary lifestyle, and a Type A behavior pattern.

Smoking History

Cigarette smoking remains one of the most dominant and independent cardiovascular risk factors for women, especially for those younger than 50 years of age. Smoking produces harmful physiologic effects by decreasing high-density lipoprotein (HDL) levels and increasing platelet aggregation and fibrinogen levels [40]. Smoking has also been associated with early menopause and may exert an antiestrogenic effect [42]. Despite these realities, an estimated 20.5% of men and 15.3% of women continue to smoke [43]. The widespread use of cigarettes, and the significance of smoking as a risk factor, led the Surgeon General to state that it is the leading preventable cause of disease and deaths in the United States [44]. Women are less likely to quit smoking than are men due to a desire for slimness. And, when women do quit smoking, they tend to experience greater weight gain than do men [21; 34].

As a risk factor, smoking accounts for more than one-half of all cardiac events [45]. Results of the Nurses' Health Study (NHS) and NHS II have indicated that the mortality rate of women who smoke is higher than that of former smokers (i.e., those who have quit smoking) and is twice that of women who have never smoked. The NHS results have also indicated that women who smoke are more likely to have comorbid conditions than women who do not smoke [46]. In addition, the risk of sudden death is related to smoking in both men and women [47].

According to the Centers for Disease Control and Prevention (CDC), cigarette smoking causes an estimated 201,773 deaths annually among women and increases a woman's risk of dying threefold [48]. The risk increases with the number of cigarettes smoked per day and the duration of the habit [49]. Women who smoke more than 24 cigarettes a day have a tenfold increase in risk for MI compared to nonsmokers. However, the risk of a first MI decreases soon after the person stops smoking. The risk of having a nonfatal MI declines within three to four years to the same level as that of women who have never smoked [20; 25; 34].

Cigarette smoking works synergistically with other cardiovascular risk factors in influencing a woman's risk for the development of heart disease. For instance, women who smoke and also use oral contraceptives increase their risk for heart disease compared to those women who neither smoke nor use the pill [50; 51]. Coronary-related mortality rates are also higher in women smokers who have high cholesterol levels [52].

Hypertension

Like smoking, hypertension is a powerful independent risk factor for the development of heart disease in both men and women. It is also the most modifiable risk factor [53]. Compared with men, hypertension is twice as prevalent in women with heart disease. Additionally, women with hypertension have three to four times the risk of developing heart disease than women with normal blood pressure [54]. Among non-Hispanic black women, hypertension tends to be more severe, occur at an earlier age, be treated less adequately, and result in more significant morbidity and mortality rates. More than 46% of non-Hispanic black women in the United States have hypertension, compared with 30.1% of white women [1]. In addition to black women, pregnant women and postmenopausal women older than 65 years of age are also at high risk for developing hypertension [55].

Hypertension damages the lining of blood vessels and promotes the deposition of plaque, thereby predisposing people to heart disease. Hypertensive women are also more likely to have other significant cardiovascular risk factors, including diabetes, obesity, or high cholesterol levels. If accompanied by obesity and oral contraceptive use, a woman's risk of heart disease increases two- to fourfold. Clearly, screening and treatment is needed to reduce hypertension as a significant risk factor for heart disease [56].

Hypertension has been defined as a blood pressure of 140/90 mm Hg or greater. Even among individuals with no evidence of hypertension by 55 to 65 years of age, an estimated 90% will eventually develop hypertension [57]. Heart disease risk increases approximately twofold in men and threefold in women with hypertension [58]. Even modest increases in blood pressure have been shown to be dangerous. As little as a 10 mm Hg rise in systolic blood pressure may increase a woman's risk for coronary heart disease and stroke by 20% to 30% [25; 34; 59]. Prehypertension is defined as 120–139/80–89 mm Hg. Patients with prehypertension may be at risk for progression to hypertension and in need of lifestyle modifications [53]. Pharmacotherapy should be considered in women whose blood pressure is 140/90 mm Hg or greater. In women with chronic kidney disease or diabetes, pharmacotherapy should be considered when blood pressure is greater than 130/80 mm Hg [10; 60].

The measurement of the ankle-brachial index (ABI) may play a role in assessing a person's level of risk for cardiovascular disease. Normally, blood pressure values are equal to or higher in the ankles compared to those in the arm. While a lower blood pressure in the ankle has been recognized as a sign of peripheral vascular disease, the ABI is a marker for overall cardiovascular disease risk. A low ABI (i.e., less than 0.9) has been associated with an increased risk of cardiovascular mortality, coronary heart disease, and stroke [59; 61; 62]. However, a systematic review conducted by the U.S. Preventive Services Task Force found very limited evidence to support ABI as a useful screen to identify asymptomatic patients at risk of cardiovascular events [59].

Hyperlipidemia

Hyperlipidemia is another traditional cardiovascular risk factor. The risk of heart disease is low if total cholesterol levels are less than 200 mg/dL. Cholesterol levels are considered borderline-high risk between 200 and 239 mg/dL and high risk when total cholesterol climbs to greater than 240 mg/dL. In addition, these high levels are the point at which a woman's risk of heart disease doubles [63]. In 2013, 53.6 million adult women had total blood cholesterol levels of 200 mg/dL or greater. Among women 20 years of age and older, 15.6% of non-Hispanic whites, 11.7% of non-Hispanic blacks, and 13.5% of Mexican Americans have total blood cholesterol levels of 240 mg/dL or greater [64]. HDL is responsible for transporting cholesterol away from blood vessels and back to the liver. Because HDL helps remove cholesterol from the blood, it has been coined the "good cholesterol." In contrast, low-density lipoprotein (LDL) transports cholesterol to organs and blood vessels. Thus, LDL is associated with the development of atherosclerotic plaque and is referred to as the "bad cholesterol." If the total cholesterol level is elevated, a lipid profile should be done to examine lipoproteins, specifically HDL and LDL. Low HDL levels correlate with heart disease risk, especially in women [42; 65]. Recommendations for lipoproteins for women include HDL levels greater than 50 mg/dL and LDL levels less than 100 mg/dL [10; 66]. Researchers have found that women with high cholesterol are 23% less likely than men to have their cholesterol medically managed [67].

Triglycerides are also important in the development of coronary artery disease. Normally, triglycerides increase following a meal. Levels are also affected by alcohol intake, medications, hormones, diet, menstrual cycle, time of day, and recent exercise. Levels are considered normal if they are less than 150 mg/dL, if cholesterol levels are also normal. Borderline-high blood triglyceride levels are those that fall in the 150–199 mg/dL range; very few individuals have levels greater than 500 mg/dL, which is considered to be very high [65; 66]. These extremely high levels are rarely caused by diet alone and usually involve other cardiovascular risk factors [65].

Diabetes

Of the estimated 29.1 million persons in the United States with diagnosed diabetes, about 13.4 million are female, a number that has more than tripled since 1980 [68]. In 2013, diabetes was the cause of death of 35,737 women, which represented 51.7% of the total number of deaths from diabetes [1]. Next to smoking, diabetes has the most significant negative effect on cardiovascular-related mortality in women [42]. Diabetes is more common in women than in men, and studies have also shown that diabetic women experience more serious cardiovascular effects and are at much greater risk for heart disease and death than men [69]. Women with diabetes have twice the risk of developing heart disease than nondiabetic women. Women with diabetes also have a much greater risk of death after suffering an MI. The mortality rate associated with an MI has been reported to be twice as high in diabetic women as in diabetic men [34; 54].

The high glucose levels seen in patients with diabetes may irritate the endothelial layer of blood vessels, leading to the development of atherosclerosis. Moreover, diabetes leads to abnormalities in the lipid profile, increasing LDL, total cholesterol, and triglyceride levels and decreasing HDL cholesterol. In addition, the protective effects of estrogen may be negated in women who have diabetes. As a result, diabetic women may be placed in the same cardiovascular risk level as men of the same age who do not have diabetes [54; 69]. For these reasons, diabetes appears to be a more significant risk factor for heart disease in women than in men [20; 34; 42; 70].

Obesity

Obesity is another traditional risk factor. In 2014, 28.9% of U.S. adults were obese, an incidence that has greatly increased in the last 20 years [71; 72]. As of 2015, every state in the United States had a greater than 20% prevalence of obesity. Twenty-one states reported a 30% to 35% prevalence of obesity among their populations, and four states had an obesity prevalence of 35% or greater [72]. Women 20 to 34 years of age have had the fastest increase in the rate of obesity and overweight. Minority women as well as low socioeconomic status individuals are disproportionately affected across all age groups, with 50% at risk of being obese. Approximately 56.9% of non-Hispanic black women and 45.7% of Mexican American women in the United States are overweight or obese [73]. If a woman is 30% overweight, she is at increased risk for developing an MI, heart failure, stroke, and even death. Mild-to-moderate obesity (i.e., 5% to 15% overweight) may also be detrimental. Women who are overweight have a two to three times greater risk of an MI compared to lean women [74]. Fluctuations in weight may also impact a women's overall risk for heart disease and metabolic syndrome [75]. Like the other cardiovascular risk factors, the risk of heart disease may increase with certain risk factor combinations, such as obesity and smoking [21; 34; 40; 46; 76]. Obesity has other unfavorable influences on metabolic processes, including elevation of triglyceride, uric acid, and blood pressure levels; reduction of HDL cholesterol; and alteration of glucose tolerance and insulin sensitivity [21].

Metabolic Syndrome

A clustering of symptoms has been recognized as playing an important role in the development of cardiovascular disease. This symptom cluster, referred to as metabolic syndrome, is defined as the presence of three or more of the following abnormalities [77]:

- Waist circumference 88 cm (35 inches) in women or ≥102 cm (40 inches) in men
- Serum triglyceride level of 150 mg/dL or greater
- HDL cholesterol level less than 50 mg/dL in women and less than 40 mg/dL in men
- Blood pressure of 130/85 mm Hg or greater
- Fasting blood glucose level of 100 mg/dL or greater

The age-adjusted prevalence of the metabolic syndrome for adult women in the United States is 35.5% among non-Hispanic black women, 38.6% among Mexican American women, and 37.4% among non-Hispanic white women [78]. All individuals diagnosed with metabolic syndrome are at greater risk for the development of heart disease, diseases related to arterial plaque build-up, and type 2 diabetes [79].

Physical Inactivity

Inactivity or the lack of consistent aerobic exercise is another traditional cardiovascular risk factor. Among women 18 years of age and older, only 17.6% engage in regular leisure-time physical activity [1]. Research studies have shown that women report lower levels of physical activity compared to men, which may place women at higher risk for heart disease [80]. However, these results should be interpreted cautiously because the measurement tools utilized in these studies may not have been accurate in terms of their ability to measure activities specific to women [34].

Regular aerobic exercise is important for cardiovascular health. Like men, women should engage in aerobic exercise for at least 30 minutes, five times per week [81; 82]. Women who have previously been sedentary should begin with short intervals of activity (e.g., 5 to 10 minutes) and gradually increase the intervals. Women with chronic health problems as well as those 50 years of age and older who are just beginning a physical activity program should first consult with a physician [80].

The benefits of aerobic exercise include lowering blood pressure and resting heart rate, as well as counteracting the detrimental effects of other cardiovascular risk factors, such as obesity and stress [34; 80; 82].

Type A Behavior Pattern

The Type A behavior pattern is another traditional cardiovascular risk factor [20; 33; 42]. Type A behavior is characterized by hurriedness, impatience, sense of time urgency, restlessness, hyperalertness, a passive pattern of competitive striving, and frequently aroused angry and hostile feelings and behaviors. In contrast to their Type A counterparts, Type B people are less harried [83].

Recognition of the Type A behavior pattern as a risk for heart disease was primarily based on the Western Collaborative Group Study, a prospective study of 3,524 employed men. This more than eight-year investigation found that men initially assessed as Type A individuals had twice the rate of heart disease as their Type B counterparts. Similarly, the Framingham Heart Study, including 1,822 male and female subjects, demonstrated a correlation between Type A behavior and heart disease, even after controlling for other risk factors [84]. However, several other studies have failed to find a correlation between coronary heart disease and Type A behavior pattern in women [85]. Some studies have demonstrated that people who are at highest risk for heart disease are those who keep their anger inside and score high on feelings of hostility [86]. More research is needed to explore the roles that stress and personality may play in the development of coronary heart disease.

GENDER-SPECIFIC RISK FACTORS

Women also face gender-specific risk factors in relation to heart disease, including employment conflict, oral contraceptives, and menopause [18; 33; 87].

Employment Role Conflict

In 2015, women comprised 57% of the total U.S. work force and are projected to account for 55.8% of the total labor force by 2024 [88]. It was once believed that with more women entering the work force, they would begin to have the same cardiac disease profile as men. While studies have established job strain (a particular form of job stress) to be predictive of coronary heart disease in men, studies in women have been few and have produced inconsistent results [89].

For example, one study of 35,038 women, which was conducted within the NHS, found no relationship between job demands, job control, or social support and heart disease [89]. The study examined four types of work experience based on the level of job demands (i.e., low or high) and the level of job control (i.e., low or high). Examples of job demands examined included excessive work, conflicting demands, insufficient time to work, fast work pace, and working hard. Examples of job control examined included skill discretion (e.g., learning new things, task variety) and decision authority (e.g., freedom to make decisions, having a voice in the workplace). The level of support received from coworkers and managers was also included in the assessment. The Framingham Offspring Study found that women with active job strain (i.e., high job demand, high job control) had a 2.8-fold increased risk of coronary heart disease when compared to women with high job strain (i.e., high job demand, low job control) [90]. Other studies have indicated that women in male-dominated jobs, women who perform caregiving outside work, and women experiencing marital stress may be at increased risk for heart disease [89; 91; 92; 93; 94; 95]. Most researchers agree that additional research is needed that specifically includes women.

Oral Contraceptives

Women who use combination hormonal contraceptives have an increased risk of MI, particularly in conjunction with other cardiovascular risk factors, such as smoking. If a woman takes hormonal contraceptives and smokes, she increases her risk level 20 times over that of a woman who neither smokes nor uses oral contraceptives. However, the risk of heart disease diminishes after the contraceptives are stopped [20]. Research has indicated that the newer, third-generation contraceptives are the first to have been associated with no excess risk of MI [96]. However, other studies have found that women taking third-generation oral contraceptives have an estimated twofold increased risk of venous thrombosis compared with those taking second generation oral contraceptives [97; 98; 99]. Additionally, the risk appears to depend upon the class of estrogen, the dose, and the duration of use [100]. A retrospective cohort study used Medicaid data from 2000 to 2013 to assess the relationship between types of oral contraceptives and incidence of CVD in women in South Carolina [101]. The authors found that, compared with combined oral contraceptives, progestin-only oral contraceptives were associated with decreased heart disease and stroke incidence. However, they also found a positive association between progestin-only contraceptive plus combined oral contraceptive and incidence of both heart disease and stroke. The debate over which contraceptives have the least possibility of harmful side effects continues; more research is needed for a definitive answer.

Menopause

At the time of menopause, serum estrogen levels decrease. The absence of estrogen increases a postmenopausal woman's vulnerability to heart disease due to the effects on lipoprotein metabolism. These changes include a decrease in HDL levels and an increase in LDL levels. In addition, blood vessels become less flexible after menopause due to the reduction in circulating estrogen [102].

Research has demonstrated that elevated iron levels greatly increase a man's risk of heart disease. However, additional studies are needed to determine if the iron retention that occurs in nonmenstruating women is a significant cardiovascular risk factor [103; 104].

RISK CLASSIFICATION

In 1997, a clinically important report outlined a classification scheme for cardiovascular risk factors. Class I risk factors are those for which good data is available showing a clear causal relationship to heart disease. Class II risk factors are supported by large observational studies that have strongly suggested a causal relationship to heart disease. With Class III risk factors, data is either not available or is limited in its ability to clearly indicate a causal relationship [105]. ***Table 3*** classifies the cardiovascular risk factors based on the evidence available.

NONTRADITIONAL RISK FACTORS

Research has uncovered other factors (i.e., nontraditional risk factors) that may be implicated in the development of coronary artery disease. This section will focus on developments related to homocysteine, lipoprotein(a), fibrinogen, C-reactive protein (CRP), subclinical hypothyroidism, and periodontal disease.

Homocysteine

Homocysteine, an amino acid by-product of foods rich in protein, occurs naturally in blood and tissues. The prevalence of elevated homocysteine, or hyperhomocysteinemia, increases with age in both sexes and has been linked to atherosclerosis, premature coronary artery disease, stroke, and blood clots, even among those with normal cholesterol levels. Research has demonstrated that elevated homocysteine (>12 mmol/L) is relatively common, with hereditary and dietary factors (e.g., high consumption of animal protein) playing a role [106]. Homocystinuria increases the risk for atherosclerosis by damaging the interior lining of arteries. A direct relationship between homocysteine and severity of artery blockages has been

CARDIOVASCULAR RISK CLASSIFICATION	
Risk Class	**Cardiovascular Risk Factor**
Class I	Smoking Hyperlipidemia Hypertension Lack of aspirin therapy, beta blockers, or angiotensin-converting enzyme (ACE) inhibitor usage post-MI
Class II	Diabetes Obesity and physical inactivity Postmenopausal state Elevated triglycerides
Class III	Psychological factors (i.e., stress, depression, lack of social support) Elevated hemostasis and inflammatory markers Oxidative stress Dietary factors (i.e., diet high in saturated fat)
Source: Compiled by Author	*Table 3*

established. Researchers have additionally found a 20% increase in risk of coronary events among men and women for every 5 mmol/L increase in homocysteine level [107]. Thus, homocysteine may become as important as other risk factors for heart disease in the future.

An assay is available for screening; however, it is important to note that screening of asymptomatic women with no history of coronary heart disease is not recommended [108]. Plasma homocysteine levels are inversely related to vitamin intake, especially vitamins B6, B12, and folate. As a result, high levels of homocysteine may usually be remedied by increasing folic acid intake through diet or supplements (400 mcg/day) [109]. Dietary sources of folate include orange juice, green leafy vegetables, and fortified cold breakfast cereals [109; 110].

Lipoprotein(a)

Lipoproteins are molecules that transport fats throughout the body. While LDL has been well documented to be deleterious to the heart, lipoprotein(a) may also wreak havoc. Lipoprotein(a) accelerates the transformation of LDL into plaque and slows the dissolution of blood clots. Tests are available but generally are reserved for young patients who suffer an MI without an apparent cardiovascular risk profile, those with family histories of very high cholesterol, or those not responding to cholesterol-lowering treatment [111]. Any lipoprotein(a) level greater than 30 mg/dL is considered elevated for adults [111]. Women with known coronary artery disease and high levels of lipoprotein(a) may benefit from combined hormone replacement therapy (HRT) [112].

Fibrinogen

Plasma fibrinogen levels have been associated with the risk of coronary heart disease and stroke. However, a direct causal relationship has not been established [113; 114].

C-Reactive Protein

C-reactive protein (CRP) is a specialized protein released when an injury must be repaired or a microbe warded off. CRP is circulated in the body at low concentrations in healthy people. Levels are increased, however, when infection and injury stimulate the body's repair mechanisms. Measuring serum levels of CRP has been shown to be a good predictor of outcome in cardiac patients (***Table 4***). If a patient with angina has large amounts of the protein in his/her blood, there is a greater chance an MI will occur; patients with elevated CRP levels who have had an MI are more likely to have another [115].

C-REACTIVE PROTEIN LEVELS AND ASSOCIATED RISKS[a]	
Level	**Risk**
<1 mg/L	Low risk
1–3 mg/L	Average risk
>3 mg/L	High risk
>10 mg/L	May indicate increased cardiac risk or recent inflammatory reaction
[a]Specific target levels for men and women, as well as various ethnic groups, are being studied.	
Source: Compiled by Author	*Table 4*

C-reactive protein may also signal whether a healthy person is headed for trouble. Although a direct correlation between elevated CRP levels and new coronary events has not been established, prospective studies of men, women, and the elderly have found that those in the upper third of CRP levels have twice the risk of MI as those with CRP levels in the lower third [115]. Another study found that C-reactive levels are a stronger predictor of cardiovascular events than LDL cholesterol levels [116]. In one study of healthy women, those with metabolic syndrome and a baseline high-sensitivity C-reactive protein (hsCRP) of 3.0 mg/L had almost twice the risk of future cardiovascular events than those with the syndrome and hsCRP <3.0 mg/L [117]. The Reynolds risk score (a risk assessment tool) incorporates hsCRP and has been shown to improve risk prediction in women [116; 117; 118; 119]. Studies have suggested that measuring CRP may increase the predictive value of other cardiovascular risk factors in women. In a study of 122 women, those who experienced a fatal or nonfatal MI, stroke, or coronary revascularization procedure had significantly higher baseline levels than the control group of four markers of inflammation (hs-CRP, serum amyloid A, soluble intercellular adhesion molecule-1 [sICAM-1], and interleukin-6); total and LDL cholesterol; homocysteine; and total cholesterol to HDL cholesterol ratio [119]. The researchers concluded that atherosclerosis must be recognized as an inflammatory disease. While high cholesterol levels foster the development of atherosclerosis, plaque instability and adverse cardiovascular outcomes result from inflammation. In using CRP levels to determine risk, women may be identified who might benefit from statin therapy, which reduces inflammation beyond the anti-inflammatory effects that aspirin provides [119; 120]. The ability of statin therapy to lower CRP levels has been shown to be directly and significantly associated with its LDL-lowering ability [121].

A CRP test (i.e., the hs-CRP assay) is widely available and may be completed at the same time as cholesterol screening. There is a general consensus that the hs-CRP should be reserved for individuals with a 10% to 20% (i.e., intermediate) 10-year risk of cardiovascular disease after screening for traditional risk factors (e.g., family history, age, hypertension) has been performed [108; 122]. Increased CRP may predict future cardiovascular events in both women and men with heart disease; therefore, using both cholesterol and CRP to determine heart attack risk is more accurate than either test alone. When both values are elevated, there is a significantly increased risk for coronary artery disease [116; 119]. It is important to recognize that CRP is only a good predictor of cardiac risk if the test is done when there is no current infection (e.g., sinus infection) or other chronic underlying inflammatory process (e.g., rheumatoid arthritis, lupus, Crohn disease). Additionally, there is a general consensus that CRP levels are most effectively used to determine risk classification and to reclassify risk of coronary events in some individuals [123]. Reducing CRP levels has not been shown to reduce coronary events [122; 124; 125].

Leukocyte Count

Given the increasing evidence supporting the role for inflammation in atherosclerotic process, the role of the leukocyte count in predicting cardiovascular disease has been receiving increased research attention. White blood cell (WBC) count is an independent predictor of cardiovascular events and all-cause mortality in postmenopausal women [126]. Specifically, a WBC count of greater than 6.7×10^9 cells/L may identify high-risk women who may not be currently identified by traditional cardiovascular risk factors. A high leukocyte count also appears to be a risk factor independent of the atherosclerotic disease status [127].

Subclinical Hypothyroidism

While subclinical hypothyroidism has also been associated with increased risk of aortic atherosclerosis and MI in postmenopausal women, this association has not been confirmed [128]. Subclinical hypothyroidism has been defined as an elevated thyroid-stimulating hormone level greater than 4.0 mU/L and a normal serum free thyroxine level (11–25 mmol/L) [129]. It occurs in 5% to 20% of women older than 60 years of age [106].

Periodontal Disease

Periodontal disease may also increase the risk of cardiovascular disease in adults by exacerbating several cardiovascular risk factors. A significant association has been found between poor periodontal status and increased levels of CRP and fibrinogen, two risk factors for heart disease. Periodontal status has also been weakly associated with an increased total cholesterol level, but not an increased HDL level. Explanations for this association include the repeated systematic exposure of individuals with periodontal disease to bacteria, endotoxin, lipopolysaccharide, and other bacterial products that influence lipid metabolism and homeostasis. Total cholesterol, CRP, and fibrinogen may be possible intermediate factors that link periodontal disease to elevated cardiovascular risk [130].

SUMMARY

Like men, women are at increased risk for heart disease due to several traditional cardiovascular risk factors, including both nonalterable factors (i.e., age, family history) and alterable factors (i.e., smoking, hypertension, hyperlipidemia, diabetes). Women additionally have gender-specific risks, such as use of hormonal contraceptives and the onset of menopause. When assessing cardiovascular risk factors in both women and men it is important to remember that many of these factors are synergistic, or work together, in significantly increasing cardiovascular disease risk.

CARDIAC DIAGNOSTIC TESTS

COMPLEXITY OF DIAGNOSIS IN WOMEN

The diagnosis of coronary heart disease is a more complex process in women for two primary reasons: age at presentation and differences in presenting symptoms. As noted, women are typically 5 to 10 years older than men when presenting with heart disease, which may be due either to a delay in diagnosis or a delay in presentation. When women do present, other conditions (e.g., osteoporosis, diabetes, hypertension) and the clinician's interpretation of the woman's chest pain may obscure the indications of disease. There is a greater prevalence of noncoronary causes of chest pain in the female population, and chest pain is frequently accompanied by abdominal pain, dyspnea, nausea, fatigue, and greater functional disability [131; 132; 133]. Additionally, a variety of intrathoracic and extrathoracic structures may cause symptoms, such as mitral valve prolapse, pericarditis, or gallbladder disease, that localize to the chest. Therefore, the differential diagnosis of chest pain must include a number of benign conditions in order to prevent a false-positive diagnosis of heart disease in women [133; 134]. ***Table 5*** outlines the differential diagnosis to initially rule out the most critical problems.

DIFFERENTIAL DIAGNOSIS OF CHEST PAIN	
System	**Potential Health Problem**
Cardiovascular	Ischemia vs. infarction Pericarditis Dissecting aortic aneurysm
Pulmonary	Spontaneous pneumothorax Pneumonia Pulmonary embolism
Gastrointestinal	Esophageal reflux/spasm Cholecystitis Peptic ulcer disease/perforation Pancreatitis
Musculoskeletal	Costochondritis Cervical/thoracic spine injuries
Psychogenic	Anxiety/panic disorder (psychosomatic)
Source: [135; 136; 137]	*Table 5*

To further complicate the picture, the clinical history and physical exam have limited value in women, except for women older than 65 years of age with definite angina [132]. The history and physical exam do provide information on the occurrence of prior events and risk factors, such as diabetes and hypertension, and also uncover symptoms of more advanced disease, such as heart failure. However, these diagnostic clues often only partially indicate disease likelihood, which makes further diagnostic tests both important and necessary [132; 138; 139]. The presence of new physical assessment findings, such as dysrhythmias, mitral regurgitation, a fourth heart sound (atrial gallop), or bibasilar crackles, increases the chances of a positive diagnosis of heart disease [140]. The diagnosis is also favored by the presence of other cardiovascular risk factors or by ECG changes at rest or during anginal episodes [140].

The Coronary Artery Surgery Study correlated women's clinical symptoms with angiographically documented heart disease. Heart disease was identified in 72% of women presenting with typical angina and in 36% of women with probable angina [134]. In those women with nonspecific chest pain, angiography rarely documented coronary disease. Because women with convincing symptoms of heart disease lack angiographic evidence almost 30% of the time, diagnosis based on clinical symptoms alone is not adequate [22; 134]. Both noninvasive and invasive cardiac diagnostic tests may be used in female patients. The following sections highlight the difficulties or nuances of diagnosing heart disease in women compared to men.

NONINVASIVE DIAGNOSTIC TESTS

Several noninvasive tests are used to diagnose coronary heart disease. These include the resting ECG, exercise ECG, nuclear medicine stress test, radionuclide ventriculogram, and exercise echocardiogram.

Resting ECG

The resting ECG is the first-line screening test used in men. It is also an important test in women due to the increased proportion of unrecognized or "silent" infarctions seen in the female population. The presence or absence of abnormal Q waves on the resting ECG may be affected by the use of HRT in women older than 50 years of age. Study results have shown that HRT, specifically estrogen therapy, lengthens the QT interval in postmenopausal women [141; 142].

Exercise ECG

Although the exercise ECG (also referred to as the stress test or exercise treadmill test) may not be as accurate in the diagnosis of heart disease in women as in men, the American College of Cardiology Foundation (ACCF) and the American Heart Association (AHA) have recommended the routine use of the exercise ECG (when combined with traditional analysis of ST-segment and heart rate changes) for evaluating suspected coronary artery disease in women who have a normal resting ECG and good exercise tolerance [143]. Women are more prone to inconclusive or false-positive results than men with this test [143]. However, a test result that is clearly negative has been found to be equally reliable in both women and men [134].

Even in women with heart disease, the accuracy of diagnosing heart disease from an exercise ECG alone is not recommended. When test results are either clearly positive or not clearly positive or negative, additional risk stratification with cardiac imaging is recommended [143]. The ACCF/AHA have recommended cardiac imaging for symptomatic women with established coronary artery disease, women who have an indeterminate or intermediate-risk exercise ECG test, and women with an intermediate-risk Duke treadmill score. Cardiac imaging has also been recommended for diabetic women, women with metabolic syndrome, and women with polycystic ovary syndrome, as these women have a significantly greater risk of cardiovascular death than women without these conditions [117; 143]. Better diagnostic results are seen in women with multivessel involvement versus single vessel or no disease. With multivessel disease, an overall accuracy of 84% has been reported [143].

A second difficulty associated with the exercise ECG is that for the test to work, a woman must be able to raise her heart rate up to 85% of maximum capacity by exercising for about 15 minutes. Women have a lower maximal aerobic capacity, which limits their ability to exercise to adequate intensity levels. As a result, the test is too strenuous for many women who are elderly, sedentary, or have other medical conditions, such as arthritis, that limit their ability to exercise [143]. Women who are older than 55 years of age and do not exercise regularly, but plan to begin a regular exercise program, should have an exercise ECG to determine a safe level of exertion [134].

Nuclear Medicine Stress Test

The nuclear medicine stress test (myocardial perfusion scanning) is another noninvasive diagnostic test that may be used in women. At peak exercise, a small amount of radioactive tracer is injected and a series of images of myocardial blood flow are then evaluated. Normal myocardial blood flow is indicated by a homogeneous distribution of thallium throughout the myocardium, while myocardial ischemia and/or infarction is suggested by either a transient or persistent defect in tracer uptake. Compared to the exercise ECG, the nuclear medicine stress test has better accuracy [144; 145]. It has also been associated with fewer false-positive tests in women, especially in those patients with multivessel disease [134; 146].

The major limitation of the nuclear medicine stress test in women is the attenuation of radioactivity in the overlying breast tissue, leading to a false-positive diagnosis of a fixed perfusion defect in the anterolateral segment. Other disadvantages are the cost of the test and exposure of the patient to radiation [12; 25; 33; 146]. Although, the radiation dose is minimal, women who are pregnant or breastfeeding should not undergo any type of radiation procedure [144].

Radionuclide Ventriculography and Radionuclide Angiography

Radionuclide ventriculography (RNV) and radionuclide angiography (RNA) are types of nuclear imaging tests in which red blood cells are labeled in vivo with technetium 99m, and gated images are recorded of blood flowing through the cardiac chambers. The tests not only assess chamber size and function, but also the response of left ventricular EF and the presence or absence of new wall motion abnormalities during exercise [147]. One of the abnormal findings of the exams is the failure of the patient to increase his/her left ventricular EF at peak exercise. The tests have been associated with increased false-positive rates because up to 30% of women do not increase their EF at peak exercise [12; 20; 25; 134]. Attenuation of myocardial activity by overlying soft tissue (e.g., breast tissue in women) also may also cause false positives [148; 149]. The tests, therefore, have reduced diagnostic value for women. Radionuclide ventriculography has been largely replaced by echocardiography, which is less expensive and does not require radiation exposure [148].

Exercise Echocardiogram

The exercise echocardiogram is a two-dimensional exam used to assess synergy of myocardial contraction. The exercise echocardiogram is more specific and reliable than the exercise ECG and a strong and independent prognostic indicator [149; 150; 151]. It is a useful diagnostic test in women because of its sensitivity to single-vessel disease, involving greater than 50% narrowing, which occurs more frequently in women compared to men (18% versus 9%). Due to the difficulty of diagnosing changes with exercise, drugs such as dipyridamole, adenosine, or regadenoson may also be used [152]. Dipyridamole is a potent coronary artery vasodilator; side effects from its use include dizziness, gastrointestinal upset, nausea and vomiting, headache, and rash. Adenosine has a more rapid onset but wears off more quickly. Adverse reactions include transient new arrhythmias and heart block [153]. Regadenoson was approved by the U.S. Food and Drug Administration (FDA) in 2008 as an additional agent for use in stress testing in patients unable to perform the standard exercise stress test [152; 153]. Regadenoson increases coronary blood flow and mimics the increase in coronary blood flow caused by exercise. Adverse reactions include tachycardia, flushing, chest discomfort, and headache [153]. In 2013, the FDA issued a warning of a rare but serious risk of myocardial infarction and death associated with both adenosine and regadenoson [154]. These agents should be avoided in patients with evidence of unstable angina or cardiovascular instability.

The American Society of Nuclear Cardiology has stated that dobutamine infusion may be an effective alternative agent for stress echocardiography [155]. Dobutamine stimulates beta-adrenergic receptors, resulting in increased contractility and heart rate. It may cause premature ventricular contractions, chest pain, and hypotension. Adverse reactions include nausea, dyspnea, and fever. It is important to note that dobutamine infusion for stress echocardiography is an off-label use [153].

When properly performed (i.e., not stopped too quickly), the exercise echocardiogram has been found to have high sensitivity and specificity (86%) for the detection of coronary artery disease in women [24].

Electron Beam Computerized Tomography (EBCT)

Electron beam computerized tomography (EBCT), also called an ultrafast CT scan, is a rapid form of x-ray imaging technology that results in a clear image of the heart and the surface of the coronary arteries. EBCT has been studied as a tool to identify individuals at risk for coronary artery disease by measuring calcium deposits in the coronary arteries, which would correlate to the amount of atherosclerosis. Experts have indicated, however, that the amount of coronary calcification does not necessarily indicate that an individual will suffer an MI, and the absence of calcification does not rule out coronary artery disease [156]. However, calcium scoring has been shown to improve risk prediction in women. The Multi-Ethnic Study

of Atherosclerosis (MESA) trial included 3,601 women, 90% of whom were classified as low risk [157]. The prevalence of any coronary calcium was associated with a six-fold increased risk of coronary artery disease (CAD), adjusted for age, ethnicity, body mass index, low-density lipoprotein, hypertension, smoking, estrogen, and statin therapy. The results showed that the presence of coronary calcium redefined the women who had been improperly labeled as low-risk, based on Framingham criteria.

Cardiac Enzyme Determination

While not a diagnostic test per se, measurement of serial cardiac enzymes is also pivotal in making an accurate diagnosis of myocardial injury and/or infarction in both men and women [158]. However, due to their smaller body size, enzyme elevations may not be as high in women as those seen in men. This information is important to know when analyzing and interpreting enzyme rises in female patients presenting with cardiac symptoms. Research studies are needed to explore cardiac enzyme activity in female cardiac patients as well [20].

INVASIVE DIAGNOSTIC TESTS

Cardiac Catheterization

Cardiac catheterization is the definitive diagnostic test to detect heart disease despite major drawbacks, such as its invasive nature, cost, and potential complications [12]. While the number of catheterizations performed on women has increased, men are more likely to be referred for catheterization than women, possibly because women may be at greater risk of adverse events, including death, following catheterization [159; 160; 161; 162]. One study found that men were 40% more likely to undergo angiography than women, despite data that indicates women have more functional impairment and unstable symptoms, as measured by angiography, than men [163; 164]. However, a 2010 study found a sharp decrease in catheterization in both men and women when age-specific rates were compared [69].

A number of factors may play a role in the decision to perform invasive testing, which would impact the diagnostic referral rates. Patient factors may include symptom severity, response to treatment, lifestyle modification, comorbidities, age, social circumstances, and personal preferences. Women may be more likely to defer invasive testing until a cardiac crisis occurs because they tend to underestimate the impact of heart disease on their lives [165; 166; 167]. Practitioner factors may include interpretation of symptoms and their severity, interpretation of noninvasive testing, perception of probability of heart disease, perception of risk/benefit of potential revascularization strategy, and bias. Social factors center on the availability of noninvasive testing and cardiac catheterization facilities [168].

Compared with men, when cardiac catheterization is performed in women the test usually reveals less extensive disease [164]. Single-vessel disease occurs in 50% of women, with the left anterior descending artery the most common site of lesions (i.e., in 43% to 54% of cases). In the remaining 50% of women, 25% have two-vessel disease and 25% have three-vessel disease. In addition, left main disease is less common in female cardiac patients compared to men [12; 20; 33].

SUMMARY

Heart disease is more complex to diagnose in women due to the fact that the overall prevalence is lower in women and also because women experience more noncoronary causes of chest pain. When heart disease is diagnosed, certain diagnostic tests are more reliable in women. These tests include the resting ECG, which is especially reliable in picking up the unrecognized or asymptomatic infarctions seen more commonly in women; the thallium scan; cardiac enzymes; and the resting or exercise echocardiogram. While cardiac catheterization is the gold standard for diagnosis in both men and women, the procedure tends to show more extensive disease in male patients. Women tend to suffer from more single vessel and two-vessel disease as opposed to the three-vessel disease seen more often in men.

Differences in the use of diagnostic cardiovascular procedures have been documented. Although the overall use of procedures is high, men with unstable angina are more likely to receive diagnostic cardiovascular procedures (e.g., stress tests, angiography) than women experiencing the same symptoms. Healthcare professionals clearly have a significant role to serve as patient advocates, speaking up for female patients to ensure they receive the appropriate diagnostic workup when presenting with potential cardiac symptomatology.

CLINICAL MANIFESTATIONS OF CARDIAC DISEASE IN WOMEN

ANGINA

After menopause, the clinical manifestations of heart disease increase in women. The most common manifestation of heart disease in both men and women is angina [169]. Approximately 6.6 million women in the United States are currently living with heart disease; 35,000 are younger than 65 years of age, and 4.1 million suffer from angina [1; 54]. The basic forms of angina include stable angina, unstable angina, and variations of angina. In terms of incidence, stable angina occurs more frequently in women in the United States than in men, with an estimated female-to-male ratio of 1.7:1 [170]. Stable anginal episodes often worsen and become more severe, leading to unstable angina.

Unstable angina is a type of chest pain that radiates more widely, may occur at rest, and is difficult to relieve. Women who suffer from unstable angina have the greatest likelihood of significant coronary artery stenosis and three-vessel or left main heart disease. Consequently, these women are at greatest risk to experience more serious cardiac events, such as an MI or sudden cardiac death [171].

There are also several variations of angina. Variant or Prinzmetal angina is a form of unstable angina usually associated with a coronary artery spasm. It is characterized by episodes of severe ischemic-type chest pain that occur at unpredictable intervals, usually when the patient is at rest. There is a tendency for the anginal episodes to occur at night or in the early morning. Transient ECG changes that may accompany the anginal episodes include ST-segment elevations. Variant angina occurring in the presence of angiographically normal coronary arteries is more common in women than in men. It may also occur in the presence of high-grade coronary artery lesions [172].

Another variation is microvascular angina, also referred to as cardiac syndrome X. It is manifested by complaints of atypical or vague chest pain and occurs more frequently in perimenopausal and postmenopausal women [173]. While the pain is comparable to the characteristics of angina, several atypical features are also present, including rest pain, prolonged pain, and a less favorable response to nitroglycerin [173]. ECG changes often include ST-segment and T-wave abnormalities at rest as well as exercise-induced ischemia [173].

By definition, microvascular angina is characterized by the presence of angiographically normal coronary arteries. In women with this syndrome, plaque accumulates in very small arteries of the heart, causing arterial narrowing, reduced oxygen flow to the heart, and pain that may be similar to that experienced by patients with blocked major coronary arteries. As noted, the difficulty with microvascular angina is that the plaque does not appear when using standard tests. Women with this type of angina have less of a likelihood of significant coronary disease, and therefore a better prognosis, compared to other forms of angina; however, these women are still at risk of suffering an MI or, at a minimum, of experiencing a reduced quality of life [174; 175; 176; 177].

It has been speculated that up to 80% of instances of this syndrome may be due to hypersensitivity in the nerves that lead to the heart, esophagus, and chest, making women acutely aware of sensations in their heart. Another possibility is that the syndrome is caused by a disorder of the small blood vessels that feed the heart, whereby the vessels fail to dilate in response to physical and/or emotional stress. The syndrome could also be due to a hormonal imbalance induced by a deficiency of estrogen. The exact etiologic mechanism is not known, and many women respond to beta blockers, calcium channel blockers, and nitrates. However, clinical experience has generally been that pain relief with medical therapy is not sustained over time and patients are commonly and unnecessarily prescribed a large number of drugs [175; 177].

Differences in Chest Pain Syndromes

The genders differ in still other ways when it comes to cardiac symptomatology. Men often experience textbook cases of angina and other heart disease symptoms, perhaps because the texts were written to describe men's symptoms. However, the classic picture of heart disease in women is just not known. For example, the hallmark symptoms of an MI (i.e., chest discomfort, pain that spreads, cold sweats, nausea) are experienced more frequently by men than women. Additionally, while chest pain is the most common symptom reported among both women and men, women more frequently report "vague" chest discomfort that comes and goes with no particular precursor [132; 178; 179].

Women may complain of classic substernal pain or have variations in their chest pain syndromes for reasons that are not completely understood. Women frequently report pain centered in the chest, pain in one or both arms, pain in the neck and/or jaw, or pain centered in the back and/or shoulders. They also frequently report nausea, back pain, dizziness, generalized fatigue, shortness of breath, and palpitations [132; 138; 178; 180; 181]. Women also experience weakness and loss of appetite [182]. After controlling for age, diabetes, anxiety, depression, and functional status, women are still more likely than men to report these symptoms [182]. Recognition of these gender differences in symptom reporting may result in preventing incorrect or delayed diagnosis and treatment as well as preventable deaths.

PSYCHOSOCIAL RESPONSES TO CARDIAC EVENTS

In addition to clinical manifestations, women may have different psychosocial responses to cardiac illness than men [183; 184]. For instance, women, especially those 65 years of age and older, tend to delay seeking treatment for many hours [185; 186; 187]. In one study, the median was 4.25 hours; other studies have reported delays of up to 15 or more hours [184; 188]. A woman may not suspect that her symptoms are related to heart disease, so it may be difficult to convince the female cardiac patient that she needs medical help. Other reasons women delay seeking treatment include perceptions about the severity of their symptoms or their vulnerability to MI and the presence of other chronic illness that create confusion about cardiac symptoms [184; 185; 189]. Maintaining control and not wanting to trouble others have also been found to influence a woman's decision about when to seek treatment for cardiac symptoms [190; 191].

Women should be taught the importance of seeking early medical attention and the subsequent clinical benefits [169; 189; 190]. For instance, in the face of an acute MI, delays in seeking treatment reduce a woman's chance of successful myocardial salvage with medications, such as thrombolytic agents. Another delay may occur once in the emergency room, especially if a female patient presents with nonspecific symptomatology and/or an initial normal ECG and cardiac enzymes [54]. Furthermore, women are also less likely to be transferred from a small hospital to a large university hospital for aggressive care. Generally speaking, men tend to be transferred to larger centers twice as fast as women.

MYOCARDIAL INFARCTION

Men and women also differ in their incidence of MI. Thirty-four percent of women with coronary heart disease experience an MI, compared to 50% of men [12; 42]. Of the 6.6 million women with coronary heart disease, about 2.7 million have a history of MI [1]. Each year, new and recurrent MI and fatal coronary heart disease will impact an estimated 405,000 women [1].

Coronary heart disease is the single leading cause of death of American females, accounting for 22.4% of all deaths in 2013 [11]. Approximately 76% of women who died suddenly of coronary heart disease had no previous symptoms [1].

Unrecognized or silent MIs are more frequent in women (54%) than men (33%) and account for more than 50% of all infarctions in women 55 years of age and older [192]. Factors that place women at increased risk include older age, hypertension, and diabetes [192]. As mentioned previously, sudden cardiac death generally occurs about 5 to 10 years later in women compared to men.

Despite the overall lower incidence, if women suffer an MI they have a much poorer prognosis than men [1]. Morbidity may be higher in women due to their advanced age at the time of the infarction and the increased number of other comorbidities or chronic health problems. In addition, women may have more extensive damage with inferior MIs due to their greater tendency to have dominant right coronary artery systems [133].

In terms of outcomes, women are twice as likely to die within the first few weeks post-MI compared to men [54]. Women are also more likely to die within the first year post-MI (23% versus 18% men) [1]. Again, the higher mortality figures may be due to the older age of women at the time of the MI. In addition to increased mortality, women also have higher post-MI complication rates. In the early hospitalization period, women have slightly higher re-infarction rates (25% versus 22% in men); women with symptomatic infarctions are at greater risk for re-infarction than those with silent or unrecognized MIs. These rates are higher even up to five years post-MI [12; 20; 33]. Within six years after a recognized heart attack, 46% of women will be disabled with heart failure [54].

In further research, Yale investigators examined the records of 229,313 men and 155,565 women who were hospitalized for MI and enrolled in the National Registry of Myocardial Infarction II (NRMI-2) from 1994 to 1998. The findings revealed that for every five-year decrease in age, the odds of women dying during hospitalization compared to men increased 11.1% [193]. Subsequent analysis revealed a marked decrease in in-hospital mortality rates in women between 1994 and 2006, with the largest relative decrease in women younger than 55 years of age [194]. In another study, data from the Global Use of Strategies to Open Occluded Coronary Arteries in Acute Coronary Syndromes IIb study (GUSTO-IIb) was examined to evaluate gender-based differences in MI presentation and outcome [195]. Women were found to have more complications than men during hospitalization and a higher mortality rate at 30 days. However, in this analysis, women were found to have similar rates of re-infarction at 30 days post-MI. Researchers concluded that these differences may be due to anatomic or pathophysiologic differences between men and women or differences in rates of referral for diagnostic work-up or revascularization. Subsequent studies have indicated that when women receive timely, appropriate cardiac intervention, their 30-day mortality rate is similar to that of men [196; 197].

Post-MI Complications

Other complications, such as heart failure, dysrhythmias, and stroke, are more common in women post-MI. The risk of heart failure during the post-MI period increases in women smokers and those with diabetes. In addition, heart failure tends to be more severe in women despite their higher left-ventricular EF and less severe ventricular dysfunction, perhaps due to the adverse effect of diabetes and hypertension on left ventricular diastolic function [12; 20; 33]. Approximately 3 million women have heart failure [1].

The incidence of supraventricular and ventricular dysrhythmias, as well as heart block, appears to be similar in women and men. However, more ventricular dysrhythmias have been reported in young women with MI who use hormonal contraceptives. Women also have a much higher risk of stroke post-MI and death from stroke compared to men [54].

SUMMARY

The clinical presentations of heart disease in men and women are different. Women are more likely to suffer from angina, while more men tend to suffer MI as an initial indication of their disease, and women's cardiac symptoms may be quite different than the "typical" presentation seen in men. In addition, if women suffer an MI, they have a much poorer prognosis than men and have higher complication rates, such as heart failure, dysrhythmias, and even stroke. These findings may be due to the fact that the women are typically older, sicker, and have more comorbidities at the time of their MI in comparison to their usually younger male counterparts.

THERAPEUTIC INTERVENTIONS

Various forms of treatment are available for heart disease. Medical management may include pharmacotherapy, PCI, and thrombolytic agents, such as streptokinase and tissue plasminogen activator (tPA). Surgical intervention may be indicated in patients who have extensive coronary artery lesions. Regardless of whether a medical or surgical approach is taken, women who have documented heart disease should be encouraged to enroll in a formal outpatient cardiac rehabilitation program.

MEDICAL THERAPIES

Angioplasty

PCI is the treatment of choice for patients with single-vessel coronary heart disease [198]. An estimated 35% of PCIs in the United States are performed in women [199]. At the time that this procedure is first performed, women tend to be on average nine years older than men, with more cardiovascular risk factors and severe unstable angina [199]. However, angiographically documented coronary artery disease has not been found to be more extensive in women compared to men [200]. On a per-lesion basis, angiographic success rates have been found to be similar between men (88%) and women (89%), as were clinical success rates [200; 201]. Determinants of PCI success include lesion-specific angiographic features, such as the severity of stenosis, coronary calcification, and intralesional thrombosis-factors that are not influenced by either age or gender [202]. In treating left anterior descending disease, CABG surgery is an attractive option due to the high rate of post-PCI restenosis [199].

Women undergoing PCI have a greater incidence of initial postprocedure complications, such as bradycardia, hypotension, and coronary dissection [201]. The latter may be attributed in part to balloon size. A higher rate of unsuccessful PCIs, defined as an inability to cannulate the vessel and pass the lesion with the balloon catheter, has also been reported in female patients. These women are more likely to have elective CABG surgery after PCI than men. Advances in new techniques and equipment, such as angioplasty catheters, as well as the clinical expertise of the physician performing the procedure, are helping to bring these rates into comparable levels between men and women [201; 203]. In addition, women have a significantly higher in-hospital mortality rate (6.0%) compared to men (2.3%) [203; 204]. One factor may be height, which has been shown to be predictive of risk level, with shorter people at highest risk. Other factors that may explain this finding include women's more advanced age, increased comorbidities, and poor cardiovascular risk factor profiles, such as hypertension and diabetes. An important factor affecting procedural mortality in women is severity of disease. An independent effect of gender on acute mortality following PCI persists after adjusting for the baseline higher risk profile in women [203; 204].

Survival rates post-PCI are similar for men and women with regard to long-term outcomes. Four-year survival, however, is lower in women (89.2%) than in men (93.4%) [203]. While women have slightly fewer coronary events and a lower incidence of restenosis and need for additional revascularization (i.e., repeat PCI or CABG), symptomatic improvement is similar for men and women [201].

Thrombolytic Therapy

Thrombolytic therapy is frequently given to patients within the first six hours of presenting with possible cardiac symptoms. It has proved beneficial in restoring vessel patency and clinical outcomes in both men and women and has resulted in a 25% to 30% reduction in short-term mortality [200; 205]. However, women are less likely to receive thrombolysis to restore vessel patency in the management of acute MI for several reasons, including advanced age, delayed arrival at the hospital, and medical contraindications [205]. Even in those eligible, women are less likely to receive thrombolytic therapy [206]. The *Gruppo Italiano per lo Studio della Streptochinasi nell'infarto Miocardico* (GISSI-1) reported a significant reduction in the 21-day mortality in women who received IV streptokinase within six hours post-MI. Despite these promising outcomes, treated women's mortality rates remain higher than men's [206].

Women who are treated with thrombolytic therapy tend to experience more complications, such as stroke and major bleeding. Increased bleeding, especially severe intracranial bleeding, has been reported in some women, particularly elderly women [205]. This finding may be due to the administration of fixed dosages. Although not validated through research, women may require lower doses of these drugs to be consistent with their smaller body mass. This question remains unanswered because women have often been excluded from the clinical trials related to cardiac medications [206].

SURGICAL INTERVENTION

The Coronary Artery Surgery Study (CASS) investigated 2,800 women and 5,300 men who were experiencing severe enough chest pain to warrant a cardiac catheterization. This study revealed a number of differences in the preoperative status of men and women prior to bypass procedures. As discussed earlier, women were found to be at increased surgical risk because they tend to be older, have more unstable angina, frequent cardiac enlargement on chest x-ray, severe mitral regurgitation, and more symptoms and comorbidities, such as heart failure, hypertension, and diabetes. Factors that place women at lower risk include the fact that they tend to have fewer diseased arteries and less myocardial damage. In other words, women generally have better EFs and ventricular wall motion, as well as less left main stenosis and three-vessel disease [12; 20; 25; 26; 33]. It has been suggested that these differences in preoperative status may be less related to gender than to delays in the initial diagnosis and treatment of symptomatic heart disease in women. This delay translates into an older age and more frequent comorbidity in women at surgical presentation [207; 208].

Additional studies offer more encouraging news for women. One study of 2,200 patients who underwent CABG at Cleveland Clinic between 1993 and 2003 found no gender difference for in-hospital mortality but did find that women have a longer length of stay after surgery as well as higher postoperative complications rates, factors that may affect a woman's postdischarge recovery. Another study, conducted by several leading New England hospitals, compared patients and outcomes from 1987 to 1989 with those from 1993 to 1997. Researchers found that although women having CABG in the latter date range were older and sicker than those in the earlier range, the mortality rate had decreased [209].

In relation to referral patterns, women tend to be referred for surgery much later than men. In one study, fewer women with symptoms were referred for catheterization, and men underwent CABG four times as often as women. Women were referred more for symptoms of unstable angina, heart failure, and post-MI angina, while men were referred on the basis of a positive exercise ECG [20; 25]. As a result, women are more likely to have surgery on an emergency basis, with potentially fewer techniques available to the surgeon, rather than on an elective basis, as is common in men. For example, the use of left internal mammary artery (LIMA) grafts are accepted as the "gold standard" for surgical revascularization. Many studies have demonstrated better long-term patency rates and survival in patients undergoing CABG with LIMA [210]. However, one study found LIMA usage to be significantly less in women and other high-risk subgroups (i.e., the elderly, diabetics, patients having emergency CABG, poor LV function, respiratory disease) because the short-term risks of LIMA use are perceived to be greater than the long-term benefits [211]. The risk-to-benefit question is of increasing importance as the proportion of high-risk subgroups continues to rise [210; 212].

In terms of operative success, the perioperative mortality rate has been documented to be higher in women than in men, particularly in women younger than 50 years of age and women 50 to 59 years of age; however, advanced age is still considered to be a significant risk factor for women [213]. The higher mortality in women may be also attributed to pre-operative clinical status, other cardiovascular risk factors, and smaller body size and coronary artery diameter, which make anastomosing grafts more difficult. As surgical techniques become more refined, the latter issue may be less of a problem. For both men and women, operative mortality does decrease as height and vessel diameter increase. Therefore, vessel diameter, and perhaps not gender, is most indicative of operative success [20; 25; 33; 34].

Postoperative outcomes of women after CABG surgery have also been studied. The findings indicate that women experience increased hospital stays, higher complication rates, and greater postoperative morbidity, leading to more hospital readmissions compared to men [25; 214]. Women report less relief of angina, poorer health, and more symptoms than men [33; 212]. Improved surgical techniques, such as off-pump coronary artery bypass appear to be safe, effective alternatives to CABG for high-risk patients, including women, and provide lower mortality and complication rates and shorter hospital stays [209]. The 5- and 10-year survival rates post-CABG are similar for men and women [215; 216].

An interesting study has compared the symptoms experienced by men and women during the first four weeks of recovery post-CABG surgery. Women reported numbness and discomfort in their breasts, while men reported more fatigue, incisional pain, and negative emotions. Both men and women felt their recovery emotions were related to their social roles and circumstances [212]. For instance, women were concerned and anxious about who would care for them during their home recovery, as they tended to be older and live alone. In contrast, men were more concerned first with their immediate physical recovery symptoms and secondly with return to work issues [217]. Researchers have noted that women tend to find strength for the postoperative recovery phase from their own spirituality and relationships with others, especially their families, friends, and social networks [218]. One study found that women's primary concerns shifted over the course of a year after cardiac surgery [219]. In the first postoperative month, women were most concerned with issues related to future plans, such as progress in recovery and resuming their lifestyle. By one year after surgery, women were most concerned about diet, and more than half of the women were exercising more.

CARDIAC REHABILITATION

Both inpatient and outpatient cardiac rehabilitation programs are an essential component of heart disease treatment in women. Challenges abound in providing phase I inpatient rehabilitation due to decreasing lengths of stay. Therefore, there is a need to emphasize survival skills to the female cardiac patient, as well as to enroll her in an outpatient phase II program. Despite these needs, reported compliance rates for formal cardiac rehabilitation programs, for both men and women, range anywhere from 21% to 75% [220].

This range in compliance rates may be a reflection of the referring physician. For example, researchers have found that as few as 7% of eligible cardiac patients are referred to a cardiac rehabilitation program and an even smaller percentage are referred for outpatient rehabilitation following hospital discharge. Lack of adherence to or awareness about referral guidelines or disagreement with guidelines may be contributing factors in low referral rates. This is important because the strength of the physician's recommendation is strongly associated with patient compliance [221]. Factors affecting physician referral include positive perceptions of a short distance to the rehabilitation site, perceived barriers to uptake of rehabilitation, limited general knowledge about cardiac rehabilitation programs (e.g., attributes, benefits), lack of insurance coverage, and low physicians' fees [222; 223].

Women tend to be referred for cardiac rehabilitation post-MI or CABG surgery less often than men and, thus, have lower overall participation rates. This is true even though an estimated 40% of cardiac events occur in women [15; 20; 218; 221]. In one study, of the 91% of female patients that were eligible for outpatient cardiac rehabilitation, only 48% were referred by their physician, in comparison to 67% of men [224]. Of those women who participated in outpatient rehabilitation, 75% completed the program versus 88% of the men. Thus, it appears that women have higher dropout rates compared with male cardiac patients, despite their higher risk of decreased quality of life and functional ability following an MI [221].

A number of factors account for the lower program completion rates among women. These factors include family commitments, financial concerns such as insurance barriers, and lack of spousal support. Other reasons for decreased program attendance in both men and women include transportation problems, distance, cost, work conflicts, medical reasons, and having a sense of personal control over their condition [222; 225]. Societal barriers, such as low education, also may impede enrollment in a rehabilitation program [226]. However, women's attendance at cardiac rehabilitation programs is more often affected by medical reasons compared to men, with complaints of increased angina and other associated symptoms, comorbidities such as arthritis and peripheral vascular disease, and/or a need for admission to transitional care postdischarge. This trend may be due to the presence of more cardiovascular risk factors and increasing cardiac symptoms in women [25; 224; 227]. On the other hand, men usually receive more family support and are accompanied by their spouse to cardiac rehabilitation programs more often than women, a finding that may partially explain women's higher dropout rates. Clearly, cardiac rehabilitation programs should be structured to the unique needs of women [221; 228]. Home-based cardiac rehabilitation programs are another attractive option for women, especially for the elderly and homebound [15; 20].

Nurse-led coordination of care after hospital discharge may have a role in improving rehabilitation uptake [229]. Some experts advocate giving nurses more responsibility to educate and motivate women to complete their recovery by participating in outpatient cardiac rehabilitation [230]. By assessing each woman prior to discharge, those who are at increased risk for not participating may be identified and targeted for follow-up. This assessment should include: a woman's psychologic state, namely anxiety and depression; other psychosocial factors, such as unemployment, lower educational and socioeconomic status, and lack of social support; and functional status.

Combined systematic and liaison-facilitated referral has been found to result in significantly greater enrollment in cardiac rehabilitation programs among women. One prospective study included 2,635 coronary artery disease inpatients that utilized one of four referral strategies [231]. All participants completed a sociodemographic survey, and one year later, 1,809 participants (452 [25%] women) completed a mailed survey that assessed their utilization of cardiac rehabilitation. Overall, more men than women were referred to (67.2% and 57.8%, respectively) and enrolled in (58.6% men and 49.3% women, respectively) a cardiac rehabilitation program. Among the women, combined systematic and liaison-facilitated referral resulted in significantly greater referral to and enrollment in a cardiac rehabilitation program when compared with usual referral strategies.

Activity and Exercise

While women have a lower aerobic capacity at baseline and after exercise training, the magnitude of their improvement is similar to or greater than that of men after a 12-week program. In other words, cardiac rehabilitation may actually have greater benefit for women because they begin with a lower functional capacity. Women develop increased physical work capacity and lower their myocardial oxygen demand through exercise training and achieve the same training effects as men [227; 232]. In addition to exercise, cardiac rehabilitation also favorably alters other cardiovascular risk factors [233; 234]. In one study, both men and women showed a trend in decreasing mean weight and quitting smoking. Yet, no changes in their lipid profiles were found before or after the program [227].

Women have a tendency to begin household activities early in the postdischarge period, often immediately upon discharge, then increase progression of their activities by the third or fourth week. In studying psychosocial responses, women tend to experience guilt feelings if they are not able to assume their usual household activities after their cardiac illness and often resist help from their family members because they do not perceive chores as a strenuous activity [212]. In contrast, men tend to rest for a period prior to progressing activity levels and begin to walk at approximately three to four weeks after discharge from the hospital [25]. As a result, women tend to be active at higher metabolic equivalent levels compared to men, most likely due to the earlier resumption of household activities. This is an area of major concern in the treatment of female patients due to their higher mortality rate post-MI. Women also experience more depression in association with their cardiac illness compared to men, which may be associated with activity limitations due to recurring symptoms and poorer health [20; 221].

Return to Work

According to research presented at the Acute Cardiac Care Congress 2013, a delay in treating patients with MI postpones their return to work and increases early retirement [235]. Researchers conducted a population-based cohort study that included 4,061 patients younger than 67 years of age admitted with STEMI during a 13-year period (1999–2011) and treated with PCI. Only patients who were employed either full-time or part-time before their admission were included in the study. After four years of follow-up, 91% of the study population had returned to work. After eight years of follow-up, 29% had retired. After adjusting for confounding factors, the researchers found that a delay in treatment of more than 120 minutes was associated with a postponed return to work. They also discovered that after eight years, a long delay in treatment of MI resulted in a 21% increase in patients' retirement rate. Researchers found no differences between men and women in the effect of treatment delay, but did find that men returned to work later than women [235].

Psychosocial Support

Another component of cardiac rehabilitation involves psychosocial support. This support may be provided either individually or in group settings [221]. Support groups may be offered as an intervention to meet the unique needs and concerns of women with heart disease. Because women tend to be more process- and relationship-oriented, they may have a need to talk about their experience with other women, family, friends, and healthcare providers after the cardiac event. Asking female cardiac patients what they believe caused their cardiac illness and what fears they have, as well as what the experience means to them or what they have learned as a result of their heart condition, may be helpful [20; 183].

Cardiac support groups may also be designed to include family members in addition to the female cardiac patient. Many different kinds of groups may be offered to provide support during the acute and convalescent phases. For instance, a support group could be offered to the families of women who have undergone CABG surgery. Family members could be asked how they perceive their relative is responding to the cardiac event and how the event is affecting their lives [183]. Other groups may be offered for only the patient, for example after recovering from an MI, or the group may be structured to also include the patient's spouse or significant other. Regardless of the approach used, the group sessions should be scheduled at times that are convenient for women and their families.

Several experts have described the common themes discussed in either patient, spouse, or couple support group settings. The common themes often discussed in patient-only groups include [236]:

- Reliving the coronary event and searching for a reason or cause for the event
- Hiding anger and depression from the family
- Uncertainty about the future
- Separation anxiety related to discharge from the hospital
- Change in family roles
- Ambivalence about medical care
- Change in sex life and fear of sex
- Dependence-independence conflict in marital relationships
- Need for control
- Conflictual relationships with young children
- Feelings of anger, hostility, helplessness, and dependency

While these themes have been reported in numerous group settings with cardiac patients and families, more research is needed to determine whether the themes are equally common when the patient is a female [236]. Perhaps some of these themes are more prevalent or are only reported in cases of men with heart disease. In addition, some themes would undoubtedly only be present when a woman in the family has heart disease.

In contrast, couple groups were concerned with issues such as expressing anger, imparting information, instilling hope, redefining wellness, identifying with others, and an altruistic concern for others. Themes in spouse groups have centered on the following areas [236]:

- Concern for the patient's medical condition, discharge from the hospital, and emotional ability
- Emotions such as anger, frustration, insecurity, guilt, loss, and uncertainty
- Anxiety about the future
- Sexual-related fears
- Conflict between self-expression and a need to protect spouse
- Catharsis
- Fear of upsetting patient
- Change in interpersonal relationships
- Sense of responsibility for patient's recovery
- Death
- Depression and psychosomatic symptoms

As with patient-only group themes, further investigation is needed to determine if the themes of couple and spouse groups are similar when the cardiac patient is a woman. These relationships will most likely be affected in unique ways when a woman in the family is struck with heart disease.

Regardless of whether a medical or surgical approach is taken in the treatment of women with heart disease, patients should be encouraged to enroll in an outpatient cardiac rehabilitation program. These programs have shown that women can favorably impact their cardiovascular risk profile and obtain physiologic benefits of aerobic exercise. Furthermore, addressing psychosocial aspects of care through support groups or individual therapy may be helpful.

IMPLICATIONS FOR NURSING PRACTICE

Women with heart problems are in special need of patient advocates. Nurses have a crucial role in supporting female patients to ensure they receive appropriate diagnostic and therapeutic care. In addition to briefly exploring this patient advocate role, this section will present common nursing diagnoses for women with heart disease during the acute care phase.

IMPLICATIONS FOR ASSESSMENT

The main implication for assessment in women is recognition that chest pain may not be their presenting symptom. Women have more complaints of vague chest pain that warrant further workup. It is important to anticipate nonspecific signs and symptoms, such as back pain and loss of appetite. It is important to be aware of the possibility of occult heart disease in women older than 65 years of age. Unrecognized heart disease may complicate the recovery course of women who are hospitalized for noncardiac problems, as women have more episodes of silent ischemia and infarction. Nurses have a critical role in the thorough assessment of patients and in providing education on reduction of cardiovascular risk factors and recognition of signs and symptoms of heart disease [237].

EVALUATION OF MEDICAL THERAPY

While little literature exists on the specific treatment of women with heart disease, it has generally been believed that women will respond to the same therapeutic interventions as men. However, the clinical outcomes may be quite different. Therefore, it is important not to assume that what has been learned about men through practice or research may be equally applied to women [238; 239]. The unique physiologic aspects of women's cardiovascular systems should be considered when implementing medical therapy [238; 239].

Nurses have a special role to play as patient advocates when caring for women with cardiac problems. Nurses should encourage symptomatic women to interact with their physician to obtain a correct diagnosis and suggest appropriate cardiac diagnostic tests, such as exercise echocardiograms. If female patients are not responding to medical or nursing interventions, nurses should question if these are the right techniques. By detecting subtle changes in a woman's response to treatment, nurses can provide input and suggestions for the plan of care. For instance, if anginal episodes post-MI are not resolving, changing to a cardioselective beta blocker and adding nitrates to the medication regime may be suggested. In addition, nurses can request researchers to gather data on women or replicate studies with women. With increased understanding of female responses to heart disease, nurses will be able to identify and test more appropriate interventions. If women and men respond differently to cardiac events, nursing care standards should then be modified and integrated into clinical practice accordingly [238; 239].

NURSING MANAGEMENT DURING THE ACUTE PHASE

Several sequelae may occur in women with heart disease during the acute hospitalization phase, including decreased cardiac output, alteration in comfort level or pain, knowledge deficit, activity intolerance, body image disturbance, and sexual dysfunction [239]. Each of these will be further explored, with special consideration given to implications for treatment in female patients.

Decreased Cardiac Output

Decreased cardiac output is one of the most significant sequelae in women with heart disease. This diagnosis exists whether the woman is experiencing angina or MI or is recovering from cardiac surgery, although the nursing implications may vary with each clinical scenario.

It is important to recognize that female cardiac patients experiencing angina have a more favorable prognosis than men. However, prevention of an acute MI is paramount in this group, because when a woman does have an MI, she has an unfavorable prognosis. A comprehensive cardiovascular risk assessment should be performed, focusing on both traditional and female-specific risk factors (e.g., myocardial dysfunction, blood loss, increase in intrapericardial pressure, changes in cardiac rhythm and/or electrical conduction) [240]. When these risk factors have been identified, female patients may be educated and counseled about strategies to reduce their coronary risks through various lifestyle modifications [138; 240].

During the post-MI phase, female patients have significant morbidity and mortality. Assess for the presence of other diseases that may impact the patient's recovery, such as diabetes or hypertension, as well as early manifestations of heart failure [138]. Several pharmacologic considerations in relation to cardiac output status apply in these patients. Cardiac medications, such as antidysrhythmics, may be less indicated in women because complex ventricular ectopy or ventricular dysrhythmias are not associated with as severe adverse prognoses as in men. It is also important to recognize that thiazide diuretics used in conjunction with antihypertensives to treat hypertension may have hyperlipidemic effects. Estrogen protects women against hyperlipidemia, so cholesterol levels should be closely monitored, especially in menopausal women [20].

Beta-blockers have been extensively evaluated in placebo-controlled clinical trials including many types of patients, including women and the elderly [241]. Three beta-blockers (i.e., carvedilol, bisoprolol, and sustained-release metoprolol [succinate]) have been found to be beneficial in women with heart failure when added to an ACEI [242; 243]. Carvedilol is a nonselective agent that improved survival in the 256 women who participated in the U.S. Carvedilol Heart Failure Study; it also reduced the combined end point of death or hospital stay in the 469 women who participated in the Carvedilol Prospective Randomized Cumulative Survival Study (COPERNICUS) trial. Bisoprolol and metoprolol succinate are beta-selective agents. Bisoprolol improved survival in the 515 women who participated in the European CIBIS II (Cardiac Insufficiency Bisoprolol Study); its use in heart failure is unlabeled. Metoprolol succinate had no survival benefit in the 898 women who participated in the Metoprolol Extended-Release Randomized Intervention Trial in Heart Failure but did reduce heart failure hospital stay by 42% [242]. Because reinfarction rates tend to be higher in women, beta blockers are an important part of treatment [12]. However, women tend to experience more medication side effects and suffer from more peripheral vascular disease, such as Raynaud's phenomenon, than men. Cardioselective beta blockers, such as atenolol or metoprolol, are a better choice for therapy in women, as nonselective agents have adverse effects on the peripheral circulation, magnifying vasospasm and vasoconstriction [241]. Additionally, beta blockers may not be the optimal first-line medication choice in diabetic women and should be used cautiously due to their hyperglycemic effects [153].

After PCI or cardiac surgery, female cardiac patients are also at increased risk for mortality, primarily those who are older and have more comorbid disease [244]. At the time of these procedures, assess the patient's status to determine the presence of other factors or comorbidities that may impact recovery. Anticipating potential complications during the acute phase may help reduce morbidity and mortality [244]. Management during the acute phase should be directed toward early detection and prevention of possible complications and prompt intervention when adverse events occur [244]. Unless contraindicated, angiotensin receptor blockers (ARBs) are recommended for women with heart failure with current or prior symptoms who are intolerant of ACEIs to reduce morbidity and mortality [243].

Pain

Pain is another nursing diagnosis that applies to women with heart disease. Nitrates and calcium channel blockers are the drugs of choice for the management of angina in women [245; 246; 247]. These medications dilate coronary arteries and are used to treat coronary artery spasms. Sublingual nitroglycerin can be used for acute relief of angina and prophylactically before activities that may precipitate angina. Long-acting, heart rate-slowing calcium channel blockers can be used to control anginal symptoms in patients with a contraindication to beta-blockers [246]. Because few women have been included in clinical trials of cardiac medications, the gender-related differences in the efficacy of these medications are not known. Therefore, women may not require the same drug dosage as men. Fluctuations in vasomotor tone may be significant because women have smaller coronary arteries. Consequently, women may require lower doses of medications such as nitrates and calcium channel blockers. However, because angina tends to be more severe in women than in men, anti-anginal treatment may need to be more intensive [12; 33].

Special considerations exist in relation to assessing chest pain in premenopausal women who may have cyclic hormonal variation to their cardiac symptoms. For instance, angina tends to occur during the second half of the menstrual cycle, when estrogen levels are low. Therefore, current menstrual cycle information is an essential part of assessment [248; 249].

Knowledge Deficit

Patient education for women with heart disease should incorporate several components, including the disease process, diagnostic tests, medications, the recovery process, and risk factor modification. In relation to the disease process, female patients should be taught symptom recognition and early treatment of complications. The positive long-term outcomes of women with angina and post-PCI and CABG surgery should be stressed when counseling patients regarding the recovery process. Medication teaching should include a description of the action and effects of the cardiac medication, along with the dosage, frequency, and possible side effects. The nurse may also act as a patient advocate with regard to diagnostic testing. Attempt to ensure that the appropriate diagnostic tests and treatment procedures are provided to the patient. Finally, risk factor modification enhances the patient's progress and quality of life [250].

Other considerations related to patient teaching focus on providing women-centered education. Much of the teaching and audio-visual materials available to women with heart disease were developed primarily with men in mind. Therefore, patient teaching materials should be modified so that patients can see other women and learn about their own unique needs [250]. The National Institutes of Health (NIH) offers booklets that cover heart healthy topics such as prevention, awareness, diet, exercise, and smoking cessation [250; 251].

Additionally, a woman's level of health literacy can affect the course of heart disease, including readmissions and early death. According to a research summary compiled by the CDC, patients with limited health literacy face difficulties performing self-care activities (e.g., monitoring weight, salt, fluid intake) [252]. The findings support training healthcare staff to deliver tailored education that matches a patient's health literacy skills. Family members should also be included in cardiac teaching, with emphasis on how they can support the female family member with heart disease. For instance, family members can be taught to encourage the patient to follow activity recommendations after discharge from the hospital. Family involvement to recognize signs and symptoms of complications postdischarge has become more important than ever with the trend towards shortened hospital stays. Other strategies to detect early complications after discharge include follow-up telephone programs and the use of home health nursing when appropriate [230; 251].

Activity Intolerance

Due to complications, women may be slow to mobilize in the acute care setting. Comorbidities such as arthritis and diabetes may also affect activity levels. As a result, activity progression should be modified as needed. However, cardiac rehabilitation should begin as soon as possible during the inpatient phase as well as in the outpatient phase. Ensuring that female patients are connected with cardiac rehabilitation programs in their community may facilitate this intervention [253].

Body Image Disturbance

A qualitative study with female CABG patients has examined experiences related to body image. The most frequently occurring themes were concern over lack of privacy in the hospital setting, difficulty adjusting to short-term memory loss, extreme breast discomfort, and visibility of chest and leg scars [33]. Therefore, female cardiac patients may need assistance in exploring concerns and attitudes related to the impact of their cardiac illness on their body image.

Sexual Dysfunction

Researchers interviewed 17 women with monogamous sexual partners in the Translational Research Investigating Underlying Disparities in Acute Myocardial Infarction Patients' Health Status (TRIUMPH) registry to understand the recovery of sexual function and improve sexual outcomes in women post-MI [199]. Although the women universally expressed a desire to receive direct advice from their physician (particularly their cardiologist) about when they could safely resume sexual activity and how much exertion would be safe for their heart, the study findings indicated that the few women who had discussed sexual activity with their physician found the counseling to be vague or confusing. Lack of counseling by a physician has been found to be one of the predictors of loss of sexual activity following MI, despite recommendations for such counseling by the ACCF/AHA and the European Society of Cardiology [199].

NURSING DIAGNOSIS AND INTERVENTIONS

Several nursing diagnoses are relevant to the female cardiac patient during both the preventive and acute care stages. This section will summarize these nursing diagnoses along with appropriate nursing interventions and measurable expected outcomes for both the patient and the family [254].

- **Altered health maintenance** related to lack of education, readiness, or motivation to modify cardiovascular risk factors

  Expected Outcomes

  1. The patient will describe lifestyles that promote cardiovascular health.
  2. The patient will describe and demonstrate health behaviors that are needed to manage the cardiac condition.

Nursing Interventions

1. Assess patient's knowledge level of primary prevention strategies:
   - Avoidance of smoking
   - Low-fat and low-cholesterol diet
   - Zero to moderate alcohol consumption
   - Regular exercise program
   - Stress management techniques
2. Teach patient the importance of secondary prevention:
   - Control of hypertension
   - Dietary or pharmacologic management of abnormal blood lipids
   - Management and control of diabetes
3. Determine knowledge that the patient and family require to implement primary and secondary prevention strategies.
4. Assess the need for other resources or referrals to assist the patient and/or family.

- **Decreased cardiac output** related to electrophysiologic, mechanical, or structural problems of the heart

Expected Outcomes

1. The patient will maintain an adequate cardiac output to meet the needs of body tissue demands, as evidenced by:
   - Vital signs within normal range
   - Optimal skin color, temperature, and peripheral pulses
   - Optimal respiratory and neurologic status
   - Optimal renal perfusion evidenced by intake and output and/or daily weight within normal limits

Nursing Interventions

1. Assess skin color and temperature and peripheral pulses. Examine for the presence of edema.
2. Assess respiratory rate, breath sounds, and heart sounds.
3. Assess intake/output and weight every day.
4. Assess neurologic status (e.g., mental status, level of consciousness).
5. Assess patient's tolerance of activity each day and modify activity progression as needed.
6. Administer cardiac medications and/or treatments as ordered.

- **Alteration in tissue perfusion:** Cardiopulmonary, related to myocardial ischemia or infarction or electromechanical problems of the heart

Expected Outcome

1. The patient will demonstrate adequate or improved cardiopulmonary tissue perfusion as evidenced by:
   - Systolic blood pressure greater than or equal to 90 mm Hg
   - Absence of dysrhythmias
   - Respiration sounds normal
   - Balanced intake/output
   - Lab values within normal limits
   - Improved comfort level

Nursing Interventions

1. Monitor hemodynamic parameters and EKG rhythm.
2. Instruct patient to report level of pain on 0 to 10 scale.
3. Assess heart sounds and breath sounds.

4. Instruct patient to avoid activity and exercise if symptoms occur and to promptly report any symptoms experienced.
5. Administer medications and/or treatments as ordered.

- **Pain** related to myocardial ischemia or infarction, cardiac procedure, and/or CABG surgery

Expected Outcomes

1. The patient will describe level of chest discomfort.
2. The patient will communicate relief of pain to a tolerable level.
3. The patient will be able to perform expected activities for recovery.
4. The patient will verbalize understanding of the pain management plan.

Nursing Interventions

1. Assess comfort level on a 0 to 10 scale every 2 hours for 24 hours and then at least every 4 hours.
2. Assess patient's physiologic and behavioral responses to pain.
3. Assess relationship of patient's activities to pain and discomfort.
4. Instruct patient to report pain promptly so pain relief measures may be instituted before the level of pain gets out of control.
5. Reassure patient and family on expected pain relief measures every 12 hours.
6. Collaborate with patient and family to develop a plan for pain control.
7. Administer analgesics or treatments as ordered for daily pain management.
8. Instruct patient and family on alternative comfort measures, such as relaxation and diversion, as appropriate every day.

- **Activity intolerance** related to alterations in oxygen transport system associated with cardiac problems

Expected Outcomes

1. The patient will identify factors that aggravate activity intolerance and verbalize understanding of need to increase activity level after undergoing cardiac procedure or surgery.
2. The patient will demonstrate desire and ability to progress with activity and exercise patterns on a daily basis.
3. The patient will demonstrate a decrease in physiologic signs and symptoms of activity intolerance.

Nursing Interventions

1. Monitor patient's vital signs in lying, sitting, and standing positions prior to ambulation and/or exercise.
2. Notify physician if patient's heart rate increases more than 20 beats per minute from baseline or if blood pressure drops more than 10–15 mm Hg from baseline values.
3. Ambulate patient with assistance, monitoring vital signs and oxygen saturation if indicated; stop activity if vital signs change according to guidelines above or if oxygen saturation drops below 90%.
4. Teach patient and family about activity and exercise pattern, especially emphasizing importance of increasing activity level by adding minutes each day to the exercise program, as opposed to emphasizing the distance walked.
5. Instruct patient and family on signs and symptoms of activity intolerance and alternative methods of completing daily living activities, including use of assistive devices if needed.

- **Knowledge deficit** related to lack of knowledge regarding cardiovascular risk factors, symptomatology, diagnostic tests, treatments and procedures, and/or surgical interventions

  Expected Outcomes

  1. The patient will verbalize understanding of risk factors for heart disease, including both traditional and gender-specific factors, about her cardiac illness or event as well as cardiac procedures and/or surgical intervention.
  2. The patient will demonstrate behaviors to modify alterable risk factors, including smoking history, hypertension, hyperlipidemia, diet, exercise, birth control methods, and HRT.

  Nursing Interventions

  1. Assess patient's and family's current knowledge base and readiness/ability to learn.
  2. Develop realistic teaching/learning objectives with patient and family as appropriate.
  3. Provide individualized instructions to patient and family on specific aspects of care every day; reinforce information as needed.
  4. Allow patient and family to verbalize concerns and questions about care as needed.
  5. Encourage family to participate in care as desired.
  6. Assess patient's and family's current knowledge base related to the cardiac event and evaluate if patient/family can verbalize/demonstrate information learned as needed.

- **Anxiety** related to impact of acute or chronic cardiac illness and/or surgical procedure

  Expected Outcomes

  1. The patient will verbalize thoughts, feelings, and fears about current cardiac illness and/or surgery and support systems/other resources to cope with the current illness stressors.
  2. The patient will verbalize understanding of hospital environment and routine as well as cardiac procedures and treatments.
  3. The patient will verbalize decreased feelings of anxiety as well as demonstrate decreased physical symptoms of anxiety.

  Nursing Interventions

  1. Assess patient's level of anxiety and knowledge of the condition and the treatment.
  2. Encourage patient to verbalize feelings and causes of anxiety.
  3. Provide information on the condition and treatment to patient and family.
  4. Support patient and family involvement in decisions regarding care and treatment.
  5. Instruct patient on measures to decrease anxiety.

- **Body image disturbance** related to acute cardiac event and/or surgical procedure

  Expected Outcomes

  1. The patient will verbalize thoughts, feelings, and fears about recent cardiac illness and/or surgery.
  2. The patient will assume role-related responsibilities and develop confidence in ability to accomplish whatever is desired.

Nursing Interventions

1. Encourage patient to express feelings about how she views herself after the cardiac event; clarify any misconceptions expressed.
2. Assess the meaning of the cardiac illness/event to the patient; support her in responding to the loss through the stages of denial, shock, anger, and depression.
3. Encourage patient to ask questions about cardiac problem, prognosis, treatments, and progress; provide information requested and reinforce to patient and family as necessary.
4. With surgical patients, assist women in resolving altered body image by encouraging them to view and touch the surgical site.
5. Encourage visits from family, significant others, and peers to provide support.
6. Encourage contact with other women who have experienced cardiac health problems to show the patient how they have successfully adapted.
7. Provide family members and significant others opportunity to express feelings and fears related to patient's cardiac illness and/or surgery.
8. Inform patient and family of community resources available, such as Mended Hearts, sponsored by the AHA.

- **Sexual dysfunction** related to serious cardiac illness or surgical procedure

Expected Outcomes

1. The patient will verbalize concerns about sexual functioning and a desire to resume sexual activity.
2. The patient will identify current life stressors.
3. The patient will express increased satisfaction with her sexuality pattern.

Nursing Interventions

1. Assess patient's sexual history, including usual sexual pattern, problems, and expectations.
2. Assist patient in developing a plan to modify lifestyle to reduce stress if negatively impacting sexual functioning (e.g., exercise program).
3. Encourage patient to express concerns and fears related to resuming sexual activities after acute cardiac event; stress the importance of patient sharing these concerns with her partner.
4. Encourage patient to resume sexual patterns as close to prior to cardiac event as possible.
5. Teach patient techniques to reduce cardiac workload, such as resting before engaging in sexual activity and avoiding sexual relations directly after eating and when tired. Sexual activity should also be terminated if chest discomfort or dyspnea occurs.

SUMMARY

Caring for women with heart disease requires knowledge of several nursing considerations, which may be broken down into the acute care phase and the primary prevention phase. Common nursing diagnoses and interventions focus on maintaining an adequate cardiac output, controlling pain, progressing activity and exercise, teaching the patient and family about the disease process and treatment, as well as attending to psychosocial concerns, such as body image alterations and sexual difficulties. Of course, women who suffer an acute cardiac event will benefit from secondary prevention strategies during the convalescent period.

PREVENTION STRATEGIES

While risk factor modification is the mainstay of primary prevention in both men and women, these strategies are not without their challenges. Because women present with heart disease an average of 5 to 10 years later than men, convincing them of the need to make lifestyle changes in the absence of symptoms may be difficult. Furthermore, the benefits of risk factor modification may not be apparent for many years due to the slow progression or later manifestation of heart disease in women [117; 255].

Despite the statistics, many women do not have an accurate picture of the threat that heart disease holds. Surveys show that women are far more afraid of breast cancer than heart disease, despite the fact that breast cancer is responsible for the deaths of one in 30 women, and heart disease claims the lives of one in three women [3; 117]. In 2012, 56% of women identified heart disease as the leading cause of death in women [256]. Not only do women not recognize heart disease as a significant health problem, many women are not aware that the signs and symptoms may differ from those of men [3].

More energy should be directed to breaking down the barrier of beliefs that heart disease primarily occurs in the male population. In fact, heart disease occurs and is fatal equally between the sexes [257]. To that end, risk factor teaching to women should emphasize the positive impact that lifestyle changes make on overall health. With modification of one or more cardiovascular risk factors, other areas may also be affected favorably [3; 258]. For instance, the woman who successfully quits smoking will undoubtedly witness improvement in her lipid profile, specifically an increase in HDL levels.

PRIMARY PREVENTION

Primary prevention of cardiovascular disease begins with general screening, including a detailed history, assessment of general health, a review of cardiovascular risk factors, and measurement of weight, blood pressure, and cholesterol. With regard to total cholesterol, the initial screen should be done at 20 years of age and followed up thereafter every five years. With female patients, obstetrician/gynecologists play a key role in this screening process. If cholesterol levels are greater than 200 mg/dL, additional testing of lipoproteins, specifically HDL and LDL, and annual checks are warranted [70]. ***Table 6*** outlines primary prevention recommendations for women, jointly developed by several organizations including the AHA, the CDC, and the NIH's Office of Research on Women's Health.

Assessment of Cardiovascular Risk Level

Over the last several years, clinics that are focused on the prevention of heart disease have emerged within hospital centers across the country [255; 260]. These clinics typically include a personalized cardiovascular assessment, goal setting, and individualized education to help women meet their goals for achieving a heart healthy lifestyle. A number of cardiovascular risk assessment tools are available to provide women with a relative risk level for the development of heart disease [3; 258]. These tools assess factors such as:

- Age
- Family history of heart disease and other medical conditions
- Personal history of cardiac symptoms, diagnosed conditions, treatments, and procedures
- Smoking history, blood pressure, cholesterol (total, LDL, HDL, total cholesterol:HDL ratio, triglycerides)
- Weight, body mass index (BMI), waist-hip ratio (WHR)
- Presence of diabetes, exercise
- Stress levels

GUIDELINES FOR PREVENTION OF CARDIOVASCULAR DISEASE IN WOMEN: CLINICAL RECOMMENDATIONS	
Lifestyle Interventions	
Cigarette smoking	Women should not smoke and should avoid environmental tobacco smoke. Provide counseling, nicotine replacement, and other pharmacotherapy as indicated in conjunction with a behavioral program or formal smoking cessation program (Class I, Level B).
Physical activity	Women should accumulate at least 150 minutes/week of moderate exercise, 75 minutes/week of vigorous exercise, or an equivalent combination of moderate- and vigorous-intensity aerobic physical activity. Aerobic activity should be performed in episodes of at least 10 minutes, preferably spread throughout the week (Class I, Level B). Women should also be advised that additional cardiovascular benefits are provided by increasing moderate-intensity aerobic physical activity to 5 hours/week, 2.5 hours/week of vigorous-intensity physical activity, or an equivalent combination of both (Class I; Level of Evidence B). Women should be advised to engage in muscle-strengthening activities that involve all major muscle groups performed on ≥2 days/week (Class I; Level of Evidence B). Women who need to lose weight or sustain weight loss should accumulate a minimum of 60 to 90 minutes of at least moderate-intensity physical activity (e.g., brisk walking) on most, and preferably all, days of the week (Class I, Level B).
Rehabilitation	A comprehensive risk-reduction regimen, such as cardiovascular or stroke rehabilitation or a physician-guided home- or community-based exercise training program, should be recommended to women with a recent acute coronary syndrome or coronary intervention, new-onset or chronic angina, recent cerebrovascular event, peripheral arterial disease (Class I, Level A), or current/prior symptoms of heart failure and a left ventricular ejection fraction (LVEF) <35% (Class I, Level B).
Dietary intake	Women should consume a diet rich in fruits and vegetables; choose whole-grain, high-fiber foods, consume fish, especially oily fish, at least twice a week; limit intake of saturated fat to <7% of total energy intake, cholesterol to <150 mg/d, alcohol intake to no more than 1 drink per day, sodium intake to <1,500 mg/d (approximately 1 tsp salt); and avoid consumption of trans fatty acids (Class I, Level B).
Weight maintenance/ reduction	Women should maintain or lose weight through an appropriate balance of physical activity, caloric intake, and formal behavioral programs when indicated to maintain/achieve a body mass index (BMI) between 18.5 and 24.9 kg/m^2 and a waist circumference ≤35 in (Class I, Level B).
Omega 3 fatty acids	Consumption of omega-3 fatty acids in the form of fish or in capsule form (e.g., eicosapentaenoic acid [EPA] 1,800 mg/d) may be considered in women with hypercholesterolemia and/or hypertriglyceridemia for primary and secondary prevention. Note: Fish oil dietary supplements may have widely variable amounts of EPA and DHA (likely the only active ingredients) (Class IIb, Level B).
Major Risk Factor Interventions	
Blood pressure—optimal level and lifestyle	Encourage an optimal blood pressure of <120/80 mm Hg through lifestyle approaches such as weight control, increased physical activity, alcohol moderation, sodium restriction, and increased consumption of fresh fruits, vegetables, and low-fat dairy products (Class I, Level B).
Blood pressure—pharmacotherapy	Pharmacotherapy in indicated when blood pressure is ≥140/90 mm Hg or at a lower blood pressure (≥130/80 mm Hg) in the setting of chronic kidney disease or diabetes. Thiazide diuretics should be part of the drug regimen for most patients unless contraindicated or if there are compelling indications for other agents in specific vascular diseases. Initial treatment of high-risk women should be with beta blockers and/or angiotensin-converting enzyme (ACE) inhibitors/ angiotensin receptor blockers (ARBs), with addition of other drugs such as thiazides as needed to achieve goal blood pressure (Class I, Level A). Criteria for high risk include established CHD, cerebrovascular disease, peripheral arterial disease, abdominal aortic aneurysm, end-stage or chronic renal disease, diabetes mellitus, and 10-year Framingham risk >20%.

Table 6 continues on next page.

GUIDELINES FOR PREVENTION OF CARDIOVASCULAR DISEASE IN WOMEN: CLINICAL RECOMMENDATIONS *(Continued)*	
Major Risk Factor Interventions	
Lipid and lipoprotein levels—optimal levels and lifestyle	The following levels of lipids and lipoproteins in women should be encouraged through lifestyle approaches: LDL <100 mg/dL, HDL >50 mg/dL, triglycerides <150 mg/dL, and non-HDL (total cholesterol minus HDL cholesterol) <130 mg/dL (Class I, Level B).
Lipids—pharmacotherapy for high-risk women	Utilize LDL-lowering drug therapy simultaneously with lifestyle therapy in women with CHD to achieve an LDL <100 mg/dL (Class I, Level A) and similarly in women with other atherosclerotic CVD or diabetes or 10-year absolute risk >20% (Class I, Level B). A reduction to <70 mg/dL is reasonable in very high-risk women with CHD and may require an LDL-lowering drug combination (Class IIa, Level B). Criteria for very high-risk include established CVD plus any of the following: multiple major risk factors, severe and poorly controlled risk factors, diabetes.
Lipids—pharmacotherapy for other at-risk women	Utilize LDL-lowering therapy if LDL level is ≥130 mg/dL with lifestyle therapy and there are multiple risk factors and 10-year absolute risk 10% to 20% (Class I, Level B). Utilize LDL-lowering therapy if LDL level is >160 mg/dL with lifestyle therapy and multiple risk factors even if 10-year absolute risk is <10% (Class I, Level B). Utilize LDL-lowering therapy if LDL ≥190 mg/dL regardless of the presence or absence of other risk factors or CVD on lifestyle therapy (Class I, Level B). In women >60 years of age and with an estimated CHD risk 10%, statins could be considered if hsCRP is >2 mg/dL after lifestyle modification and no acute inflammatory process is present (Class IIb, Level B).
Lipids—pharmacotherapy for low HDL, or elevated non-HDL, high-risk women	Utilize niacin or fibrate therapy when HDL is low or non-HDL is elevated in high-risk women after LDL goal is reached (Class IIa, Level B).
Lipids—pharmacotherapy for low HDL or elevated non-HDL, other at-risk women	Consider niacin or fibrate therapy when HDL is low (<50 mg/dL) or non-HDL is elevated (>130 mg/dL) after LDL goal is reached in women with multiple risk factors and a 10-year absolute risk 10% to 20% (Class IIb, Level B).
Diabetes	Lifestyle and pharmacotherapy should be used as indicated in women with diabetes to achieve an HbA1c <7% if this can be accomplished without significant hypoglycemia (Class IIa, Level B).
Preventive Drug Interventions	
Aspirin, high risk	Aspirin therapy (75–325 mg/d)[a] should be used in high-risk women unless contraindicated (Class I, Level A). If a high-risk woman is intolerant of aspirin therapy, clopidogrel should be substituted (Class I, Level B). Aspirin therapy (75–325 mg/d) is reasonable in women with diabetes unless contraindicated (Class IIa, Level B).
Aspirin—other at-risk or healthy women	In women ≥65 years of age, consider aspirin therapy (81 mg daily or 100 mg every other day) if blood pressure is controlled and benefit for ischemic stroke and MI prevention is likely to outweigh risk of gastrointestinal bleeding and hemorrhagic stroke (Class IIa, Level B) and in women <65 years of age when benefit for ischemic stroke prevention is likely to outweigh adverse effects of therapy (Class IIb, Level B).
Beta blockers	Beta blockers should be used for up to 12 months in all women after MI or acute coronary syndrome, with normal left ventricular function, unless contraindicated (Class I, Level A). Long-term beta blocker therapy should be used indefinitely for women with left ventricular failure unless contraindications are present (Class I, Level A). Long-term beta-blocker therapy may be considered in other women with coronary or vascular disease and normal left ventricular function (Class IIb, Level C).

Table 6 continues on next page.

GUIDELINES FOR PREVENTION OF CARDIOVASCULAR DISEASE IN WOMEN: CLINICAL RECOMMENDATIONS *(Continued)*	
Preventive Drug Interventions	
ACE inhibitors/ARBs	ACE inhibitors should be used (unless contraindicated) in women after MI and in those with clinical evidence of heart failure or an LVEF ≤40% or with diabetes (Class I, Level A). In women after MI and in those with clinical evidence of heart failure or an LVEF ≤40% or with diabetes who are intolerant of ACE inhibitors, ARBs should be used instead (Class I, Level B).
Aldosterone blockade	Use aldosterone blockade after MI in women who do not have significant hypotension, renal dysfunction, or hyperkalemia who are already receiving therapeutic doses of an ACE inhibitor and beta blocker, and have LVEF ≤40% with symptomatic heart failure (Class I, Level B).
Class III Interventions (Not Useful/Effective and May Be Harmful)	
Menopausal therapy	Hormone therapy and selective estrogen-receptor modulators should not be used for the primary or secondary prevention of CVD (Class III, Level A).
Antioxidant supplements	Antioxidant vitamin supplements (e.g., vitamin E, C, and beta carotene) should not be used for the primary or secondary prevention of CVD (Class III, Level A).
Folic acid	Folic acid, with or without B6 and B12 supplementation, should not be used for the primary or secondary prevention of CVD (Class III, Level A).
Aspirin for MI in women <65 years of age	Routine use of aspirin in healthy women <65 years of age is not recommended to prevent MI (Class III, Level B).
[a]After percutaneous intervention with stent placement or coronary artery bypass grafting within previous year and in women with noncoronary forms of CVD, use current guidelines for aspirin and clopidogrel.	
Source: [259] Reprinted from Mosca L, et al. Effectiveness-Based Guidelines for the Prevention of Cardiovascular Disease Prevention in Women–2011 update: A Guideline From the American Heart Association. Circulation. 2011;123:1243-126. With permission from Lippincott Williams & Wilkins. (c) American Heart Association. *Table 6*	

STRENGTH OF RECOMMENDATIONS	
Classification	
Class I	Intervention is useful and effective.
Class IIa	Weight of evidence/opinion is in favor usefulness/efficacy.
Class IIb	Usefulness/efficacy is less well established by evidence/opinion.
Class III	Intervention is not useful/effective and may be harmful.
Level of Evidence	
A	Sufficient evidence from multiple randomized trials
B	Limited evidence from single randomized trial or other nonrandomized studies
C	Based on expert opinion, case studies, or standard of care

The ACCF/AHA recommend obtaining a Framingham-like (global) risk score for all asymptomatic adults without a history of CAD. They additionally recommend risk-stratifying women based on their risk scores into one of three categories: 1) high risk (e.g., women with known CAD); 2) at risk (e.g., one or more risk factors, such as cigarette smoking); and 3) optimal risk (e.g., having all of a specifically defined group of risk factors) [117; 259; 261].

Following data collection, many cardiac centers will provide women with an individual computerized or hand-scored summary assessment of their cardiovascular risk profile. This summary profile details each cardiovascular risk factor according to the history provided by the woman, along with specific recommendations for lifestyle modification to reduce her risk level and develop a prevention-based program focused on heart-healthy living. An overall risk rating scale for heart disease is also often provided, ranging from low to moderate to high. The summary may conclude with a health risk summary, which briefly emphasizes key areas in need of attention, such as smoking cessation or development of a regular exercise program.

Risk assessments of this nature are intended for education purposes, not to be a substitute for medical attention by a woman's personal physician. Furthermore, women who receive cardiac risk assessment profiles should be informed to consult their physicians before making any major lifestyle changes, especially those women who have existing heart or serious cardiovascular conditions [3; 258].

Stages of Change and Goal Setting

The Stages of Change model was developed by psychologists to describe the phases that an individual making significant behavioral changes experiences. Because changes to lifestyle are so important in preventing and managing heart disease, knowledge of the model is helpful for all healthcare professionals. The Stages of Change model may be applied to both primary and secondary prevention programs. In this model, women are helped through the stages of change with behavior modification strategies aimed at enhancing long-term maintenance of new healthy behaviors. The first stage, precontemplation, is generally defined as avoidance (i.e., not seeing a problem behavior or not considering a change) [262]. In the second stage, contemplation, a problem is acknowledged, but the woman may struggle with feelings of ambivalence, weighing the pros and cons and benefits and barriers to change.

In stage three, the preparation/determination stage, the patient is ready to begin to change behavior by initiating a step-by-step plan. In stage four, action/willpower, the woman makes the change and begins living with the new behavior—an all-consuming activity. Stage five is the maintenance stage, in which the woman continues with her plan on a regular basis, making changes in goals as needed, based on what has worked well and what has not. The change is integrated into her life [262]. The stages of change model may be used to help guide women as they make plan to meet their heart health goals.

Lifestyle Interventions

Smoking Prevention and Cessation

As mentioned earlier, approximately 15% of women in the United States are cigarette smokers [43]. A reduction in this incidence is considered vital to decreasing several negative public health effects, including coronary heart disease. For teenage female smokers, emphasizing social undesirability, rather than long-term health implications, may be more successful in reducing tobacco use. For older patients, the 60% reduction in risk of MI that has been associated with smoking cessation may be more persuasive as a reason to quit [263].

The use of nicotine gum or patches, bupropion, counseling, and/or smoking cessation programs, alone or in combination, may be very helpful, especially for those who smoke more than 25 cigarettes a day. While the overall cost-effectiveness of smoking cessation counseling may not seem impressive, its success is considerable when compared to our ability to influence other cardiovascular risk factors [264].

The fear of weight gain may be a major obstacle or concern for women contemplating quitting smoking. Diet and exercise strategies should be incorporated into the overall smoking cessation program because women have been reported to gain more weight after quitting than men [44]. A study published in 2001 found that cognitive behavioral therapy reduced weight concerns and was more effective than weight control counseling in ensuring smoking cessation after one year [265].

Diet

Dietary factors play a significant role in the primary prevention of heart disease. Major dietary goals include achieving and maintaining normal weight for height and body size and decreasing intake of sodium, cholesterol, and fat [3; 258]. Maintaining a normal weight is essential due to the negative health consequences that may be associated with weight fluctuation [266]. National guidelines define a person with a BMI of 25 or more as overweight and a BMI of 30 or more as obese [267]. One drawback to the use of BMI is that it does not distinguish between individuals with high percentages of body fat versus those who are muscular. A measurement of waist circumference and/or WHR may be useful in identifying abdominal adiposity and determining the distribution of weight and total body fat [267]. One study has demonstrated that women with a waist circumference of 76.2 cm or greater and/or a WHR of 0.76 or greater are associated with a more than twofold increase in risk of coronary heart disease [268]. Significant health improvements may be achieved by a 5% to 10% reduction in body weight [269].

Heart-smart eating includes choosing from a wide variety of foods, concentrating more on whole foods, such as fruits, vegetables, and legumes, than on processed or refined foods. In 2005, the traditional Food Pyramid was replaced as the national dietary guideline model. In its place, the U.S. Department of Agriculture established ChooseMyPlate, which individualizes dietary recommendations based on age, sex, and activity level [270]. These guidelines continue to emphasize the importance of whole grains, fruits, and vegetables, and in addition, provide an upper limit of calories that may be derived from extra fats and sugars. In addition, it is essential to teach patients how to read nutrition labels when grocery shopping and how to choose low-fat, low-sodium, and low-calorie food items [270]. Alternatively, the American College of Cardiology Foundation/American Heart Association (ACCF/AHA) recommends adoption of the (dietary approaches to stop hypertension (DASH) dietary pattern to improve heart health [82]. The DASH diet plan was developed by the U.S. National Institutes of Health to help lower blood pressure without medication. The DASH diet emphasizes vegetables, fruits, and low-fat dairy foods and moderate amounts of whole grains, fish, poultry, and nuts. It also recommends limiting sodium intake [271].

Folate, an essential B vitamin, which is found in fruits, vegetables, beans, and fortified grain products, has been touted as the new supernutrient. It has been shown to improve endothelial function and decrease homocysteine levels and may significantly lower the risk of heart disease.

A moderate alcohol intake is associated with beneficial changes in serum lipids and lipoproteins. One glass of red wine per day has been shown to increase HDL levels and may reduce the risk of MI; however, regular exercise has the same benefit and the AHA does not recommend consuming alcohol to derive any potential gains, and women who do not drink should not be encouraged to start [272]. Other health risks, such as obesity, hypertension, and cancer, may be associated with alcohol use [272]. A University of Wisconsin study found that drinking red grape juice may also render beneficial heart effects, without the other risks associated with alcohol. Red grape juice may delay the oxidation of LDL among people with coronary artery disease [272; 273].

Exercise

Reports on physical activity and coronary heart disease in women have been conflicting. While some studies have found no reduction in heart disease risk, many other studies have demonstrated lower all-cause mortality in women and men with higher levels of fitness. A study published in 2001 reported that even light-to-moderate amounts of exercise (i.e., at least one hour of walking a week) were associated with a lowered risk of coronary heart disease in women [274]. This correlation extended to women with heightened risk for heart disease, including those who were overweight, who had high cholesterol, and who smoked. Exercise may favorably modify other cardiovascular risk factors by increasing HDL, decreasing total cholesterol levels, augmenting fibrinolytic activity to decrease the risk of thromboembolism, and improving insulin resistance, especially in obese women. Additional benefits associated with exercise include weight and blood pressure control, as well as promoting a general sense of well-being [275].

According to the American Heart Association, women should be advised to accumulate at least 150 minutes per week of moderate exercise, 75 minutes per week of vigorous exercise, or an equivalent combination of moderate- and vigorous-intensity aerobic physical activity. Aerobic activity should be performed in episodes of at least 10 minutes, preferably spread throughout the week.

(https://www.guideline.gov/summaries/summary/33603. Last accessed December 20, 2016.)

Level of Evidence: IB (Intervention is deemed useful and effective based on limited evidence from single randomized trial or other nonrandomized studies.)

Female patients should be instructed on the importance of aerobic exercise for cardiovascular fitness. Guidelines recommend moderate- to vigorous-intensity exercise for 30 minutes on most days of the week [276]. Cardiovascular fitness is reached when the patient's heart rate decreases 30 beats per minute within the first minute after stopping maximum exercise [70].

Stress Management

Encouraging women to take an honest look at the stressors in their lives and search for methods to lessen them will promote well-being and a healthy outlook on life. Stress management techniques that are effective vary from person to person but may include hobbies, exercise, daily periods of solitude , looking for ways to better organize and simplify their lives, and spending time with friends and loved ones. Although current data regarding the role of stress and lack of social support in the development of heart disease are scarce, there does seem to be some correlation.

Alternative Birth Control Methods

Contraceptives containing both estrogen and progestin have been associated with an increased risk of cardiovascular disease. The risk is highest in women who are older than 35 years of age, are smokers, and have other cardiovascular risk factors. Estrogen has been linked to some beneficial or favorable effects on lipids and serum lipoproteins (i.e., increases HDL and decreases LDL, but increases triglyceride levels), while progestins are believed to produce unfavorable effects by decreasing HDL and increasing LDL levels. In addition to changes in lipid metabolism, hormonal contraceptives have an effect on blood pressure for some patients [277].

As a result of these lipid changes, birth control counseling is a mainstay of primary prevention in high-risk women. These women should explore safer birth control methods, such as the diaphragm or contraceptive sponge. While the birth control pill poses increased risk, the oral contraceptives available today are safer and contain less estrogen than those seen during the 1960s [278].

Major Risk Factor Interventions

Blood Pressure Control

Appropriate management of systolic and diastolic hypertension is critical to reduce adverse cardiac effects. Lifestyle changes that may assist in achieving healthy blood pressure include weight control, physical activity, moderate alcohol intake, and moderate sodium restriction. If blood pressure readings remain greater than ≥140/90 mm Hg (≥130/80 mm Hg in the setting of chronic kidney disease and diabetes) after three months of lifestyle modification, or if initial readings are greater than 160 mm Hg systolic or 100 mm Hg diastolic, pharmacologic intervention should be initiated and individualized for each woman [259].

The American Heart Association asserts that pharmacotherapy is indicated when blood pressure is ≥140/90 mm Hg (≥130/80 mm Hg in the setting of chronic kidney disease and diabetes). Initial treatment of high-risk women with acute coronary syndrome or myocardial infarction should be with β-blockers and/or angiotensin-converting enzyme (ACE) inhibitors/angiotensin receptor blockers (ARBs), with addition of other drugs such as thiazides as needed to achieve goal blood pressure. However, ACE inhibitors are contraindicated in pregnancy and ought to be used with caution in women who may become pregnant.

(https://www.guideline.gov/summaries/summary/33603. Last accessed December 20, 2016.)

Level of Evidence: IA (Intervention is deemed useful and effective based on Sufficient evidence from multiple randomized trials.)

Hyperlipidemia Management

Secondary prevention is aimed at lowering elevated serum cholesterol and triglyceride levels. Controlling diet, weight management, smoking avoidance, and exercise are positive lifestyle choices that should be promoted in all women, and especially those with elevated lipid profiles. Lifestyle interventions that may help lower high cholesterol and triglyceride levels include [259]:

- Avoiding smoking
- Achieving and maintaining normal blood glucose levels
- Achieving and maintaining a healthy body weight
- Limiting intake of sugar, refined carbohydrates, and trans-fatty acids
- Eating complex carbohydrates and high-fiber goods (whole-grain products, dried beans and peas, fruits, and vegetables)
- Limiting fat intake to 25% to 35% of total calories
- Eating sources of omega-3 fatty acids (e.g., salmon, mackerel, herring, lake trout, flaxseed and flaxseed oil, canola oil, soybean oil, and nuts)
- Engaging in regular physical activity

Despite positive lifestyle changes, some women may require a lipid-lowering agent [259].

Diabetes Control

The effects of glycemic control in diabetic patients in reducing cardiovascular risk are unclear. A diet with less than 30% of calories from fat, less than 7% of calories from saturated fat, 0% from trans-fatty acids, and cholesterol intake less than 150 mg/day should be encouraged [259]. When indicated, the use of insulin and hypoglycemic agents may be used to control blood glucose levels based on the type of diabetes and patient response. Regular physical activity should also be encouraged in women with diabetes [259]. In addition, for metabolic syndrome, lifestyle changes such as weight loss, exercise, and smoking cessation are the main treatment strategies [60].

Preventive Drug Interventions

Aspirin Therapy

As with men, low-dose aspirin therapy may play a role in the primary prevention of heart disease in women. The NHS demonstrated a 32% reduction in risk of first MI in women who took low-dose aspirin (i.e., one to six aspirin per week) [279]. While

low-dose aspirin may be associated with a somewhat lower cardiovascular and total mortality rate in women, its cardioprotective role is not without limitations. Routine use of aspirin for the primary prevention of MI in healthy women younger than 65 years of age is not recommended unless the benefit outweighs the risk of adverse effects [259]. The optimum dose of aspirin as a primary preventive measure has not been established. Also, the benefit of such therapy should be weighed against the risk of stroke and gastrointestinal bleeding [280].

Clopidogrel Therapy

Clopidogrel is an antiplatelet agent that has been studied in post-MI and unstable angina patients around the world and has been approved since 1997 for use in the reduction of atherosclerotic events in patients with recent MI. Clopidogrel inhibits platelet aggregation through the adenosine diphosphate pathway, while aspirin works as a thromboxane inhibitor; the combination decreased the need for thrombolytic therapy or IIIb/IIa inhibitors [281]. Like aspirin, the drug helps keep blood platelets from sticking together and forming clots. Clopidogrel is recommended as a preventive intervention in high-risk women who are intolerant of aspirin therapy [259].

The Clopidogrel in Unstable Angina to Prevent Recurrent Ischemic Events (CURE) trial enrolled 12,562 patients with unstable angina or non-Q-wave MI. The study found that the addition of clopidogrel to aspirin for patients with acute coronary syndrome reduced the risk of death, reinfarction, or stroke by 20% in people who had survived a mild heart attack. These patients were at serious risk of further complications in the days and months following their attack. The drug showed equal benefits for those with unstable angina. The effects were evident within two hours and were sustained [281].

Additional research has evaluated clopidogrel versus aspirin. The Clopidogrel versus Aspirin in Patients at Risk of Ischemic Events (CAPRIE) study was one of the largest studies conducted on a medication in development. The study showed clopidogrel to be more effective than aspirin in reducing the number of MIs, strokes, and vascular deaths in at-risk patients. Researchers found that aspirin prevented about 25% of these events in study participants, whereas clopidogrel prevented about 33% of them [282].

All of the patients in CAPRIE had been diagnosed with the same underlying disease: atherosclerosis. Atherosclerotic plaques can cause cracks or fissures in the vessel wall. Blood platelets aggregate around these fissures and cause the formation of thrombi that can completely block or occlude arteries. This process, atherothrombosis, is the common link that results in ischemic strokes, MIs, and vascular death. Both aspirin and clopidogrel prevent some platelet aggregation, but do so by different mechanisms.

Importantly, CAPRIE showed that patients treated with clopidogrel were significantly less likely to suffer from severe gastrointestinal bleeding than those treated with aspirin. This finding is particularly striking because the entire study population had been rigorously selected to exclude those patients with a history of ulcers or gastrointestinal bleeding. The study showed no other relevant differences in clinical or biologic effects between the groups. CAPRIE was a three-year, international clinical study of 19,185 patients who had previously suffered an ischemic stroke, MI, or symptomatic peripheral arterial disease. Patients received either 75 mg of clopidogrel or 325 mg of aspirin daily [282].

In the CURE trial, a major side effect was serious bleeding, such as stomach ulcers, which occurred in about 1% of patients and was similar to the effects of aspirin [281]. In CAPRIE, the most common clinically important side effects were pruritus, purpura, diarrhea, and rash; infrequent events included intracranial hemorrhage (0.4%) and severe neutropenia (0.04%). Suspected cases of thrombotic thrombocytopenic purpura have been reported at a rate of about four cases per million patients exposed [282].

Studies have revealed that responsiveness to clopidogrel is not uniform and that a low response is linked to a higher incidence of thrombotic events. As a result, newer P2Y12 receptor antagonists (e.g., prasugrel, ticagrelor) and a combination of clopidogrel with newer oral anticoagulants (e.g., dabigatran, apixaban, rivaroxaban) are being studied for their use in patients with stable and unstable coronary disease [283; 284; 285; 286].

Antioxidant Vitamins

The role of antioxidants in reducing the risk of cardiovascular disease in both men and women has been a topic of interest. Antioxidants such as vitamin C, vitamin E, and beta-carotene have been found to be effective in inhibiting either the oxidation of LDL cholesterol or its uptake into the endothelium of coronary arteries. Although more research is needed, some preliminary studies have demonstrated a significant inverse relationship between the use of antioxidant vitamins and a reduction in coronary artery disease [21; 76]. On the other hand, the Alpha-Tocopherol Beta Carotene Cancer Prevention Study Group reported no significant reduction in the incidence of heart disease in middle-aged male smokers who took beta-carotene and/or vitamin E daily supplements. Rather, in this study there was a concern for an increased risk of hemorrhagic stroke among those subjects who took vitamin E supplements. Therefore, the findings of these studies are inconclusive regarding the benefits of antioxidant vitamins in reducing risk for cardiovascular disease and also point out some of the potential associated health risks [287; 288]. In 2004, after reviewing all available studies regarding antioxidant supplementation and heart disease, the AHA concluded that the evidence indicated antioxidant supplements had little to no definitive effect on preventing or treating heart disease. Due to the findings from this analysis, the AHA does not recommend the use of antioxidant vitamins as part of the treatment or prevention of heart disease [289]. It continues to stress the importance of diet and does not rule out the possible role of antioxidants derived from food sources as beneficial for patients with heart disease [259; 289].

Hormone Replacement Therapy

Estrogen was once thought to have a relative protective value against coronary artery disease in premenopausal women. In the past, HRT was shown to decrease the risk of heart disease in women by as much as 50% [18; 42; 70]. It was believed to confer protection not only by decreasing triglyceride and LDL levels, but also by increasing HDL levels. While further evidence suggests that estrogen provides protection by improving lipid and carbohydrate metabolism, lowering blood pressure, and producing beneficial coagulation patterns, newer studies have identified that HRT does not provide protection against heart disease in women as once believed [18; 290; 291; 292; 293]. The AHA, the U.S. Preventive Services Task Force, and the Institute for Clinical Systems Improvement agree that HRT should neither be initiated nor continued to prevent cardiovascular disease [219; 294; 295; 296].

The U.S. Preventive Services Task Force recommends against the use of combined estrogen and progestin for the prevention of chronic conditions in postmenopausal women.

(https://www.guideline.gov/summaries/summary/38537. Last accessed December 20, 2016.)

Strength of Recommendation: D (USPSTF recommends against routinely providing the service based on at least fair evidence that it is ineffective or that harms outweigh benefits.)

HEALTHY COMMUNITIES INITIATIVES

Following the successful healthy communities movement begun in the early 1990s, the American Hospital Association's Health Forum launched a cardiovascular healthy communities initiative in 1997. The cardiovascular health improvement initiative selects interested individuals along with committed healthcare professionals from a variety of disciplines (e.g., physicians, nurses, cardiac rehabilitation specialists, healthcare executives) as fellows. The cardiovascular fellows propose and complete an action learning project aimed at improving some facet of cardiovascular health

within their local communities. Examples of projects from around the country include both primary and secondary prevention strategies and range from heart disease clinics for women linked with community nurse programs, primary prevention clinics for women, and risk reduction strategies for minority women.

The Healthy People 2020 Initiative has been launched by the U.S. Department of Health and Human Services and tracks leading health indicators for individuals and the country as a whole. Those indicators with a cardiovascular focus, such as physical activity, obesity, and tobacco abuse, are tracked and reported by HHS on an annual basis to give communities and the country feedback on how well public health goals for the 21st century are being reached [297].

Other strategies should be identified to educate the public about women's risk for heart disease. This education should include recognition of signs and symptoms of heart disease and reducing the time between onset of signs and symptoms of MI and seeking medical care [250]. In 2000, the AHA launched the public awareness campaign "Go Red for Women," whereby advertisements were distributed nationally to encourage women to obtain informational materials about heart disease and to take action to improve or protect their own heart health [298].

Additionally, it is important to understand what motivates women to seek health care and what barriers they may face when seeking care. A report prepared for the Office on Women's Health has suggested that a woman's decision to seek health care is influenced by whether she believes she has a health problem, which is based upon her perceptions and knowledge of illness. Concerns about her resources (e.g., financial, personal) will then influence whether she feels she can seek care. Finally, her perceptions about ease of access to care and her attitude toward healthcare providers will influence whether she actually makes the decision to seek care [299].

SUMMARY

In terms of primary and secondary prevention, strategies should be targeted to each woman's specific risk factors. Many risk factor assessment tools are available in healthcare centers to help women gain awareness of their cardiovascular risk profile and the areas they should pay more attention to in terms of positive lifestyle changes. For instance, if a woman is a smoker, motivating her to quit smoking is of paramount importance, as smoking is one of the three most significant cardiovascular risk factors. Other areas of primary prevention focus on controlling blood pressure, cholesterol, and diabetes, managing diet and stress, and incorporating regular exercise. Developments have also occurred with respect to measurement of CRP, homocysteine levels, and diagnosis of subclinical hypothyroidism.

IMPLICATIONS FOR FURTHER RESEARCH

Most of what is known about women and heart disease is descriptive because, in the past, women have largely been excluded from the large-scale clinical trials investigating diagnostic and therapeutic interventions related to heart disease. This section will explore some of the more common reasons for this exclusion and federal programs that have turned this trend around. In addition, areas in need of further research in relation to women and heart disease will be highlighted.

FACTORS AFFECTING THE CURRENT RESEARCH BASE

In the past, a paucity of research existed regarding women and heart disease. Women have been excluded from studies for a number of reasons. Women of reproductive age have been excluded due to the possible risks to the fetus, while older women have not been studied because they often have multiple health problems, which may create health risks or confuse the research findings. As a result, women have had restrictions in clinical care, such as the underutilization of thrombolytic therapy for the management of evolving MIs.

Age-based exclusions of women from clinical trials on invasive diagnostic or therapeutic techniques have also limited the participation of women [8; 300; 301].

Additionally, sample sizes of existing studies have traditionally been too small to either evaluate effects or draw conclusions. As a result, the findings of studies conducted with men, as well as with younger populations, have been used to diagnose and treat women and the elderly. In other words, studies done on men were driving clinical practice with female cardiac patients. Yet, research indicates that differences exist in disease presentation, cardiovascular risk factors, and the diagnosis and response of women to various treatments for heart disease [117; 302].

At the federal level, two major initiatives have been instituted to expand the base of research related to women-specific health issues. The NIH has mandated that investigators include women and minorities in clinical research populations for health-related studies. At the very least, the investigator must adequately justify any decisions to exclude potential subjects from these studies [303]. A second factor that has influenced the research base related to women's health is the development of the NIH Interdisciplinary Women's Health Research Center, formed to encourage studies related to issues affecting women's health [304].

The Women's Health Initiative (WHI), a 15-year study of 160,000 women, was undertaken as the largest NIH clinical trial to answer questions regarding postmenopausal women's health. The WHI specifically addressed the major health problems of menopausal women, including heart disease, cancer, and osteoporosis [305]. In relation to heart disease, the WHI studied the effects of low-fat diets in preventing coronary disease and the risks and benefits of HRT [305]. As discussed earlier, the WHI trials investigated both combination (estrogen plus progestin) and unopposed estrogen hormone therapy. Both trials were cut short prior to the projected completion dates. In July 2002, the WHI halted the combination therapy trials due to a significantly increased incidence of breast cancer. In February 2004, the unopposed estrogen study was stopped when researchers determined that the heightened risk of stroke was unacceptable to continue the trial. In the case of the combination hormone study, researchers found an increased risk for MI, stroke, and venous thromboembolism. The estrogen-only study resulted in increased risk of stroke and venous thromboembolism, but no difference in the risk of MI [291; 292]. Again, there is some controversy regarding the trials' designs and whether the findings are universally applicable [306; 307]. However, the U.S. Food and Drug Administration continues to recommend against the routine use of HRT as preventive treatment for heart disease in postmenopausal women [308].

AREAS IN NEED OF FURTHER RESEARCH

Beyond the large NIH trials that have been initiated, other research by various disciplines is desperately needed related to women and heart disease. This research involves asking questions, such as those listed in ***Table 7***, related to cardiovascular risk factors, the impact of heart disease on the patient and family, the clinical course of women with heart disease, and intervention studies. For instance, why do women fail to receive diagnostic studies or therapeutic interventions to the same extent that men do? Many studies have shown less active or aggressive diagnosis and management of heart disease in women. Fewer women with positive noninvasive cardiac tests are catheterized and fewer women have revascularization by either PCI or CABG surgery compared to men [117; 196; 212; 309]. The question remains: Are men overtreated, or are women undertreated?

A comparison of symptomatic improvement in men and women treated with certain medical and surgical therapies is another area worthy of scientific investigation. Some authors have advocated that physicians may guard against the adverse outcome of increased perioperative mortality in women by preferentially prescribing medical therapy; only when medical therapy is unsatisfactory are the women referred for invasive procedures.

RESEARCH QUESTIONS
Cardiovascular Risk Factors
• What is the epidemiologic basis of the major cardiovascular risk factors in women? Are these the same major risk factors as seen in men? • Why do cardiovascular risk factors seem to differ in men and women? • What strategies for risk factor reduction are effective in various subgroups of women (e.g., working mothers, middle-aged and elderly women)? • Do nurse-run clinics significantly affect the success of women making heart-healthy lifestyle changes, reducing their risk for heart disease? • What role do diabetes and other comorbidities, such as altered coagulation parameters, play in the development of heart disease in women? • What is the relationship between estrogen and lipid metabolism? • Which women benefit from HRT? Are there ethnic or sociologic differences in response to therapy? • What is the relationship between aspirin therapy and the prevention of heart disease in women? • What is the relationship between clopidogrel therapy and the prevention of heart disease in women? • What are the benefits of antioxidant therapy in women? • What is the relationship between personality traits and heart disease in women? Stress and risk of cardiovascular disease?
Impact of Heart Disease on Patient and Family
• What meanings do women attach to a cardiac event at different life phases (i.e., premenopausal, menopausal, postmenopausal)? • What are the common themes expressed in support groups between female cardiac patients? Cardiac family members? • Which nursing interventions do women perceive to be most helpful in adjusting to a diagnosis of heart disease?
Clinical Course
• Why is the clinical course of heart disease in women different from that in men (after controlling for age, extent of disease, and coexisting illness)? • What are the clinical outcomes of women with heart disease who do or do not undergo invasive diagnostic or therapeutic procedures? • What factors are responsible for the higher risk of death in women post-MI? • What are the responses of women to cardiac medications? • What are the complications of dysrhythmia in women? • What factors predict readiness and effectiveness of cardiac teaching in women? • Why does cardiovascular disease have a later onset in women compared to men? What role does normal aging play in disease progression?
Intervention Studies
• Why do women not receive diagnostic studies or therapeutic interventions to the same extent as men? • What is the long-term effectiveness of PCI in women with diffuse multivessel disease? • What is the comparative efficacy of cardiac procedures (e.g., thrombolytic therapy, PCI, atherectomies, stents, CABG surgery) in women? • Is there comparability of symptomatic improvement in men and women with medical and surgical therapies?
Cardiac Rehabilitation
• Which interventions can be started early during hospitalization for PCI, MI, or CABG surgery to increase the likelihood that women will participate in outpatient cardiac rehab? • What factors affect the enrollment and completion rates for women in outpatient cardiac rehabilitation programs? What factors are associated with keeping women in these programs?
Source: [10; 46; 72; 258] *Table 7*

As a result of these later referrals, when women are treated they tend to be at more advanced age with more frequent comorbidities, more serious symptoms, and are more often seen on an urgent or emergency basis. Overall, the evidence does not substantiate deliberate negative bias, but at the same time, it does not exclude inappropriate overuse of invasive procedures in men or underuse in women [309; 310]. Or could it be that coronary heart disease is different in women? Only further research will reveal the answers.

SUMMARY

For many years, women have been excluded from many of the larger studies investigating areas related to heart disease. Women have been excluded during reproductive years due to risk to the fetus and during later years due to potential comorbidities. New NIH outreach programs and strategic plans for women's health research are changing this [311; 312]. Continued research is necessary to advance scientific knowledge in coming years to help provide better care to female cardiac patients.

CASE STUDIES

The following case studies offer an opportunity for healthcare professionals to test or improve their skills in observation and diagnosis. While the outcome in each has already been determined, the information and scenarios may be used to help in day-to-day patient interaction. Analyses of all of the case studies are presented following this section.

CASE STUDY 1

Read through the following clinical vignettes and take time to review each woman's cardiovascular risk factor profile. Then, refer to the questions at the end of the case study to analyze each female patient's current health status.

- Patient S is a white woman, 43 years of age, and mother of three small children. She has a long-standing history of significant obesity with little success in dieting over the years. At 5'3", she is obese, weighing 220 pounds. Her fat distribution is "apple-shaped" and consequently, her waist-hip ratio is more than the 0.8 normal range. In addition, Patient S lives a fairly sedentary lifestyle and does not have a regular exercise program. Her dietary habits do not take into account basic recommendations for cardiac nutrition.
- Patient J is 55 years of age and teaches high school English. Her coronary risk factor profile includes a 30-pack-year history of cigarette smoking and altered lipid levels. Her HDL is only 35 mg/dL and her LDL is 145 mg/dL. Patient J has tried with little success to control her cholesterol with diet. Recently, she began taking gemfibrozil as prescribed by her family physician, but has not followed his recommendation to quit smoking and enroll in a smoking cessation program at a local hospital. Rather, she continues to smoke one pack of cigarettes per day.
- Patient V is a woman, 47 years of age, who has a family history of heart disease. Although she denies ever experiencing cardiac symptoms, her brother suffered a nonfatal MI at 46 years of age and her father had an MI at 53 years of age. Both of these cardiac events were medically managed. However, her father's disease did progress to the point that he underwent CABG surgery five years ago. He had three coronary artery lesions bypassed. In addition to her family history, Patient V is approximately 30 pounds overweight and does not exercise on a regular basis. She drinks approximately two to three glasses of red wine per day and has never smoked.

- Patient D is 67 years of age and lives in an assisted living retirement community. An insulin-dependent diabetic since adolescence, Patient D is unable to care for herself due to the effects of the diabetes on her eyesight, as well as the development of peripheral neuropathies. In addition to the diabetes, Patient D continues to smoke. By now, she has a 40-pack-year history of smoking.
- Patient F is an African American woman, 36 years of age, with a history of mild hypertension. Her blood pressure has been fairly well controlled on an ACE inhibitor over the past two years. Patient F eats a well-balanced, nutritious diet, exercises three to five times a week, and does not have a history of smoking or alcohol use. However, she does exhibit many of the characteristics of the Type A behavior pattern, such as excessive competitiveness, being harried, and rushing to complete more and more tasks in an ever-shrinking period of time. In addition to these characteristics, she exhibits a somewhat cynical or negative outlook with occasional expression of hostile or angry thoughts and feelings.

In analyzing these clinical vignettes, consider the following questions:

1. Which of these women is at greatest risk for heart disease?
2. Who is at least risk?
3. What recommendations would you make in counseling each patient regarding her cardiovascular health?

CASE STUDY 2

Patient M is a white woman, 75 years of age, who presented to her local emergency room with sudden complaints of chest pain. She described the pain as a severe substernal burning sensation that radiated across the chest to her shoulders bilaterally and then to the neck and jaw region. Although not brought on by exertion, the chest pain was associated with dyspnea, pallor, diaphoresis, nausea, and epigastric discomfort. Patient M had taken one nitroglycerin tablet with partial relief. When the chest pain recurred 10 to 15 minutes later, her family dialed 911 and the local emergency medical service responded. Once transported to the emergency room, her pain persisted. She received two additional doses of nitroglycerin and was placed on 2 L of oxygen per nasal cannula.

Following stabilization, she was admitted to a telemetry floor for further observation and medical management. Nursing assessment revealed the following cardiovascular risk factors: 50-pack-year history of cigarette smoking, hypertension, and mild-to-moderate obesity. As part of the medical workup, Patient M was scheduled for a cardiac catheterization the following day. The cardiac catheterization revealed an 80% blockage of the right coronary artery and the cardiologist recommended Patient M consider a PCI to open the coronary artery blockage.

The following day, Patient M underwent a PCI to the right coronary artery. The procedure was progressing uneventfully until she had an episode of bradycardia; her heart rate dropped to 38 beats per minute. The patient received a 0.5 mg dose of IV atropine, which was repeated in 10 minutes. Other than this episode, Patient M did not experience any other postprocedure complications, such as hypotension, or other technical-related problems.

The day after the PCI, Patient M was receiving her discharge instructions from her nurse when she began noticing a return of the dull epigastric pain. The pain did not appear to be related to her food intake because she was progressing on her diet. Later that day, as the pain persisted, Patient M had an ultrasound of her abdomen, which showed multiple walnut-sized gallstones. The gastroenterologist referred her to a general surgeon who recommended that she undergo a cholecystectomy for further relief of her gastrointestinal symptoms. The surgeon advised her of the risks and benefits of laparoscopic versus traditional surgery, and Patient M opted for the laparoscopic procedure.

Four small incisions were made in her abdomen, and the cholecystectomy was performed without any complications. Three days postoperatively, she complained again of moderate-to-severe epigastric pain and became jaundiced. An endoscopic retrograde cholangiopancreatography revealed retained stones in the common bile duct, which were removed. Patient M subsequently recovered and was discharged home after a total of nine days in the hospital.

In analyzing this case study, consider the following questions:

1. What coronary risk factors are present? What risk factors are negative?
2. Is the patient's chest pain syndrome typical or atypical for women? Why or why not?
3. What tests would you anticipate to be in the diagnostic workup of women experiencing angina?
4. What nursing diagnoses would be appropriate for this patient during hospitalization? What special implications do these diagnoses have in women?

CASE STUDY 3

Patient Y, a woman 76 years of age, was seen in the Women's Cardiac Center for a personalized health and risk factor assessment. Assessment findings included a heart rate of 84 beats per minute, blood pressure 172/68 mm Hg, height 5'5", and weight 171 pounds. Waist-hip ratio was 0.75, and skin fold calipers measured 42% body fat. Lipid profile included total cholesterol of 239 mg/dL, HDL 40 mg/dL, LDL 159 mg/dL, ratio 5.9 mg/dL, and triglycerides 248 mg/dL. Fasting glucose was 79 mg/dL. Past medical history included hiatal hernia, cholecystectomy, hypothyroidism, arthritis, insomnia, and a long-standing history of ankle edema. The patient also reported symptoms suspicious of sleep apnea.

Based on this assessment, cardiovascular risk factors were identified and the patient was instructed on risk factor modification. Four months later, she phoned the Women's Cardiac Center with complaints of anterior chest discomfort that radiated to her neck, jaw, and back and was accompanied by shortness of breath. She was referred to Cardiology and seen three days later.

The diagnostic workup included a 12-lead EKG and nuclear medicine stress test (thallium scan), followed by cardiac catheterization. She was not considered a candidate for the exercise EKG due to her advanced age and other comorbidities, specifically arthritis, which would limit her ability to exercise at adequate intensity levels. The 12-lead EKG revealed nonspecific T-wave changes in the inferior leads, and the nuclear medicine test was positive, suggestive of single-vessel disease of the left circumflex artery. Cardiac catheterization was then performed and showed triple vessel disease with significant left main disease. Her occlusions were 50% to 60% of the left main, 90% of the circumflex, and 60% of the right coronary artery. EF was estimated at 60%, indicating preserved left ventricular function. Based on these diagnostic findings, the patient was referred for cardiac surgery.

Two weeks later, Patient Y underwent CABG surgery with internal mammary grafting. During surgery, she required inotropic support with dobutamine and epinephrine and atrioventricular sequential pacing. An intra-aortic balloon pump (IABP) was also placed via the right femoral artery due to right heart failure. On the first postoperative day, the patient remained in the intensive care unit on the IABP and ventilator. Lab values showed a creatine phosphokinase of 3113 IU/L and creatine kinase isoenzyme MB of 169.4 IU/L. A bedside echocardiogram confirmed an inferior-posterior and right ventricular infarct.

The patient was transferred to the cardiac surgical stepdown unit on the third postoperative day, where she developed atrial fibrillation and was digitalized. Oxygen was administered at 5 L per nasal cannula and her ambulation was significantly limited. In addition, a bruit was noted in her right groin. An echo-Doppler revealed a two-chamber pseudoaneurysm, which was unsuccessfully compressed. On the sixth postoperative day, the patient went in and out of atrial fibrillation/flutter and converted to sinus rhythm on postoperative day 7. As a result, she was weaned from oxygen and progressed with independent ambulation. However, she remained hospitalized until postoperative day 12 for observation of her heart rhythm and right groin pseudoaneurysm.

Two days after discharge, the patient received a follow-up telephone call from the Cardiac Liaison Nurse to assess her condition. Patient Y stated she was "feeling pretty good," yet indicated some difficulty with incisional pain, anorexia, fluid loss, insomnia, and confusion about her medications. After recuperating at home, the patient enrolled in a phase II cardiac rehabilitation program. At this time, the patient reports no angina or chest discomfort. She is progressing in her exercise program and tolerating activity. Problems experienced since discharge include a urinary tract infection, depression, and increasing heart failure. Her furosemide dosage has been increased, and she has obtained good relief of her symptoms.

In analyzing this case study, consider the following questions:

1. What coronary risk factors are present? What risk factors are negative?
2. Is the patient's chest pain syndrome typical or atypical for women? Why or why not?
3. What is the common picture of a woman's general health and cardiac status when referred for CABG surgery?
4. What significance does this patient's perioperative MI have for her long-term prognosis?
5. What nursing diagnoses would be appropriate for this patient during hospitalization? What special implications do these diagnoses have in women?
6. Identify ways to assess both short- and long-term outcomes of women post-CABG surgery.

CASE STUDY 4

Patient A was a woman, 88 years of age, who lived in an assisted living retirement home. She had been a widow for 20 years, after losing her husband to long-term complications associated with diabetes. Until approximately seven years ago, Patient A had been in relatively good health with no major health problems, but she suffered a mild stroke at 81 years of age. At that time, she decided to quit her 50- to 60-year smoking habit. Other than her smoking history, she did not have any other significant cardiovascular risk factors.

After recuperating from her stroke, Patient A decided to leave her apartment and move into the assisted living facility where she would not only have some companionship but also receive assistance with meals and transportation to doctor's appointments and other activities. About six years after suffering the cerebrovascular accident, she had a bout of heart failure. She was admitted to the local hospital and received oxygen per nasal cannula, IV furosemide, and digoxin. After two weeks in the hospital, the patient was discharged home in apparently better condition. However, two days after returning home Patient A suffered a sudden cardiac death event at the breakfast table. Efforts at resuscitation were unsuccessful.

In analyzing this case study, consider the following questions:

1. What coronary risk factors are present? What risk factors are negative?
2. Is the patient's chest pain syndrome typical or atypical for women? Why or why not?

CASE STUDY 5

Patient H, a white woman 60 years of age, suddenly began complaining of chest pain to her family one evening. The pain was substernal, spread down both arms bilaterally, and radiated to her neck and jaw region. Patient H also complained of shortness of breath, nausea, and diaphoresis. Never having witnessed these symptoms before, Patient H's husband and daughter transported her to the local emergency room.

When she arrived in the emergency room, immediate priorities focused on obtaining a brief yet comprehensive history of symptomatology and past medical problems, as well as instituting appropriate treatments. The health assessment revealed numerous cardiovascular risk factors. Of course, Patient H's increasing age is one nonalterable risk factor present. In addition, she has a significant family history of heart disease. Her mother and grandmother both suffered fatal heart attacks in their late 50s or early 60s. While Patient H does not have a history of smoking, she does have hypertension, hyperlipidemia, and diabetes. She is also obese, with a height of 5'2" and weight of 240 pounds, and does not report engaging in a regular exercise program.

In terms of supportive treatment, Patient H was placed on 3 L of supplemental oxygen per nasal cannula and given sublingual nitroglycerin. She rated her pain an 8 on a 0 to 10 scale and did not report an appreciable decrease in her pain level after the first nitroglycerin dose. A second sublingual dose was given, after which she obtained relief. In the diagnostic workup phase, Patient H had a 12-lead EKG that revealed signs of ischemia in leads II and III and a ventricular fibrillation. Serial cardiac enzymes were also drawn to rule out MI. Patient H was admitted to the coronary care unit (CCU) for treatment of an inferior MI.

Once transferred to the CCU, the patient was placed on the bedside monitor and a left radial arterial line and left subclavian Swan Ganz catheter were inserted for hemodynamic monitoring purposes. A bedside echocardiogram was also performed to assess left ventricular EF and overall function of the chambers of the heart. The exam revealed that left ventricular EF was not preserved, estimated at only about 40%. Positive inotropes were started to increase the contractility of the heart and improve cardiac output. Intravenous nitroglycerin that was started in the emergency room was continued to improve coronary perfusion and for afterload reduction. After two days, Patient H was transferred out of the CCU to the cardiology stepdown unit. Telemetry showed slight sinus bradycardia at a rate of 56 beats per minute without ectopy. Other vital signs included blood pressure 102/56 mm Hg and a respiratory rate of 26 breaths per minute. Patient H remained on supplemental oxygen at 2 L per nasal cannula.

Cardiac rehabilitation was initiated when Patient H was in the stepdown unit. Rehabilitation activities first focused on identifying her risk stratification level, from low to high on a continuum, to guide initial activity and further exercise prescriptions. Because the patient's left ventricular EF was approximately 40%, her risk stratification level was identified as moderate and she was instructed that her cardiac rehabilitation activity would entail ambulating three times a day, first with monitored assistance in the hallway, working eventually toward the goal of independent ambulation. Prior to her first ambulation, Patient H's nurse took orthostatic blood pressure readings with the following results: lying 120/68 mm Hg; sitting 116/64 mm Hg; and standing 112/62 mm Hg. Heart rate pre-exercise was 58 beats per minute. As a result of these data, Patient H was assisted into the hallway for monitored ambulation. After walking for approximately two minutes, her heart rhythm converted from sinus bradycardia into a fast atrial fibrillation, with a ventricular rate of 180 beats per minute. Her blood pressure was 102/56 mm Hg. The patient was assisted back to bed, and a cardiology consult was requested.

The consulting cardiologist ordered a diltiazem drip. After her ventricular rate was under control, the patient was digitalized with 1 mg of digoxin followed by a maintenance dose of 0.125 mg IV. Other cardiac medications added to the regime included a beta blocker, furosemide, and potassium.

On the day of discharge, Patient H's family was present for discharge teaching. Her nurse explained the list of medications, including the dose and frequency, as well as her activity limitations. Patient H was instructed not to drive a car for two weeks and to increase her walking each day by one minute until she arrived at the goal of approximately 30 to 45 minutes at least three times a week. In addition, Patient H was informed about the nearest outpatient cardiac rehabilitation program. It was explained to her that the primary benefits of attending an outpatient program would be that the staff would assist her in developing an activity and exercise program individualized to her needs and physical capabilities. In addition, they would teach her and her family other components of heart healthy living, such as cardiac nutrition, managing diabetes, and stress.

After discharge, the patient did enroll in an outpatient cardiac rehabilitation program and had attended three sessions when she began developing symptoms of heart failure, including orthopnea, shortness of breath, and weight gain. On physical examination, crackles were auscultated bibasilarly and dependent pitting edema was present in her ankles bilaterally. On being seen in the heart failure clinic, she was restarted on a diuretic, furosemide, and an ACE inhibitor and her digoxin was kept at the same dosage.

In analyzing this case study, consider the following questions:

1. What coronary risk factors are present? What risk factors are negative?
2. Is the patient's chest pain syndrome typical or atypical for women? Why or why not?
3. What nursing diagnoses would be appropriate for this patient during hospitalization? What special implications do these diagnoses have in women?
4. What special implications exist with regard to dosing cardiac medications in women?
5. Describe the common response of women with heart disease to activity.
6. What factors influence women's involvement in cardiac rehabilitation programs?

CASE STUDY 6

The following vignettes describe women with cardiac symptomatology who received either medical or surgical treatment. Read through these vignettes and analyze them using the questions that are presented at the end of the case studies.

- Patient R, a black woman 52 years of age, recently underwent a CABG procedure. Cardiac catheterization revealed three-vessel disease. As a result, she had bypasses to her right coronary artery, left circumflex artery, and obtuse marginal artery.
- Patient B is a white woman, 65 years of age, with a long-standing history of stable angina. She has been medically managed for the past several months on nitrates (sublingual nitroglycerin) and an ACE inhibitor.
- Patient L is 45 years of age. She experienced a sudden onset of chest and arm pain while driving to a family affair with her husband. Because the pain did not subside, her husband drove her directly to the local emergency room, where she was evaluated and underwent several diagnostic tests, including a 12-lead EKG, serial cardiac enzymes, and a dipyridamole echocardiogram. The 12-lead EKG and cardiac enzyme elevations suggested an evolving MI. As a result, Patient L was treated with thrombolytic therapy in the emergency room, then admitted to the CCU for further treatment and observation.
- Patient E, an Asian American woman 52 years of age, had been experiencing episodes of pain that spread across her chest and occasionally radiated down one or both arms and/or to her jaw region. Over the last week or so, the chest pain episodes increased in frequency to the point she thought she should have a medical evaluation. Patient E saw a cardiologist,

who suggested the patient undergo a cardiac catheterization. The procedure revealed a 60% lesion of the right coronary artery that the cardiologist believed could be treated successfully with angioplasty.

In analyzing this case study, consider the following questions:

1. Based on the information, which woman has the best prognosis? The worst prognosis? Why?
2. What are some of the complications associated with each of these medical and surgical therapies?

CASE STUDY ANALYSES

CASE STUDY 1

Case Study 1 Analyses

1. *Which of these women is at greatest risk for heart disease?*

All five of these women have risk factors for heart disease. However, Patients J and D possess three of the most significant cardiovascular risk factors: cigarette smoking, diabetes, and hyperlipidemia. Therefore, based on the data available in the vignettes, Patients J and D are at greatest risk for coronary heart disease. If further information was available about each woman's cardiac risk factor profiles, we might be able to differentiate even further to determine which of these two women is at greater risk.

2. *Who is at least risk?*

Patient F appears be in the best cardiovascular state among the group. Her mild hypertension is well controlled; she is not overweight, eats a sensible diet, and sees that she gets some form of aerobic exercise at least three times a week.

3. *What specific recommendations would you make in counseling each woman about her cardiovascular health?*

Patient S

Counseling recommendations for Patient S would primarily focus on cardiac nutrition aspects and developing an exercise program for cardiovascular fitness. Because she is more than 30% overweight, she is at a tremendously increased risk of coronary heart disease due to the added stress on her heart and the changes that occur in lipid metabolism when fat is distributed in the abdominal versus gluteal region. Therefore, patient teaching should emphasize good nutrition and reading nutrition labels to manage caloric intake, as well as limiting intake of fat and cholesterol. In addition to changes in diet, Patient S should be counseled on incorporating some form of aerobic exercise, such as walking, three to five times a week to achieve cardiovascular fitness. The exercise will also have the added benefit of helping her modify her weight level.

Patient J

Two major concerns become evident in assessing Patient J's health status—her smoking history and her hyperlipidemia. Recommendations would focus on encouraging and motivating the patient to quit smoking, through the use of the nicotine patch or gum with the additional support of bupropion and/or a smoking cessation program to increase her chances of successfully quitting. These programs are essential because they teach the patient behavioral and psychologic techniques to utilize at various stages of the quitting process and help the person identify specific problem situations and how these can be realistically managed. Patient J's lipid profile should be closely monitored to determine the effectiveness of gemfibrozil in lowering her LDL levels. In addition, patient teaching should focus on the deleterious effects of smoking on lipid profiles, specifically HDL levels. Smoking tends to decrease levels of HDL, which could be used as another health information tidbit to motivate Patient J to quit smoking.

Patient V

Recommendations for cardiac health for Patient V would primarily focus on the alterable factors rather than her significant family history, which cannot be changed. As a result, patient teaching and counseling would be geared toward getting her weight into a more desirable range by paying attention to nutrition and getting some form of regular aerobic exercise. Patient V would also benefit from more health teaching regarding alcohol consumption. While a moderate intake of alcohol may be associated with positive antioxidant effects that can impart some protection against the development of heart disease, the key is moderation. One drink per day is the recommendation for alcohol consumption in women.

Patient D

In assessing Patient D's health history, her diabetes and smoking habit are big concerns. In terms of her diabetes, she is in need of strict control to prevent further progression and significant complications associated with the disease, such as coronary heart disease. Another major factor that would help prevent a major cardiac event is for her to quit smoking. Remember that many cardiovascular risk factors are synergistic. In other words, risk factors work together in increasing an individual's risk of developing coronary heart disease. Cigarette smoking and diabetes are both powerful independent risk factors for heart disease, and together, they significantly elevate the chances of developing the disease.

Patient F

Patient counseling recommendations for Patient F are twofold: continued control of her hypertension and stress management. Patient F and all of the women should be applauded regarding the positive habits they have incorporated into their lifestyle. In this patient's case, these positive aspects include attention to nutrition, aerobic exercise, and staying away from smoking or alcohol use. She does, however, need assistance with stress management. While her regular exercise program is most likely one avenue for her to deal with this stress, it obviously is not singly effective. In other words, additional stress management strategies could be added to her repertoire.

CASE STUDY 2

Case Study 2 Analyses

1. *What coronary risk factors are present? What risk factors are negative?*

The cardiovascular risk factors that are known for Patient M from the case study are her age, the fact that she has past menopause, her smoking history, and hypertension.

2. *Is the patient's chest pain syndrome typical or atypical for women? Why or why not?*

The chest pain syndrome experienced by Patient M is typical for women. She described the chest pain as a substernal burning sensation that radiated across her precordium to her shoulder region bilaterally and then to her neck and jaw. In addition, her chest pain was accompanied by dyspnea, diaphoresis, nausea, and epigastric distress, all of which may or may not be associated with anginal episodes in women. In contrast, chest pain in men often begins substernally and spreads across the left precordium down the left arm.

3. *What tests would you anticipate to be in the diagnostic workup of women experiencing angina?*

The diagnostic phase for women with angina often begins with a resting 12-lead EKG. This test is useful in women due to their higher proportion of silent or unrecognized infarctions. Conversely, the exercise EKG is not considered a good test in women due to high false-positive rates and other problems associated with women exercising at adequate intensity levels. Other noninvasive cardiac diagnostic tests might include the nuclear medicine stress test, ventriculogram, and exercise echocardiogram. Of these three tests, the exercise echocardiogram is the best test for women. It is associated with the highest accuracy rates and is especially sensitive to single vessel disease, which occurs more frequently in women than in men.

4. *What nursing diagnoses would be appropriate for this patient during hospitalization? What special implications do these diagnoses have in women?*

- **Decreased Cardiac Output**: With the sudden onset of angina and need to undergo a PCI to open a blockage of the right coronary artery, Patient M is at risk for decreased cardiac output. Women should be taught to take angina seriously and to have it evaluated by a physician as soon as possible. This is especially critical in women because they have an unfavorable prognosis post-MI. After PCI, women also have higher mortality rates and, therefore, should be carefully assessed. Complications must be recognized early in their course so they can be corrected and managed successfully.
- **Pain**: Patient M really has two etiologies of her pain: chest pain and epigastric discomfort referred from her biliary tract disease. It is important to recognize that angina is often more severe in women than men (and both stable and unstable angina are more frequent in women), and therefore, necessary pharmacologic therapy may be more intense. In women, angina is managed best by either nitrates or calcium channel blockers, although the dosage may not be the same as it is in men. Because women have been excluded from many clinical drug trials testing cardiac medications, the optimal dose of various medications to treat women is less well known. Further research is needed to guide this area of clinical practice.
- **Knowledge Deficit**: Like any other patient undergoing diagnostic testing and an invasive cardiac procedure, not to mention the cholecystectomy, Patient M should be taught about various components of her illness and hospitalization. These components include her disease process, diagnostic tests, medications, risk factor modification, and the recovery process, with emphasis on the long-term positive outcomes associated with PCI in women. In addition, when teaching female cardiac patients, it is vital to search for patient teaching materials that discuss the unique concerns of women with heart disease.

CASE STUDY 3

Case Study 3 Analyses

1. *What coronary risk factors are present? What risk factors are negative?*

Patient Y has the following cardiovascular risk factors:

- Age: Older than 60 years of age
- Positive family history: Both parents died from heart disease
- Hypertension: 172/68 mm Hg
- Hypercholesterolemia: Total cholesterol 239 mg/dL; HDL 40 mg/dL; LDL 159 mg/dL; ratio 5.9; triglycerides 248 mg/dL
- Body composition: Percentage of body fat is 42%
- Menopause: Received HRT for 20 years
- Stress: Rated as a 5 on a 0 to 10 scale

The following cardiovascular risk factors are negative:

- Personal history of cardiovascular or cerebrovascular disease
- Diabetes
- Smoking history
- History of alcohol consumption
- Sedentary lifestyle (Reports walking one mile per day)

2. *Is the patient's chest pain syndrome typical or atypical for women? Why or why not?*

As in the previous case study, Patient Y's chest pain syndrome is fairly typical for women. She experienced chest discomfort in the anterior region of her chest, which then radiated to her neck, jaw, and back. The chest pain was also accompanied by shortness of breath, which may or may not occur in women, just like other associated symptoms such as nausea, diaphoresis, or lightheadedness.

3. *What is the common picture of a woman's general health and cardiac status when referred for CABG?*

Like Patient Y, women who are referred for cardiac surgery tend to be older with more comorbidities or multiple health problems, including hypertension, hypothyroidism, questionable sleep apnea, arthritis, hiatal hernia, and sciatica. In terms of cardiac status, women tend to be referred more often for unstable angina, in comparison to men, who usually are referred on the basis of a positive exercise EKG. In addition, women tend to have a lower incidence of prior MI before surgery and, therefore, better EFs; fewer diseased arteries or more single vessel disease (50% have single-vessel disease versus 25% two-vessel and 25% three-vessel disease); and more left ventricular hypertrophy and mitral regurgitation.

4. *What significance does the patient's perioperative MI have for her long-term prognosis?*

Women who suffer an MI have a worse prognosis than men, which is why timely diagnosis with an appropriate workup and treatment is so important in women experiencing anginal symptoms. When women go on to infarct, they have a much greater chance of not surviving, both in the early postinfarct period as well as later on.

5. *What nursing diagnoses would be appropriate for this patient during hospitalization? What special implications do these diagnoses have in women?*

- **Decreased Cardiac Output**: Patient Y was a woman with complaints of angina who underwent CABG surgery. During the surgical procedure, she suffered an inferior-posterior and right ventricular infarct. Despite the fact that her left ventricular EF was preserved at 60% post-MI, she should be carefully observed for early signs of heart failure, as well as any other complications during the postoperative period.
- **Pain**: Again, prior to surgical intervention, Patient Y's angina should be carefully assessed and treated with nitrates or calcium channel blockers to prevent an acute MI, which would significantly impact her prognosis and long-term outcome. While postsurgical pain is most likely incisional, it is still important to assess for the return of angina, which could signal reocclusion of one of the bypass grafts.
- **Activity Intolerance**: Patient Y is 76 years of age with multiple health problems, including arthritis. She will likely be slow to mobilize in the postoperative phase to begin with, which is compounded by the problems she developed with postoperative atrial fibrillation. After her ventricular rate was controlled and the pseudoaneurysm was addressed, her cardiac rehabilitation activity and exercise program was appropriately resumed.
- **Body Image Disturbance**: This is a potential nursing diagnosis for Patient Y given her feelings of depression in the postdischarge phase. These feelings could be considered a normal part of recuperation and a reflection of perceived changes in body image due to the sternotomy and leg incisions. After being discharged home, she did complain of continued incisional pain that could be partially alleviated by wearing a supportive bra to decrease tension from the breasts.
- **Knowledge Deficit**: As with Patient M in Case Study 2, Patient Y has a knowledge deficit regarding her cardiac disease and surgical procedure. Patient teaching for Patient Y should incorporate elements such as disease process, cardiac medications, activity restriction, caring for the surgical incision, risk factor modification, outpatient cardiac rehabilitation, and the recovery process. She would also benefit from gender-specific patient teaching aids, if available,

so she could relate to the unique concerns and needs of women who have faced heart disease and cardiac surgery.

6. *Identify ways to assess both short- and long-term outcomes of women post-CABG surgery.*

Patient outcomes may be measured both during the hospitalization phase and during the postdischarge phase. During the hospitalization phase, examples of clinical outcomes to be assessed for a population of female cardiac patients include complication rates (e.g., perioperative MIs, dysrhythmias, pseudoaneurysms); length of stay (both intensive care unit and hospital length of stay); and readmissions (both intensive care units and hospital readmissions), along with the clinical reasons.

After the hospitalization phase, patient outcomes may be assessed again. Examples of outcomes to be measured in the early discharge phase include pain, appetite, wound healing (incisions in surgical patients), rest/sleep patterns, psychologic comfort, and exercise patterns. Teaching and learning outcomes are also important to assess, including whether the female cardiac patient understood her discharge instructions related to activity and exercise, cardiac medications, diet, and when to return to work. Quality of life becomes an important consideration for this population. Research suggests that women experience more days of restricted activity due to continuing cardiac symptomatology, such as recurring chest pain and dyspnea. Ability to return to work and previous hobbies and pastimes would be an important area to assess in this regard.

CASE STUDY 4

Case Study 4 Analyses

1. *What coronary risk factors are present? What risk factors are negative?*

Positive cardiovascular risk factors for Patient A include the nonalterable factors of age and menopause and the alterable factor of smoking history. The risk factors that were negative in her history include family history of cardiovascular disease, hypertension, hyperlipidemia, obesity, sedentary lifestyle, or Type A behavior pattern.

2. *Is the patient's chest pain syndrome typical or atypical for women? Why or why not?*

Patient A's cardiac event is atypical for women in terms of initial presentation of the disease process. MI and sudden cardiac death are more commonly a first manifestation of heart disease in men, while angina is the most common presenting scenario for women. Women tend to lag behind men in both the occurrence and incidence of heart disease, as well as sudden cardiac death events. In terms of Patient A's history, it is possible that she initially suffered an MI, which was not recognized, and went on to develop heart failure as a post-MI complication. This then explains her increased risk for earlier reinfarction and higher mortality.

CASE STUDY 5

Case Study 5 Analyses

1. *What coronary risk factors are present? What risk factors are negative?*

Patient H has the following cardiovascular risk factors:

- Age: 60 years of age
- Positive family history: Mother and grandmother both died prematurely from an MI
- Hypertension
- Hyperlipidemia
- Diabetes
- Obesity: Weight 240 pounds; height 5'2"
- Sedentary lifestyle
- Postmenopausal

The following cardiovascular risk factors are negative:

- Personal history of cardiovascular or cerebrovascular disease
- Smoking history
- History of alcohol consumption
- Perceived stress

2. *Is the patient's chest pain syndrome typical or atypical for women? Why or why not?*

Patient H's chest pain was located substernally and radiated down both arms and to her neck and jaw. In addition, she was short of breath, diaphoretic, and nauseated. This clinical picture is fairly typical in women. Unlike the usual presentation in men, women may complain of no chest pain or chest pain that does or does not radiate. The pain may also be accompanied by other cardiac symptoms such as diaphoresis, dyspnea, or lightheadedness, but not necessarily so; these symptoms may be altogether absent.

3. *What nursing diagnoses would be appropriate for this patient during hospitalization? What special implications do these diagnoses have in women?*

Nursing diagnoses that would apply in this case study include decreased cardiac output, pain, activity intolerance, and knowledge deficit. The nursing implications that these diagnoses have in women have been discussed in previous case studies. In women who have suffered an MI, it is important to assess for other health problems or conditions that could impact their recovery because their morbidity and mortality rates are already higher than women with angina or those who have undergone a revascularization procedure.

4. *What special implications exist with regard to dosing cardiac medications in women?*

Research to date has not generally included women in clinical trials on the efficacy of cardiac medications. The optimal dose of these medications in women requires further study because, for the most part, they were tested on men. It may be that women need less, more, or the same dose as men. Further research including women is needed to determine the therapeutic dosage ranges for various cardiac medications, such as nitrates, beta blockers, or calcium channel blockers.

5. *Describe the common response to activity of women with heart disease.*

In general, women with heart disease tend to be older than their male counterparts. As a result, women presenting with cardiac problems may also have other significant comorbidities such as diabetes, hypertension, and arthritis, which may slow their activity progression. Therefore, during the acute phase, it is essential to involve either physical therapy and/or cardiac rehabilitation to begin mobilizing the patient and progressing with activity as appropriate to the patient's condition.

6. *What factors influence women's involvement in cardiac rehabilitation programs?*

Many factors have been studied regarding women's participation in formal outpatient cardiac rehabilitation programs. Some of the most common reasons women give for decreased attendance include family commitments, financial concerns, and medical problems, such as increasing angina and/or other cardiac symptoms.

CASE STUDY 6

Case Study 6 Analyses

1. *Based on the information, which woman has the best prognosis? The worst prognosis? Why?*

Patient B has the best prognosis. She has a longstanding history of stable angina that has been adequately managed with nitrates and an ACE inhibitor. Women with angina have a better prognosis than those who suffer an MI, one of the main reasons why it is so important to accurately assess a woman's cardiovascular risk factors and work on modifying those areas possible to prevent an MI from ever happening. After a woman has an MI, the mortality rates are significantly higher.

On the other hand, Patient R and Patient L have the worst prognoses of the women presented in this vignette. Women who undergo CABG surgery have double the perioperative mortality rate of men and also fare poorer in the early postoperative period, generally complaining of more angina, dyspnea, and reduced mobility. These findings may

be due to the fact that women tend to be older at the time of surgery, have more advanced disease, and significant comorbidities. However, five- and 10-year survival rates between men and women are comparable.

2. *What are some of the complications associated with each of these medical and surgical therapies?*

- **Medical Management**: A possible complication or adverse effect associated with medical management focuses on the dosage of cardiac medications used to treat women with heart disease. Women may have a different vasomotor tone compared to men and, thus, may require less nitrates. Only further research will give us the answers to guide clinical practice decisions.
- **Thrombolytic Therapy**: The main complication associated with thrombolytic therapy in women is bleeding, especially intracranial bleeding. The reason for this increased incidence in women may be dose related.
- **PCI**: The most common reported complications associated with angioplasty include bradycardia, hypotension, and coronary artery dissection. However, dissection is becoming less common as advances and improvements are made in angioplasty catheters.
- **CABG Surgery**: During the operative phase, incomplete revascularization (resulting in angina, dyspnea, and subsequent restricted activity) may occur due to women's smaller coronary arteries and difficulty in anastomosis. However, improved surgical tools and techniques have minimized the difficulties. Reports have also shown that women have longer hospital stays, greater complication rates, and higher postoperative morbidity, as previously suggested.

RESOURCES

American Heart Association
Go Red for Women
https://www.goredforwomen.org

Centers for Disease Control and Prevention: Heart Disease Facts
http://www.cdc.gov/heartdisease/facts.htm

National Heart, Lung, and Blood Institute
http://www.nhlbi.nih.gov/health/health-topics/topics/hdw/

National Institutes of Health, Office of Research on Women's Health
http://orwh.od.nih.gov

Women Heart: The National Coalition with Women and Heart Disease
http://www.womenheart.org

Works Cited

1. American Heart Association. Statistical Fact Sheet 2016 Update: Women and Cardiovascular Diseases. Available at https://www.heart.org/idc/groups/heart-public/@wcm/@sop/@smd/documents/downloadable/ucm_483971.pdf. Last accessed December 13, 2016.
2. American Heart Association Go Red For Women. Heart Disease Statistics at a Glance. Available at https://www.goredforwomen.org/about-heart-disease/facts_about_heart_disease_in_women-sub-category/statistics-at-a-glance/. Last accessed December 13, 2016.
3. American Heart Association. Symptoms of a Heart Attack and Stroke. Available at https://www.goredforwomen.org/home/about-heart-disease-in-women/symptoms-of-heart-disease. Last accessed December 13, 2016.
4. Mozaffarian D, Benjamin EJ, Go AS, et al. Heart disease and stroke statistics—2016 update: a report from the American Heart Association. *Circulation*. 2016;133(4):e38-e360.
5. Framingham Heart Study. History of the Framingham Heart Study. Available at http://www.framinghamheartstudy.org/about-fhs/history.php. Last accessed December 13, 2016.
6. U.S. Census Bureau. State and County Quick Facts. Available at https://www.census.gov/quickfacts/table/PST045216/00. Last accessed December 13, 2016.
7. National Center for Health Statistics. *Health, United States, 2009: With Special Feature on Medical Technology*. Hyattsville, MD: US Department of Health and Human Services; 2010.
8. Gist YJ, Hetzel LJ. We the People: Aging in the United States: Census 2000 Special Reports. Available at http://www.census.gov/prod/2004pubs/censr-19.pdf. Last accessed December 13, 2016.
9. U.S. Census Bureau. National Population Projections. Available at http://www.census.gov/population/projections/data/national/index.html. Last accessed December 13, 2016.
10. Hayes SN. Preventing cardiovascular disease in women. *Am Fam Physician*. 2006;74(8):1331-1340.
11. Centers for Disease Control and Prevention. Health Equity: Women's Health. Leading Causes of Death in Females, 2013. Available at http://www.cdc.gov/women/lcod/. Last accessed December 12, 2016.
12. Packard B. Clinical aspects of coronary heart disease in women. In: Wenger NK, Hellerstein HK (eds). *Rehabilitation of the Coronary Patient*. 3rd ed. New York, NY: Churchill Livingstone; 1991.
13. Eaker ED, Packard B, Thom TJ. Epidemiology and risk factors for coronary heart disease in women. *Cardiovasc Clin*. 1989;19(3):129-145.
14. Kohli P, Gulati M. Exercise stress testing in women: going back to the basics. *Circulation*. 2010;122(24):2570-2580.
15. Judelson D. Gender differences in evaluation and management of coronary disease. *Cardiovasc Dis Chest Pain*. 1994;10:3-8.
16. Wong Y, Rodwell A, Dawkins S, Livesey SA, Simpson IA. Sex differences in investigation results and treatment in subjects referred for investigation of chest pain. *Heart*. 2001;85(2):149-152.
17. Ghali WA, Faris PD, Galbraith PD, et al. Sex differences in access to coronary revascularization after cardiac catheterization: importance of detailed clinical data. *Ann Intern Med*. 2002;136(10):723-732.
18. Romeo KC. The female heart: physiological aspects of cardiovascular disease in women. *Dimens Crit Care Nurs*. 1995;14(4)170-177.
19. Beery TA. Gender bias in the diagnosis and treatment of coronary artery disease. *Heart Lung*. 1995;24(6):427-435.
20. Cochrane BL. Acute myocardial infarction in women. *Crit Care Nurs Clin North Am*. 1992;4(2):279-289.
21. Flavell CM. Women and coronary heart disease. *Prog Cardiovasc Nurs*. 1994;9(4):18-27.
22. Bairey Merz CN, Shaw LJ, Reis SE, et al. Insights from the NHLBI-Sponsored Women's Ischemia Syndrome Evaluation (WISE) study: part II: gender differences in presentation, diagnosis, and outcome with regard to gender-based pathophysiology of atherosclerosis and macrovascular and microvascular coronary disease. *J Am Coll Cardiol*. 2006;47(3 suppl S):S21-S29.
23. Pepine CJ, Kerensky RA, Lambert CR, et al. Some thoughts on the vasculopathy of women with ischemic heart disease. *J Am Coll Cardiol*. 2006;47(3 suppl S):S30-S35.
24. Judelson DR. Examining the gender bias in evaluating coronary disease in women. *Med Gen Med*. 1999;1(2).
25. Murdaugh C. Coronary artery disease in women. *J Cardiovasc Nurs*. 1990;4(4):35-50.
26. Wenger NK. Coronary heart disease in women: a "new" problem. *Hosp Pract*. 1992;27(11):59-62, 64, 67.
27. Jensen L, King KM. Women and heart disease: the issues. *Crit Care Nurse*. 1997;17(2):45-53.
28. Hay M, Huxley VH. Sexual dimorphism in hypertension. In: Dipette DJ, Schiffrin EL, Re RN, Sowers JR (eds). *Molecular Mechanisms of Hypertension*. Philadelphia, PA: Taylor and Francis; 2006.
29. Reis JP, Araneta MR, Wingard DL, Macera CA, Lindsay SP, Marshall SJ. Overall obesity and abdominal adiposity as predictors of mortality in U.S. white and black adults. *Ann Epidemiol*. 2009;19(2):134-142.
30. Canoy D. Distribution of body fat and risk of coronary heart disease in men and women. *Curr Opin Cardiol*. 2008;23(6):591-598.
31. Page JH, Rexrode KM, Hu F, Albert CM, Chae CU, Manson JE. Waist-height ratio as a predictor of coronary heart disease among women. *Epidemiology*. 2009;20(3):361-366.

32. Rexrode KM, Carey VJ, Hennekens CH, et al. Abdominal adiposity and coronary heart disease in women. *JAMA*. 1998;280(21):1843-1848.
33. Wingate S. Women and coronary heart disease: implications for the critical care setting. *Focus Crit Care*. 1991;18(3):212-214, 216-218, 220.
34. Penckofer S, Holm K. What you should know about women and heart disease. *Nursing*. 1993;23(6):42-46.
35. Rexrode KM, Manson JE, Lee IM, et al. Sex hormone levels and risk of cardiovascular events in postmenopausal women. *Circulation*. 2003;108(14):1688-1693.
36. Sesso HD, Lee IM, Gaziano JM, Rexrode KM, Glynn RJ, Buring JE. Maternal and paternal history of myocardial infarction and risk of cardiovascular disease in men and women. *Circulation*. 2001;104(4):393-398.
37. Weijmans M, van der Graaf Y, Reitsma JB, Visseren FL. Paternal or maternal history of cardiovascular disease and the risk of cardiovascular disease in offspring. A systematic review and meta-analysis. *Int J Cardiol*. 2015;179:409-416.
38. Huggins S. The role of the advanced practice nurse in reducing coronary heart disease in African-American women. *Top Adv Pract Nurs eJ*. 2006;6(2).
39. Vaccarino V, Rathore S, Wenger NK, et al., for the National Registry of Myocardial Infarction Investigators. Sex and racial differences in the management of acute myocardial infarction, 1994 through 2002. *N Engl J Med*. 2005;353(7):671-682.
40. American Heart Association. Smoking and Cardiovascular Disease (Heart Disease). Available at http://www.heart.org/HEARTORG/HealthyLiving/QuitSmoking/QuittingResources/Smoking-Cardiovascular-Disease_UCM_305187_Article.jsp#. Last accessed December 13, 2016.
41. Hemingway A. Determinants of coronary heart disease risk for women on a low income: literature review. *J Adv Nurs*. 2007;60(4):359-367.
42. Das BN, Banka VS. Coronary artery disease in women: how it is—and isn't—unique. *Postgrad Med*. 1992;91(4):197-200, 203-206.
43. American Lung Association. Smoking Facts: Health Effects. Available at http://www.lung.org/stop-smoking/about-smoking/health-effects/smoking.html. Last accessed December 13, 2016.
44. Office on Smoking and Health. *Women and Smoking: A Report of the Surgeon General*. Atlanta, GA: Centers for Disease Control and Prevention; 2001.
45. Bullen C. Impact of tobacco smoking and smoking cessation on cardiovascular risk and disease. *Expert Rev Cardiovasc Ther*. 2008;6(6):883-895.
46. Sarna L, Bialous SA, Jun HJ, Wewers ME, Cooley ME, Feskanich D. Smoking trends in the Nurses' Health Study (1976–2003). *Nurs Res*. 2008;57(6):374-382.
47. Centers for Disease Control and Prevention. Highlights: Smoking Among Adults in the United States: Coronary Heart Disease and Stroke [archive]. Available at http://www.cdc.gov/tobacco/data_statistics/sgr/2004/highlights/heart_disease/index.htm. Last accessed December 13, 2016.
48. Centers for Disease Control and Prevention. Smoking and Tobacco Use: Tobacco-Related Mortality. Available at https://www.cdc.gov/tobacco/data_statistics/fact_sheets/health_effects/tobacco_related_mortality/. Last accessed December 13, 2016.
49. Centers for Disease Control and Prevention. Smoking and Tobacco Use. Highlights: Health Consequences of Tobacco Use Among Women. Available at https://www.cdc.gov/tobacco/data_statistics/sgr/2001/highlights/consequences/. Last accessed December 13, 2016.
50. Chasan-Taber L, Stampfer M. Oral contraceptives and myocardial infarction: the search for the smoking gun. *N Engl J Med*. 2001;345(25):1841-1842.
51. U.S. Food and Drug Administration. Press Release: FDA Approves New Combination Product Oral Contraceptive. Available at http://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/ucm211176.htm [archive]. Last accessed December 13, 2016.
52. Centers for Disease Control and Prevention. Women and Heart Disease Fact Sheet. Available at http://www.cdc.gov/dhdsp/data_statistics/fact_sheets/fs_women_heart.htm. Last accessed December 13, 2016.
53. Madhur MS, Maron DJ. Hypertension. Available at http://emedicine.medscape.com/article/241381-overview. Last accessed December 13, 2016.
54. Women's Heart Foundation. Women and Heart Disease Fact Sheet. Available at http://www.womensheart.org/PDFs/FactSheet_WHD.pdf. Last accessed December 13, 2016.
55. National Heart, Lung, and Blood Institute. Risk Factors for High Blood Pressure. Available at https://www.nhlbi.nih.gov/health/health-topics/topics/hbp/atrisk. Last accessed December 13, 2016.
56. American Heart Association. Heart-Health Screenings. Available at http://www.heart.org/HEARTORG/Conditions/Heart-Health-Screenings_UCM_428687_Article.jsp#. Last accessed December 13, 2016.
57. Rosendorff C, Black HR, Cannon CP, et al. Treatment of hypertension in the prevention and management of ischemic heart disease: a scientific statement from the American Heart Association Council for High Blood Pressure Research and the Councils on Clinical Cardiology and Epidemiology and Prevention. *Circulation*. 2007;115(21):2761-2788.
58. Riaz K, Ali YS. Hypertensive Heart Disease. Available at http://emedicine.medscape.com/article/162449-overview. Last accessed December 13, 2016.

59. Lin JS, Olson CM Johnson ES, Whitlock EP. The ankle-brachial index for peripheral artery disease screening and cardiovascular disease prediction in asymptomatic adults: a systematic evidence review for the U.S. Preventive Services Task Force. *Ann Intern Med*. 2013;159(5):333-341.

60. American Heart Association. The American Heart Association's Diet and Lifestyle Recommendations. Available at http://www.heart.org/HEARTORG/HealthyLiving/HealthyEating/Nutrition/The-American-Heart-Associations-Diet-and-Lifestyle-Recommendations_UCM_305855_Article.jsp#. Last accessed December 13, 2016.

61. Heald CL, Fowkes FG, Murray GD, Price JF, Ankle Brachial Index Collaboration. Risk of mortality and cardiovascular disease associated with the ankle-brachial index: systematic review. *Atherosclerosis*. 2006;189(1):61-69.

62. Ankle Brachial Index Collaboration, Fowkes FG, Murray GD, et al. Ankle brachial index combined with Framingham Risk Score to predict cardiovascular events and mortality: a meta-analysis. *JAMA*. 2008;300(2):197-208.

63. American Heart Association Go Red For Women. Cholesterol and Heart Disease. Available at https://www.goredforwomen.org/know-your-risk/factors-that-increase-your-risk-for-heart-disease/cholesterol-heart-disease/. Last accessed December 13, 2016.

64. American Heart Association. Statistical Fact Sheet 2013 Update: High Blood Cholesterol and Other Lipids. Available at http://www.heart.org/idc/groups/heart-public/@wcm/@sop/@smd/documents/downloadable/ucm_319586.pdf. Last accessed December 13, 2016.

65. American Heart Association. What Your Cholesterol Levels Mean. Available at http://www.heart.org/HEARTORG/Conditions/Cholesterol/AboutCholesterol/What-Your-Cholesterol-Levels-Mean_UCM_305562_Article.jsp#. Last accessed December 13, 2016.

66. Healthy Women. Cholesterol. Available at http://www.healthywomen.org/condition/cholesterol. Last accessed December 13, 2016.

67. Agency for Healthcare Research and Quality. Cardiovascular Disease and Other Chronic Conditions in Women: Recent Findings (Program Brief). http://www.ahrq.gov/research/findings/factsheets/women/womheart/index.html. Last accessed December 13, 2016.

68. Centers for Disease Control and Prevention. 2014 National Diabetes Statistics Report. Available at http://www.cdc.gov/diabetes/data/statistics/2014statisticsreport.html. Last accessed December 13, 2016.

69. Fransoo RR, Martens PJ, Prior HJ, Burland E, Château D, Katz A. Age difference explains gender difference in cardiac intervention rates after acute myocardial infarction. *Healthc Policy*. 2010;6(1):88-103.

70. Burkman RT. Strategies for reducing cardiovascular risk in women. *J Reprod Med*. 1991;36(3):238-246.

71. Wang Y, Beydoun MA. The obesity epidemic in the United States—gender, age, socioeconomic, racial/ethnic, and geographic characteristics: a systematic review and meta-regression analysis. *Epidemiol Rev*. 2007;29(1):6-28.

72. Centers for Disease Control and Prevention. Overweight and Obesity: Data, Trends and Maps. Available at https://www.cdc.gov/obesity/data/databases.html. Last accessed December 13, 2016.

73. Ogden CL, Carroll MD, Fryar CD, Flegal KM. *Prevalence of Obesity Among Adults and Youth: United States, 2011–2014. NCHS Data Brief, No 219*. Hyattsville, MD: National Center for Health Statistics; 2015.

74. Hu FB. Overweight and obesity in women: health risks and consequences. *J Womens Health (Larchmt)*. 2003;12(2):163-172.

75. Vergnaud AC, Bertrais S, Oppert JM, et al. Weight fluctuations and risk for metabolic syndrome in an adult cohort. *Int J Obes (Lond)*. 2008;32(2):315-321.

76. Rich-Edwards JW, Manson JE, Hennekens CH, Buring JE. The primary prevention of coronary heart disease in women. *N Engl J Med*. 1995;332(26):1758-1766.

77. International Diabetes Federation. The IDF Consensus Worldwide Definition of the Metabolic Syndrome. Available at http://www.idf.org/webdata/docs/MetS_def_update2006.pdf. Last accessed December 13, 2016.

78. Aguilar M, Bhuket T, Torres S, et al. Prevalence of the metabolic syndrome in the United States, 2003–2012. *JAMA*. 2015;313(19):1973-1974.

79. American Heart Association. Metabolic Syndrome. Available at http://www.heart.org/HEARTORG/Conditions/More/MetabolicSyndrome/Metabolic-Syndrome_UCM_002080_SubHomePage.jsp. Last accessed December 13, 2016.

80. Office of the Surgeon General. Physical Activity and Health: The Link Between Physical Activity and Morbidity and Mortality. Available at http://www.cdc.gov/nccdphp/sgr/pdf/mm.pdf. Last accessed December 13, 2016.

81. Institute of Medicine of the National Academies. *Dietary Reference Intakes for Energy, Carbohydrate, Psychophysiology: Human Behavior and Physiological Response. Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids*. Washington, DC: The National Academies Press; 2005.

82. Eckel RH, Jakicic JM, Ard JD, et al. 2013 AHA/ACC guideline on lifestyle management to reduce cardiovascular risk. A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *Circulation*. 2014;129(suppl 2):S76-S99.

83. Friedman M, Rosenman R. *Type A Behavior and Your Heart*. New York, NY: Knopf; 1974.

84. Haynes SG, Levine S, Scotch N, Feinleib M, Kannel WB. The relationship of psychosocial factors to coronary heart disease in the Framingham study. *Am J Epidemiol*. 1978;107(5):362-383.

85. Andreassi JL. *Psychophysiology: Human Behavior and Physiological Response*. 5th ed. New York, NY: Lawrence Erlbaum Associates; 2006.

86. Goldsmith MF. Heart research efforts aim at fairness to women in terms of causes, care of cardiac disorders. *JAMA*. 1990;264(24):3112-3113.

87. Mayo Clinic. Heart Disease in Women: Understand Symptoms and Risk Factors. Available at http://www.mayoclinic.org/diseases-conditions/heart-disease/in-depth/heart-disease/art-20046167. Last accessed December 13, 2016.

88. U.S. Department of Labor. Data and Statistics. Women in the Labor Force. Available at https://www.dol.gov/wb/stats/stats_data.htm. Last accessed December 13, 2016.

89. Lee S, Colditz G, Berkman L, Kawachi I. A prospective study of job strain and coronary heart disease in U.S. women. *Intl J Epidemiol*. 2002;31(6):1147-1153.

90. Eaker ED, Sullivan LM, Kelly-Hayes M, D'Agostino RB Sr., Benjamin EJ. Does job strain increase the risk for coronary heart disease or death in men and women? The Framingham Offspring Study. *Am J Epidemiol*. 2004;159(10):950-958.

91. Peter R, Siegrist J, Hallqvist J, Reuterwall C, Theorell T, the SHEEP Study Group. Psychosocial work environment and myocardial infarction: improving risk estimation by combining two complementary job stress models in the SHEEP Study. *J Epidemiol Community Health*. 2002;56(4):294-300.

92. Peter R, Hammarstrom A, Hallqvist J, Siegrist J, Theorell T, the SHEEP Study Group. Does occupational gender segregation influence the association of effort-reward imbalance with myocardial infarction in the SHEEP study? *Int J Behav Med*. 2006;13(1):34-43.

93. Kivimaki M, Virtanen M, Elovainio M, Kouvonen A, Vaananen A, Vahtera J. Work stress in the etiology of coronary heart disease-a meta-analysis. *Scand J Work Environ Health*. 2006;32(6):431-442.

94. Orth-Gomer K, Wamala SP, Horsten M, Schenck-Gustafsson K, Schneiderman N, Mittleman MA. Marital stress worsens prognosis in women with coronary heart disease: the Stockholm Female Coronary Risk Study. *JAMA*. 2000;284(23):3008-3014.

95. Blom M, Janszky I, Balog P, Orth-Gomer K, Wamala SP. Social relations in women with coronary heart disease: the effects of work and marital stress. *J Cardiovasc Risk*. 2003;10(3):201-206.

96. Lewis MA, Heinemann LA, Spitzer WO, MacRae KD, Bruppacher R. The use of oral contraceptives and the occurrence of acute myocardial infarction in young women: results from the Transnational Study on Oral Contraceptives and the Health of Young Women. *Contraception*. 1997;56(3):129-140.

97. Kemmeren JM, Algra A, Grobbee DE. Third generation oral contraceptives and risk of venous thrombosis: meta-analysis. *BMJ*. 2001;323(7305):131-134.

98. Jick H, Kaye JA, Vasilakis-Scaramozza C, Jick SS. Risk of venous thromboembolism among users of third generation oral contraceptives compared with users of oral contraceptives with levonorgestrel before and after 1995: cohort and case-control analysis. *BMJ*. 2000;321(7270):1190-1195.

99. Jick SS, Kaye JA, Russmann S, Jick H. Risk of nonfatal venous thromboembolism with oral contraceptives containing norgestimate or desogestrel compared with oral contraceptives containing levonorgestrel. *Contraception*. 2006;73(6):566-570.

100. Shapiro S, Dinger J. Risk of venous thromboembolism among users of oral contraceptives: a review of two recently published studies. *J Fam Plan Reprod Health Care*. 2010;36(1):33-38.

101. Samson ME, Adams SA, Merchant AT, et al. Cardiovascular disease incidence among females in South Carolina by type of oral contraceptives, 2000-2013: a retrospective cohort study. *Arch Gynecol Obstet*. 2016;294(5):991-997.

102. Coney P. Menopause. Available at http://emedicine.medscape.com/article/264088-overview. Last accessed December 13, 2016.

103. Sun Q, Ma J, Rifai N, Franco OH, Rexrode KM, Hu FB. Excessive body iron stores are not associated with risk of coronary heart disease in women. *J Nutr*. 2008;138(12):2436-2441.

104. Zegrean M. Association of body iron stores with development of cardiovascular disease in the adult population: a systematic review of the literature. *Can J Cardiovasc Nurs*. 2009;19(1):26-32.

105. Mason M. An evidence-based disease reversal strategy. *Cardiovasc Dis Manage*. 1997;3:1-5, 7.

106. Taber's Online Medical Dictionary. Available at http://www.tabers.com/tabersonline/ub/. Last accessed December 13, 2016.

107. Humphrey LL, Fu R, Rogers K, Freeman M, Helfand M. Homocysteine level and coronary heart disease incidence: a systematic review and meta-analysis. *Mayo Clin Proc*. 2008;83(11):1203-1212.

108. US Preventive Services Task Force. Using nontraditional risk factors in coronary heart disease risk assessment: U.S. Preventive Services Task Force recommendation statement. *Ann Intern Med*. 2009;151(7):474-482.

109. American Heart Association. Folic Acid and Cardiovascular Disease. Available at http://www.heart.org/HEARTORG/Encyclopedia/Heart-Encyclopedia_UCM_445084_Encyclopedia.jsp?levelSelected=11&title=folic%20acid%20and%20cardiovascular%20disease. Last accessed December 13, 2016.

110. Graham IM, O'Callaghan P. Vitamins, homocysteine and cardiovascular risk. *Cardiovasc Drugs Ther*. 2002;16(5):383-389.

111. Nordestgaard BG, Chapman MJ, Ray K, et al. Lipoprotein(a) as a cardiovascular risk factor: current status. *Eur Heart J*. 2010;31(23):2844-2853.

112. Berglund L, Anuurad E. Role of lipoprotein(a) in cardiovascular disease. *J Am Coll Cardiol*. 2008;52(2):132-134.

113. Koenig W. Fibrin(ogen) in cardiovascular disease: an update. *Thromb Haemost*. 2003;89(4):601-609.

114. Fibrinogen Studies Collaboration, Danesh J, Lewington S, et al. Plasma fibrinogen level and the risk of major cardiovascular diseases and nonvascular mortality: an individual participant meta-analysis. *JAMA*. 2005;294(14):1799-1809.

115. Ridker PM. C-reactive protein. A simple test to help predict risk of heart attack and stroke. *Circulation*. 2003;108:e81-e85

116. Ridker PM, Rifai N, Rose L, Buring JE, Cook NR. Comparison of c-reactive protein and low-density lipoprotein cholesterol levels in the prediction of first cardiovascular events. *N Engl J Med*. 2002;347(20):1557-1565.

117. Sharma K, Gulati M. Coronary artery disease in women: a 2013 update. *Global Heart*. 2013;8(2):105-112.

118. Wenger NK. The Reynolds Risk Score: improved accuracy for cardiovascular risk prediction in women? *Nat Clin Pract Cardiovasc Med*. 2007;4:366-367.

119. Ridker PM, Hennekens CH, Buring JE, Rifai N. C-reactive protein and other markers of inflammation in the prediction of cardiovascular disease in women. *N Engl J Med*. 2000;342(12):836-843.

120. Mora S, Ridker PM. Justification for the Use of Statins in Primary Prevention: An Intervention Trial Evaluating Rosuvastatin (JUPITER): can C-reactive protein be used to target statin therapy in primary prevention? *Am J Cardiol*. 2006;97(2A):33A-41A.

121. O'Keefe JH, Carter MD, Lavie CJ, Bell DS. The gravity of JUPITER (Justification for the Use of Statins in Primary Prevention: An Intervention Trial Evaluating Rosuvastatin). *Postgrad Med*. 2009;121(3):113-118.

122. Wilson PW, Pencina M, Jacques P, Selhub J, D'Agostino R Sr., O'Donnell CJ. C-reactive protein and reclassification of cardiovascular risk in the Framingham Heart Study. *Circ Cardiovasc Qual Outcomes*. 2008;1(2):92-97.

123. Yousuf O, Mohanty BD, Martin SS, et al. High-sensitivity C-reactive protein and cardiovascular disease: a resolute belief or an elusive link? *J Am Coll Cardiol* 2013;62(5):397-408.

124. Buckley DI, Fu R, Freeman M, Rogers K, Helfand M. C-reactive protein as a risk factor for coronary heart disease: a systematic review and meta-analyses for the U.S. Preventive Services Task Force. *Ann Intern Med*. 2009;151(7):483-495.

125. Shah T, Casas JP, Cooper JA, et al. Critical appraisal of CRP measurement for the prediction of coronary heart disease events: new data and systematic review of 31 prospective cohorts. *Int J Epidemiol*. 2009;38(1):217-231.

126. Joanna Briggs Institute. Nurse-led cardiac clinics for adults with coronary heart disease. *Best Practice*. 2005;9(1):1-6.

127. Madjid M, Awan I, Willerson JT, Casscells SW. Leukocyte count and coronary heart disease: implications for risk assessment. *J Am Coll Cardiol*. 2004;44(10):1945-1956.

128. Surks MI, Ortiz E, Daniels GH, et al. Subclinical thyroid disease: scientific review and guidelines for diagnosis and management. *JAMA*. 2004;291(2):228-238.

129. Hak AE, Pols HAP, Visser TJ, Drexhage HA, Hofman A, Witteman JCM. Subclinical hypothyroidism is an independent risk factor for atherosclerosis and myocardial infarction in elderly women: the Rotterdam Study. *Ann Intern Med*. 2000;132(4):270-278.

130. Wu T, Trevisan M, Genco RJ, Falkner KL, Dorn JP, Sempos CT. Examination of the relation between periodontal health status and cardiovascular risk factors: serum total and high density lipoprotein cholesterol, C-reactive protein, and plasma fibrinogen. *Am J Epidemiol*. 2000;151(3):273-282.

131. Kimble LP, McGuire DB, Dunbar SB, et al. Gender differences in pain characteristics of chronic stable angina and perceived physical limitation in patients with coronary artery disease. *Pain*. 2003;101(1-2):45-53.

132. Kyker KA, Limacher MC. Gender differences in the presentation and symptoms of coronary artery disease. *Curr Womens Health Rep*. 2002;2(2):115-119.

133. Pregler, JP, Decherney AH. *Women's Health: Principles and Clinical Practice*. 1st ed. Shelton, CT: People's Medical Publishing House; 2002.

134. Taylor P, Becker RC. Noninvasive diagnosis of coronary heart disease in women. *Cardiology*. 1990;77(suppl 2):91-98.

135. Pray WS. The patient with chest pain. *US Pharmacist*. 2007;32(2).

136. Fass R, Dickman R. Non-cardiac chest pain: an update. *Neurogastroenterol Motil*. 2006;18:408-417.

137. Ringstrom E, Freedman J. Approach to undifferentiated chest pain in the emergency department: a review of recent medical literature and published practice guidelines. *Mt Sinai Med*. 2006;73:499-505.

138. O'Keefe-McCarthy S. Women's experiences of cardiac pain: a review of the literature. *Can J Cardiovasc Nurs*. 2008;18(3):18-25.

139. Swap CJ, Nagurney JT. Value and limitations of chest pain history in the evaluation of patients with suspected acute coronary syndromes. *JAMA*. 2005;294(20):2623-2629.

140. Dosh SA. Diagnosis of heart failure in adults. *Am Fam Physician*. 2004;70(11):2145-2152.

141. Gökçe M, Karahan B, Yilmaz R, Orem C, Erdöl C, Ozdemir S. Long term effects of hormone replacement therapy on heart rate variability, QT interval, QT dispersion and frequencies of arrhythmia. *Int J Cardiol*. 2005;99(3):373-379.

142. Sedlak T, Shufelt C, Iribarren C, Merz CN. Sex hormones and the QT interval: a review. *J Womens Health (Larchmt)*. 2012;21(9):933-941.

143. Mieres JH, Shaw LJ, Arai A, et al. Role of noninvasive testing in the clinical evaluation of women with suspected coronary artery disease: consensus statement from the Cardiac Imaging Committee, Council on Clinical Cardiology, and the Cardiovascular Imaging and Intervention. *Circulation*. 2005;111(5):682-696.

144. Di Carli MF, Dorbala S. Exercise testing and nuclear scanning. *Circulation*. 2003;107:e100-e102.

145. Arbab-Zadeh A. Stress testing and non-invasive coronary angiography in patients with suspected coronary artery disease: time for a new paradigm. *Heart Int*. 2012;7:32.

146. Boden WE. Is myocardial perfusion imaging an important predictor of mortality in women and if so, is this likely cost effective? *J Am Coll Cardiol Img*. 2011;4(8):889-893.

147. American Heart Association. Radionuclide Ventriculography or Radionuclide Angiography (MUGA Scan). Available at http://www.heart.org/HEARTORG/Conditions/HeartAttack/SymptomsDiagnosisofHeartAttack/Radionuclide-Ventriculography-or-Radionuclide-Angiography-MUGA-Scan_UCM_446354_Article.jsp. Last accessed December 13, 2016.

148. Merck Manuals Online Medical Library. Radionuclide Imaging. Available at http://www.msdmanuals.com/en-au/professional/SearchResults?query=radionuclide+imaging. Last accessed December 13, 2016.

149. Marwick TH. Stress echocardiography. *Heart*. 2003;89:113-118.

150. Greulich S, Bruder O, Parker M, et al. Comparison of exercise electrocardiography and stress perfusion CMR for the detection of coronary artery disease in women. *J Cardiovasc Magn Reson*. 2012;14:36.

151. Dodi C, Cortigiani L, Masini M, Olivotto I, Azzarelli A, Nannini E. The incremental prognostic value of pharmacological stress echo over exercise electrocardiography in women with chest pain of unknown origin. *Eur Heart J*. 2001;22(2):145-152.

152. Akinpelu D. Pharmacologic Stress Testing. Available at http://emedicine.medscape.com/article/1827166-overview. Last accessed December 13, 2016.

153. Lexi-Comp Online. Available at http://online.lexi.com. Last accessed December 13, 2016.

154. U.S. Food and Drug Administration. Lexiscan (Regadenoson) and Adenoscan (Adenosine): Drug Safety Communication—Rare but Serious Risk of Heart Attack and Death. Available at http://www.fda.gov/Safety/MedWatch/SafetyInformation/SafetyAlertsforHumanMedicalProducts/ucm375981.htm. Last accessed December 13, 2016.

155. Douglas PS, Khandheria B, Stainback RF, Weissman NJ. ACCF/ASE/ACEP/AHA/ASNC/SCAI/SCCT/SCMR 2008 appropriateness criteria for stress echocardiography: a report of the American College of Cardiology Foundation Appropriateness Criteria Task Force, American Society of Echocardiography, American College of Emergency Physicians, American Heart Association, American Society of Nuclear Cardiology, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Computed Tomography, and Society for Cardiovascular Magnetic Resonance. *J Am Coll Cardiol*. 2008;51(11):1127-1147.

156. O'Rourke RA, Brundage BH, Froelicher VF, et al. American College of Cardiology/American Heart Association expert consensus document on electron-beam computed tomography for the diagnosis and prognosis of coronary artery disease. *Circulation*. 2000;102(1):126-140.

157. Lakoski SG, Greenland P, Wong ND, et al. Coronary artery calcium scores and risk for cardiovascular events in women classified as "low risk" based on Framingham risk score: the Multi-Ethnic Study of Atherosclerosis (MESA). *Arch Intern Med*. 2007;167:2437-2442.

158. Antman EM, Hand M, Armstrong PW, et al. 2007 focused update of the ACC/AHA 2004 Guidelines for the Management of Patients With ST-Elevation Myocardial Infarction: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines: developed in collaboration With the Canadian Cardiovascular Society endorsed by the American Academy of Family Physicians: 2007 Writing Group to Review New Evidence and Update the ACC/AHA 2004 Guidelines for the Management of Patients With ST-Elevation Myocardial Infarction, Writing on Behalf of the 2004 Writing Committee. *Circulation*. 2008;117(2):296-329.

159. Rathore SS, Chen J, Wang Y, Radford MJ, Vaccarino V, Krumholz HM. Sex differences in cardiac catheterization: the role of physician gender. *JAMA*. 2001;286(22):2849-2856.

160. Gold LD, Krumholz HM. Gender differences in treatment of heart failure and acute myocardial infarction: a question of quality or epidemiology? *Cardiol Rev*. 2006;14(4):180-186.

161. Kaczmarek RG, Liu CH, Gross TP. Medical device surveillance: gender differences in pulmonary artery rupture after pulmonary artery catheterization. *J Womens Health (Larchmt)*. 2003;12(9):931-935.

162. King KM, Ghali WA, Faris PD, et al. Sex differences in outcomes after cardiac catheterization: effect modification by treatment strategy and time. *JAMA*. 2004;291(10):1220-1225.

163. Roger V, Farkouh ME, Weston SA, et al. Sex differences in evaluation and outcome of unstable angina. *JAMA*. 2000;283(5):646-652.

164. Jacobs AK. Women, ischemic heart disease, revascularization, and the gender gap. What are we missing? *J Am Coll Cardiol*. 2006;47(suppl S):S63-S65.

165. Canto JG, Goldberg RJ, Hand M, et al. Symptom presentation of women with acute coronary syndromes: myth vs. reality. *Arch Intern Med*. 2007;167(22):2405-2413.

166. Sketch MH Jr, Pieper KS, Warner J, et al. Mobile cardiac catheterization laboratories increase use of cardiac care in women and African Americans. *Am Heart J*. 2007;154(3):532-538.

167. Peterson LF, Peterson LR. The safety of performing diagnostic cardiac catheterizations in a mobile catheterization laboratory at primary care hospitals. *Angiology*. 2004;55(5):499-506.

168. Leuzzi C, Modena MG. Coronary artery disease: clinical presentation, diagnosis and prognosis in women. *Nutr Metab Cardiovasc Dis*. 2010;20(6):426-435.

169. American Heart Association. Heart Attack Symptoms in Women. Available at http://www.heart.org/HEARTORG/Conditions/HeartAttack/WarningSignsofaHeartAttack/Heart-Attack-Symptoms-in-Women_UCM_436448_Article.jsp. Last accessed December 13, 2016.

170. Hemingway H, Langenberg C, Damant J, Frost C, Pyorala K, Barrett-Connor E. Prevalence of angina in women versus men: a systematic review and meta-analysis of international variations across 31 countries. *Circulation*. 2008;117(12):1526-1536.

171. American Heart Association. Unstable Angina. Available at http://www.heart.org/HEARTORG/Conditions/HeartAttack/SymptomsDiagnosisofHeartAttack/Unstable-Angina_UCM_437513_Article.jsp. Last accessed December 13, 2016.

172. Wang SS. Coronary Artery Vasospasm. Available at http://emedicine.medscape.com/article/153943-overview. Last accessed December 13, 2016.

173. Devabhaktuni SR. Cardiac Syndrome X. Available at http://emedicine.medscape.com/article/1967073-overview. Last accessed December 13, 2016.

174. National Institutes of Health. WISE Study of Women and Heart Disease Yields Important Findings on Frequently Undiagnosed Coronary Syndrome. Available at https://www.nhlbi.nih.gov/news/press-releases/2006/wise-study-of-women-and-heart-disease-yields-important-findings-on-frequently-undiagnosed-coronary-syndrome. Last accessed December 13, 2016.

175. Asbury EA, Collins P. Cardiac syndrome X. *Int J Clin Pract*. 2005;59(9):1063-1069.

176. American Heart Association. Microvascular Angina. Available at http://www.heart.org/HEARTORG/Conditions/HeartAttack/DiagnosingaHeartAttack/Microvascular-Angina_UCM_450313_Article.jsp#. Last accessed December 13, 2016.

177. Cannon RO III. Microvascular angina and the continuing dilemma of chest pain with normal coronary angiograms. *J Am Coll Cardiol*. 2009;54(10):877-885.

178. Berg J, Bjorck L, Dudas K, Lappas G, Rosengren A. Symptoms of a first acute myocardial infarction in women and men. *Gend Med*. 2009;6(3):454-462.

179. Albarran JW, Clarke BA, Crawford J. "It was not chest pain really, I can't explain it!" An exploratory study on the nature of symptoms experienced by women during their myocardial infarction. *J Clin Nurs*. 2007;16(7):1292-1301.

180. Kearney M. Women don't get heart attacks? *Reflect Nurs Leadersh*. 2000;26(2):18-20.

181. Philpott S, Boynton PM, Feder G, Hemingway H. Gender differences in descriptions of angina symptoms and health problems immediately prior to angiography: the ACRE study. *Soc Sci Med*. 2001;52(10):1565-1575.

182. DeVon H, Zerwic J. The symptoms of unstable angina: do women and men differ? *Nurs Res*. 2003;52(2):108-118.

183. Schaefer KM. The female cardiac patient: caring for the new majority. *Dimens Crit Care Nurs*. 1992;11(2):65-66.

184. Rosenfeld AG. Treatment-seeking delay among women with acute myocardial infarction: decision trajectories and their predictors. *Nurs Res*. 2004;53(4):225-236.

185. Lefler LL, Bondy KN. Women's delay in seeking treatment with myocardial infarction: a meta-synthesis. *J Cardiovasc Nurs*. 2004;19(4):251-268.

186. Nguyen HL, Saczynski JS, Gore JM, Goldberg RJ. Age and sex differences in duration of prehospital delay in patients with acute myocardial infarction: a systematic review. *Circ Cardiovasc Qual Outcomes*. 2010;3(1):82-92.

187. Isaksson RM, Holmgren L, Lundblad D, Brulin C, Eliasson M. Time trends in symptoms and prehospital delay time in women vs. men with myocardial infarction over a 15-year period. The Northern Sweden MONICA Study. *Eur J Cardiovasc Nurs*. 2008;7(2):152-158.

188. Khraim FM, Carey MG. Predictors of pre-hospital delay among patients with acute myocardial infarction. *Patient Educ Couns*. 2009;75(2):155-161.

189. Lefler L. The advanced practice nurse's role regarding women's delay in seeking treatment with myocardial infarction. *J Am Acad Nurse Pract*. 2002;14(10):449-456.

190. Dempsey S, Dracup K, Moser D. Women's decision to seek care for symptoms of acute myocardial infarction. *Heart Lung*. 1995;24(6):444-456.

191. Moser DK, McKinley S, Dracup K, Chung ML. Gender differences in reasons patients delay in seeking treatment for acute myocardial infarction symptoms. *Patient Educ Couns*. 2005;56(1):45-54.

192. de Torbal A, Boersma E, Kors JA, et al. Incidence of recognized and unrecognized myocardial infarction in men and women aged 55 and older: the Rotterdam Study. *Eur Heart J*. 2006;27:729-736.

193. Vaccarino V, Parsons L, Every NR, Barron HV, Krumholz HM, for the National Registry of Myocardial Infarction 2 Participants. Sex-based differences in early mortality after myocardial infarction. *N Engl J Med*. 1999;341(4):217-225.

194. Vaccarino V, Parsons L, Peterson ED, Rogers WJ, Kiefe CI, Canto J. Sex differences in mortality after acute myocardial infarction: changes from 1994 to 2006. *Arch Intern Med*. 2009;169(19):1767-1774.

195. Hochman JS, Tamis JE, Thompson TD, et al. Sex, clinical presentation, and outcome in patients with acute coronary syndromes: global use of strategies to open occluded coronary arteries in acute coronary syndromes llb investigators. *N Engl J Med*. 1999;341(4):226-232.

196. Tillmanns H, Waas W, Voss R, et al. Gender differences in the outcome of cardiac interventions. *Herz*. 2005;30(5):375-389.

197. Zimmermann S, Ruthrof S, Nowak K, et al. Short-term prognosis of contemporary interventional therapy of ST-elevation myocardial infarction: does gender matter? *Clin Res Cardiol*. 2009;98(11):709-715.

198. Movahed MR, Ramaraj R, Jamal MM, Hashemzadeh M. Nationwide trends in the utilization of multivessel percutaneous coronary intervention (MVPCI) in the United States across different gender and ethnicities. *J Interv Cardiol*. 2009;22(3):247-251.

199. Levine GN, Bates ER, Blankenship JC, et al. 2011 ACCF/AHA/SCAI guideline for percutaneous coronary intervention: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines and the Society for Cardiovascular Angiography and Interventions. *Circulation*. 2011;124:e574-e651.

200. Tamis-Holland JE, Palazzo A, Stebbins AL, et al. Benefits of direct angioplasty for women and men with acute myocardial infarction: results of the Global Use of Strategies to Open Occluded Arteries in Acute Coronary Syndromes (GUSTO II-B) Angioplasty Substudy. *Am Heart J*. 2004;147(1):133-139.

201. Singh M, Rihal CS, Gersh BJ, et al. Mortality differences between men and women after percutaneous coronary interventions: a 25-year, single-center experience. *J Am Coll Cardiol*. 2008;51(24):2313-2320.

202. Smith SC, Feldman TE, Hirshfield JW, et al. ACC/AHA/SCAI 2005 guideline update for percutaneous intervention. *J Am Coll Cardiol*. 2006;47(1):e1-e121.

203. Smith SC Jr, Dove JT, Jacobs AK, et al. ACC/AHA guidelines for percutaneous coronary intervention (revision of the 1993 PTCA guidelines): executive summary. *Circulation*. 2001;103:3019-3041.

204. De Luca G, Suryapranata H, Dambrink JH, et al. Sex-related differences in outcome after ST-segment elevation myocardial infarction treated by primary angioplasty: data from the Zwolle Myocardial Infarction Study. *Am Heart J*. 2004;148(5):852-856.

205. Mallik S, Vaccarino V. Outcomes of thrombolytic therapy for acute myocardial infarction in women. *Prog Cardiovasc Dis*. 2004;47(1):58-71.

206. Ostadal P, Ostadal B. Women and the management of acute coronary syndrome. *Can J Physiol Pharmacol*. 2012;90(9):1151-1159.

207. Woods SE, Noble G, Smith JM, Hasselfeld K. The influence of gender in patients undergoing coronary artery bypass graft surgery: an eight-year prospective hospitalized cohort study. *J Am Coll Surg*. 2003;196(3):428-434.

208. Koch CG, Weng YS, Zhou SX, et al. Prevalence of risk factors, and not gender per se, determines short- and long-term survival after coronary artery bypass surgery. *J Cardiothorac Vasc Anesth*. 2003;17(5):585-593.

209. Edwards ML, Albert NM, Wang C, Apperson-Hansen C. 1993–2003 gender diffrences in coronary artery revascularization: has anything changed? *J Cardiovasc Nurs*. 2005;20(6):461-467.

210. Karthik S, Fabri BM. Left internal mammary artery usage in coronary artery bypass grafting: a measure of quality control. *Ann R Coll Surg Engl*. 2006;88(4):367-369.

211. Leavitt BJ, Olmstead EM, Plume SK, et al. Use of the internal mammary artery graft in Northern New England. *Circulation*. 1997;96(suppl II):32-37.

212. Vaccarino V, Koch CG. Long-term benefits of coronary bypass surgery: are the gains for women less than for men? *J Thorac Cardiovasc Surg*. 2003;126(6):1707-1711.

213. Vaccarino V, Abramson JL, Veledar E, Weintraub WS. Sex differences in hospital mortality after coronary artery bypass surgery: evidence for a higher mortality in younger women. *Circulation*. 2002;105(10):1176-1181.

214. Koch CG, Khandwala F, Cywinski JB, et al. Health-related quality of life after coronary artery bypass grafting: a gender analysis using the Duke Activity Status Index. *J Thorac Cardiovasc Surg*. 2004;128(2):284-295.

215. Herlitz J, Brandrup-Wognsen G, Karlson BW, et al. Mortality, risk indicators of death, mode of death and symptoms of angina pectoris during 5 years after coronary artery bypass grafting in men and women. *J Intern Med*. 2000;247(4):500-506.

216. Jacobs AK, Kelsey SF, Brooks MM, et al. Better outcome for women compared with men undergoing coronary revascularization: a report from the Bypass Angioplasty Revascularization Investigation (BARI). *Circulation*. 1998;98(13):1279-1285.

217. Moore SM. A comparison of women's and men's symptoms during home recovery after coronary artery bypass surgery. *Heart Lung*. 1995;24(6):495-501.

218. King KM, Gortner SR. Women's short-term recovery from cardiac surgery. *Prog Cardiovasc Nurs*. 1996;11(2):5-15.

219. King KB, Rowe MA, Zerwic JJ. Concerns and risk factor modification in women during the year after coronary artery surgery. *Nurs Res*. 2000;49(3):167-172.

220. De Vos C, Li X, Van Vlaenderen I, et al. Participating or not in a cardiac rehabilitation programme: factors influencing a patient's decision. *Euro J Preventive Cardiol*. 2013;20(2):341-348.

221. Ghali JK, Pina IL, Gottlieb SS, Deedwania PC, Wikstrand JC, MERIT-HF Study Group. Metoprolol CR/XL in female patients with heart failure: analysis of the experience in Metoprolol Extended-Release Randomized Intervention Trial in Heart Failure (MERIT-HF). *Circulation*. 2002;105(13):1585-1591.

222. Grace SL, Gravely-Witte S, Brual J, et al. Contribution of patient and physician factors to cardiac rehabilitation referral: a prospective multilevel study. *Nat Clin Pract Cardiovasc Med*. 2008;5(10):653-662.

223. Moradi B, Maleki M, Esmaeilzadeh M, Abkenar HB. Physician-related factors affecting cardiac rehabilitation referral. *J Tehran Heart Cent*. 2011;6(4):187-192.

224. Halm M, Penque S, Doll N, Beahrs M. Women and cardiac rehabilitation: referral and compliance patterns. *J Cardiovasc Nurs*. 1999;13(3):83-92.

225. Shanmugasegaram S, Oh P, Reid RD, McCumber T, Grace SL. Cardiac rehabilitation barriers by rurality and socioeconomic status: a cross-sectional study. *Int J Equity Health*. 2013;12(1):72.

226. Sanderson BK, Shewchuk RM, Bittner V. Cardiac rehabilitation and women: what keeps them away? *J Cardiopulm Rehabil Prev*. 2010;30(1):12-21.

227. Cannistra LB, Balady GJ, O'Malley CJ, Weiner DA, Ryan TJ. Comparison of the clinical profile and outcome of women and men in cardiac rehabilitation. *Am J Cardiol*. 1992;69(16):1274-1279.

228. Azad NA, Bouchard K, Mayhew A, Carter M, Molnar FJ. Safety and predictors of adherence of a new rehabilitation program for older women with congestive heart failure. *J Geriatr Cardiol*. 2012;9(3):243-246.

229. Beswick AD, Rees K, West RR, et al. Improving uptake and adherence in cardiac rehabilitation: literature review. *J Adv Nurs*. 2005;49(5):538-555.

230. Chyun D. Nursing management of coronary heart disease in women: using research findings. *Crit Care Nurse*. 1997;17(2):10, 12, 14.

231. Gravely S, Anand SS, Stewart DE, Grace SL, CRCARE Investigators. Effect of referral strategies on access to cardiac rehabilitation among women. *Eur J Prev Cardiol*. 2014;21(8):1018-1025.

232. Shabani R, Gaeini AA, Nikoo MR, Nikbackt H, Sadegifar M. Effect of cardiac rehabilitation program on exercise capacity in women undergoing coronary artery bypass graft in Hamadan-iran. *Int J Prev Med*. 2010;1(4):247-251.

233. Ghashghaei FE, Sadeghi M, Marandi SM, Ghashghaei SE. Exercise-based cardiac rehabilitation improves hemodynamic responses after coronary artery bypass graft surgery. *ARYA Atheroscler*. 2012;7(4):151-156.

234. Kim C, Youn JE, Choi HE. The effect of a self-exercise program in cardiac rehabilitation for patients with coronary artery disease. *Ann Rehabil Med*. 2011;35(3):381-387.

235. European Society of Cardiology. Heart Attack Patients Return to Work Later and Retire Earlier if Treatment is Delayed. Available at https://www.escardio.org/The-ESC/Press-Office/Press-releases/Heart-attack-patients-return-to-work-later-and-retire-earlier-if-treatment-is-de. Last accessed December 13, 2016.

236. Halm MA, Alpen MA. Support groups: an annotated bibliography for critical care nurses. *Crit Care Nurse*. 1994;14(3):118-128.

237. National Heart, Lung, and Blood Institute. How Does Heart Disease Affect Women? Available at http://www.nhlbi.nih.gov/health/health-topics/topics/hdw/. Last accessed December 13, 2016.

238. American Heart Association. Cardiovascular Disease: Women's No. 1 Health Threat. Available at http://www.heart.org/idc/groups/heart-public/@wcm/@adv/documents/downloadable/ucm_302256.pdf. Last accessed December 13, 2016.

239. National Institute of Nursing Research. Subtle and Dangerous: Symptoms of Heart Disease in Women. Available at https://www.ninr.nih.gov/sites/default/files/subtle-and-dangerous-symptoms-heart-disease-in-women-booklet.pdf. Last accessed December 13, 2016.

240. Pereira de Melo R, Venicios de Oliveira Lopes M, Leite de Araujo T, de Fatima da Silva L, Aline Arrais Sampaio Santos F, Moorhead S. Risk for decreased cardiac output: validation of a proposal for nursing diagnosis. *Nurs Crit Care*. 2011;16(6):287-294.

241. Hunt SA, Abraham WT, Chin MH, et al. 2009 focused update incorporated into the ACC/AHA 2005 guidelines for the diagnosis and management of heart failure in adults: a report of the American College of Cardiology Foundation/American Heart 221. Association Task Force on Practice Guidelines. *J Am Coll Cardiol*. 2009;53:e1-90.

242. Hsich EM, Piña, IL. Heart failure in women: a need for prospective data. *J Am Coll Cardiol*. 2009;54(6):491-498.

243. Yancy CW, Jessup M, Bozkurt B, et al. 2013 ACCF/AHA guideline for the management of heart failure: executive summary. A report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. *Circulation*. 2013;128:1810-1852.

244. Jacobs AK, Eckel RH. Evaluating and managing cardiovascular disease in women: understanding a woman's heart. *Circulation*. 2005;111:383-384.

245. National Heart, Lung, and Blood Institute. How is Angina Treated? Available at http://www.nhlbi.nih.gov/health/health-topics/topics/angina/treatment. Last accessed December 13, 2016.

246. Alaeddini J. Angina Pectoris Treatment and Management. Available at http://emedicine.medscape.com/article/150215-treatment. Last accessed December 13, 2016.

247. American Heart Association. Angina in Women can be Different than Men. Available at http://www.heart.org/HEARTORG/Conditions/HeartAttack/WarningSignsofaHeartAttack/Angina-in-Women-Can-Be-Different-Than-Men_UCM_448902_Article.jsp#. Last accessed December 13, 2016.

248. Lloyd GW, Patel NR, McGing E, Cooper AF, Brennand-Roper D, Jackson G. Does angina vary with the menstrual cycle in women with premenopausal coronary artery disease? *Heart*. 2000;84(2):189-192.

249. Kawano H, Motoyama T, Ohgushi M, Kugiyama K, Ogawa H, Yasue H. Menstrual cyclic variation of myocardial ischemia in premenopausal women with variant angina. *Ann Intern Med*. 2001;135(11):977-981.

250. National Institutes of Health. Women's Heart Health: Developing a National Health Education Action Plan. Strategy Development Workshop Report. Available at https://www.nhlbi.nih.gov/health-pro/resources/heart/women-heart-education-plan. Last accessed December 13, 2016.

251. Sandmaier M. Your Guide to a Healthy Heart. Available at http://www.nhlbi.nih.gov/health/public/heart/other/your_guide/healthyheart.pdf. Last accessed December 13, 2016.

252. Centers for Disease Control and Prevention. Health Literacy. Evidence Reviews and Research Summaries. Available at http://www.cdc.gov/healthliteracy/researchevaluate/evidence-research.html. Last accessed December 12, 2016.

253. Sanderson BK, Shewchuk RM, Bittner V. Cardiac rehabilitation and women: what keeps them away? *J Cardiopulm Rehabil Prev*. 2010;30(1):12-21.

254. Carpenito-Moyet LJ. *Handbook of Nursing Diagnosis*. 14th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2012.

255. Farrell MA, Hayashi T, Loo RK, et al. Clinic-based nutrition and lifestyle counseling for Hispanic women delivered by community health workers: design of the California WISEWOMAN study. *J Womens Health (Larchmt)*. 2009;18(5):733-739.

256. Mosca L, Hammond G, Mochari-Greenberger H, Towfighi A, Albert MA. Fifteen-year trends in awareness of heart disease in women: results of a 2012 American Heart Association national survey. *Circulation*. 2013;127:1-29.

257. Centers for Disease Control and Prevention. Heart Disease Facts. Available at http://www.cdc.gov/heartdisease/facts.htm. Last accessed December 13, 2016.

258. American Heart Association. About Heart Disease in Women. Available at https://www.goredforwomen.org/home/about-heart-disease-in-women/. Last accessed December 13, 2016.

259. Mosca L, Benjamin EJ, Berra K, et al. Effectiveness-based guidelines for the prevention of cardiovascular disease in women—2011 update: a guideline from the American Heart Association. *Circulation*. 2011;123(11):1243-1262.

260. Halm MA, Denker J. Primary prevention programs to reduce heart disease risk in women. *Clin Nurse Spec*. 2003;17(2):101-109.

261. Greenland P, Alpert JS, Beller GA, et al. 2010 ACCF/AHA guideline for assessment of cardiovascular risk in asymptomatic adults: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. *J Am Coll Cardiol*. 2010;56:e50-e103.

262. Gold S. Stages of Change. Available at https://psychcentral.com/lib/stages-of-change/. Last accessed December 11, 2016.

263. Mons U, Muezzinler A, Gellert C, et al. Impact of smoking and smoking cessation on cardiovascular events and mortality among older adults: meta-analysis of individual participant data from prospective cohort studies of the CHANCES consortium. *BMJ*. 2015;350:h1551.

264. Centers for Disease Control and Prevention. Smoking and Tobacco Use. Quitting Smoking. Available at http://www.cdc.gov/tobacco/data_statistics/fact_sheets/cessation/quitting/index.htm. Last accessed December 13, 2016.

265. Perkins KA, Marcus MD, Levine MD, et al. Cognitive-behavioral therapy to reduce weight concerns improves smoking cessation outcome in weight-concerned women. *J Consult Clin Psychol*. 2001;69(4):604-613.

266. Lee JS, Kawakubo K, Kobayashi Y, Mori K, Kasihara H, Tamura M. Effects of ten-year body weight variability on cardiovascular risk factors in Japanese middle-aged men and women. *Int J Obes Relat Metab Disord*. 2001;25(7):1063-1067.

267. Centers for Disease Control and Prevention. Healthy Weight. About Adult BMI. Available at http://www.cdc.gov/healthyweight/assessing/bmi/adult_BMI/. Last accessed December 13, 2016.

268. Rexrode KM, Carey VJ, Hennekens CH, et al. Abdominal adiposity and coronary heart disease in women. *JAMA*. 1998;280(21):1843-1848.

269. National Heart, Lung, and Blood Institute. Aim for a Healthy Weight. Available at http://www.nhlbi.nih.gov/health/public/heart/obesity/lose_wt/behavior.htm. Last accessed December 13, 2016.

270. U.S. Department of Agriculture. Choose My Plate. Available at http://www.choosemyplate.gov. Last accessed December 13, 2016.

271. Mayo Clinic. Nutrition and Health Eating: DASH Diet: Healthy Eating to Lower Your Blood Pressure. Available at http://www.mayoclinic.org/healthy-lifestyle/nutrition-and-healthy-eating/in-depth/dash-diet/art-20048456. Last accessed December 12, 2016.

272. American Heart Association. Alcohol and Heart Health. Available at http://www.heart.org/HEARTORG/Conditions/More/MyHeartandStrokeNews/Alcohol-and-Heart-Disease_UCM_305173_Article.jsp#. Last accessed December 11, 2016.

273. Hozumi T, Sugioka K, Shimada K, et al. Beneficial effect of short term intake of red wine polyphenols on coronary microcirculation in patients with coronary artery disease. *Heart*. 2006;92(5):681-682.

274. Lee IM, Rexrode KM, Cook NR, Manson JE, Buring JE. Physical activity and coronary heart disease in women: is "no pain, no gain" passé? *JAMA*. 2001;285(11):1447-1454.

275. Artinian NT, Fletcher GF, Mozaffarian D, et al. Interventions to promote physical activity and dietary lifestyle changes for cardiovascular risk factor reduction in adults: a scientific statement from the American Heart Association. *Circulation*. 2010;122(4):406-441.

276. Office of Disease Prevention and Health Promotion. Dietary Guidelines for Americans 2015–2020. Available at https://health.gov/dietaryguidelines/2015/guidelines/. Last accessed December 13, 2016.

277. Boldo A, White WB. Blood pressure effects of the oral contraceptive and postmenopausal hormone therapies. *Endocrinol Metab Clin North Am*. 2011;40(2):419-432.

278. Womenshealth.gov. Birth Control Methods Fact Sheet. Available at http://www.womenshealth.gov/publications/our-publications/fact-sheet/birth-control-methods.html#top. Last accessed December 13, 2016.

279. Manson JE, Willett WC, Stampfer MJ, et al. A prospective study of aspirin use and primary prevention of cardiovascular disease in women. *JAMA*. 1991;266(4):521-527.

280. U.S. Preventive Services Task Force. Aspirin for the prevention of cardiovascular disease: U.S. Preventive Services Task Force recommendation. *Ann Intern Med*. 2009;150(6):396-404.

281. Yusuf S, Zhao F, Mehta SR, et al. Effects of clopidogrel in addition to aspirin in patients with acute coronary syndromes without ST-segment elevation. *N Engl J Med*. 2001;345(7):494-502.

282. CAPRIE Steering Committee. A randomised, blinded, trial of clopidogrel versus aspirin in patients at risk of ischaemic events (CAPRIE). *Lancet*. 1996;348(9038):1329-1339.

283. Sarafoff N, Byrne RA, Sibbing D. Clinical use of clopidogrel. *Curr Pharm Des*. 2012;18(33):5224-5239.

284. Martischnig AM, Mehili J, Pollak J, et al. Impact of dabigatran versus phenprocoumon on ADP induced platelet aggregation in patients with atrial fibrillation with or without concomitant clopidogrel therapy (the Dabi-ADP-1 and Dabi-ADP-2 Trials). *Biomed Res Int*. 2015;798486.

285. Olivier CB, Diehl P, Schnabel K, et al. Third generation P2Y12 antagonists inhibit platelet aggregation more effectively than clopidogrel in a myocardial infarction registry. *Thromb Haemost*. 2014;111(2):266-272.

286. Olivier CB, Schnabel K, Weber S, et al. Platelet reactivity after administration of third generation P2Y12=antagonists does not depend on body weight in contrast to clopidogrel. *J Thromb Thrombolysis*. 2016;42(1):84-89.

287. The Alpha-Tocopherol Beta Carotene Cancer Prevention Study Group. The effect of vitamin E and beta carotene on the incidence of lung cancer and other cancers in male smokers. *N Engl J Med*. 1994;330(15):1029-1035.

288. Hennekens CH, Buring JE, Peto R. Antioxidant vitamins-benefits not yet proved. *N Engl J Med*. 1994;330(15):1080-1081.

289. Kris-Etherton PM, Lichtenstein AH, Howard BV, Steinberg D, Witztum JL, for the Nutrition Committee of the American Heart Association Council on Nutrition, Physical Activity, and Metabolism. Antioxidant vitamin supplements and cardiovascular disease. *Circulation*. 2004;110(5):637-641.

290. Hulley S, Grady D, Bush T, et al. Randomized trial of estrogen plus progestin for secondary prevention of coronary heart disease in postmenopausal women. Heart and Estrogen/Progestin Replacement Study (HERS) Research Group. *JAMA*. 1998;280(7):605-613.

291. Hsai J, Langer RD, Manson JE, et al. Conjugated equine estrogens and coronary heart disease: the Women's Health Initiative. *Arch Intern Med*. 2006;166(3):357-365.

292. Writing Group for the Women's Health Initiative Investigators. Risks and benefits of estrogen plus progestin in healthy postmenopausal women: principal results from the Menopausal hormone therapy for the primary prevention of chronic conditions: U.S. Preventive Services Task Force recommendation statement. Women's Health Initiative randomized controlled trial. *JAMA*. 2002;288(3):321-333.

293. Herrington DM, Reboussin DM, Brosnihan KB, et al. Effects of estrogen replacement on the progression of coronary-artery atherosclerosis. *N Engl J Med*. 2000;343(8):522-529.

294. Moyer VA, U.S. Preventive Services Task Force. Menopausal hormone therapy for the primary prevention of chronic conditions: U.S. Preventive Services Task Force recommendation statement. *Ann Intern Med*. 2013;158(1):47-54.

295. Institute for Clinical Systems Improvement. *Menopause and Hormone Therapy: Collaborative Decision-Making and Management*. Bloomington, MN: Institute for Clinical Systems Improvement; 2008.

296. Boardman HM, Hartley L, Eisinga A, et al. Hormone therapy for preventing cardiovascular disease in post-menopausal women. *Cochrane Database Syst Rev*. 2015;(3):CD002229.

297. HealthyPeople.gov. Healthy People 2020. Available at https://www.healthypeople.gov/. Last accessed December 13, 2016.

298. American Heart Association. Go Red for Women. Available at https://www.goredforwomen.org/. Last accessed December 13, 2016.

299. Brittle C, Bird CE. *Literature Review on Effective Sex- and Gender-Based Systems/Models of Care*. Arlington, VA: U.S. Office on Women's Health; 2007.

300. U.S. Department of Health and Human Services. Guidelines for the Study and Evaluation of Gender Differences in the Clinical Evaluation of Drugs. Available at http://www.fda.gov/downloads/RegulatoryInformation/Guidances/UCM126835.pdf. Last accessed December 13, 2016.

301. Angell M. Caring for women's health: what is the problem? *N Engl J Med*. 1993;329(4):271-272.

302. Gendered Innovations in Science, Health and Medicine, Engineering, and Environment. Heart Disease in Women: Formulating Research Questions. Available at http://genderedinnovations.stanford.edu/case-studies/heart.html#tabs-1. Last accessed December 13, 2016.

303. National Institutes of Health, Office of Extramural Research. NIH Policy and Guidelines on the Inclusion of Women and Minorities as Subjects in Clinical Research, Amended, October 2001. Available at http://grants.nih.gov/grants/funding/women_min/guidelines_amended_10_2001.htm. Last accessed December 13, 2016.

304. National Institutes of Health. Office of Research on Women's Health. Research. Available at http://orwh.od.nih.gov/research/index.asp. Last accessed December 13, 2016.

305. Women's Health Initiative. WHI Background and Overview. Available at http://www.nhlbi.nih.gov/whi/background.htm. Last accessed December 13, 2016.

306. Maclaran K, Stevenson JC. Primary prevention of cardiovascular disease with HRT. *Women's Health*. 2012;8(1):63-74.

307. Manson JE, Chlebowski RT, Stefanick ML, et al. Menopausal hormone therapy and health outcomes during the intervention and extended poststopping phases of the Women's Health Initiative randomized trials. *JAMA*. 2013;310(13):1353-1368.

308. U.S. Food and Drug Administration. Estrogen and Estrogen with Progestin Therapies for Postmenopausal Women [archive]. Available at http://www.fda.gov/Drugs/DrugSafety/InformationbyDrugClass/ucm135318.htm. Last accessed December 13, 2016.

309. Reynolds HR. Percutaneous and surgical revascularization procedures in women. *Curr Cardiovasc Risk Reports*. 2008;2:2270232.

310. Maserejian NN, Lutfey KE, McKinlay JB. Do physicians attend to base rates? Prevalence data and statistical discrimination in the diagnosis of coronary heart disease. *Health Serv Res*. 2009;44(6):1933-1949.

311. Office of Research on Women's Health. Moving into the Future with New Dimensions and Strategies: A Vision for 2020 for Women's Health Research: Strategic Plan. Available at https://orwh.od.nih.gov/resources/pdf/ORWH_StrategicPlan2020_Vol1.pdf. Last accessed December 13, 2016.

312. Office of Research on Women's Health. Advancing Novel Science in Women's Health Research. Available at https://www.nlm.nih.gov/ep/answhr.html. Last accessed December 13, 2016.

Evidence-Based Practice Recommendations Citations

Mosca L, Benjamin EJ, Berra K, et al. Effectiveness-based guidelines for the prevention of cardiovascular disease in women—2011 update: a guideline from the American Heart Association. *Circulation*. 2011;123(11):1243-1262. Summary retrieved from National Guideline Clearinghouse at https://www.guideline.gov/summaries/summary/33603. Last accessed December 20, 2016.

U.S. Preventive Services Task Force. Menopausal hormone therapy for the primary prevention of chronic conditions: U.S. Preventive Services Task Force recommendation statement. *Ann Intern Med*. 2013;158(1):47-54. Summary retrieved from National Guideline Clearinghouse at https://www.guideline.gov/summaries/summary/38537. Last accessed December 20, 2016.