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Assessing Nurses' Demographic Cardiovascular Risk Factors and Pharmacogenetic Testing Knowledge and Acceptance

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Abstract

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By

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MSN Gardner-Webb University, 2007

BSN, University of South Carolina, 1996

Proposal Submitted in Partial Fulfillment

Of the Requirements for the Degree of

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Abstract

The lack of knowledge of pharmacogenetic testing for cardiovascular disease (CVD), coupled with their increased risk for CVD, may impair nurses' cognitions and attitudes toward pharmacogenetic testing for CVD. The purpose of this quantitative cross-sectional correlational study, conducted with 230 RNs without CVD who worked in acute-care settings in Georgia, was to determine if their years of education, years of experience, and gender significantly influenced their perceived risk for CVD (Questions 1–3) and their perceived knowledge of pharmacogenetic testing for CVD (Questions 4–6), and if their perceived risk for CVD significantly influenced their acceptance of pharmacogenetic testing for CVD (Question 7). Various regression analyses (hierarchical multiple linear regression, multiple linear regression, hierarchical, linear regression) were conducted for hypothesis testing. Results showed that: (a) gender significantly predicted perceived risk for CVD, in that male nurses perceived themselves to be more at risk for CVD than did female nurses; (b) years of education was a significant predictor of knowledge of pharmacogenetic testing for CVD, in that as nurses' education level increased, so did their knowledge; and (c) knowledge of pharmacogenetic testing for CVD, but not perceived risk for CVD, significantly predicted acceptance of pharmacogenetic testing for CVD. This study may act as a catalyst to promote empirical work and inform practice in nurses' CVD health and their knowledge and acceptance of pharmacogenetic testing for CVD.

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Dedication

This dissertation is dedicated to my parents, the late Mr. Anthony Osigwe and Mrs. Bridget Osigwe, for being perfect parents and for my perfect upbringing. You were wonderful and I could not ask for more.

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Chapter 1: Introduction

Cardiovascular diseases (CVDs) are disorders that affect the heart, such as hypertension with or without renal disease, stroke, atherosclerosis, rheumatic fever, coronary heart disease, and heart failure (American Heart Association [AHA], 2015; Centers for Disease Control and Prevention [CDC], 2015). As of 2014, approximately 82 million adults in the United States had some form of heart disease (AHA, 2015; CDC, 2015). Moreover, one in every three individuals in the United States had at least one risk factor for CVD (Go et al., 2013). Cardiovascular disease is the leading cause of death among U.S. adults (AHA, 2015).

Nurses are knowledgeable about CVD (Paul & Hice, 2014), yet studies have documented that they are at risk for CVD (Lang, Lepage, Schieber, Lamy, & Kelly-Irving, 2012; McElligott, Siemers, Thomas, & Kohn, 2009). Obesity, diabetes, and high cholesterol are significantly associated with increased risk of mortality due to CVD (AHA, 2015). In comparison to the 35.7% of American adults who are obese, 57% to 70% of nurses are obese (American Nurses Association [ANA], 2015). Across studies examining CVD risk factors in nurses, results have shown that the average percentage of nurses with diabetes is 10%, higher than the 8.3% of Americans in general with diabetes (ANA, 2015). The percentage of nurses with elevated cholesterol levels has ranged from 15% to 50% across studies (Khan et al., 2012; Lang et al., 2012; Puett et al., 2009), substantially higher than the 12.9% of American adults with high cholesterol (Cho & Lee, 2012). Sedentary behavior, poor dietary behaviors, and smoking additionally place nurses at risk for CVD (Khan et al., 2012; Louie & Wedell, 2014). In a study conducted by the Preventive Cardiovascular Nurses Association (2008), 43% of nurses did not engage in

regular physical activity, 50% had very poor diets, and 18% of surveyed nurses were smokers. Moreover, Lang et al. (2012) found that the rate CVD was elevated in nurses due to the high rates of work-related stress and negative social interactions between nurses and their supervisors.

The elevated risk for CVD among nurses is further complicated by their perceived lack of risk for developing CVD (Hörnsten, Lindahl, Persson, & Edvardsson, 2014; Jones, Weaver, Grimley, Appel, & Ard, 2006). Results from the few studies that have examined perceived risk for CVD among nurses have shown that, despite having numerous risk factors for CVD, nurses do not believe they are especially at risk for CVD (Hörnsten et al., 2014; Jones et al., 2006). If nurses perceive their risk for developing CVD is low, they may lack motivation to change behaviors that place them at increased risk for CVD (Khan et al., 2012).

Advances in genetics, medicine, and healthcare technology have brought CVD genomic medicine models to the patient-centered healthcare system (Humma & Terra, 2012; Johnson & Cavallari, 2013; Kee, Hayes, & McCuistion, 2014). Among the newest of genomic medical approaches for CVD management is pharmacogenetic testing (Howland, 2012; Johnson & Cavallari, 2013; Musunuru et al., 2012). Pharmacogenetic testing, which is a form of genetic testing, refers to the process of identifying and considering differences in an individual's genetic makeup, so that practitioners can attempt to anticipate a client's reaction to medications and make appropriate prescriptive decisions (Blakey & Hall, 2011; Howland, 2012; Musunuru et al., 2012; Shin, Kayer, & Langaee, 2009).

Acute-care nurses must have knowledge of the most current healthcare practices and the ability to effectively transfer this knowledge to the patient-provider domain (Chadwell, 2013; McNeils, Ironside, Zvonar, & Ebright, 2014). Acute-care nurses work in a hospital setting with patients experiencing short-term acute medical problems; they differ from critical-care nurses, who work in intensive-care units and emergency medicine (Rosenthal & Guerrasio, 2009). In the future, acute-care nurses may be expected to provide patient education related to pharmacogenetic testing (Johnson & Cavallari, 2013).The knowledge base of nurses (and other healthcare providers) of pharmacogenetic testing is limited as a result of the newness of such testing and the existing controversy that surrounds it such as confidentiality of test results (Johnson & Cavallari, 2013; Verschuren et al., 2011). Knowledge and acceptance of pharmacogenetic testing related to CVD is also relevant in the field of nursing due to the high prevalence rate of CVD in nurses (Lang et al., 2012; McElligott et al., 2009).

Results from this study have the potential to effect positive social change on numerous levels and impact many stakeholders. For example, student nurses working in a healthcare setting were increasingly focused on genomic medicine models, requiring they have current relevant knowledge and skills to provide effective and meaningful patient care (Maughan, Bobo, Butler, Schantz, & Schoessler, 2015). Results can inform changes in nursing education, especially in the development of courses and curricula focusing on genetics and pharmacogenetic testing. Health-promotion interventions for nurses have become increasingly important with the national shortage of nurses, as participation in such programs can reduce work-related stress and absenteeism (Kaewthummanukul & Brown, 2006; Nahm, Warren, Zhu, An, & Brown, 2012). Due to their low perceived risk

of CVD, despite having numerous risk factors for CVD, coupled with their lack of knowledge and acceptance of CVD-related medical practices including pharmacogenetic testing for CVD, acute-care nurses may not be good patient advocates and role models in CVD risk prevention and reduction (Nahm et al., 2012). Results from the present study can increase understanding of the demographic and work factors related to perceived risk for CVD among nurses, which can result in targeted interventions specific to nurses' gender, education level, and years of practice. Moreover, this study's findings can empower nurses to become social-change agents by adopting patient-centered practices aimed at reducing CVD risk and increasing patient knowledge and understanding of pharmacogenetic testing.

The purpose of this chapter is to introduce and elaborate on the proposed study and to provide specific information on the study's purpose and methodology. The chapter opens with a background section that reviews the pertinent literature on study topics, which then informs the statement of the problem. The chapter includes a summary of the purpose of the study and the research questions and hypotheses. The chapter elucidates the guiding theory of the study, followed by a section on the nature of the study. The chapter then continues with sections on definitions, assumptions, scope and delimitations, limitations, and significance. A summary concludes the chapter.

Background

Pharmacogenetic testing has been recognized in the medical community as a means to prevent and treat CVD, and tests are currently added to a host of diagnostic measures to identify the risks associated with CVD and to manage the disease in those patients with CVD (Dodson, 2011; Roederer, Van Riper, Valgus, Knafl, & McLeod,

2012; Squassina et al., 2010). Pharmacogenetic testing, which is a form of genetic testing, refers to the process of identifying and considering differences in an individual's genetic makeup, so practitioners can attempt to anticipate a client's reaction to medications and make appropriate prescriptive decisions (Blakey & Hall, 2011; Howland, 2012). Although pharmacogenetic testing in the clinical arena is relatively new, the use of such testing is slowly gaining momentum (Kee et al., 2014).

Nurses in general and acute-care nurses specifically must have a strong knowledge base regarding CVD (Johnson & Cavallari, 2013). However, researchers have shown that acute-care nurses may have limited knowledge of CVD-related issues, including heart-failure principles, asymptomatic hypotension, advanced risk assessment of CVD, clinical best practices for CVD, and pharmacogenetic testing for CVD (Calzone, Jenkins, Culp, Bonham, & Badzek, 2013; Delaney, Apostolidis, Lachapelle, & Fortinsky, 2011; Lanuza, Davidson, Dunbar, Hughes, & De Geest, 2011).

Researchers have also shown that nurses have numerous risk factors for CVD (Lang et al., 2012; Louie & Wedell, 2014; McElligott et al., 2009; Slater, McElwee, Fleming, & McKenna, 2005). According to a study by Louie and Wedell (2014), who used data from the Nurses' Health Study (NHS), 60% of acute-care nurses who participated in the study were obese or overweight and more than 50% of participants were severely inactive and had poor dietary habits. In another survey conducted by the Preventive Cardiovascular Nurses Association (2008), 47% of acute-care nurses were overweight/obese, 43% did not engage in physical activity, 50% had very poor diets, and 18% were smokers.

Moreover, the few studies addressing CVD in nurses documented a "paradox" between actual risk and perceived risk for CVD among nurses: they do not perceive themselves as being at risk for CVD despite having numerous risk factors for this disease (Hörnsten et al., 2014; Jones et al., 2006). This lack of congruence may not only impair the health and work behaviors of nurses, but may also influence their cognitions and attitudes toward CVD-related practices, such as pharmacogenetic testing for CVD (Chan & Perry, 2012; Jones et al., 2006). Acute-care nurses may not be good role models for CVD risk reduction or promotion of emerging treatments for CVD, including pharmacogenetic testing (Louie & Wedell, 2014).

The U.S. healthcare system has become a patient-centered medical community that is quickly moving toward a genomic model of health practice, requiring that nurses have specific knowledge and skills with regard to CVD, genetics, and pharmacogenetic testing to be effective healthcare providers (Kee et al., 2014). Nurses must have the most current knowledge of CVD, increasingly need to have knowledge of pharmacogenetic testing for CVD, must be able to advocate for such testing, and should be able to translate the meaning of such testing to their patients (Kee et al., 2014). It remains unclear, however, as to whether demographic factors such as gender, years of education, and years of practice play a role in influencing nurses' knowledge of their perceived risk for CVD as well as pharmacogenetic testing for CVD, and if their knowledge of pharmacogenetics for CVD influences their acceptance of its use.

Problem Statement

Nurses are known to have numerous risk factors for CVD that may not only impair their health and work behaviors, but may also influence their work-related

attitudes and behaviors toward CVD-related practices, such as pharmacogenetic testing for CVD (Dodson, 2011, 2014; Knisely, Carpenter, & Von Ah, 2014; J. Zhang, While, & Norman, 2010). The incidence of CVD can be reduced through preventive measures such as health-promotion programs, and nurses are the ones assessing risk factors and promoting lifestyle changes for their patients (Fair, Gulanick, & Braun, 2009). Teaching patients and their families how to achieve CVD health (e.g., healthy eating habits, smoking cessation, blood-pressure screening, cholesterol screening, and active lifestyle, to mention but a few) is a core competency of the nursing profession (ANA, 2015; Kee et al., 2014).

Genetic tests are currently added to a host of diagnostic measures to identify the risks associated with CVD and to manage the disease in those patients with CVD (ANA, 2015; Heller, Fisher, Marks, & Hsieh, 2014). Pharmacogenetic testing, which is a form of genetic testing, refers to the process of identifying and considering differences in an individual's genetic makeup, so practitioners can attempt to anticipate a client's reaction to medications and make appropriate prescriptive decisions (Heller et al., 2014).

Although pharmacogenetic testing in the clinical arena is relatively new, the use of such testing is slowly gaining momentum (Heller et al., 2014). Studies conducted during the emergence of genomic medicine in the mid- to late 2000s (Elder, 2007; Haga & Burke, 2008; Shin et al., 2009) reported that acceptance by healthcare professionals—especially nurses—was the most influential factor in whether patients accepted and used a new test. Results from contemporary research (e.g., Cuffe et al., 2014; Hess, Fonseca, Scott, & Fagerness, 2015) continue to support this argument.

Studies conducted with groups of healthcare professionals that have included nurses (e.g., Dodson, 2011; Dodson & Van Riper, 2011; Moen & Lamba, 2012) and were made up solely of nurses (e.g., Kadafour, Haugh, Posin, Kayser, & Shin, 2009; Van Riper, Barksdale, & Knafl, 2011), have documented that nurses have limited knowledge of pharmacogenetic testing. Dodson's (2011) review of the literature on healthcare providers' knowledge of pharmacogenetic testing showed that the majority (66% to 84%) of healthcare providers, including nurses, reported minimal knowledge of pharmacogenetic testing. In Moen and Lamba's (2012) study, conducted with healthcare professionals including nurses, 4% of respondents believed they were well educated about the subject. In the same study, healthcare professionals who were 30 years or younger and worked less than 4 years had a higher level of familiarization with pharmacogenetics (Moen & Lamba, 2012).

Although the percentage of nurses who reported poor understanding of pharmacogenetic testing was lower in studies conducted by Van Riper et al. (2011) and Kadafour et al. (2009)—33% and 40% respectively—these percentages are disconcertingly high. Although it is clear that some disparities exist in what healthcare professionals know and how they feel about pharmacogenetic testing, currently not as well-understood are factors that may explain some of those differences in knowledge (Dodson, 2011; Howland, 2012). As stated by Dodson (2011), "since nursing is a key link between physicians and patients, more research needs to be done to assess nursing knowledge and attitudes towards pharmacogenetic testing" (p. 427).

Gaps in knowledge persist in nurses' perceptions of their risk for CVD and their knowledge of pharmacogenetic testing for CVD (Kee et al., 2014). As stated previously,

studies have shown that a paradox exists between actual risks and perceived risk for CVD among nurses in that they do not perceive themselves to be a risk for CVD (Hörnsten et al., 2014; Jones et al., 2006). Healthcare leaders lack understanding, however, of whether demographic factors such as gender, years of education, and years of nursing experience may influence this perceived risk. It is important to gain clarity on these associations, especially as these predictors tie to CVD risk (Berry et al., 2012; Go et al., 2013; Lang et al., 2012).

It is also important to assess if gender, years of education, and years of nursing experience play a role in the level of pharmacogenetic testing for CVD. For example, yet another paradox exists that increased years of nursing experience aligns with lowered degrees of knowledge of pharmacogenetic testing for CVD. Understanding the linkages between gender, years of education, and years of nursing experience and pharmacogenetic testing for CVD is highly pertinent to the existing literature on nurses' ethical concerns and perceived advantages of pharmacogenetic testing (Calzone et al., 2010; Dodson, 2011; Dodson & Van Riper, 2011). Linkages between nurses' knowledge and attitudes toward pharmacogenetic testing for CVD are missing in the empirical literature. These associations also relate to ethical concerns on the part of the nurse as well as the practitioners who develop interventions for nurses to best address these knowledge gaps.

Purpose of the Study

The purpose of this quantitative study, using a cross-sectional design, was to determine if acute care nurses' gender, highest level of education, and years of nursing experience significantly influenced their perceived risk for CVD and their knowledge of

pharmacogenetic testing for CVD, and whether significant associations exist between nurses' perceived risk for CVD and their acceptance of pharmacogenetic testing for CVD. This study had seven research questions. The first set of three questions (Questions 1–3) determined if the independent variables of acute-care nurses' years of education, years of experience, and gender significantly influenced their perceived risk for CVD, the dependent variable. The second set of three questions (Questions 4–6) assessed if the independent variables of acute-care nurses' years of education, years of experience, and gender significantly influenced their perceived knowledge of pharmacogenetic testing for CVD, the dependent variable. The seventh and last research question examined if acute-care nurses' perceived risk for CVD, the independent variable, significantly influenced their acceptance of pharmacogenetic testing for CVD, the dependent variable. I included two potential covariates, health factors related to estrogen and medication-related CVD risk, in the study as potential covariates. I conducted this study with a sample of 228 registered acute-care nurses who reside and work in acute-care hospital settings in Atlanta, Georgia. As the study examined risk factors for CVD, the sample included only acute-care nurses who have not been diagnosed with CVD.

Research Questions and Hypotheses

I conducted this quantitative study using a cross-sectional research design with licensed acute-care nurses who work in Atlanta, Georgia. I posited seven questions with associated null and alternative hypotheses for this study.

Research Question 1

Is there a significant association between acute-care nurses' years of education and perceived risk for CVD, controlling for health factors related to estrogen and medication-related CVD risk?

$H_0$1. There is no association between acute-care nurses' years of education and perceived risk for CVD, controlling for health factors related to estrogen and medication-related CVD risk.

H_a1. There is a significant association between acute-care nurses' years of education and perceived risk for CVD, controlling for health factors related to estrogen and medication-related CVD risk.

Research Question 2

Is there a significant association between acute-care nurses' years of practice and perceived risk for CVD, controlling for health factors related to estrogen and medication-related CVD risk?

Ho2. There is no association between acute-care nurses' years of practice and perceived risk for CVD, controlling for health factors related to estrogen and medication-related CVD risk.

Ha2 There is a significant association between acute-care nurses' years of practice and perceived risk for CVD, controlling for health factors related to estrogen and medication-related CVD risk.

Research Question 3

Is there a significant association between acute-care nurses' gender and perceived risk for CVD, controlling for health factors related to estrogen and medication-related CVD risk?

Ho3. There is no association between acute-care nurses' gender and perceived risk for CVD, controlling for health factors related to estrogen and medication-related CVD risk.

Ha3. There is a significant association between acute-care nurses' gender and perceived risk for CVD, controlling for health factors related to estrogen and medication-related CVD risk.

Research Question 4

Is there a significant association between acute-care nurses' years of education and knowledge of pharmacogenetic testing for CVD, controlling for health factors related to estrogen and medication-related CVD risk?

Ho4. There is no association between acute-care nurses' years of education and knowledge of pharmacogenetic testing for CVD, controlling for health factors related to estrogen and medication-related CVD risk.

Ha4. There is a significant association between acute-care nurses' years of education and knowledge of pharmacogenetic testing for CVD, controlling for health factors related to estrogen and medication-related CVD risk.

Research Question 5

Is there a significant association between acute-care nurses' years of practice and knowledge of pharmacogenetic testing for CVD, controlling for health factors related to

estrogen and medication-related CVD risk, controlling for health factors related to estrogen and medication-related CVD risk?

Ho5. There is no association between acute-care nurses' years of practice and knowledge of pharmacogenetic testing for CVD, controlling for health factors related to estrogen and medication-related CVD risk.

Ha5. There is a significant association between acute-care nurses' years of practice and knowledge of pharmacogenetic testing for CVD, controlling for health factors related to estrogen and medication-related CVD risk.

Research Question 6

Is there a significant association between acute-care nurses' gender and knowledge of pharmacogenetic testing for CVD, controlling for health factors related to estrogen and medication-related CVD risk?

Ho6. There is no association between acute-care nurses' gender and knowledge of pharmacogenetic testing for CVD, controlling for health factors related to estrogen and medication-related CVD risk.

Ha6. There is a significant association between acute-care nurses' gender and knowledge of pharmacogenetic testing for CVD, controlling for health factors related to estrogen and medication-related CVD risk.

Research Question 7

Is there a significant association between acute-care nurses' perceived risk for CVD and acceptance of pharmacogenetic testing for CVD, controlling for health factors related to estrogen and medication-related CVD risk?

Ho7. There is no association between acute-care nurses' perceived risk for CVD and acceptance of pharmacogenetic testing for CVD, controlling for health factors related to estrogen and medication-related CVD risk.

Ha7. There is a significant association between acute-care nurses' perceived risk for CVD and acceptance of pharmacogenetic testing for CVD, controlling for health factors related to estrogen and medication-related CVD risk.

Theoretical Framework

The health belief model (HBM), developed by Rosenstock and colleagues (i.e., Becker & Rosenstock, 1987; Hochbaum, Rosenstock, & Kegels, 1952; Rosenstock, 1974; Rosenstock, Strecher, & Becker, 1988), was the guiding theory for this study. The HBM posits that engaging in a preventative health behavior—the *likelihood of action*—depends on the individual's *perceptions of a disease* (i.e., the perceived seriousness of it coupled with the perceived likelihood of acquiring it) and their *perceptions of a new health behavior* (i.e., the benefits of engaging in a health behavior and the barriers that could prevent the individual from adopting it; Rosenstock, 1974; Rosenstock et al., 1988). Perceptions of the disease and the health-behavior change needed to reduce its likelihood are influenced by *modifying factors* (i.e., demographic, psychological, and cognitive factors of the individual) and *cues to action* (i.e., such things as doctors' reminders and advice from others; Rosenstock, 1974; Rosenstock et al., 1988).

As it is a health change model, it is unsurprising that the HBM has been used in numerous nursing studies (e.g., Hong, Kim, & Suh, 2010; Shahrabani, Benzion, & Yom Din, 2009; Tastan, Iyigün, Kilic, & Unver, 2011; J. Zhang et al., 2010). Empirical researchers have used the HBM to explain nurses' health behavioral changes in influenza

vaccinations (e.g., Shahrabani et al., 2009; J. Zhang et al., 2010), cancer screenings (e.g., Tastan et al., 2011; Yaren, Ozklinc, Guler, & Oztop, 2008), physical activity and exercise (Kaewthummanukul & Brown, 2006; Nahm et al., 2012), and medical services use (Hong et al., 2010).

What is surprising is the dearth of literature that has used the HBM to explain nurses' health behaviors surrounding CVD and its prevention. A review of the nursing literature published between 2000 and 2015 that involved an examination of at least two elements of the HBM yielded one quantitative study by Jones et al. (2006). The authors focused their study on the influence of modifying factors on perceived susceptibility of CVD among 194 African American nurses who did not have CVD (Jones et al., 2006). Despite having numerous risk factors for CVD (e.g., being of older age, overweight/obese, and sedentary), nurses did not perceive themselves to be at risk for developing CVD, even though their knowledge of CVD was quite substantial (Jones et al., 2006).

The implications of the Jones et al. (2006) results were quite profound, especially when considering the central role of nurses in personalized medicine that increasingly uses genomic models (Frazier, Wung, Sparks, & Eastwood, 2009; Howland, 2012). If nurses do not perceive themselves to be at risk for developing CVD, despite having risk factors for CVD—and knowledge of these risk factors—they may be quick to overlook or dismiss CVD risk factors in their patients (Jones et al., 2006). Nurses may also be less likely to promote advances in CVD prevention and treatment, such as pharmacogenetic testing for CVD, especially if they perceive such advances as relevant only to severe or unusual cases of CVD (Dodson, 2011, 2014; Fair, Gulanick, & Braun, 2009; J. Zhang et

al., 2010). A review of the literature review from 2000 uncovered no studies that were guided by the HBM and involved CVD risk among acute-care nurses. This was a disconcerting gap in the literature, yet it validated the need for this study.

Using the HBM, this study examined if the modifying factors of gender, highest level of education, and years of practice significantly influenced a *perception of the disease* outcome (perceived risk for CVD) and a *perception of the health change behavior* outcome (knowledge of pharmacogenetic testing for CVD). The study further examined if a *perception of the disease* outcome (perceived risk for CVD) significantly influenced a *likelihood of action* outcome (acceptance of pharmacogenetic testing for CVD).

Nature of the Study

I used a quantitative design for this study. The quantitative design was appropriate as I used the scientific method; that is, I developed hypotheses that were tested through statistical analysis of numerical data (aligned with Stangor, 2014). The study did not use an experimental research design as the goal of the study was not to test effects from an intervention or to determine differences between groups of acute-care nurses; rather, the study provides an examination of relationships between naturally occurring variables (i.e., risk factors and knowledge and acceptance of pharmacogenetic testing; Stangor, 2014). This study was correlational, as I sought to determine, through statistical analyses, theory-driven relationships between the independent variables and the dependent variables in an objective manner (as explained by Stangor, 2014). A cross-sectional design was appropriate because I measured these variables at a one point in time rather than over a period of time (Stangor, 2014).

I conducted this quantitative correlational cross-sectional study with a sample of 228 registered nurses (RNs) without CVD working in acute-care settings in Georgia. This study had seven research questions with differing independent and dependent variables. For Questions 1–3, I conducted a hierarchical multiple linear regression (HMLR) to assess if the independent variables of nurses' years of education, years of experience, and gender significantly predicted the dependent variable of perceived risk for CVD. The variable of take medications, which could include blood pressure medications, was included in the HMLR analysis as a covariate, as it significantly aligned with the dependent variable. For Questions 4–6, I performed a multiple linear regression (MLR) to determine if the independent variables of years of education, years of experience, and gender significantly predicted the dependent variable of knowledge of pharmacogenetic testing for CVD. For the seventh and last research question, I ran a hierarchical linear regression (HLR) to ascertain if the independent variable of perceived risk for CVD was a significant predictor of acceptance of pharmacogenetic testing for CVD. I included the variable of knowledge of pharmacogenetic testing as a covariate in the HLR due to its significant association with the dependent variable.

Definitions of Terms

Cardiovascular diseases (CVDs). Cardiovascular diseases are diseases that involve the human body's cardiovascular system. The main causes of CVD are blockage of the heart and hypertension (Frazier, Johnson, & Sparks, 2009).

Deoxyribonucleic acid (DNA). DNA refers to the molecule that encodes the genetic instructions used for the functioning of all living things and viruses (Haga & LaPointe, 2013).

Pharmacogenetics. Pharmacogenetics refers to the application of genomic technologies to the discovery of new drugs to determine the variability of individual genes in susceptibility to disease as well as drug response (Calzone et al, 2010).

Pharmacotherapy. Pharmacotherapy refers to the use of medication for disease management (Calzone et al, 2010).

Assumptions

This study rested on certain assumptions or aspects of the research study that I accepted as true (aligned with Stangor, 2014). The positivist paradigm that reality is objective guides quantitative studies, assuming the researcher is knowledgeable of this reality and the researcher can explain this objective reality by the use of the scientific method. In accordance with the scientific method, I established a priori hypotheses and, through the use of statistical analyses, drew objective conclusions about study findings (as suggested by Stangor, 2014).

Methodological assumptions in this study concerned issues related to study participants and instruments. I assumed, as study criteria, that participants were registered acute-care nurses in Atlanta who do not have CVD. This study used an online survey platform to obtain study data. To increase assurances that this assumption was met, participants had to provide correct responses to screening questions before they could take the online survey, including questions that they consented to the study, that they were registered acute-care nurses with active nursing licenses, and that they did not have CVD. A methodological assumption was that participants understood survey questions, answered the survey honestly, and provided responses that truly reflected their attitudes, beliefs, and knowledge about survey topics (as put forth by Stangor, 2014).

Scope and Delimitations

I considered a few theoretical models prior to selecting Rosenstock's (1974) HBM. Bandura's (1974) social-cognitive theory was too general and its theoretical components (e.g., self-efficacy and modeling) did not capture the constructs examined in this study. I also gave attention to Pender's (1982) health-promotion model (HPM), especially as it was developed specific to the nursing field. Key components of the HPM (e.g., prior behaviors and social support) were not emphasized in this study model; ultimately I decided the study topics did not adequately fit with Pender's HPM. Rosenstock's (1974) HBM aligned well with the study topics and provided a meaningful framework for the relationships between variables in this study.

The present study was limited to registered licensed acute-care nurses who work in hospital acute-care settings in Atlanta without a CVD diagnosis. Data collection occurred during the fall of 2015. The decision to limit the study to acute-care nurses rested on their routine involvement with patients who have numerous types of CVDs and the critical roles they play in CVD patient diagnosis, assessment, treatment, management, and education. I excluded nurses who did not work in acute-care settings from this study, and nurses who did not have access to a computer or did not have the computer skills to be able to link to the survey and complete it. As I provided no translation of the survey, nurses had to have the ability to read and write in English. The criteria set for inclusion and exclusion may have reduced the generalizability of study results.

In the present study, pharmacogenetic testing was limited to CVD, as CVD among nurses was the focal point of the study. The decision to limit the independent variables to gender, level of education, and years of practice for the first six questions

rested not only on Rosenstock's (1974) HBM, but also on prior literature that identified gender, level of education, and years of practice as risk factors for CVD in acute-care nurses (Tucker, Harris, Pipe, & Stevens, 2010; Zapka, Lemon, Magner, & Hale, 2009) and as factors significantly related to knowledge of pharmacogenetic testing among the general public (e.g., Haga, O'Daniel, Tindall, Lipkus, & Agans, 2012). I included the seventh research question examining the relationship between perceived risk for CVD and acceptance of pharmacogenetic testing for CVD to provide a holistic examination of pharmacogenetic testing for CVD.

Limitations

This study had a few limitations or elements of the study that were beyond the control (as explained by Stangor, 2014). Although researcher objectivity is a desired goal in any quantitative study, the researcher is human and is not necessarily neutral or value free. In parallel, a possibility exists that participants differed in their understanding and interpretation of survey questions, which may influence study data. The use of convenience sampling in this study was a limitation**.** Convenience sampling increases the likelihood that the participants are not a representative sample of the population of RNs working in acute-care settings in Atlanta, Georgia. Another limitation of this study was the use of a quantitative nonexperimental design, which precluded the ability to infer cause-and-effect (aligned with Stangor, 2014).

Objectivity is of the utmost importance in empirical research, and a certain degree of objectivity is not only necessary but required to reach sound study conclusions (Stangor, 2014). However, research conducted with human subjects, especially research using nonexperimental methods, has some methodological and design limitations that can

reduce study objectivity and quality. Study objectivity can improve as researchers establish sound study-validity processes (Jackson, 2015).

Study Internal Validity

Internal validity "speaks to the validity of the research itself" (Stangor, 2014, p. 34). It pertains to the degree of accuracy of the relationship between the independent and dependent variables (Stangor, 2014). Nonexperimental research studies are limited by certain issues that reduce the internal validity of a study, otherwise known as *threats to internal validity* (Jackson, 2015). One threat to internal validity, *confound bias*, has the potential to make the study as a whole invalid (Jackson, 2015). Confound bias results in the inability to conclude that the dependent variable effects were a result of the independent variable or were due to an unmeasured "third variable"—a variable that significantly aligns with the independent and the dependent variables (Armistead, 2014, p. 2).

Although researchers cannot completely eliminate the "third variable problem" (Armistead, 2014, p. 2), it was reduced in this study by controlling for covariates: variables known to relate to the independent and the dependent variable (Jackson, 2015). This study had two potential covariates. The first covariate was estrogen-related health factors/events (e.g., postmenopausal status, hormone-replacement therapy, or birth control pills). The second covariate was medication(s) used for health conditions other than CVD but that nonetheless increase CVD risk (e.g., birth control or prednisone) or decrease CVD risk (e.g., diuretics). I determined significant associations between the two covariates and the three dependent variables by significant (i.e., $p < .05$) Spearman's rho correlation coefficients (Stangor, 2014), if found to be significantly associated with any

of the three dependent variables in this study, I controlled for covariates in the statistical analyses for hypothesis testing, HMLR, by entering them in the first step or model of the HMLR (Jackson, 2015).

One other bias common to nonexperimental research studies, especially those using self-report instruments, is *social desirability bias*, where participants provide answers to survey questions that are not truthful but present a "favorable image" of the participant (Armistead, 2014, p. 5). Social desirability bias increases when researchers ask participants sensitive questions (Armistead, 2014). Although this study did not include questions that were highly sensitive, participants may have provided answers on the perceived risk for CVD scale that were socially desirable in that nurses may have thought they should have few or no risk factors for CVD. I reviewed participant data for extreme scores and outliers and adjusted accordingly (i.e., winsorized outliers; Armistead, 2014).

Significance of the Study

Acute-care nurses have numerous modifiable risk factors for CVD (Lang et al., 2012; Louie & Wedell, 2014; McElligott et al., 2009; Slater et al., 2005). Lang et al. (2012) found that acute-care nurses had elevated CVD due to the high rates of work-related stress and negative social interactions between acute-care nurses and their supervisors. According to a study by Louie and Wedell (2014), who used data from the NHS, 60% of acute-care nurses who participated were obese or overweight and more than 50% of participants were severely inactive and had poor dietary habits.

In the present study, I collected data from nurse participants in Georgia. The State of Georgia is one of the least healthy states in the United States (Hensley, 2014). Of

Georgians, 30% are obese and 76% have unhealthy diets (Hensley, 2014). In 2010, 28.2% of deaths and 120,000 hospitalizations cost $5.5 billion, attributed to CVD and stroke in Georgia (Hensley, 2014). The total direct and indirect cost resulting from CVD in Georgia is about $7.5 billion annually (Hensley, 2014). Because CVD is more prevalent in the State of Georgia than elsewhere, acute-care nurses who work and reside in Georgia are likely to have CVD risk factors (Hensley, 2014). To date, no study has examined CVD risk factors of acute-care nurses in the Atlanta area. Further, no study has examined the association between CVD risk factors and pharmacogenetic testing in acute-care nurses.

Social change can result from this study's findings including a direct impact on nursing knowledge and training through the development of targeted educational materials for acute-care nurses (and ultimately, patients) about CVD risk factors and pharmacogenetic testing on patient health outcomes and on the empowerment of acute-care nurses to act as patient advocates. Developing a better understanding of demographic and CVD risk factors among acute-care nurses will allow for specific intervention and targeted educational programs in nursing schools and training programs in healthcare organizations. Moreover, results from this study may facilitate future research on how acute-care nurses' perceptions of CVD risk factors and pharmacogenetic testing influence their patient-care practices and patient advocacy, including increasing patient awareness and knowledge of CVD risk factors and the benefits of pharmacogenetic testing,

Summary

CVD and pharmacogenetics related to CVD are relevant in the field of nursing due to the high prevalence of CVD in acute-care nurses (McElligott et al., 2009). Acute-care nurses are knowledgeable about CVD, yet studies have documented that they are at risk (Lang et al., 2012; McElligott et al., 2009). Research has also shown that acute-care nurses have numerous risk factors for CVD (McElligott et al., 2009; Slater et al., 2005). Due to their increased risk for CVD, their lack of knowledge of pharmacogenetic testing, and their concerns about such testing, acute-care nurses may not be good role models in CVD risk reduction, which may impact their patient-education behaviors (Louie & Wedell, 2014).

Hence, the need exists for this study as well as a better understanding of the literature presented in Chapter 2. Chapter 2 provides a comprehensive review of the theoretical framework guiding the study. Also, the chapter presents pertinent literature on acute-care nurses' perceived risk for CVD, and their knowledge and attitudes toward pharmacogenetic testing.

Chapter 2: Literature Review

Acute-care nurses carry an increased burden of CVD, and their perceptions of their own risk for CVD may play a role in their patient-centered communication, behaviors, and practices (Dodson, 2011, 2014). This increased focus on personalized healthcare has dovetailed with new and emerging genetic medicine models and practices, including pharmacogenetic testing for CVD. These practices are so new that researchers have yet to assess the various recommended pharmacogenetic methods, practices, and tests available to physicians, pharmacists, and acute-care nurses (Johnson & Cavallari, 2013). Using Rosenstock's (1974) HBM, I addressed the gaps in the literature by examining relationships between the independent variables of gender, highest level of education, and years of practice, and the dependent variables of perceived risk for CVD and knowledge of pharmacogenetic testing. I also examined the association between perceived risk for CVD and acceptance of pharmacogenetic testing in acute-care nurses.

My objective in this chapter is to provide a review of the relevant literature as it pertains to the study topics. The chapter opens with a summary of the literature search strategy. A comprehensive review of the HBM follows, including discussions of HBM theoretical constructs and a summary of the HBM literature on acute-care nurses, CVD, and genetic testing. I then review CVD and risk factors for CVD, followed by a review of the literature on acute-care nurses' risk factors for CVD. The chapter changes to a discussion and review of the pertinent literature on acute-care nurses' knowledge and attitudes toward pharmacogenetic testing. As this literature is so new, studies reviewed addressed pharmacogenetic testing for any disease; not just CVD. A conclusion ends the chapter.

Literature Search Strategy

The literature search for this study started with Walden University library and the use of ProQuest, which is linked to CINAHL, a cumulative index of Nursing and Allied Health Periodicals, Medline, PubMed, EBSCO*host*, and Google Scholar. The search centered on peer-reviewed journal articles in the fields of nursing, medicine, psychology, and public health. The key terms used to search for relevant peer-reviewed journal articles included *nurses health, acute care nurses' health, nurses' perceived risk for cardiovascular disease, acute care nurses and health risks, cardiovascular disease in healthcare providers, acute care nurses and cardiovascular disease, risk factors for cardiovascular disease in nurses, pharmacogenetic testing, pharmacogenomic testing, healthcare and pharmacogenetic testing, nurses and pharmacogenetic testing, acceptance of pharmacogenetic testing, knowledge of pharmacogenetic testing, measurement of pharmacogenetic testing knowledge and attitudes, "attitudes toward pharmacogenetic testing, health belief model and nurses,* and *health belief model and pharmacogenetic testing.* White papers, reports, data tables, and publications from national health organizations such as the World Heart Federation (WHF, 2014), AHA (2015), and CDC (2015) augmented empirical works.

Theoretical Framework: Rosenstock's (1974) Health Belief Model

The theory that guided this research study was the HBM developed by Rosenstock and colleagues (i.e., Becker & Rosenstock, 1987; Cummings, Jette, & Rosenstock, 1978; Rosenstock, 1974; Rosenstock, Strecher, & Becker, 1994). The underlying premise of the HBM is that *perceptions of a disease* and *perceptions of a new health behavior* are influenced by *modifying factors* to, in turn, influence *likelihood of*

action of engaging in a new health behavior (e.g., increased exercise) or change a negative health behavior (e.g., smoking cessation; Rosenstock, 1974; Rosenstock et al., 1988, 1994). I discuss the components and constructs of the HBM in the following sections.

Disease Perceptions: Perceived Susceptibility, Seriousness, and Threat

Three components of the HBM pertain to the construct of *perceptions of the disease*. Two of these factors are the *perceived susceptibility* to or risk of acquiring a health issue and *perceived severity* or seriousness of a health issue (Rosenstock, 1974; Rosenstock et al., 1988, 1994). Perceived susceptibility pertains to an individual's assessment of risk or likelihood of acquiring a health issue, disorder, or disease. Rosenstock (1974) argued that individuals who believe they are at greater risk than others in acquiring a disease are more likely to engage in behaviors that decrease this risk. Perceived seriousness refers to the individual's thoughts and cognitions on the severity of a disease (Rosenstock, 1974; Rosenstock et al., 1988, 1994). Rosenstock (1974) posited that perceptions of the seriousness of health issues is most often informed by an individual's knowledge and understanding of it.

The third perception of the disease component is *perceived threat* of the health issue, which is considered a *modifying factor* (Rosenstock, 1974; Rosenstock et al., 1988, 1994). The construct of perceived threat of a health issue has been neglected in theoretical conversations due to empirical inconsistency in its operational definition; indeed, some texts do not contain its definition nor do they describe this perception of the disease factor in any detail (Rosenstock et al., 1987, 1994). Perceived threat of the disease has been considered a *response efficacy* and has been used as a proxy for self-

efficacy (Rogers, 1983); alternatively, it has been operationally defined as an extension of perceived susceptibility (Mikhail, 1981). The most consistent definition in the HBM literature of perceived threats is "a sequential function of perceived severity and perceived susceptibility" (Champion & Skinner, 2008, p. 47), which was the definition used in this study, considered a *perception of the disease* indicator.

Health Behavior Perceptions: Perceived Benefits versus Barriers

Two components concern *perceptions of the new health behavior*: the *perceived benefits* of a new health behavior and the *perceived barriers* or obstacles to adopting the new health behavior (Rosenstock, 1974; Rosenstock et al., 1988, 1994). Rosenstock (1974) posited that, when considering a new health behavior, individuals balance the perceived benefits with the perceived barriers, and these two components act together to increase the *likelihood of action* of adopting a new health behavior. The component of perceived benefits refers to individuals' opinions of the value, importance, and usefulness of engaging in a certain health behavior to decrease the risk or likelihood of acquiring a disease or disorder. Simply stated, individuals are likely to adopt and continue engaging in a health behavior if they hold a firm belief in its efficacy in preventing a disease (Rosenstock, 1974).

Perceived barriers pertain to individual obstacles that prevent an individual from adopting the new health behavior. Although some barriers are contextual (e.g., lack of financial or personal resources to obtain medical services), many are intrapersonal and can include fear, inconvenience, and distress of engaging in a new behavior (Rosenstock, 1974; Rosenstock et al., 1988, 1994). Ultimately, an individual is more likely to take a health action if they perceive the benefits of the new health behavior outweigh the

barriers (Rosenstock, 1974; Rosenstock et al., 1988, 1994). As perceived benefits and perceived barriers pertain to the health behavior itself, knowledge of a health behavior can indicate this balance (Champion & Skinner, 2008).

Modifying Factors

The components that comprise the construct of modifying factors are individual factors. These include: (a) personal demographics, such as ethnicity, age, or gender, which were modifying factors examined in this study; (b) personality and psychological factors; and (c) prior experience with and knowledge of the *disease,* but not knowledge of the new health behavior (Rosenstock, 1974; Rosenstock et al., 1988, 1994). Modifying factors influence perceptions of the disease and perceptions of the health-behavior factors (Rosenstock, 1974; Rosenstock et al., 1988, 1994).

Cues to Action

Cues-to-action constructs are stimuli that elicit the decision-making process to adopt a new health behavior. Cues to action factors can be internal or external to the individual. Internal cues to action include disease symptomatology (e.g., fever or pain) whereas external cues to actions can be events, situations, or individuals who influence the individual to adopt a new health behavior (Rosenstock, 1974; Rosenstock et al., 1988, 1994). Acute-care nurses themselves can act as cues to action in patient health behavioral change (McNeils et al., 2014).

Relationships Between Health Belief Model Factors

Rosenstock (1974) posited that modifying factors directly influence the perceptions of the disease variables of perceived susceptibility, perceived seriousness (severity), and perceived threat. Modifying factors also directly influence the perceptions

of perceived benefits and perceived barriers to new health behavior and inform the decision-making process when balancing perceived benefits with perceived barriers (Rosenstock, 1974). Perceptions of the disease and perceptions of the new health behavior in turn influence the likelihood of action: the adoption of a new health behavior or a change in health behavior (Rosenstock, 1974). I comprehensively discuss the theoretical relationships that this study addressed after a presentation of the literature on the HBM and acute-care nurses' health behaviors.

The Health Belief Model in Nursing Research

The HBM is one of the most common theoretical frameworks used in health research (Bakas et al., 2012) and a substantial body of literature has been published on HBM-guided nursing interventions that promote health and prevent disease in patients (Boyde, Turner, Thompson, & Stewart, 2011; Heller et al., 2014; McNeils et al., 2014). The body of literature using the HBM to frame nurses' *own* health behaviors is quite insubstantial, especially when considered in the context of CVD. Of the few studies that have used the HBM to advance understanding of nurses' health behaviors, the majority have focused on nurses' attitudes and behaviors about being vaccinated for influenza (Coe, Gatewood, Moczygemba, Goode, & Beckner, 2012; Ofstead, Tucker, Beebe, & Poland, 2008; Prematunge et al., 2012; Shahrabani et al., 2009; J. Zhang et al., 2010). Studies by Coe et al. (2012), Ofstead et al. (2008), and Prematunge et al. (2012) found significant associations between the HBM factors of perceived susceptibility and perceived seriousness of influenza and increased likelihood of getting vaccinated against influenza among nurses. Shahrabani et al. (2009), in a study with 299 Israeli nurses, found that perceived susceptibility and perceived seriousness of influenza significantly

predicted the likelihood of acute-care nurses getting an influenza vaccination. Results further showed that nurses' increased knowledge of influenza, considered a modifying factor in the study, significantly predicted they would get vaccinated (Shahrabani et al., 2009).

J. Zhang et al. (2010) conducted a review of the literature of 12 studies that examined the relationships between HBM factors and nurses' vaccination statuses. The overarching conclusions from the J. Zhang et al. (2010) review of studies, which were all correlational and used self-report data, was that as nurses' knowledge of influenza and perceived seriousness of influenza increased, so did their likelihood of getting the influenza vaccination. Results further showed that acute-care nurses' receipt of the influenza vaccine directly aligned with the increased likelihood that they would encourage their patients to receive the influenza vaccination (J. Zhang et al., 2010). This finding is relevant to this study, as it demonstrated that acute-care nurses' own health behaviors align with advocacy for health behaviors in their patients.

Other studies that used the HBM with nurse participants tended to focus on health promotion and preventative behaviors, such as cancer screenings (e.g., Yaren et al., 2008); breast self-examinations (e.g., Tastan et al., 2011); hand washing (Ghanbari, Farazi, Shamsi, Khorsandi, & Esharti, 2014); and the prevention of workplace injuries (Tveito et al., 2014). Other studies conducted with nurses (Chan & Perry, 2012; Chi et al., 2015) were evaluations of HBM-guided health-promotion interventions for nurses and their effects on nurses' health behaviors. In a unique and rigorously designed randomized-controlled-trial (RCT) study with 100 Taiwanese pregnant nurses, Chi et al.

(2015) determined that participation in a second-hand smoking intervention resulted in nurses' increased knowledge of and decreased exposure to second-hand smoke.

The scarcity of HBM-guided intervention evaluation studies conducted with acute-care nurses as participants was evidenced in Chan and Perry's (2012) review of the literature. Chan and Perry reviewed only three studies, found after Chan and Perry widened their literature search beyond RCTs to include any studies "that tested an appropriate intervention" with acute-care nurses (2012, p. 12). Of these three studies, none were methodologically rigorous. Researchers conducted the studies with three different nursing samples (in the United States, in Canada, and in Taiwan), which lessened the generalizability of findings. Furthermore, the three studies aimed to promote or decrease a variety of health behaviors (e.g., increased exercise, reduced smoking of cigarettes, or reduced use of alcohol).

Despite these methodological concerns, Chan and Perry (2012) demonstrated that all three studies showed that nurses' participation in health-promotion interventions resulted in significant changes in nurses' health behaviors, including reduction in the number of cigarettes smoked per day and increased workplace exercise-based activity levels. The Chan and Perry study draws attention to the HBM theoretical relevance of studying nurses' health behaviors as well as the dearth of HBM-driven studies on nurses.

Health-belief model, nurses, and cardiovascular disease. Researchers conducted an overwhelming majority of studies using the HBM as a foundation to explore CVD-related interventions, practices, and behaviors with patients (e.g., Abed, Khalil, & Moser, 2015; Baghianimoghadam et al., 2013; Boyde et al., 2011). A general finding emerging from these studies was that increased knowledge of CVD risk factors

among patients did not significantly influence patients' perceived susceptibility for CVD (Abed et al., 2015; Baghianimoghadam et al., 2013; Boyde et al., 2011). This body of literature showed that individuals who display numerous clinical indicators for CVD frequently perceived themselves to be at small to moderate risk for CVD (Abed et al., 2015; Boyde et al., 2011).

A gap in knowledge, however, exists with regard to nurses. A review of the literature yielded two HBM-guided studies (e.g., Hörnsten et al., 2014; Jones et al., 2006), one quantitative and one qualitative, conducted with acute-care and primary-care nurses and pertained to nurses' own CVD-disease prevention behaviors. The Jones et al. (2006) study examined associations between modifying factors and perceived susceptibility and seriousness of CVD among 194 African American acute-care nurses who did not have CVD. Despite having risk factors for CVD (e.g., being of older age, overweight/obese, and sedentary) and considerable knowledge of CVD, acute-care nurses did not perceive themselves to be at risk for developing CVD. Although acute-care nurses who were older had more knowledge of CVD than did younger acute-care nurses, age did not moderate knowledge of CVD and increased perceived risk for CVD. The incongruence between perceptions of risk for and seriousness of CVD seen in the Jones et al. study suggested a need for theoretically driven studies on CVD risk factors among more diverse groups of acute-care nurses. The Jones et al. study focused only on female acute-care nurses; the researchers did not consider gender to be a modifying factor, nor were highest level of education or years of practice considered, which were examined as modifying factors in this study.

In contrast to Jones et al. (2006), Hörnsten et al. (2014) conducted a qualitative case study guided by the HBM and conducted with 10 primary care nurses in Sweden. The objective of the Hörnsten et al. study was not to examine primary-care nurses' health behaviors as they related to CVD but rather healthcare provider–patient communication strategies that primary-care nurses used to promote health behaviors among patients who were at risk for CVD. Analysis of interviews yielded five themes centered on acute-care nurses' communication practices with patients on CVD. The first theme concerned nurses' acknowledgement of the importance of listening to patients' concerns rather than directing and controlling the conversation. The second themes were the importance of instilling confidence and not fear in patients about their susceptibility to CVD. Two themes that shared commonalities were (a) guiding patients toward better lifestyle choices rather than pressuring them to change poor health behaviors and (b) engaging in motivational communication practices that encourage lifestyle changes among patients rather than demanding patients take responsibility for their behaviors. The last theme was that primary-care nurses played a key role in promoting patients' communication regarding psychologically distressing health topics with their healthcare provider rather than patients avoiding such topics (Hörnsten et al., 2014).

Health-belief model, nurses, and genetic testing. Although somewhat dated, the review of the literature on healthcare provider–patient communication practices regarding genetic testing by Edwards (2009) is a meaningful and relevant empirical work that had implications for the present study. The goal of the Edwards study was to systematically review literature on healthcare provider–patient communication on genetic testing and its influence on patient outcomes. Edwards focused on studies that avoided the topic of

genetic counseling and instead specifically addressed healthcare provider–patient "risk communication" interventions for genetic testing, or "the open two-way exchange of information and opinion about risk, leading to better [patient] understanding and better [healthcare provider-driven] decisions" (p. 4).

The Edwards (2009) review of literature included studies that ranged from rigorously designed RCTs to qualitative case studies of genetic-testing information exchanges or interventions, resulting in a total of 28 studies. The majority (> 80%) of studies involved genetic counselors or psychologists as healthcare providers. To increase the number of studies reviewed, Edwards included studies that focused on the efficacy of any type of "genetic testing intervention," inclusive of RCTs, face-to-face informational meetings between a healthcare professional and a patient, risk assessments, "pedigree construction," videos, and interactive digital products (2009, p. 17). The type of specific genetic-testing interventions included general psychosocial counseling, psychosocial counseling specific to a patient-outcome domain (e.g., stress management, problem solving, or decision making), "cognitive-affective preparation" concerning a negative genetic-testing outcome, and basic informational sessions (Edwards, 2009, p. 18).

Edwards (2009) compared studies and noted those where the interventions were effective and feasible. The researchers also examined the influence of the intervention on patient outcomes. Patient outcomes varied, as the interventions differed in intent. For example, some studies examined interventions that focused on patients' interest in receiving genetic testing (e.g., for a specific disease, such as breast cancer) whereas other studies addressed interventions to assist patients with a newly diagnosed genetic condition found through genetic testing. The most common dependent variables

examined were (a) patient knowledge and understanding of the outcomes of a genetic test, conducted for themselves or for a family member (e.g., a child with Down syndrome); (b) patient perceived risk of developing a genetic-based disorder or disease risk (e.g., breast cancer due to having the BRCA1/2 gene mutation); and (c) patient-perceived health-behavior change (e.g., undergoing BRCA1/2 testing, mammography, or breast examination; Edwards, 2009).

Despite the varied types of studies reviewed, Edwards (2009) did find consistency in results with regard to significant and positive associations between risk-communication interventions and increases in patients' disease and genetic-testing knowledge and perceived risk for acquiring a disease. However, risk-communication interventions did not systematically influence patient affective states, health status, or health behavior change. Edwards also found that patient characteristics of "low-to-moderate risk" status and higher levels of education aligned with increased responsiveness to participation in risk-communication interventions (p. 18).

One assumption of the HBM is that individuals have the capacity to change their health-related behaviors for health promotion and disease prevention (Rosenstock, 1974; Rosenstock et al., 1988, 1994). The body of literature on the HBM supports an additional argument that not only do acute-care nurses have the ability to influence others' health behavior by increasing their knowledge of a disease or genetic testing, but they themselves would be more accepting of the adoption of new health behaviors (Johnson & Cavallari, 2013). In other words, if acute-care nurses are knowledgeable enough about pharmacogenetic testing through acceptance and awareness, they would be able to teach their patients about this new technology.

Application of the Health Belief Model to the Proposed Study

The present study focused on (a) the *modifying factors* of gender, highest level of education, and years of practice; (b) *perceived susceptibility* or risk for CVD; (c) *perceived benefits versus barriers to health behavior,* measured as knowledge of pharmacogenetic testing for CVD; and (d) *likelihood of action,* measured by acceptance of pharmacogenetic testing for CVD. Figure 2 presents the pathways examined in this study. The pathway from modifying factors to perceived susceptibility, Path A, was addressed by Research Questions 1 through 3. These three research questions inquired if acute-care nurses' gender, years of education, and years of practice (the independent variables) significantly influence perceived susceptibility for CVD (the dependent variable). The pathway from modifying factors to perceptions of benefits over barriers, Path B, was addressed in Research Questions 4 through 6. These three questions inquired if acute-care nurses' gender, years of education, and years of practice (the independent variables) significantly influenced their knowledge of pharmacogenetic testing for CVD (the dependent variable). The final pathway between the perceived susceptibility to likelihood of action, Path C, inquired as to whether perceived susceptibility for CVD significantly influenced the likelihood of the action behavior of accepting pharmacogenetic testing for CVD.

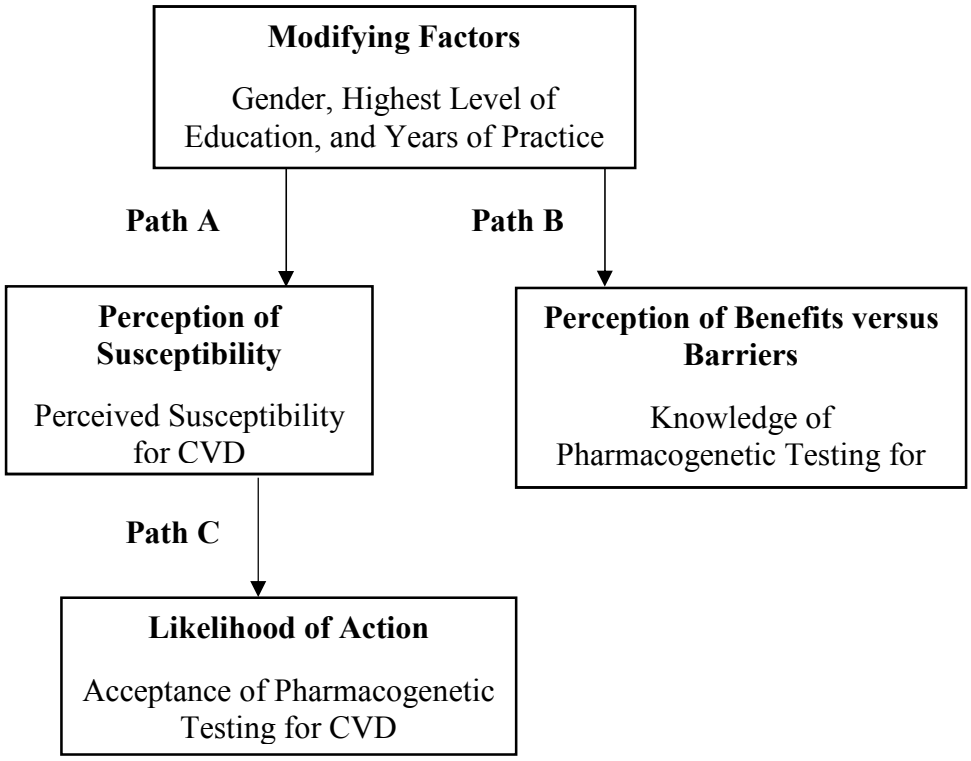

Figure 1. Proposed study pathways using the HBM (*Note.* This figure was created specifically for the study)

Cardiovascular Disease

CVDs are diseases that affect the heart and blood vessels such as ischemic heart disease, cerebrovascular disease (stroke), heart failure, and coronary artery disease (CDC, 2015). Mortality and morbidity associated with CVD in the United States has diminished drastically as a result of improvement in disease prevention, diagnoses, and treatment options. Although CVD incidence has diminished, it still impacts the health and well-being of many Americans. Three major risk factors associated with CVD are uncontrolled hypertension, elevated cholesterol levels, and smoking. In 2007–2008, 49.7% of individuals aged 20 years or older had at least one of the risk factors associated

with CVD, 21.3% had the two of three risk factors, and 2.4% had all three risk factors associated with CVD. Nationally, CVD causes one in three deaths each year (CDC, 2015).

Cardiovascular Risk Factors

Despite the high incidence of CVD, CVD has declined from 6.7% in 2000 to 6.0% in 2010 (CDC, 2015). The drop in CVD is partly due to recognition of the risk factors for CVD (CDC, 2015; Go et al., 2013; WHF, 2014). However, some risk factors cannot be changed; that is, they are inherent to the individual and are *unmodifiable*. Other risk factors for CVD can be changed, and are considered *modifiable* (CDC, 2015; Go et al., 2013; Roger et al., 2012: WHF, 2014).

Unmodifiable cardiovascular disease risk factors. The most common unmodifiable risk factors are age, gender, family history, and ethnicity (CDC, 2015; Roger et al., 2012). Studies (Berry et al., 2012; Go et al., 2013; Lang et al., 2012) and public health reports (CDC, 2015; WHF, 2014) have consistently documented significant associations between aging and increased risk of developing CVD. Subtle physiological changes can occur in the cardiovascular system even in the absence of CVD (AHA, 2015; Roger et al., 2012; WHF, 2014). Aging aligns with advanced growth of plaque formations that result from genetic or lifestyle factors (Go et al., 2013; Qi, Meigs, Rexrode, Hu, & Qi, 2013). Moreover, among older individuals, the heart muscles relax less completely between beats, stiffening the heart chamber and lessening its effectiveness in pumping blood throughout the body (AHA, 2015; Go et al., 2013; Roger et al., 2012).

It is difficult to discuss unmodifiable risk factors in isolation from one another: aging, gender, ethnicity, and family history all interact to influence risk for CVD (CDC,

2015; Cho & Lee, 2012). A report on CVD by age, gender, and ethnic groups by the AHA (2015) documented that 6.3% of U.S. men and 5.6% of U.S. women aged 40 to 59 years of age have CVD. These percentages increase to 19.9% and 9.7% for men and women aged 60 to 79 years of age, respectively (AHA, 2015). However, male gender aligns with increased likelihood of CVD only when comparing men to nonmenopausal women (Cho & Lee, 2012; WHF, 2014). When women reach menopausal age, the risk of CVD equals that of men (Cho & Lee, 2012; WHF, 2014). The increased likelihood of CVD for women after menopause has been credited to loss of estrogen (Cho & Lee, 2012; Crandall & Barrett-Connor, 2013). Moreover, postmenopausal women have significantly higher levels of obesity and hypercholesterolemia than do men of the same age; obesity and hypercholesterolemia are modifiable risk factors for CVD (ANA, 2015; Baum et al., 2012; Go et al., 2013). Nonetheless, studies have shown that African American men have the greatest risk for CVD in comparison to African American women and Caucasian men and women, and remain at greatest risk across age groups (AHA, 2015; Go et al., 2013).

Modifiable cardiovascular disease risk factors. Modifiable risk factors are those factors that can be controlled and treated such as high blood pressure, elevated cholesterol, overweight, tobacco use, sedentary lifestyle, poor diet, and diabetes; in other words, those risks that can be changed or modified through behavioral change (AHA, 2015; Roger et al., 2012; WHF, 2014). Medical treatment has little impact in preventing premature death. However, individuals can prevent premature death by preventing unhealthy habits, which accounts for 40% of all premature deaths (AHA, 2015; Roger et al., 2012; WHF, 2014).

Hypertension. Hypertension is the leading cause of CVD globally, determined by constant elevation of systolic pressure (the top number) at 140 millimeters of mercury or higher (when the heart is at work) or when diastolic (the bottom number) pressure is 90 millimeters of mercury or above (when the heart is at rest; CDC, 2015; Louie & Wedell, 2014; Roger et al., 2012). Prehypertension is when systolic blood pressure is 120–139 mm Hg or diastolic blood pressure of 80–89 mm Hg (CDC, 2015; Louie & Wedell, 2014). According to the CDC (2015), hypertension is a leading CVD-risk factor. Lack of physical activity, poor diet, and heavy smoking can lead to uncontrollable hypertension, hence CVD risk (Go et al., 2013; Roger et al., 2012).

Smoking. According to the World Health Organization (WHO, 2015), approximately 1 billion people in the world smoke and as such, the risk of being diagnosed with CVD is extremely high among female smokers, younger male smokers, and heavy smokers, and smoking causes about 10% of all CVD deaths. In the United States, 350,000 men and 80,000 women die prematurely each year from CVD as a result of smoking (Louie & Wedell, 2014; WHO, 2015). By 2020, smokers will increase their rate of smoking to 6.7 trillion cigarettes globally, and by 2030 tobacco-related deaths will increase to 80% of all deaths (Lang et al., 2012; WHO, 2015).

Elevated cholesterol/Poor diet. Elevation of blood-level cholesterol remains one CVD risk factor and causes 2.6 million deaths (4.5% of all CVD deaths globally; Mendis, Puska, & Norrving, 2011). The incidence of CVD has increased significantly due to changes in dietary habits. In a study conducted by Burke, Thompson, Roos, Verdouw, and Troe (2011) about CVD prevention, the consumption of foods high in fats, processed foods, and simple sugars has increased the development of CVD. In the same study,

researchers found an increase of 250 kcal intakes per capita per day and also an increase in fat intake per capita per day of 14 grams (Burke et al., 2011). This suggests that diet rich in fruits and vegetables, water, and less salt intake will improve cardiovascular health (Roger et al., 2012).

***Diabetes*.** Diabetes mellitus is one of the modifiable risk factors associated with CVD affecting more than 16 million individuals in the United States alone (Louie & Wedell, 2014),for those with the two types of diabetes—type 1 and type 2—individuals have twice the chance of being diagnosed with CVD. CVD mortality occurs more in individuals diagnosed with diabetes. The risk factor for type 2 diabetes is being obese, coupled with lack of exercise and poor diet. In the NHS, 60% of participants (acute-care nurses) were obese or overweight; more than 50% were severely inactive and had poor dietary habits (Louie & Wedell, 2014).

Overweight/Obesity. Obesity, indicated by a body mass index equal or greater than 30, is one of the strongest predictors of CVD (Louie & Wedell, 2014). Excessive body weight significantly impacts other CVD risk factors such as hypertension, low-density lipoprotein, triglycerides, and diabetes. These lead to increased risk of CVD, hence premature death (Louie & Wedell, 2014). In several epidemiological studies, overweight individuals have a 32% chance of being diagnosed with CVD and obese individuals have an 81% chance (Alexander, 2001). In a meta-analysis of 26 observational studies, (390,000 men and women) conducted at the Harvard School of Public Health, “women with a body-mass index of 30 or higher had 62% greater risk of dying from [coronary artery disease] and CVD” (Alexander, 2001, p. 45).

Cardiovascular Disease Risk Factors and Genetics: Nurses' Health Study Research

As stated previously, family history is an unmodifiable risk for CVD (AHA, 2015; Louie & Wedell, 2014), and 43% of American adults have a family history of CVD (Zlot, Valdez, Han, Silvey, & Leman, 2010). Family history as a risk factor for CVD has led to studies examining the roles genes play in the development of CVD, with much of this research recognizing the complex interaction among genotypes, the individual, and the environment (J. Zhang et al., 2010). Studies that have used Harvard's NHS data (e.g., Baum et al., 2012; Crandall & Barrett-Connor, 2013; de Oliveira Otto et al., 2013; Fretts et al., 2014; Qi et al., 2013) are at the forefront of this literature. Most researchers using NHS data tend to identity participants as women and not acute-care nurses; therefore, it is important to acknowledge that results from studies pertain to women and to acute-care nurses.

The contribution of NHS research studies to the understanding of genetic and physiological contributions to CVD cannot be overstated. Studies using NHS data are expansive and comprehensive, with numerous studies examining various genetic antecedents of CVD. This has led to some consistencies in the findings. Contemporary studies using NHS data shown significant and consistent associations between shortened telomere length and increased risk for CVD (Crous-Bou et al., 2014; Devore, Prescott, De Vivo, & Grodstein, 2011; Du et al., 2013; Gu et al., 2015). Studies using NHS data led to increased knowledge of the genetic variants involved in phospholipid synthesis (Ferrell & Chiang, 2015, Fretts et al., 2014), inflammatory and fatty-acid processes (Baum et al., 2012; de Oliveira Otto et al., 2013; Hak, Karlson, Feskanich, Stampfer, & Costenbader, 2009), and glucose and estrogen regulation (Burns & Korach, 2012;

Crandall & Barrett-Connor, 2013; Qi et al., 2013; Qi, Workalemahu, Zhang, Hu, & Qi, 2012; H. Zhang, Mo, Hao, & Gu, 2012), all of which increase the odds of having CVD.

With consistent acknowledgement of the genes-environment complexities involved in the development of CVD, the body of literature using NHS has contributed to the practice of patient-centered practices by identifying individuals at risk for CVD, as well as behaviors that reduce CVD risk (Squassina et al., 2010). Results from NHS studies showed that the risk for CVD is more likely among women (and nurses) with (a) metabolic syndrome and Type 2 diabetes (Du et al., 2013; Ferrell & Chiang, 2015; Kalea, Harrison, Stephens, & Talmud, 2012; Qi et al., 2013, 2012; Stanhope, Schwartz, & Havel, 2013); (b) estrogen-related disorders, including early menopause (Burns & Korach, 2012; Crandall & Barrett-Connor, 2013; Shuster, Rhodes, Gostout, Grossardt, & Rocca, 2010); (c) depression (Hek et al., 2013); (d) sleep disorders, including sleep apnea and restless leg syndrome (Ferrell & Chiang, 2015; Innes, Selfe, & Agarwal, 2012; Sharma et al., 2011); (e) Vitamin B and D deficiencies (Bartali, Devore, Grodstein, & Kang, 2014; Gunta, Thadhani, & Mak, 2013; Willett, 2012); and (f) certain auto-immune disorders (e.g., rheumatoid arthritis, Karlson et al., 2013, Solomon et al., 2003; and lupus, Hak et al., 2009). Results from the Huertas-Vazquez et al. (2013) study, which used NHS data, documented potential linkages between schizophrenia and increased risk for CVD resulting from a neuregulin 1 genetic mutation. Studies using NHS data have additionally provided support that CVD risk can be reduced by (a) eating a Mediterranean diet (Crous-Bou et al., 2014; Gu et al., 2015; Hindy et al., 2014); (b) reducing the intake of foods high in fats and fructose (Stanhope et al., 2013; Willett, 2012); (c) engaging in

exercise (Archer & Blair, 2011; Du et al., 2013); and increasing coffee intake (Freedman, Park, Abnet, Hollenbeck, & Sinha, 2012).

Cardiovascular Disease Risk Factors Among Nurses

Nurses are knowledgeable about CVD, yet studies have documented that they are at risk for CVD (Lang et al., 2012; McElligott et al., 2009). According to the Department for Professional Employees (DPE, 2012), 91.1% of RNs and 93.4% of licensed practical nurses were women. The mean age of nurses as of 2011 was 50 years (Nahm et al., 2012). The high prevalence of female nurses and the aging of nurses increase the likelihood that individuals in this white-collar profession are at greater risk for CVD compared to those in other professions (DPE, 2012; McElligott et al., 2009; Nahm et al., 2012). Family history of CVD is another demographic risk factor (CDC, 2015). Fair et al. (2009), in a study of CVD risk factors in nurses, found that more than 20% of nurses in the study had a family history of premature death from CVD. The percentage of nurses with a family history of early onset CVD was 34.2% in the Puett et al. (2009) study using NHS data.

High rates of CVD risk factors exist among nurses across the health, mental health, health-related behaviors, and demographic-risk domains, which can negatively impact people's health and well-being (ANA, 2015; Baer et al., 2011; Fair et al., 2009; Khan et al., 2012). A major risk factor for CVD among nurses is obesity (ANA, 2015). In a study by Louie and Wedell (2014) using NHS data, 60% of acute-care nurses in the study were obese or overweight. In a recent study by the ANA (2015), the percentage of nurses who were obese was a disconcerting 70%. Associated with obesity are a sedentary lifestyle and poor dietary habits (ANA, 2015).

Across studies examining CVD risk factors in nurses, results showed that, on average, 11% of nurses have diabetes; higher that the average percentage of 9% for U.S. adults (Khan et al., 2012; Preventive Cardiovascular Nurses Association, 2008). The percentage of nurses with hypertension in studies has ranged from approximately 18% to over 40%, and the percentage of nurses with elevated cholesterol levels has ranged from 15% to 50% (Khan et al., 2012; Lang et al., 2012; Puett et al., 2009). Baer et al. (2011) and Li et al. (2006), using data from the NHS, concluded that obesity, diabetes, hypertension, and high cholesterol significantly aligned with increased risk of mortality due to CVD among nurses.

Pharmacogenetic and Pharmacogenetic Testing

Pharmacogenetics, which "blends components of the disciplines of genetics and pharmacology," refers to the study of genetic variations of individuals that affect drug metabolism (Johnson & Cavallari, 2013, p. 987). The premise of pharmacogenetics is that genetic variability can results in two types of drug reactions related to pharmacokinetics, or the effects of a dosage of the drug and pharmacodynamics, or the effects of the drug itself on the body (Howland, 2012; Johnson & Cavallari, 2013). Pharmacokinetics and pharmacodynamics assist in the clinical understanding of (a) drug concentration, metabolism, and clearance; (b) drug dosage needed for clinical affect; and (c) the likelihood of an adverse drug reaction (Blakey & Hall, 2011; Howland, 2012). Pharmacogenetic is a prime example of personalized medicine (Johnson & Cavallari, 2013; Scott, 2011). "Personalized medicine entails engagement between patient and health care provider, identification of relevant genetic variations for implementation,

assay reliability, point-of-care decision support, and necessary institutional investments" (Scott, 2011, p. 987).

Pharmacogenetic research has existed for more than 60 years, with the term pharmacogenetic coined in 1959. Until the late 1990s, most pharmacogenetic studies, uncommon in the literature, focused on DNA sequencing to identify patients who might respond differently to medications (Johnson & Cavallari, 2013; Squassina et al., 2010). Advances in the understanding of genetics, the growth of specialized technology for medicine, the high rates of CVD, and the advent of personalized medicine contributed to the emergence of pharmacogenetic research related to major cardiovascular medications in the late 2000s (Scott, 2011), with much work conducted on CVD drugs such as antiplatelet agents, warfarin, statins, beta blockers, diuretics, as well as antiarrhythmic agents (Kadafour et al., 2009; Musunuru et al., 2012; Roden, 2012; Van Schie et al., 2012; Verschuren et al., 2011).

The study conducted by Frazier et al. (2005) stressed that knowledge of genetic components of CVD (such as cardiomyopathy and heart failure) in conjunction with pharmacogenetics can improve cardiovascular nursing care. Heart failure is the decreased ability of the heart to fill and to eject adequate blood to the entire body. Cardiomyopathy is the second highest cause of sudden cardiac death in the United States; the primary cause of cardiomyopathy is genetic disposition (Frazier et al., 2005). For instance, patients with ischemic heart disease with genotypes associated with poor prognosis respond well to statins (Kadafour et al., 2009; Verschuren et al., 2011). Patients with a gene that encodes angiotensin converting enzymes and β_1-adrenergic receptors respond less well to cardiovascular drugs (Verschuren et al., 2011).

Nurses' Knowledge of Pharmacogenetic Testing

To effectively communicate with patients about pharmacogenetic testing, it is important that healthcare providers have at least adequate levels of knowledge of pharmacogenetic testing: "patients demand accurate and timely information … about … pharmacogenetic testing and what the results mean" (Payne & Annemans, 2013, p. 20). Results from the minimal body of literature on healthcare providers' knowledge of pharmacogenetic testing (e.g., Bannur, Bahaman, Salleh, & Kek, 2014; Moen & Lamba, 2012; Roederer et al., 2012; Stanek et al., 2012) showed that physicians and pharmacists lack such knowledge. The knowledge of pharmacogenetic testing among nurses is even less understood.

The body of literature on nurses' knowledge of pharmacogenetic testing is small but growing. Some studies (e.g., Dodson, 2011; Dodson & Van Riper, 2011; Haga & LaPointe, 2013; Haga, O'Daniel, Tindall, Lipkus, et al., 2012) included various healthcare providers, including nurses, as participants. The focus of the Haga, O'Daniel, Tindall, Lipkus, et al. (2012) and Haga, Tindall, & O'Daniel (2012) qualitative studies were to examine differences between primary care and genetics in healthcare professionals' knowledge of pharmacogenetic testing specific to CVD. Of the 21 participants, 11 were primary-care providers and 10 were genetics healthcare professionals. Participants included nurse practitioners, but not nurses, in both groups. From focus-group data, specific themes emerged surrounding differences between primary care and genetics healthcare providers' knowledge of pharmacogenetic testing. Nurse practitioners conceded their lack of knowledge of pharmacogenetic testing, and did

so at a greater degree than did primary-care physicians (Haga, O'Daniel, Tindall, Lipkus et al., 2012; Haga, O'Daniel, Tindall, Mills et al, 2012).

Dodson (2011) conducted a review of the literature on healthcare providers' knowledge of pharmacogenetic testing that included studies conducted with nurses. Dodson (2011) reviewed 12 studies, the oldest published in 1999, equally divided across quantitative and qualitative methodologies, and 50% were conducted in the United States. Notable findings were that a substantial majority—66% to 84%—of healthcare providers, including nurses, reported having minimal knowledge of pharmacogenetic testing. No differences emerged in knowledge between nurses and pharmacists.

Dodson extended this work with a follow-up study (Dodson & Van Riper, 2011) conducted with 184 healthcare providers, of which 75 were RNs and 35 were nursing students. The researchers asked participants to respond to a series of open-ended questions about pharmacogenetic testing, and analyzed responses using content analysis. Many of the four themes that emerged provided examples as to how the (lack of) knowledge of pharmacogenetic testing impaired healthcare providers' patient-centered practices. The first theme concerned healthcare providers' negative concerns regarding pharmacogenetic testing. Decreased knowledge of pharmacogenetic testing often led to healthcare providers' perceptions that pharmacogenetic testing itself was inaccurate, unreliable, or impractical. The second theme concerned the lack of successful integration of pharmacogenetic testing into general healthcare practices. The lack of knowledge of pharmacogenetic testing led to increased *resistance* among healthcare providers to educate themselves on and increase their knowledge and use of pharmacogenetic testing. Much of this resistance stemmed from healthcare providers' perceptions that

pharmacogenetic testing was too new and novel to be meaningful to their current patient practices (Dodson & Van Riper, 2011).

The third and fourth themes found in the study by Dodson and Van Riper (2011) focused on patients, specifically with regard to patient healthcare disparities and potential harm of pharmacogenetic testing to patients. A majority (80%) of the 75 RNs in the study noted concerns that, as seen with other medical advances, availability and access to pharmacogenetic testing would be limited to those who could afford it, thereby "exacerbating disparity" between high- and low-income healthcare consumers (Dodson & Van Riper, 2011, p. 536). In turn, the disparity in availability and access to pharmacogenetic testing may result in "two different standards of care": one for the wealthy and one for the poor (Dodson & Van Riper, 2011, p. 536). Aligned with these disparities was the potential harm of pharmacogenetic testing: healthcare providers voiced concerns that pharmacogenetic testing could cause more harm than benefit to patients. Perceptions of harm included (a) increased healthcare costs for patients; (b) prolonging the life of patients who had very poor quality of life; (c) physician reliance on testing, resulting in "less vigilance" in monitoring, for example, medication reactions; and (d) increasing patient distress, anxiety, and fear of genetic conditions or genetic-based diseases (Dodson & Van Riper, 2011).

Fewer studies (e.g., Blakey & Hall, 2011; Godino & Skirton, 2012; Kadafour et al., 2009; Van Riper et al., 2011) focused exclusively on nurses. Results from these studies reiterated the lack of knowledge of pharmacogenetic testing among nurses as well as the possible consequences that may occur as a result of this lack of knowledge. Blakey and Hall (2011), in a study conducted with British nurses, found that a major challenge

for nurses was to explain results from pharmacogenetic testing to patients, who required expert knowledge on genetics and pharmacogenetic; knowledge nurses reported not having. Results from the Kadafour et al. (2009) study suggested that lack of knowledge of pharmacogenetic testing may prevent nurses from participating in studies on the topic: of the 2,038 nurses recruited for the study, only 448 (22%) completed the study. Moreover, of these 448 nurses, 40% reported being unclear as to the clinical benefits of pharmacogenetic testing (Kadafour et al., 2009). The most concerning result was that the average pharmacogenetic-testing-knowledge score among nurses was 40% (Kadafour et al., 2009).

Although not examining nurses' knowledge of pharmacogenetic testing *per se*, Godino and Skirton (2012) conducted a systematic review of the literature on nurses' knowledge of genetics. Godino and Skirton's review of the literature shared similarities to previous literature reviews discussed in a chapter by Edwards (2009) and Dodson (2011). Godino and Skirton retrieved only six relevant studies, and even with this small number of articles, considerable variability existed in location (e.g., three studies were conducted in the United States, three each in Scotland, Singapore, and Canada). The review was, however, strengthened by its focus on quantitative descriptive cross-sectional studies that used nurse participants, had the singular aim of providing descriptions of nurses' level of knowledge on genetics, and measured nurses' perceived knowledge of genetics. Results from Godino and Skirton's study replicated previous findings in that, across studies, nurses' knowledge of genetics was poor.

The most comprehensive study on nurses' knowledge of pharmacogenetic was conducted by Van Riper et al. (2011) with 560 RNs. Although the initial intent of the

study was to determine nurses' knowledge of pharmacogenetic as it pertained to CVD, the study expanded to include other pharmacogenetic topics. Results from the Van Riper et al. study reiterated those found in previous studies (e.g., Dodson, 2011, 2014, 2015; Kadafour et al., 2009). A third (33%) of nurses reported their understanding of pharmacogenetic as *poor* and 44% reported their knowledge as *fair*. Most concerning was the performance on tests that gauged knowledge of pharmacogenetic testing: the mean score of the 10-item test was 60.3%, equivalent to a grade of D. Only 33% of nurses correctly responded with *true* when answering the statement, "genetic determinants of drug response change over a person's lifetime" (Van Riper et al., 2011, p. 7).

Nurses' Attitudes about Pharmacogenetic Testing

One important factor influencing a successful implementation of pharmacogenetic testing is nurses' attitudes toward it: these attitudes often determine their behavior in caring for the patients (Chadwell, 2013; Dodson, 2011, 2014, 2015). The literature on nurses' attitudes toward pharmacogenetic testing is somewhat less robust than the literature on nurses' knowledge, with much of the empirical work done by Dodson (2011, 2014, 2015) and Haga and colleagues (Haga, Kawamoto, Agans, & Ginsburg, 2011; Haga & LaPointe, 2013; Haga & Mills, 2015; Haga, O'Daniel, Tindall, Lipkus et al., 2012, ; Haga, O'Daniel, Tindall, Mills et al. 2012; Mills & Haga, 2013). Despite the dearth of such studies, results from these studies have consistently documented that *ethical issues* and *advantages of testing* are central concerns among nurses (Dodson, 2011, 2014, 2015; Haga et al., 2011; Haga & LaPointe, 2013; Haga & Mills, 2015). These two attitudinal issues are discussed in the following sections.

Pharmacogenetic testing: Ethical issues. In the era of the Affordable Care Act, patient-centered care, and genomic medicine, numerous issues surround pharmacogenetic testing (Dodson, 2011). In Dodson's (2011) review of the literature, eight of the 11 articles reported nurses' ethical concerns about testing; the most frequent being employment and insurance discrimination based on the individual's pharmacogenetic testing profile. Ethical issues emerged as a primary issue in the Van Riper et al. (2011) study; with 47% of the nurses expressing concern that pharmacogenetic testing would result in employment and insurance discriminatory practices. Ethical issues regarding pharmacogenetic testing have been so concerning to nurses and other healthcare providers that in numerous studies, nurses and other providers have voiced a need for informed consent for this type of testing (Bartlett, 2011; Dodson, 2011, 2014, 2015). As stated by Bartlett (2011), "patients (accepted) pharmacogenetic testing (when) their rights to consent and privacy were fully protected" (p. 27).

At issue is whether patients' genetic information would be given to their employers, health-insurance representatives, and other agencies and individuals (Bartlett, 2011). According to Haga and Burke (2008) and Haga et al. (2011), pharmacogenetic testing does not have comprehensive reimbursement of companion diagnostics, even when recommended by the Food and Drug Administration. Health-insurance representatives are quite reluctant to reimburse for pharmacogenetic testing as they claim that its clinical usefulness coupled with knowledge of pharmacogenetic is very questionable (Haga & Burke, 2008; Haga et al., 2011; Haga & LaPointe, 2013). For instance, for warfarin, a CVD medication, individuals with a particular enzyme activity called CYP2C9 need a reduced dose and require constant monitoring of their blood level

to prevent bleeding (Bannur et al., 2014). In view of this problem, the Food and Drug Administration mandated genotyping for all patients prior to issuing a warfarin prescription; this poses significant challenges when insurers do not reimburse for the companion testing (Haga et al., 2011).

Despite the benefits associated with pharmacogenetic testing, doctors, nurses, pharmacists, and other healthcare professionals face ethical dilemmas regarding who should be tested and the appropriateness of testing in conjunction with treatment options (Calzone et al., 2010). Shin et al. (2009) maintained that the lack of availability of pharmacogenetic testing for patients and the high cost, as well as the lack of reimbursement, all impede the introduction of pharmacogenetic testing in the healthcare arena. Only 8% of laboratories in the United States can competently perform the pharmacogenetic tests needed for patient care, which eventually caused a much longer turnaround time for needed test results (Calzone et al., 2010). Because turnaround time might take several days or weeks, the safety and well-being of patients is compromised if the test result is needed immediately for clinical decision making, as in the case of warfarin dosing for anticoagulation purposes. The average cost of pharmacogenetic testing ranges from $250 to $500. Insurers tend to reimburse only a few of these tests, as the majority of them are considered experimental (Calzone et al., 2010).

Pharmacogenetic testing: Advantages. The second theme seen in the literature on nurses' attitudes about pharmacogenetic testing pertained to its perceived advantages. The most frequently reported advantage reported by nurses was the reduced likelihood of patient adverse reactions to drugs (Dodson, 2011, 2015). Haga et al. (2011) and Haga and Mills (2015) reported similar findings. Van Riper et al. (2011) also examined attitudes

toward pharmacogenetic testing among nurses and their results were quite similar to those found by Dodson (2011). In contrast to Dodson (2011), who reported one primary advantage of pharmacogenetic testing (i.e., reduced adverse reactions to medications), Van Riper et al. elicited additional advantages from nurses: (a) decreased drug reactions in general, (b) decreased drug reactions to CVD medications, (c) reduced time needed to titrate a CVD medication, and (d) decreased costs of pharmacogenetic-derived medications.

A criticism of the research on attitudes toward pharmacogenetic testing, as well as the research on knowledge, is that most studies used a descriptive cross-sectional research design or were reviews of literature, resulting in a gap in the literature concerning antecedents of nurses' knowledge of pharmacogenetic testing. In Dodson's (2014) seminal study, the researcher examined work-based, demographic, and personality antecedents of pharmacogenetic testing knowledge and attitudes of 368 oncology acute-care nurses in North Carolina. Results showed that various factors influenced pharmacogenetic testing knowledge and attitudes among acute-care nurses. Although experience and exposure to pharmacogenetic testing led to increased knowledge and acceptance of pharmacogenetic testing among nurses, nurses' personality factors of openness to experience, conscientiousness, and agreeableness, and their "desire for innovation" were additional predictors of higher levels of acceptance of pharmacogenetic testing (Dodson, 2014, p. e68).

Summary and Conclusions

The purpose of Chapter 2 was two-fold. The first purpose was to provide an extensive review of the study's guiding theory: the Rosenstock et al. (1974) HBM. In

addition to an explication of the theoretical components of the HBM were discussions of the HBM in nursing research and the present study's application of the HBM. The second purpose of the chapter was to provide a comprehensive review of the literature with regard to nurses' perceptions of their own risk for CVD as well as nurses' knowledge and attitudes toward pharmacogenetic testing. The literature review revealed that few studies have been conducted with acute-care nurses about their perceived risk for CVD; the Jones et al. (2006) study was the most informative study on this topic to date. Studies examining nurses' knowledge and attitudes toward pharmacogenetic testing were, for the most part, descriptive studies (e.g., Dodson, 2014, 2015; Haga, O'Daniel, Tindall, Lipkus et al., 2012; Haga, O'Daniel, Tindall, Mills et al. 2012; Haga, Tindall, et al., 2012; Van Riper et al., 2011) or reviews of the literature (e.g., Dodson, 2011; Godino & Skirton, 2012; Verschuren et al., 2011). Studies concerning nurses' attitudes toward pharmacogenetic testing (e.g., Dodson, 2011, 2015) highlighted concerns about pharmacogenetic testing, such as ethical and financial reimbursement issues, as well as advantages, including reduced likelihood of adverse reactions to medications among patients.

The review of the literature uncovered gaps in the literature concerning knowledge and attitudes of acute-care nurses regarding pharmacogenetic testing. A primary gap found was the lack of studies examining antecedents of perceived risk for CVD and knowledge and acceptance of pharmacogenetic testing for CVD. Dodson's (2014) seminal work provided much of the foundation for the present study, as it was the only study that examined work-based, demographic, and personality antecedents of pharmacogenetic testing knowledge and of attitudes in acute-care nurses. The present

study addressed this concerning gap in the literature. The implications of prior research on this research have been fully addressed. The study methodology, including the research design, sampling issues, study variables and their operational definitions, and data collection and analysis procedures are the focus of Chapter 3.

Chapter 3: Methodology

In this quantitative study, using a correlational, cross-sectional design and conducted with licensed acute-care nurses in Atlanta, Georgia, I had three goals aligned with the HBM (Rosenstock, 1974). The first goal was to determine if nurses' gender, highest level of education, and years of experience significantly related to their perceived risk for CVD. The second goal was to determine if nurses' gender, highest level of education, and years of experience significantly related to their knowledge of pharmacogenetic testing for CVD. The third and last goal was to determine if a significant association arose between nurses' perceived risk for CVD and their acceptance of pharmacogenetic testing for CVD.

The purpose of this chapter is to provide a summary of the research design and methodology. First, I review the research design and rationale in this chapter, and continue with an overview of the population and sample, sample size, and sampling procedures. I then comprehensively discuss the study methodology, inclusive of the instruments used in the study, data-collection procedures, and data analysis. Upon completion of the methodology discussion, I provide a summary of instrument reliability and validity and outline the ethical procedures of the study. The chapter ends with a summary and conclusion section.

Research Design and Rationale

The study was quantitative in nature and used a cross-sectional research design. The quantitative approach was appropriate for this study, as I statistically analyzed numerical data from self-report surveys for hypothesis testing (Stangor, 2014). The quantitative approach was guided by the scientific method, with a goal of objectivity.

This study was correlational, examining relationships between variables, and cross-sectional, as data accrued at one point in time (Stangor, 2014). This study was not appropriate for a quantitative causal-comparative research design as it focused on relationships between independent and dependent variables and does not examine group differences on a dependent variable. As this was not a study with intervention and control groups, quantitative quasi-experimental and experimental research designs were not applicable (aligned with Treiman, 2014). As this was not an experimental quantitative study, causality could not be proven (as averred by Kleinbaum, Kupper, Nizam, & Rosenberg, 2013).

Methodology

Population and Sample

Study participants, who represented the population of acute-care nurses in the United States, were registered acute-care nurses with active licenses working in acute hospital settings in Atlanta, Georgia. The sample frame—the group of acute-care nurses who had a chance to participate in the study—included all registered acute-care nurses in Atlanta, Georgia. As of 2014, the number of licensed acute-care nurses in Georgia was 155,607 (Stephens, 2015). Approximately 7.5% (n = 11, 670) of these licensed nurses worked in acute-care settings in the city of Atlanta (Stephens, 2015). I retrieved work-contact information for these acute-care nurses from the database of the Georgia Board of Nursing with permission of the Board, and I informed all registered acute-care nurses who work in acute-care settings in Atlanta of this study and invited them to participate.

I gave every RN working in an acute-care setting in Atlanta Georgia an equal opportunity to participate in this study. However, I did not randomly select acute-care

nurses for the study; that is, although the study was open to all acute-care nurses who met study criteria, acute-care nurses themselves chose whether to participate in the study. Thus, participants comprised a nonprobability purposive sample; being acute-care nurses, they were a subset of all acute-care nurses.

Sample Size

In accordance with recommendations from Kasiulevičius, Šapoka, and Filipavičiūtė (2006) and Charan and Biswas (2013), I conducted an epidemiological power analysis for a cross-sectional descriptive study. The power analysis mathematical formula for a cross-sectional descriptive study is $Z_{1-\alpha/2}{}^2\, p\,(1-p)/d^2$, where $Z_{1-\alpha/2}{}^2$ is the normal variate of 1.96 for significance (p) set at < .05, p is the prevalence rate of the health issue in the population; and d is "absolute error or precision" as indicated by confidence levels, typically set at 95% (or +/- 5% confidence limits; Charan & Biswas, 2013, p. 122). Power analyses for epidemiological descriptive cross-sectional studies may also include a design effect (DE), which is a ratio of the actual variance using the selected sampling method to the possible variance using random sampling (Kasiulevičius et al., 2006). However, DE is a concern when using clustered data, which this study did not use (Kasiulevičius et al., 2006).

I conducted the power analysis using an online epidemiological power analysis calculator (http://www.openepi.com/SampleSize/SSPropor.htm). I set the prevalence rate to 30%, based on rates of CVD among Caucasian middle-aged women in the United States (AHA, 2015; Go et al., 2013; WHF, 2014), the confidence level to 95%, and left the DE at the default value of 1.00, as the study data were clustered (Kasiulevičius et al.,

2006). Results from the power analysis determined that a sample size of $N = 228$ was required for the study.

Sampling Procedure

I obtained a purposive sample of $N = 228$ licensed nurses without a CVD diagnosis working in acute-care units at Atlanta metropolitan-area hospitals. With Board permission, I retrieved work-contact information of these acute-care nurses from the database of the Georgia Board of Nursing. I sent out a study-invitation email to all acute-care nurses who met study criteria. In this email, I explained the purposes, nature, length, and intent of the study; this information was summarized in a study-information letter attached to the email. I included a link to the study's Survey Monkey survey in the text of the email and in the study-information letter. The email also contained language that reviewed the informed consent procedure and included, as an attachment, the study's informed consent form. The informed consent form stated that participation in the study was voluntary and participants could stop answering the survey at any time without penalty. I summarized the risks and benefits of participating in the study in the consent form, and provided my contact information and the contact information of the Institutional Review Board of Walden University.

The email ended with a request for interested participants to send me an email to schedule a phone call to discuss the study in detail, should they want more information about the study. Participants had the ability to choose to forgo the phone call and click on the Survey Monkey survey link to take the survey online. Before they could answer the survey, they first had to read the consent form online and then click "yes" to three statements: (a) they understood their rights as a human subject in this research study,

(b) their questions or concerns about the study or their role in it were answered; and (c) they provided informed consent to participate in the study. If participants clicked "no" to any of these statements, they were automatically directed out of the survey link site and could not access it again if using the same computer.

Participants who wished to know more about the study and their role in the study could email me to schedule a phone call. I answered any questions from potential participants regarding the study during this phone call. Following this call, I again sent (through email) the Survey Monkey study link for participants to complete the study survey. Participants also had the option to click on the Survey Monkey survey link in the original email (and attached document) I sent to them. Participants had 3 weeks to answer the survey. The Survey Monkey site that contained the data was accessible only to me, as I had registered with Survey Monkey and could only access the data by providing my user name and password.

Instrument and Operationalization of Constructs

In this section, I first present the instruments used for the study's independent and dependent variables. Following the description of instruments are descriptions on the measurement of the independent variables of gender, years of practice, and years of education and the study covariates.

Independent and dependent variables: Perceived risk for cardiovascular disease. Perceived risk for CVD was both an independent and dependent variable in this study, measured using the Perception of Risk of Heart Disease Scale (PRHDS; Ammouri & Neuberger, 2008, see Appendix B). The HBM was the theoretical framework for the development of the PRHDS (Ammouri & Neuberger, 2008), as health-risk perceptions

were influenced by the individual's demographics (e.g., age, education level, and gender), psychological factors (e.g., self-concept, worldview, and cultural identity), and contextual factors (e.g., media reports of CVD risk factors and availability of social resources). The PRHDS measures the continuum of perceived risk of heart disease from thinking that one has *little risk for CVD* (e.g., "My lifestyle habits do not put me at risk for heart disease") to *dread risk for CVD*, or that one's risk for CVD is definitive ("I feel sure that I will get heart disease"; Because the PRHDS measures perceived risk for CVD on a continuum, it was treated as an interval-coded scale (Ammouri & Neuberger, 2008).

The PRHDS has 20 items scored using a Likert-type scale from 1 = strongly disagree to 4 = strongly degree (Ammouri & Neuberger, 2008). Of the items, 12 are reverse scored and should be recoded before summing items to create the full scale. Scores on the PRHDS can range from 20 to 80 points with a higher score denoting higher levels of perceived risk for heart disease (Ammouri & Neuberger, 2008).

A panel of 10 survey development experts assessed the content validity of the PRHDS, examining items "for clarity, homogeneity of content, and representativeness of the concept domain" (Ammouri & Neuberger, 2008, p. 87). Once the experts gave their approval for the survey, Ammouri and Neuberger (2008) confirmed the content validity of the PRHDS by conducting a confirmatory factor analysis that showed the one-factor PRHDS explained 53% of the variance. There are significant associations between the PRHDS and scale of health responsibility, physical activity, spiritual growth, and stress management, confirmed criterion-related validity of the PRHDS with *r*s ranging from .21 to .39, $p < .01$. The inter-item reliability for the PRHDS had a Cronbach's alpha of .80 and the 2-week test–retest reliability is .69 (Ammouri & Neuberger, 2008).

Dependent variable: Knowledge of pharmacogenetic for cardiovascular disease. I assessed knowledge of pharmacogenetic testing for CVD, which was a dependent variable in this study, using the Pharmacogenomics Knowledge Scale (PKS; Bannur et al., 2014, see Appendix C). Bannur et al. (2014) developed the PKS to inform the professional practice of CVD pharmacogenetic testing in healthcare settings, arguing that healthcare providers must demonstrate "the skill to translate patient's genetic history for optimum drug therapy" to prevent or delay CVD (p. 40). The ratio-coded PKS comprised five items scored as 1 = true and 0 = false; three items are true and two items are false. An example item is "Pharmacogenetic testing is currently available for most heart disease medications" (scored as a false item). The total PKS scale score is a sum of the number of correct items divided by five to obtain a percentage score, which can range from 0% to 100% (Bannur et al., 2014).

The PKS went through a rigorous two-panel review process to determine its content validity. Five researchers specializing in the field of pharmacogenetic testing sat on the first panel, and the second panel included 10 pharmacists and physicians (Bannur et al., 2014). The two panels confirmed the content validity of the PKS. Bannur et al. (2014) validated the PKS in a study conducted with 503 healthcare professionals. Significant relationships between pharmacogenetic testing knowledge and genetics knowledge (at $r = .27$, $p < .01$) provided support for criterion-related validity. Statistical results supported the discriminant validity of the PKS, showing significantly higher mean scores among pharmacists and physicians having more years of practice than those having fewer years of practice, χ^2 (4, $N = 1{,}500$) = 78.79, $p < .001$, and pharmacists and

physicians working in urban healthcare settings versus rural healthcare settings, χ^2 (2, N = 1,500) = 7.48, p = .024 (Bannur et al., 2014). The PKS scores dichotomously.

Dependent variable: Acceptance of pharmacogenetic testing for cardiovascular disease. I used the Attitudes Toward Pharmacogenomics Scale (APS; Bannur et al., 2014) to measure acceptance of pharmacogenetic testing for CVD, which was a dependent variable in this study. Bannur et al. (2014) developed the APS to address the lack of awareness of CVD pharmacogenetic testing among healthcare providers. The APS is a Likert-coded scale comprising eight questions that assess the degree to which healthcare providers feel comfortable with and accept pharmacogenetic testing for CVD for their patients. An example item is, "How comfortable would you be having genetic information incorporated into the determination of your patient's initial warfarin dose?" The response coding for APS items range from 1 = very uncomfortable to 5 = very comfortable. Summing the scores from each of the eight items provides a total APS score; scale scores can range from 8 to 40 with a higher score denoting higher levels of comfort/acceptance (Bannur et al., 2014).

The APS went through a rigorous two-panel review process to determine its content validity. Five researchers specializing in the field of pharmacogenetic testing sat on the first panel, and the second panel included 10 pharmacists and physicians (Bannur et al., 2014). These two panel reviews confirmed the content validity of the APS (Bannur et al., 2014). A study conducted with 1,500 healthcare professionals validated the APS. Significant relationships between acceptance of pharmacogenetic testing and genetics knowledge (r = .17, p < .05) provided support for criterion-related validity. Findings showing significantly higher mean scores among cardiologists, compared to other types

of physicians, $F(2, 500) = 7.80$, $p = .001$, and healthcare providers working at pharmacies or medical schools, compared to healthcare providers working in other settings (e.g., public/private hospital, private practice), $F(2, 500) = 2.71$, $p = .041$ supported the discriminant validity of the APS. The inter-item reliability of the APS is .76 (Bannur et al., 2014).

Independent variable: Gender. I measured the independent variable of *gender* with a dichotomously coded question: "What is your gender?" The response coding was 0 = female and 1 = male.

Independent variable: Years of education. I measured the independent variable of *years of education* with an ordinal-coded item: "What is the highest educational degree you have completed?" Responses scored were 1 = Associates' degree, 2 = Bachelors' degree, 3 = Master's degree, and 4 = Doctorate degree.

Independent variable: Years of practice. I measured the independent variable of *years of practice* with an open-ended question: "How long have you been in your current position?" The question aimed to obtain information on years of practice, a ratio variable.

Covariate: Health factors related to estrogen. In the survey, I asked participants if they (a) had a hysterectomy, (b) were postmenopausal, (c) were on hormone-replacement therapy, or (d) took birth-control pills. If participants answered "yes" to one or more of these items, they were categorized as 1 = have health factor related to estrogen. If participants answered "no" to all of these questions, they were categorized as 0 = have no health factors related to estrogen.

Covariate: Medication-related cardiovascular disease risk. I asked acute-care nurses if they took any medications(s) that can influence CVD risk; that is, medications used for other health conditions but that increased CVD risk (e.g., birth control, prednisone) or decreased CVD risk (e.g., diuretics). I provided participants a list of medications that had associated CVD risk and asked them to select the medications they were currently prescribed. I categorized participants who did take such medication(s) into the 1 = have medication-related CVD risk group, whereas participants who did not take such medication(s) were categorized into the 0 = do not have medication-related CVD risk group.

Data-Analysis Plan

I transferred the Survey Monkey data file directly into an SPSS 22.0 data file, kept on a jump drive. Once I downloaded the data into an SPSS data file, I reviewed the data set and corrected for entry mistakes, missing data, and outliers. If a case was missing >= 50% or if a case had >= 25% of data missing not at random (MNAR), it was removed from the data set (aligned with Stangor, 2014). I determined univariate outliers using the SPSS outlier function, and winsorized identified outliers (i.e., replaced them with the next lowest or highest value. I detected multivariate outliers with the SPSS Mahalanobis distance function. I calculated the inter-item reliability for pharmacogenetic testing knowledge and acceptance scales with Cronbach's alpha; an acceptable Cronbach's alpha is >= .70 (in line with Stangor, 2014). I computed study scales.

Prior to performing the regression analyses for hypothesis testing, I conducted descriptive and preliminary inferential statistical analyses, reporting frequencies and percentages for the demographic variables and covariates and the means, standard

deviations, and minimum and maximum scores for the study scales (i.e., PRHDS, PKS, and APS). I conducted specific statistical tests to determine and address violations of assumptions for regression analyses (as suggested by Stangor, 2014). I determined the assumption of normality in the distribution of scale scores by calculating scale skewness scores (i.e., skewness value divided by skewness standard error). A skewness value that is < 2.00 indicates that the multivariate normality assumptions have been met. Homoscedasticity is an assumption that pertains to the equality of residual errors (i.e., errors are constant), tested by plotting residuals using scatterplots. If the data points display an equivalent distribution above and below the horizontal line, this assumption has been met (Stangor, 2014). Multicollinearity, another assumption for linear regression analyses, refers to a very high correlation among independent variables to the extent that they are measuring the same construct. Variance inflation factors (VIFs) for each independent variable association determine multicollinearity. This assumption is met if VIFs are < 4.00 (Stangor, 2014).

For this dissertation, I proposed seven research questions. For Research Questions 1 through 3, I conducted one HMLR. I entered the covariate of take medication that affected CVD risk in the first model (step) of the HMLR, as it significantly related to the dependent variable of perceived risk for CVD. I entered the independent variables of gender, years of education, and years of experience together in the second model (step) of the HMLR. Perceived risk for CVD was the dependent variable for these first three research questions.

For Questions 4 through 6, I conducted a MLR; I did not include the two variables of take medication that affects CVD and estrogen-related health conditions in analyses as

they did not significantly correlate with the dependent variable of knowledge of pharmacogenetic testing for CVD. I entered the independent variables of gender, years of education, and years of experience collectively in the first and only model (step) of the MLR. The dependent variable for the fourth through sixth research questions was knowledge of pharmacogenetic testing for CVD.

I conducted an HLR for the seventh and last research question. Knowledge of pharmacogenetic testing for CVD significantly aligned with acceptance of pharmacogenetic testing for CVD and thus, I entered it as a covariate in the first model (step) of the HLR, followed by the independent variable of perceived risk for CVD in the second model (step) of the HLR. Perceived acceptance toward pharmacogenetic testing for CVD was the dependent variable for the seventh and last research question.

The decision to enter independent variables collectively versus singly would have required six HMLRs/MLRs, which would have decreased the power of the study, resulting in an increased likelihood of committing a Type I error (i.e., rejecting the null hypothesis when it should have been retained). Entering the independent variables together on one model (step) of the HMLR/MLR increased the statistical power of the analysis. Further, these analyses allowed determination of which of the three independent variables were most influential and also informed me "about the structure by which multiple predictors simultaneously" related to the dependent variable (Stangor, 2014, p. 341).

I determined statistical significance of the HMLR models by a significance level of $p < .05$ (as suggested by Kleinbaum et al., 2013). Results included the overall F- and p-values for the two models, and determined the model effect size by the model R^2

(Kleinbaum et al., 2013). Results for the individual predictors included the predictors' standardized beta weights (β) and p-values (Kleinbaum et al., 2013).

Instrument Reliability and Validity

Instrument reliability refers to the degree to which an assessment tool produces stable and consistent results across times (test–retest reliability), observers (interrater reliability), and instrument items (inter-item reliability; Stangor, 2014). Conducting test–retest reliability was beyond the scope of this study, and the uses of self-report instruments precluded the need to conduct interrater reliability (according to Stangor, 2014). The instruments used in this study demonstrated sound inter-item reliability. Nonetheless, I calculated the inter-item reliability coefficients by computing Cronbach's alphas for the study instruments. Cronbach's alphas that are .70 or higher are acceptable and Cronbach's alphas that are greater than .90 are deemed excellent for inter-item reliability (Stangor, 2014).

Instrument validity is the degree to which a test measures what it is purported to measure (Stangor, 2014). Of the different types of instrument validity, content validity concerns the degree to which the items in an instrument measure a desired construct. Expert panels often determine content validity of an instrument when considering nonstatistical approaches, and exploratory of confirmatory factor analyses when using statistical approaches. Discriminant validity refers to the ability of an instrument to detect and measure differences between two or more groups that should demonstrate differences (Stangor, 2014). For example, as stated previously, the discriminant validity of the PKS was demonstrated by significantly higher mean scores between pharmacists and

physicians who had more years of practice than their counterparts who had fewer years of practice (Bannur et al., 2014).

Criterion-related validity refers to the degree to which a scale score correlates with a score on an instrument that measures the same or similar construct (Stangor, 2014). As noted previously, the APS (Bannur et al., 2014) demonstrated criterion-related validity by significantly correlating with a test of genetics knowledge ($r = .17$, $p < .05$; Bannur et al., 2014). Psychometric studies confirmed the validity of the study scales, leaving no need to conduct validity testing of instruments that have already been shown to be valid.

Study Validity

Three types of validity in quantitative research studies pertain to study limitations in research methodology and design: (a) *internal validity*, or the degree to which it can be stated that the observed effects on the dependent variable(s) is due to independent variables and not to unmeasured confounding variables; (b) *external validity*, or the ability to generalize study results to the population or other samples, settings, and times; and (c) *construct validity*, or how well a study instrument operationally captures the constructs under study (Jackson, 2015). Quantitative studies have threats to internal, external, and construct validity, but these differ according to the type of quantitative research design employed in the study (Jackson, 2015).

Threats to Internal Validity

Threats to internal validity are participant or study factors that compromise the ability to state that dependent variable effects were the result of the independent variable (Jackson, 2015). Threats exist to the internal validity for associational quantitative studies,

the primary ones being (a) confound bias, (b) self-selection bias, (c) social-desirability-response bias, and (d) reverse causation (Jackson, 2015). Confound bias, the "third variable problem," concerns the inability to conclude that dependent-variable effects are a result of the independent variable, due to an unmeasured extraneous variable that significantly aligned with the independent and dependent variables (Armistead, 2014, p. 2). Covariate analysis is a recommended technique to control for confounds bias (Armistead, 2014). In the present study, two covariates were health factors related to estrogen and medication-related CVD risk.

Self-selection or volunteer bias occurs in studies that rely on a convenience sample rather than on random selection of study participants; participants who volunteer for a study tend to differ in "relevant clinical characteristics" from those who do not participate in a study (Tripepi, Jager, Dekker, & Zoccali, 2010, p. 98). Examinations of the self-selection bias in healthcare research has shown that study volunteers tend more likely to be women and have high levels of education (Tripepi et al., 2010). As these two factors were variables in this study, I considered this bias when analyzing, interpreting, and reporting study data.

Social-desirability-response bias, the tendency of study participants to provide answers to survey items that are socially acceptable irrespective of the truth, is an issue in associational studies using self-report instruments (Stangor, 2014). Social-desirability-response bias is more likely to occur when researchers ask participants sensitive questions, such as questions about their weight, health and mental health problems, and attitudes toward coworkers and supervisors (Chung & Monroe, 2003; Edmonds & Kennedy, 2012). I considered the study variables of gender, level of education, and years

of practice to be unthreatening as they are questions often asked in daily settings. It was unlikely that nurses found the knowledge and attitudes toward pharmacogenetic testing for CVD to be threatening or sensitive, as these questions pertained more to their skill set than to personal aspects of their life. Of all study variables, perceived risk for CVD may have been the variable that was most impacted by this bias: participants may have felt that, as nurses, they should not be at risk for CVD and may have downplayed their actual risk. Some evidence exists that social-desirability bias is less likely to occur in studies that use online-survey formats due to the perceived social distance between study participants and researcher (Chung & Monroe, 2003; Stangor, 2014). The informed-consent process, wherein I informed participants that their survey responses were confidential and anonymous, may have also reduced social-desirability bias (as suggested by Stangor, 2014).

A final threat to internal validity for correlational studies is reverse causation, which concerns the inability to determine temporal precedence of variables (Jackson, 2015). Genders, level of education, and length or practice were, in this study, immutable variables that could not be changed by or result from a dependent variable. The only research question that reverses causation might have influenced was the seventh question pertaining to perceived risk for CVD and attitudes toward pharmacogenetic testing: participants' attitude toward pharmacogenetic testing may have influenced their perceived risk for CVD. However, as these variables measured disparate constructs, the risk of reverse causation diminished. The use of HMLR analyses rather than bivariate correlation analysis further minimized this threat (Jackson, 2015).

Threats to External Validity

External validity pertains to the ability to generalize study results beyond the study sample to the population (or other samples), to other points in time, and to other settings (Jackson, 2015). The external validity of a study depends greatly on the degree to which study participants represent the population. Convenience sampling reduced the external validity of the present study, and generalizations of results from this study are limited (aligned with Jackson, 2015). Results from this study cannot be generalized to acute-care nurses who work in outpatient settings, critical care, primary care, public health departments, doctor's offices, or other nonhospital clinical milieus. Furthermore, results from this study cannot be generalized to registered acute-care nurses working in other locations in the United States, nurse assistants, or acute-care nurses who have CVD.

Threats to Construct Validity

Construct validity pertains to the degree to which an instrument measures the construct it is intended to measure (Houghton, Hunter, & Meskell, 2012). One threat to construct validity that was a concern in this study was the *inadequate explication of constructs*, which concerned the incorrect or inexact operationalization of study constructs. The measures used in this study have sound construct validity, minimizing the threat of inadequate explication of constructs. Another threat to construct validity is *monomethod bias*, which is the use of a single measure of a construct in a study (Houghton et al., 2012). This study was limited by this bias, and conclusions from results are legitimate only in relation to the specific operationalization of the variables of perceived risk for CVD and knowledge and acceptance of pharmacogenetic testing for CVD.

Ethical Considerations

Ethics should be the foundation of any research study, but are especially important in a study that involves the use of human subjects (Stangor, 2014; National Institutes of Health Approval No. 894379, see Appendix D). I followed the ethical procedures outlined by The Institutional Review Board of Walden University (approval number is **03-11-16-0172642 and it expires March 10, 2017.**), which had ultimate approval of this research project prior to data collection, to ensure participants were fully protected. Participants in this study had to review and agree to informed consent, acknowledge they understood their rights as human subjects in research studies, and confirm that any questions they had were answered. They were required to click "yes" to denote their agreement to statements that (a) they gave consent to participate in the study; (b) they understood their rights as human subjects in research; and (c) if they had any questions, these were answered to their satisfaction. "No" responses resulted in a termination of the survey, which participants could no longer access.

Other study procedures provided additional ethical assurances. Due to the blind recruitment and participation process, I had no knowledge as to who completed the study. The data were confidential and anonymous. I treated the study data and material in an ethical manner. I was the only person with access to the Survey Monkey survey link, survey site, and data. Once the study was completed, I deleted the Survey Monkey files from the Survey Monkey server. I kept data on a jump drive (not a computer hard drive), stored in a secured and locked file cabinet in my home office. Study paper documents and the jump drive will be destroyed after 3 years.

Summary

Describing acute-care nurses' CVD risk-factor awareness and knowledge of pharmacogenetic testing is quite crucial in developing interventions for CVD risk among acute-care nurses. Because acute-care nurses are at the forefront of health promotion and disease prevention, it is very important for them to observe healthy behaviors and to educate their patients to perceive the severity of CVD risk. I wanted to know if acute-care nurses' CVD awareness significantly impacted healthy behavior such as smoking cessation, healthy eating habits, regular physical activity, maintaining a healthy weight, and blood pressure and cholesterol screening habits. In Chapter 4, I discuss the study findings.

Chapter 4: Results

Researchers have documented a paradox between actual risk and perceived risk for CVD among nurses: nurses do not perceive themselves as being at risk for CVD despite often having numerous risk factors for this disease (Hörnsten et al., 2014; Jones et al., 2006). This lack of congruence may not only impair the health and work behaviors of nurses, but may also influence their cognitions and attitudes toward CVD-related practices, such as pharmacogenetic testing for CVD (Chan & Perry, 2012). The knowledge base among nurses of pharmacogenetic testing, as well as the acceptance of such testing, is furthermore limited as a result of the newness of such testing and the controversy that surrounds it such as the confidentiality of the test results (Johnson & Cavallari, 2013; Verschuren et al., 2011). Nurses' lack of perceived risk of CVD, lack of knowledge of pharmacogenetic testing for CVD, and limited acceptance of pharmacogenetic testing for CVD may influence their nursing practices, interactions with patients, and the types of information and knowledge they share with patients (Dodson, 2011, 2015; Moen & Lamba, 2012). Ultimately, patients' health and well-being is at stake (Moen & Lamba, 2012).

The purposes of this study were three-fold. The first purpose was to examine if nurses' highest level of education, years working as RNs, and gender significantly influenced their perceived degree of risk for CVD. The second purpose was to examine if these three factors significantly influenced their reported level of knowledge of pharmacogenetic testing for CVD. The third and final purpose of this study was to determine if nurses' perceived degree of risk for CVD significantly influenced their reported level of acceptance of pharmacogenetic testing for CVD.

The purpose of this chapter is to present and discuss the results of regression analyses (HMLR, MLR, and HLR) conducted for hypothesis testing. The chapter opens with a review of the data-collection procedures, including the time frame in which the data collection occurred and the representativeness of the study sample. This section provides substantial attention to response rates. The chapter continues with a presentation of the descriptive information of study-participant variables, including demographic and health factors. I then discuss the results of the study, beginning with a review of study variables including scale construction, descriptive statistics, missing data and outliers, and how these were addressed. The results section also includes the testing for covariates and the testing of assumptions for linear regression models. I devote the last sections of the chapter to hypothesis testing, with results from the linear regression models assessed in relation to the null hypotheses of the research questions. A summary concludes the chapter.

Data Collection

I distributed a total of 1,545 surveys to acute-care nurses in the state of Georgia through email from March 1, 2016 to April 30, 2016. Of 1,545 surveys sent, 344 (23.8%) nurses responded to the surveys. I then removed cases if participants (a) did not provide informed consent (n = 26, 7.6%), (b) did not meet study criteria (n = 46, 13.4%), or (c) did not answer any of the survey questions (n = 34, 9.9%). This resulted in a sample of N = 238 nurses who provided informed consent and met study criteria, 69.2% of those who clicked on the Survey Monkey survey link.

I reviewed the dataset for MNAR data and missing completely at random data. Eight cases had MNAR data. Of these eight, three (37.5%) did not provide answers to the

PKS (Bannur et al., 2014) and the PRHDS (Ammouri & Neuberger, 2008) and five did not answer the PRHDS or the questions regarding taking medication to control blood pressure. As the data were MNAR, I removed these cases from analyses, lowering the study sample size to 230, the final sample, 66.9% of those who clicked on the Survey Monkey survey link. The remaining missing data were missing completely at random, with a total of 14 missing data points across a total of 12 items (eight PRHDS items and four PKS items). I used mean imputation to replace missing data.

Descriptive Statistics: Participants

Two hundred and thirty nurses participated in this study. Table 1 presents demographic and work information from participants. Of these 230 participants, 37 (16.1%) were male and 193 (83.9%) were female. A chi-square (χ^2) goodness-of-fit test determined that this study sample had a significantly higher percentage of male nurses compared to the population of nurses, χ^2 (1) = 33.58, $p < .001$. Almost half of participants (n = 108, 47.0%) had bachelor's degrees, and almost a quarter of participants (n = 56, 24.3%) had bachelor's degrees plus additional training/certification. Of participants, 35 (15.2%) had associate's degrees, 13 (5.7%) had master's degrees, and 16 had master's degrees plus additional training/certification. Participants indicated a broad range of years worked as a RN, from less than 1 year to more than 30 years. The majority (n = 132, 57.4%) of participants worked as RNs between 1 and 10 years.

Table 1

Descriptive Statistics: Demographics of Study Participants (N = 230)

	Frequency	Percentage
Gender		
Male	37	16.1
Female	193	83.9
Highest level of education		
Associate's	37	16.1
Bachelor's	108	47.0
Bachelor's plus additional training/certification	56	24.2
Master's	13	5.7
Master's plus additional training/certification	16	7.0
Years worked as a registered nurse		
Less than 1 year	13	5.7
1–3 years	40	17.4
4–6 years	52	22.6
7–10 years	40	17.4
11–14 years	17	7.4
15–19 years	17	7.4
20–24 years	16	7.0
25–30 years	24	10.4
More than 30 years	11	4.7

Descriptive Statistics: Covariates

I asked participants if they had any disorders or diseases related to estrogen levels and if they took medication that is known to affect blood pressure. Descriptive information on these variables appears in Table 2. The majority of female participants (n = 168, 81.0%) reported no estrogen-related disorders, diseases, or events, and 48 (20.9%) female participants (100% female) reported one estrogen-related disorder, disease, or event. Of those 48 participants, seven (14.6%) reported having polycystic

ovarian syndrome, six (12.5%) reported infertility, and three (6.3%) reported having endometriosis. In addition, 22 (45.8%) participants reported the event of post menopause whereas 10 (20.8%) reported the event of having a hysterectomy. Of 100% female participants, 14 (6.1%) reported two estrogen-related disorders or diseases: specifically, hysterectomy and post menopause.

I asked participants if they took medication that could affect their blood pressure. The majority of participants (n = 168, 73.0%) reported not taking such medications and 40 (17.4%) reported taking one medication. Of those 40 participants, 11 (27.5%) reported taking nonsteroidal anti-inflammatories, seven (17.5%) reported taking estradiol/birth-control pills, six (15.0%) reported taking statins, four (10.0%) reported taking synthetic thyroid-replacement medication, three (7.5%) reported taking diuretics, three (7.5%) reported taking calcium channel-blocking agents, three (7.5%) reported taking synthetic estrogen-replacement medication, two (5.0%) reported using an asthma inhaler, and one (2.5%) reported taking proton-pump inhibitors. Almost three quarters of participants reported taking no medications that affect blood pressure.

Descriptive Statistics: Study Scales

This study had three primary scales: (a) the PRHDS (Ammouri & Neuberger, 2008), used in this study as an independent and dependent variable, assessed the degree to which one perceives oneself to be at risk for getting any type of CVD; (b) the PKS (Bannur et al., 2014), a dependent variable that measured the degree of knowledge about pharmacogenetic testing for CVD; and (c) the APS (Bannur et al., 2014), a dependent variable that measured the level of acceptance toward pharmacogenetic testing for CVD.

Table 2

Descriptive Statistics: Study Participants' Number of Estrogen-Related Diseases, Disorders, or Events, and Number of Medications Taken that Affect Blood Pressure

	Frequency	Percentage
Number of Estrogen-Related Diseases or Disorders (Female Only, n = 193)		
0	131	67.9
1	48	24.9
2	14	7.2
Number of Medications Taken That Affect Blood Pressure (All Participants, N = 230)		
0	168	73.0
1	40	17.4
2	15	6.6
3	5	2.2
4	1	0.4
5	1	0.4

Scale Development and Computations

The 20-item PRHDS measures the degree to which one perceives oneself at risk for any type of CVD. The PRHDS, on which 12 of the 20 items are reverse-scored, comprises three subscales. The 7-item Unknown Risk subscale comprises items that assess external locus of control aspects of risk for CVD; an example is "No matter what I do, if I am going to get heart disease, I will get it."

The computation of the PRHDS was initiated by recoding the 12 reverse-scored items to correspond to the scoring of the other 8 items. I then examined the scale inter-item reliability by computing the Cronbach's alpha for the total PRHDS scale. The Cronbach's alpha was an unacceptable .60 for the overall PRHDS. A review of Cronbach's alpha values if certain items were deleted from the scale showed that the

seven Unknown Risk items were the cause of the low Cronbach's alpha. When I removed these seven items, the Cronbach's alpha was a very acceptable .77. This study thus used a 13-item PRHDS, comprised of the two subscales of Dread Risk and Risk.

I scored the 5-item PKS, used to measure knowledge of pharmacogenetic testing for CVD, as though it was a test or examination, using a scale from 0% to 100%. Due to the true/false scoring of the PKS, I could not compute a Cronbach's alpha. The APS measured acceptance of pharmacogenetic testing for CVD. Outlier boxplots and unusual case-function testing revealed that the APS had two outliers, both of which were extremely low scores of 11. I winsorized these two scores, replacing them with the next lowest score, which was 15. Outlier boxplots and unusual case-function testing revealed no univariate outliers for the PRHDS and PKS. The computation of the Mahalanobis distances uncovered no multivariate outliers.

The descriptive statistics for these three scales appear in Table 3. Information included in Table 3 includes the $z_{skewness}$ value of the scale. This is an indicator of normality: $z_{skewness}$ values less than +/-1.96 indicate relative normality (Kim, 2013). I report Cronbach's alphas (αs) as indicators of inter-item reliability for the APS and PRHDS scales. A Cronbach's α greater than or equal .70 indicates acceptable inter-item reliability (Garson, 2012).

The mean score on the PRHDS was 26.30 (SD = 4.97), with PRHDS scores ranging from 13.00 to 40.00 points. The mean was relatively low, and the range of scores did not extend to the highest possible score of 52. These descriptive statistics suggested participants perceived they had a relatively low risk for developing CVD. PRHDS nonetheless had a normal distribution of scale scores, as indicated by a $z_{skewness}$ value

of -1.65. The Cronbach's α of the PRHDS was good, with a Cronbach's α of .77. The mean score on the PKS was 68%, equivalent to a D+, and scores on the PKS ranged from 0% to 100%. The $z_{skewness}$ value of -1.55 indicated that the PKS had relative normality. The mean score of the APS was 31.77 (*SD* = 5.13), and scores on the APS ranged from 15.00 to 45.00 points. The APS had an acceptable $z_{skewness}$ value of -1.77, indicating relative normality and the inter-item reliability of the APS was sound, with a Cronbach's α of .75.

Table 3

Descriptive Statistics: Attitude Toward Pharmacogenomics Scale, Pharmacogenomics Knowledge Scale, and Perceived Risk for Heart Disease Scale (N = 230)

	M	*SD*	*Min*	*Max*	$z_{skewness}$	Alpha
Perceived Risk for Heart Disease Scale (PRHDS)	26.30	4.97	13.00	40.00	-1.65	.77
Pharmacogenomics Knowledge Scale for CVD (PKS)	0.68	0.19	0.00	1.00	-1.55	N/A
Attitudes toward Pharmacogenomics for CVD Scale (APS)	31.77	5.13	15.00	45.00	-1.77	.75

Note. *M* = mean, *SD* = standard deviation, *Min* = minimum score, *Max* = maximum score. $z_{skewness}$ = skewness/standard error of skewness; and α = Cronbach's alpha; The possible range of scores on the PRHDS is 13.00–52.00 points. The possible range of scores on the PKS is 0%–100%. The possible range of scores on the APS is 9.00–45.00 points.

Testing of Covariates

I included the questions about estrogen-related diseases, disorders, and events, and the medications taken that could affect blood pressure in the study survey as potential covariates; that is, I thought they would significantly relate to the dependent variables of (a) perception of risk for heart disease, as measured by the PRHDS; (b) pharmacogenetic testing knowledge, as measured by the PKS, and (c) acceptance of pharmacogenetic

testing, as measured by the APS. I summed the total scores of the estrogen-related diseases, disorders, and event items and the medication that could affect blood pressure items, dichotomized so that 1 = presence of disease, disorder, or event or take at least one medication and 0 = absence of disease, disorder, or event and do not take any medication. I then conducted Spearman's rho, with results presented in Table 4.

As seen on Table 4, although the variable of having estrogen-related diseases, disorders, or events did not significantly associate with perceptions of risk for CVD, the variable of take medications that could affect blood pressure did significantly associate with this dependent variable, $r_s(230) = .14$, $p = .038$. I included take medication that could affect blood-pressure in the analyses to test Research Questions 1 through 3. Neither presence/absence of estrogen-related diseases, disorders, or events, or currently taking medication that could affect blood pressure significantly aligned with acceptance of pharmacogenetic testing or with knowledge of pharmacogenetic testing. Thus, I included neither item as a covariate in the analyses to test Research Questions 4 through 7.

I conducted one Pearson bivariate correlation between pharmacogenetic testing knowledge and acceptance of pharmacogenetic testing. The result from the Pearson bivariate correlation showed significance, $r\ (230) = .14$, $p = .043$, indicating that, as knowledge of pharmacogenetic testing increased, so did acceptance of such testing. I entered the variable of pharmacogenetic-testing knowledge as a covariate in the analyses to test Research Question 8.

Table 4

Spearman's Rho Correlations: Estrogen-Related Diseases, Disorders, or Events, and Currently Take Medications That Could Affect Blood Pressure and Attitude Toward Pharmacogenomics Scale and Pharmacogenomics Knowledge Scale (N = 230)

	Perception of Risk for Heart Disease Scale (PRHDS)	Attitudes toward Pharmacogenomics Scale for CVD (APS)	Pharmacogenomics Knowledge for CVD Scale (PKS)
Have estrogen-related disease, disorder, or event (Y/N)	.08	-.03	-.12
Take medications that could affect blood pressure (Y/N)	.14*	-.03	-.07

Note. CVD = cardiovascular disease; *$p < .05$

Testing of Assumptions for Linear Regression Models

HMLR, conducted to address Research Questions 1 through 3, MLR, conducted to address Research Questions 4 through 7, and HLR, conducted to address the eighth research question all had the same assumptions: (a) normality of continuously-coded independent and dependent variables; (b) lack of multicollinearity between independent variables; (c) independence of errors in linear regression/HLR results; and (d) homoscedasticity of errors in linear regression/HLR results (Garson, 2012). Normality was already addressed by computing z_{skewness} values, and the three study variables had $z_{skewness}$ under 1.96, signifying the normality assumption was met. The three remaining assumptions were tested, with results presented in the following sections.

Assumption of Lack of Multicollinearity

I assessed multicollinearity, or high correspondence between independent variables so they essentially are measuring the same construct (Garson, 2012; Kleinbaum et al., 2013), by computing Spearman's rho correlations and VIFs among the independent

variables of highest level of education, years of working as a RN, and gender. A Spearman's rho correlation of r_s >= .90, p < .001 and a VIF > 10.00 indicate multicollinearity (Garson, 2012; Kleinbaum et al., 2013).

I did not expect these demographic and work variables to display multicollinearity, and results from the Spearman's rho correlation analyses and the computing of VIFs supported this expectation. Gender significantly correlated with years worked as a RN, $r_s(230) = .20$, $p = .003$: being female significantly aligns with increased number of years worked as an RN. The correlation coefficient of $r_s = .20$ was well below the critical coefficient value of $r_s = .90$. All VIFs were considerably below the critical value of 10.00. Multicollinearity was not evident in these findings. The assumption of lack of multicollinearity was met (see Table 5).

Table 5

Testing for Multicollinearity: Spearman's Rho Correlation Coefficients and Variance Inflation Factors (N = 230)

	Highest level of education	Years as a registered nurse	Gender
Highest level of education	—	1.00	1.04
Years as registered nurse	.06	—	1.00
Gender	-.01	.20*	—

Note. *p < .05. Spearman's rho correlations are below the diagonal and variance inflation factors are above the diagonal.

Assumption of Independence of Errors

I tested the assumption of independence of errors, or the lack of autocorrelation among errors, by calculating Durbin-Watson values for each HMLR/MLR/HLR model. Durbin-Watson values between 1.00 and 3.00 indicated this assumption was met (Garson,

2012; Kleinbaum et al., 2013). The Durbin-Watson values for each model of the three regression analyses conducted appear in Table 6. As can be seen in Table 6, all Durbin-Watson values fell between 1.00 and 3.00, signifying that the assumption of independence of errors was met for all models in the regression analyses.

Table 6

Testing for Independence of Errors: Durbin–Watson Values for Each Regression Analysis for Hypothesis Testing (N = 230)

	HMLR for RQs 1–3	MLR for RQs 4–7	HLR for RQ 8
Durbin–Watson Value	1.86	2.04	1.94

Note. HMLR = hierarchical multiple linear regression; RQ = research question; MLR = multiple linear regression; HLR = hierarchical linear regression.

Assumption of Homoscedasticity of Errors

I tested the assumption of homoscedasticity of errors, or the constancy of errors in linear regression analyses, by plotting residuals using scatterplots. If the data points displays an equivalent distribution above and below the horizontal line at zero, this assumption has been met (Garson, 2012; Kleinbaum et al., 2013). I computed three scatterplots for each of the three linear regression analyses. As shown in Figures 3, 4, and 5, the distribution of error data points was equivalent above and below the horizontal zero for each scatterplot. The assumption of homoscedasticity of errors was met for each linear regression model.

Hypothesis Testing

This study posed seven research questions. As stated in Chapter 3, one MLR addressed Research Questions 1 through 3 as were Research Questions 4 through 6. An HLR addressed the seventh and last research question. This section of the chapter is

structured to present the results from the MLRs, followed by a presentation of results for each research question, with reference to whether the results supported the rejection or acceptance of the null hypothesis.

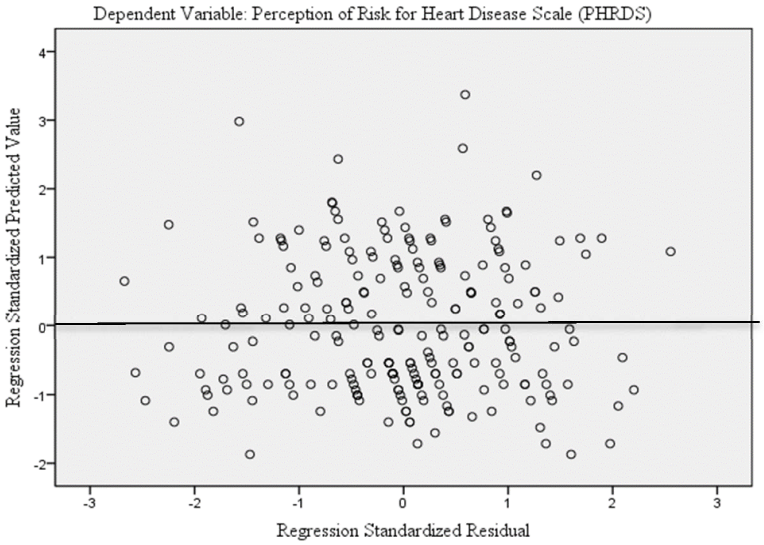

Figure 2. Scatterplot of residuals: Medication that could affect blood pressure, highest level of education, years worked as a registered nurse, and gender predicting perceived risk for CVD.

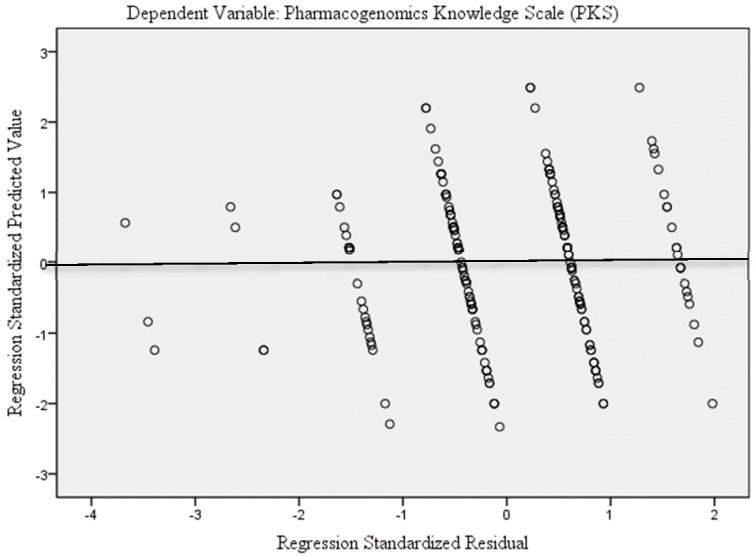

Figure 3. Scatterplot of residuals: Highest level of education, years worked as registered nurse, and gender predicting knowledge of pharmacogenetic testing.

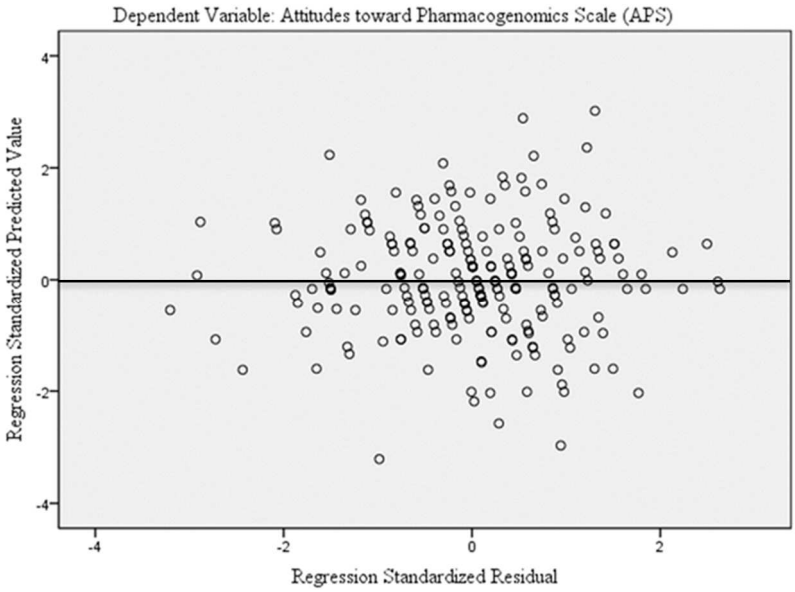

Figure 4. Scatterplot of residuals: Knowledge of pharmacogenetic testing and perceived risk for CVD predicting acceptance of pharmacogenetic testing.

Hierarchical Multiple Linear Regression 1: Research Questions 1–3

The first through third research questions examined if highest level of education, years worked as a RN and gender were significant predictors of perceived risk for CVD. I entered take medication that could affect blood pressure as a covariate in the first model of the HMLR, as it significantly correlated with perception of risk for CVD. I entered all three independent variables as predictors of perception of risk for CVD on the second model of the HMLR.

Results from the HMLR appear in Table 7. The first model of the HMLR, with take medication that could affect blood pressure entered as a predictor of perceived risk for CVD, was significant, $F(1, 228) = 3.80$, $p = .046$, $R^2 = .016$. Based on the coding of the predictor variable, this finding indicated that taking medication that could affect blood pressure significantly aligned with higher perceived risk for CVD, $\beta(230) = .140$,

p = .046. The second model, in which the independent variables of highest level of education, years worked as a RN, and gender predicted perceived risk for CVD, was significant, F_{change} (3, 225) = 2.85, p = .038, R^2_{change} = .036. However, only gender emerged as a significant predictor of perceived risk for CVD, β (230) = -.163, p = .015. Based on the coding of the gender variable, this significant result indicated that being male significantly aligned with increased perceived risk for CVD.[1] The covariate of take medication that could affect blood pressure was no longer a significant predictor of perception of risk for CVD, β (230) =.122, p = .066 in the second model of the HMLR.

Table 7

Hierarchical Multiple Linear Regression (HMLR): Take Medication That Could Affect Blood Pressure (Covariate), Highest Level of Education, Years Worked as a Registered Nurse, and Gender Predicting Perceived Risk for Cardiovascular Disease (N = 230)

	Model 1			Model 2		
	B	*SE B*	β	*B*	*SE B*	β
Medication	1.42	.749	.140*	1.35	.731	.122
Level of education				-.445	.310	-.094
Years worked as an RN				.178	.147	.082
Gender				-2.20	.895	-.163*
R^2	.016			.036		
F for R^2	3.80			2.85		
p	.046			.038		

Note. RN = registered nurse; *p < =.05

Research Question 1. The first research question was, "Is there a significant association between nurses' years of education and perceived risk for CVD?" Results

[1] An independent samples t-test confirmed this finding. Male nurses had a significantly higher mean scores on the PRHDS (n = 37, M = 27.86, SD = 4.63) than did female nurses (n = 193, M = 26.00, SD = 4.99), t(228) = 2.11, p = .036

from the HMLR showed no significant associations between nurses' years of education and perceived risk for CVD, β (230) = -.094, p = .153. Based on the nonsignificant findings, I retained the null hypothesis, "There is no association between nurses' years of education and perceived risk for CVD."

Research Question 2. The second research question was, "Is there a significant association between nurses' years of practice and perceived risk for CVD?" Results from the MLR showed that nurses' years of practice was not significantly associated with perceived risk for CVD, β (230) = .082, p = .226. Due to the lack of significant findings, I retained the null hypothesis, "There is no association between nurses' years of practice and perceived risk for CVD."

Research Question 3. The third research question was, "Is there a significant association between nurses' gender and perceived risk for CVD?" Results from the MLR showed that gender did significantly align with perceived risk for CVD, β (230) = -.163, p = .015. Based on the coding of the gender variable, this significant result indicated that being male significantly aligned with increased perceived risk for CVD. The significant findings led to the rejection of the null hypothesis, "There is no association between nurses' gender and perceived risk for CVD."

Multiple Linear Regression 2: Research Questions 4–6

The fourth through sixth research questions examined if highest level of education, years worked as a RN and gender were significant predictors of knowledge of pharmacogenetic testing for CVD. As no demographic variables significantly correlated with the dependent variable of knowledge of pharmacogenetic testing for CVD, only one model was required for the regression analysis. The collective entry of the three

independent variables in one model as predictors of knowledge of pharmacogenetic testing for CVD required the use of an MLR.

Results from the MLR appear in Table 8. The overall regression model was not significant, F (3, 226) = 1.94, p = .095, R^2 =.024. When examining individual predictors, however, one variable, highest level of education, did significantly align with knowledge of pharmacogenetic testing for CVD, β (230) = .164, p = .042. As education level increased, so did knowledge of pharmacogenetic testing for CVD.

Table 8

Multiple Linear Regression: Highest Level of Education, Years Worked as a Registered Nurse, and Gender Predicting Knowledge of Pharmacogenetic Testing for Cardiovascular Disease (N = 230)

		Model 1		
		B	*SE B*	*B*
Level of education		.043	.022	.164*
Years worked as an RN		-.009	.006	-.103
Gender		.024	.035	.046
R^2	.024			
F for R^2	1.94			
p	.095			

Note. RN = registered nurse; *p < =.05

Research Question 4. The fourth research question was, "Is there a significant association between nurses' years of education and knowledge of pharmacogenetic testing for CVD?" Results from the MLR showed significant associations between nurses' years of education and knowledge of pharmacogenetic testing for CVD, β (230) = .164, p = .042. As years of education increased, so did knowledge of pharmacogenetic testing

for CVD. The significant findings led to the rejection of the null hypothesis, "There is no association between nurses' years of education and knowledge of pharmacogenetic testing for CVD."

Research Question 5. The fifth research question was, "Is there a significant association between nurses' years of practice and knowledge of pharmacogenetic testing for CVD?" Results from the MLR showed that nurses' years of practice did not significantly align with knowledge of pharmacogenetic testing for CVD, β (230) = -.103, p = .126. Due to the lack of significant findings, I retained the null hypothesis, "There is no association between nurses' years of practice and knowledge of pharmacogenetic testing for CVD."

Research Question 6. The sixth research question was, "Is there a significant association between nurses' gender and knowledge of pharmacogenetic testing for CVD?" Results from the MLR showed that gender did not significantly align with perceived risk for CVD, β (230) = .046, p = .495. As I found no significant results, the null hypothesis, I retained "There is no association between nurses' gender and knowledge of pharmacogenetic testing for CVD."

Hierarchical Linear Regression: Research Question 7

The seventh and last research question examined whether a significant association existed between nurses' perceived risk for CVD and their acceptance of pharmacogenetic testing for CVD. As knowledge of pharmacogenetic testing for CVD significantly aligned with acceptance of pharmacogenetic testing for CVD, I entered it as a covariate in the first model of the HLR. I entered the single predictor of perceived risk for CVD on the

second model of the HLR as a predictor of acceptance of pharmacogenetic testing for CVD.

Results from the HLR appear in Table 9. The first regression model, with knowledge of pharmacogenetic testing for CVD predicting acceptance of pharmacogenetic testing for CVD, was significant, $F(1, 228) = 3.86$, $p = .048$, $R^2 = .017$. As knowledge of pharmacogenetic testing for CVD increased, so did acceptance of pharmacogenetic testing, β (230) = .134, $p = .048$. The second model of the HLR, with perceived risk of CVD entered as a predictor of acceptance of pharmacogenetic testing, was not significant, $F(1, 227) = 2.78$, $p = .097$, $R^2 = .012$. Knowledge of pharmacogenetic testing nonetheless remained a significant predictor of acceptance of pharmacogenetic testing, β (230) = .129, $p = .049$, in the second regression model. Based on the lack of significance between perceived risk for CVD and acceptance of pharmacogenetic testing, I retained the null hypothesis for Research Question 7.

Summary

I conducted this quantitative study, which used a correlational research design, with 230 RNs working in acute-care settings in hospitals throughout the State of Georgia. The sample of 230 nurse participants was 66.9% of the original group of 344 nurses who accessed the Survey Monkey link. A substantial number of nurses ($n = 26$) did not provide consent and an additional 34 nurses did not complete the study survey even after having provided consent and meeting study criteria. The sample of 230 was nonetheless robust to achieve power at .80. An equal number ($n = 168$) of nurses reported never having had estrogen-related diseases, disorders, or events and not currently taking any medication that could affect their blood pressure.

Table 9

Hierarchical Linear Regression: Knowledge of Pharmacogenetic Testing for Cardiovascular Disease (Covariate) and Perceived Risk for Cardiovascular Disease Predicting Acceptance of Pharmacogenetic Testing for Cardiovascular Disease (N = 230)

	Model 1			Model 2		
	B	*SE B*	*B*	*B*	*SE B*	*B*
Knowledge of pharmacogenetic testing for CVD	3.47	1.75	.134*	3.45	1.85	.129*
Perceived risk for CVD				-.113	.068	-.109
R^2	.017			.012		
F for R^2	3.86			2.78		
p	.048			.097		

Note. CVD = cardiovascular disease; *p < =.05.

The descriptive statistics on the study variables provided additional insights into the sample of nurses in this study. The mean score on the PRHDS scale was relatively low, indicating that, as a group, these nurses did not perceive themselves to be at risk for CVD. The score on the APS indicated that participants had neither high nor low levels of acceptance of pharmacogenetic testing for CVD. The participants had low levels of knowledge of pharmacogenetic testing for CVD, based on the mean PKS test score of 68%.

I conducted three types of linear regression models (HMLR, MLR, and HLR) for hypothesis testing, and a few findings were found to be significant. Male gender significantly aligned with increased perceived risk for CVD; that is, male nurses reported higher levels of perceived risk for CVD than did female nurses. Highest level of education emerged as significantly associated with increased knowledge of

pharmacogenetic testing: as education level increased, so did knowledge of pharmacogenetic testing. Other findings that emerged as significant included significant associations between taking medications that could affect blood pressure with increased perceived risk for CVD and knowledge and acceptance of pharmacogenetic testing for CVD. I discuss these findings in greater detail, especially in relation to previous research, in Chapter 5.

Chapter 5: Introduction

The U.S. healthcare system has become a patient-centered medical community that is quickly adopting pharmacogenetic testing practices for CVD (ANA, 2015; Heller et al., 2014). The knowledge base of nurses has grown beyond basic CVD concepts, and nurses increasingly need to have knowledge of pharmacogenetic testing for CVD to best advocate for such testing and translate the meaning of such testing to their patients (ANA, 2015). However, empirical evidence suggests that nurses have limited understanding of pharmacogenetic testing (Bannur et al., 2014; Roederer et al., 2012). This lack of knowledge coupled with nurses' perceptions of being at low risk for CVD, despite having numerous CVD risk factors, may lead to resistance in advocating for the use of pharmacogenetic testing for CVD, which can ultimately impair patient health.

This quantitative study, which had a response rate of 14.9%, was conducted with 230 predominantly (83.9%) female RNs working in acute-care medical settings in the state of Georgia. The study was guided by Rosenstock's (1978) HBM. In the first set of research questions, I examined, through HMLR, if the modifying factors of nurse gender, highest level of education, and years of experience significantly predicted nurses' perceived risk for CVD, controlling for taking medication that could affect blood pressure. Only one independent variable, gender, was significant: men more than women perceived themselves to be at increased risk for CVD. The covariate of taking medication that could affect blood pressure also significantly predicted perceived risk for CVD. The second set of research questions examined, through MLR, if these same modifying factors significantly predicted nurses' knowledge of pharmacogenetic testing for CVD. Highest level of education was the only significant predictor of knowledge of

pharmacogenetic testing for CVD; as education level increased, so did knowledge. The last research question, which I addressed through the use of an HLR, inquired as to whether perceived risk for CVD significantly aligned with acceptance of pharmacogenetic testing for CVD, controlling for knowledge of pharmacogenetic testing for CVD. Perceived risk for CVD was not a significant predictor of acceptance of pharmacogenetic testing for CVD (the covariate of knowledge of pharmacogenetic testing for CVD was significant).

Interpretation of the Findings

I had empirical and theoretical goals that I attempted to achieve with this quantitative study. My primary empirical goal was to enhance understanding of nurses' perceived risk for CVD and if certain demographic modifying factors significantly contributed to these perceptions. Researchers documented that nurses have numerous health, mental health, and health-related behaviors and demographic risk factors for CVD (ANA, 2015; Baer et al., 2011; Fair et al., 2009; Louie & Wedell, 2014; Khan et al., 2012) and yet, as a group, nurses do not perceive themselves to be at risk for developing CVD (Jones et al., 2006). An additional goal was to address gaps in the nursing literature concerning nurses' knowledge and attitudes toward pharmacogenetic testing. Rosenstock's (1974) HBM provided a theoretical framework from which to examine these constructs and relationships. This section of the chapter is devoted to an examination of the study findings. I discuss the results in relation to prior empirical work conducted on pertinent study constructs as well as the applicability of Rosenstock's (1974) HBM.

Interpretation of Findings: Comparisons to Prior Research Findings

The first goal of this study was to determine if the demographic modifying factors of gender, highest level of education, and years worked as an RN significantly predicted increased levels of perceived risk for CVD. Evidence from this study showed that male gender did significantly align with increased perceived risk for CVD among nurses (as was the covariate of taking medication for blood pressure). Although no studies have examined these associations with samples of healthcare providers, an extensive body of research has examined actual and perceived risk for CVD among diverse *patient* groups (Imes & Lewis, 2014). In their review of the literature on the contribution of demographic and health factors on patients' perceived risk for CVD, Imes and Lewis (2014) reported equivocal findings across studies with regard to patient gender. The researchers posited that the inconsistencies in gender differences and perceived risk for CVD were a result of the diversity of study-participant samples, noting that gender results were likely obscured by other modifiable (e.g., education level, history of tobacco use, obesity/ overweight, cholesterolemia, diagnosis of Type 2 diabetes) and unmodifiable (e.g., age, ethnicity, genetic predisposition) risk factors for CVD.

This study further examined nurses' knowledge of pharmacogenetic testing and the influence of gender, education level, and years of experience on such knowledge. Results from this study showed that education level but not gender or years worked as a RN was significant predictors of knowledge of pharmacogenetic testing for CVD. Social science studies that examined healthcare practitioners' perceptions of pharmacogenetic testing have tended to focus on physicians and pharmacists (Yáu, Husain, & Haque, 2015), even while acknowledging that the successful implementation of pharmacogenetic

testing is the nurse's attitudes toward it (Chadwell, 2013). To this end, researchers know little of the personal characteristics of nurses that significantly align with knowledge of pharmacogenetic testing for CVD. Researchers showed that few differences exist in the profession, as a substantial majority, 66% to 84% of physicians, pharmacists, and nurses, reported having low levels of pharmacogenetic testing knowledge (Dodson, 2011; Dodson & Van Riper, 2011). Roederer et al. (2012) examined pharmacogenetic testing knowledge and attitudes among pharmacists. Results from the Roederer et al. study showed that, similar to the results in this study, pharmacists with higher levels of education (i.e., doctorates) had higher levels of pharmacogenetic testing knowledge than did pharmacists with lower levels of education.

An interesting finding in the Roederer et al. (2012) study was that pharmacists who matriculated within the prior 5 years and thus had fewer years of experience, had higher level of pharmacogenetic testing knowledge than did pharmacists who matriculated over 5 years prior and thus had more years of experience. Moreover, pharmacists who had matriculated more than 30 years prior had the lowest pharmacogenetic-testing-knowledge scores (Roederer et al., 2012). Although the results were not significant in this study with regard to years of experience, they did show a negative relationship between nurses' years of experience and pharmacogenetic-testing knowledge, suggesting that a similar finding might arise among nurses. The Roederer et al. findings suggested that exposure to pharmacogenetic testing is more a function of the contemporary healthcare educational system and less a function of on-the-job exposure to pharmacogenetic testing.

The final research question of this study examined whether nurses' perceived risk for CVD led to significant increases in acceptance of pharmacogenetic testing for CVD. Results were not significant. Empirical work on acceptance of pharmacogenetic testing has predominantly focused on the acceptance of pharmacogenetic testing among patients. The literature on patient factors has documented consistent linkages between the specific patient demographic factors of young-adult status (i.e., ages 18–34 years), Caucasian ethnicity, and higher levels of education, and increased levels of acceptance of pharmacogenetic testing for CVD (Chan & Perry, 2012; Haga, O'Daniel, Tindall, Lipkus et al., 2012; Haga, O'Daniel, Tindall, Mills et al., 2012). In contrast, highest level of education was not a significant predictor of acceptance of pharmacogenetic testing for CVD among nurses in this study. I could locate no studies that examined the relationship between perceived risk for CVD and acceptance of pharmacogenetic testing for CVD in patients or healthcare providers.

Results from this study also provided descriptive information on current topics highly relevant to the nursing field. The mean score on the Bannur et al. (2014) PKS in this study was 68%. The percentage of participants who failed the PKS, 14%, was higher than the percentage of study participants who received a score of 100%: 9.6%. These findings suggested a poor understanding of pharmacogenetic testing among nurses in this study. Kadafour et al. (2009) and Van Riper et al. (2011) found similar results, documenting mean pharmacogenetic-testing-knowledge test scores of 40% and 60.3%, respectively, among nurses.

Another finding was that nurses perceived themselves to be at low risk for CVD. Substantial evidence exists from a robust body of empirical literature that nurses have

numerous modifiable and unmodifiable risk factors for CVD (ANA, 2015; Baer et al., 2011; Chan & Perry, 2012; DPE, 2012; Fair et al., 2009; Khan et al., 2012; Lang et al., 2012; Li et al., 2006; Louie & Wedell, 2014; McElligott et al., 2009; Nahm et al., 2012; Puett et al., 2009; Slater et al., 2005). However, the strong empirical focus on actual CVD risk factors in nurses has not, surprisingly, prompted empirical work on nurses' perceived risk for CVD. The only work to date that has focused on nurses' perceptions of their risk for developing CVD has been the qualitative study by Jones et al. (2006), who documented perceived low risk of CVD in a sample of African American nurses, despite this group having numerous risk factors for CVD. The results from the Jones et al. study align with results from this study.

Interpretation of Findings: Comparisons to Health-Belief Model Framework

This study tested various pathways delineated among health-factor variables proposed by Rosenstock (1974) in the HBM. The first three research questions tested theoretical relationships between the *modifying* factors of gender, highest level of education, and years of practice and the *perception of susceptibility* factor of perceived risk for CVD. The only modifying factor found to be significant was gender, with male nurses perceiving themselves to be at greater risk for CVD than female nurses. The fourth through sixth research questions tested if the *modifying* factors of gender, highest level of education, and years of practice significantly predicted the *perceived benefits versus barriers* factor of knowledge of pharmacogenetic testing for CVD. Highest level of education emerged as the only significant predictor of increased knowledge for pharmacogenetic testing for CVD. The seventh and last research question examined the relationship between the *perception of susceptibility* factor of perceived risk for CVD and

the *likelihood of action behavior* of acceptance of pharmacogenetic testing for CVD. Results indicated that nurses' perceptions of their CVD risk did not significantly affect their acceptance of pharmacogenetic testing for CVD.

The overall study findings did not provide support for the HBM in the context of nurses' perceptions of their risk for CVD, their knowledge of pharmacogenetic testing for CVD, or their acceptance of pharmacogenetic testing for CVD. One assumption of the HBM is that individuals have the capacity to change their health-related behaviors for health promotion and disease prevention (Rosenstock, 1974; Rosenstock et al., 1988, 1994). In this study, this idea was taken a step further: I posited that nurses' perceptions of their own risk for CVD would lead to an increased acceptance of pharmacogenetic testing for CVD, which would likely influence their own health behaviors as well as the health behaviors of their patients. Although not a focus of this study, I found that nurses' knowledge of pharmacogenetic testing, considered to be a theoretical *perception of benefits versus barrier*s *of health behavior* factor, did influence their *likelihood of action* to accept pharmacogenetic testing for CVD. Results from this study suggest that the personal health of nurses is not nearly as important as their knowledge of pharmacogenetic testing for CVD in influencing their acceptance of such practices.

Limitations of the Study

Objectivity is of the utmost importance in empirical research, and a certain degree of objectivity is not only necessary but required to reach sound study conclusions (Stangor, 2014). However, research conducted with human subjects, especially research using nonexperimental methods, often has methodological, design, and data limitations that can reduce study objectivity and quality (Stangor, 2014). Although the link to the

study survey was sent to 1,545 nurses, only 344 nurses responded to the survey. Moreover, I removed 114 of the 344 cases from the data set due to some participants not providing informed consent, others not meeting study criteria, and still others not completing the survey. Although the sample of 230 nurses was large enough to achieve the desired power, it was a concern that the response rate was only 14.9%. A large nonresponse bias may increase the likelihood of self-selection bias in that participants who responded to the survey may have differed in some ways from those who did not. For example, participants who completed the study survey may have had fewer risk factors for CVD and thus perceived themselves to be at less risk for CVD, or they may have had more knowledge of pharmacogenetic testing for CVD. Both nonresponse and self-selection bias make it difficult to generalize study findings to the population of RNs working in acute-care settings in Georgia.

The large nonresponse rate may have resulted from another limitation of using a convenience sample of nurses. Convenience sampling increased the likelihood that participants in this study were not a representative sample of the population of RNs working in acute-care settings in Atlanta, Georgia, which limited the generalizability of study findings and the external validity of this study (Stangor, 2014). Another limitation of this study was the use of a quantitative cross-sectional research design, which precluded the ability to infer cause and effect (as suggested by Stangor, 2014).

Although researcher objectivity is a desired goal, researchers are human and are not necessarily neutral or value free (Stangor, 2014). In parallel, a possibility exists that participants differ in their understanding and interpretation of survey questions, which may have influenced study data (aligned with Stangor, 2014). The low pharmacogenetic-

testing-knowledge score and its alignment with results from prior studies suggests that study participants were being truthful about their knowledge. They may have been less truthful about their perceptions of CVD risk. The instrument measuring nurses' perceptions of risk for CVD displayed poor inter-item reliability, necessitating that I use a shortened version of the instrument.

Recommendations

I hope this study acts as a catalyst to promote additional empirical work as it pertains to nurses' CVD health and their knowledge and acceptance of pharmacogenetic testing for CVD as well as the applicability of Rosenstock's (1974) HBM to these topics and relationships. This study adds to the small body of literature (e.g., Jones, 2006) that has documented that, despite having numerous risk factors for CVD, nurses do not perceive themselves to be at risk for CVD. Additional empirical work is needed to further validate these results, as are studies that compare nurses' actual versus perceived risk for CVD. Results from this study combined with those found in the Roederer et al. (2012) study suggest that recent matriculation may play more of a role than does length of experience in influencing nurses' knowledge of pharmacogenetic testing for CVD. Studies are needed that examine the linkages between nursing school curricula, required nursing courses, and exposure to and training in pharmacogenetic-testing procedures and nurses' knowledge and acceptance of pharmacogenetic testing for CVD. In parallel, studies that assess improvements in nurses' knowledge and acceptance of pharmacogenetic testing for CVD as a result of their participation in professional-development opportunities on pharmacogenetic testing for CVD are needed.

This study operationally defined HBM theoretical constructs and examined theoretical pathways in very specific ways. Results from this study did not lend strong support for the HBM. It may be that this study examined two research topics—perceived risk for CVD among nurses versus nurses' knowledge and acceptance of pharmacogenetic testing for CVD—that shared little theoretical overlap. However, both topics have been recognized as having empirical relevance. A need persists for studies that use the HBM theoretical pathway to provide a more cohesive and comprehensive picture of factors that influence and are influenced by nurses' health factors as they pertain to CVD compared to those that concern nurses' knowledge and acceptance of pharmacogenetic testing for CVD.

Implications for Social Change

The positive social change that can result from this study's findings include a direct impact on nursing knowledge and training through the development of targeted educational materials for acute-care nurses (and ultimately, patients) about CVD risk factors and pharmacogenetic testing, on patient health outcomes, and on the empowerment of acute-care nurses to act as patient advocates. Developing a better understanding of demographic and CVD risk factors among acute-care nurses will allow for specific intervention and targeted educational programs in nursing schools and training programs in healthcare organizations. Moreover, results from this study may facilitate future research on how acute-care nurses' perceptions of CVD risk factors and pharmacogenetic testing influence their patient-care practices and patient advocacy, including increasing patient awareness and knowledge of CVD risk factors and the benefits of pharmacogenetic testing.

Conclusion

This quantitative study investigated if acute-care nurses' gender, highest level of education, and years of nursing practice significantly influenced their perceived risk for CVD and their knowledge of pharmacogenetic testing for CVD, and whether significant associations exist between nurses' risk for CVD and acceptance of pharmacogenetic testing for CVD. The data analysis revealed some significant association between the independent and dependent variables in the seven research questions. Male gender significantly aligned with increased perceived risk for CVD more than female nurses. Highest level of education significantly aligned with increased knowledge of pharmacogenetic testing: as education level increased, so did knowledge of pharmacogenetic testing. Significant associations emerged between taking medications that could affect blood pressure with increased perceived risk for CVD and knowledge.

The field of pharmacogenetic testing has existed for over 60 years; however, the empirical body of CVD pharmacogenetic testing literature is only a decade old (Tonk, Gurwitz, Maitland-van der Zee, & Janssens, 2016). Pharmacogenetic-testing empirical literature is still in its infancy. Studies in clinical biochemistry, behavioral genetics, pharmaceutical chemistry, and molecular biology are continuing to greatly eclipse the body of social science literature, especially studies on healthcare practitioners' knowledge, use, and attitudes toward pharmacogenetic testing. A dearth of literature persists on the CVD health of nurses as well as their knowledge and acceptance of pharmacogenetic testing for CVD. The crucial role that nurses' play in their patients' achievement of their heart health necessitates that further research be conducted on these topics.

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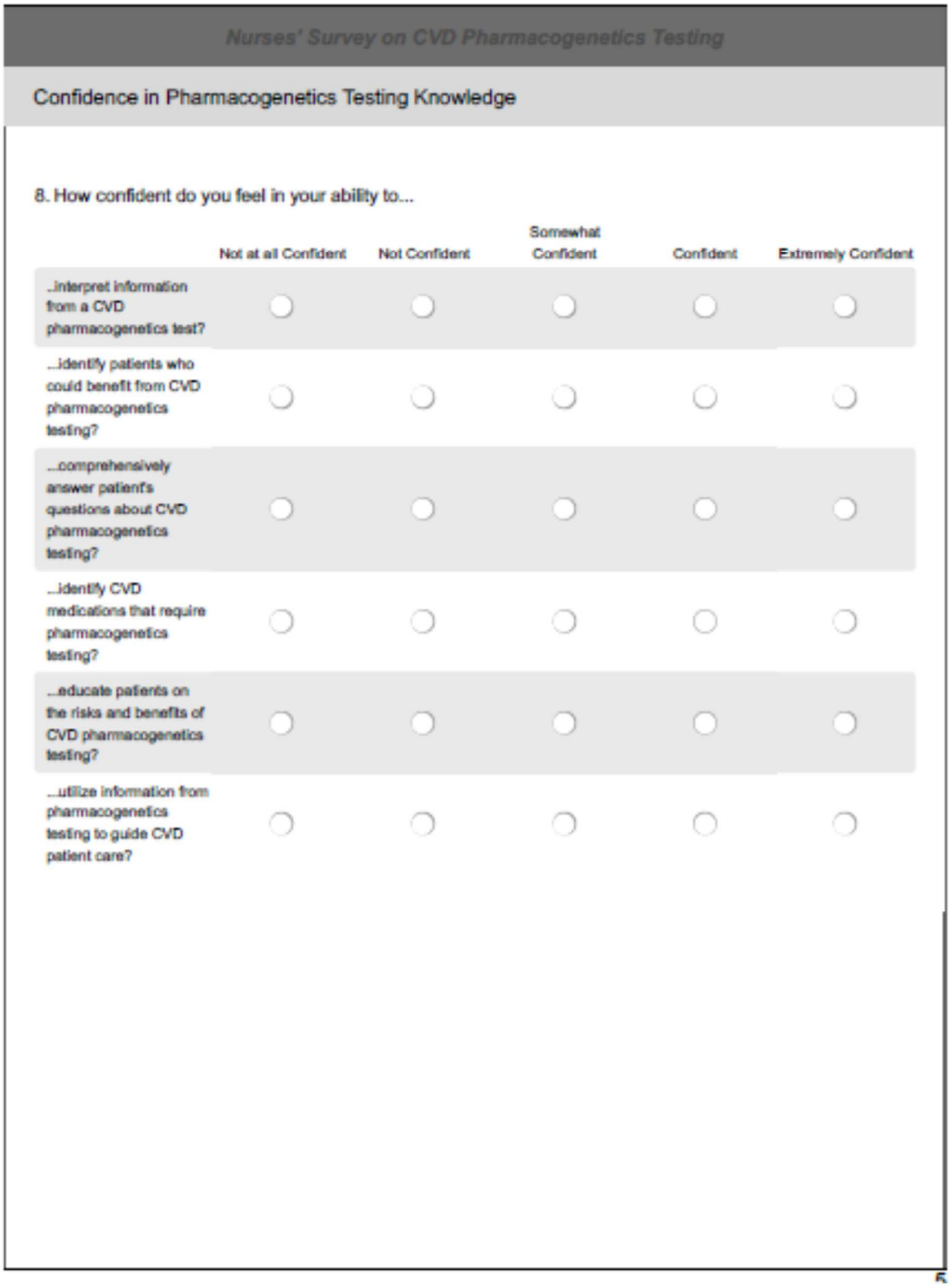
Appendix A: Study Survey



Nurses' Survey on CVD Pharmacogenetics Testing

Confidence in Pharmacogenetics Testing Knowledge

8. How confident do you feel in your ability to...

	Not at all Confident	Not Confident	Somewhat Confident	Confident	Extremely Confident
...interpret information from a CVD pharmacogenetics test?	○	○	○	○	○
...identify patients who could benefit from CVD pharmacogenetics testing?	○	○	○	○	○
...comprehensively answer patient's questions about CVD pharmacogenetics testing?	○	○	○	○	○
...identify CVD medications that require pharmacogenetics testing?	○	○	○	○	○
...educate patients on the risks and benefits of CVD pharmacogenetics testing?	○	○	○	○	○
...utilize information from pharmacogenetics testing to guide CVD patient care?	○	○	○	○	○

Nurses' Survey on CVD Pharmacogenetics Testing

Confidence in Pharmacogenetics Testing Knowledge

8. How confident do you feel in your ability to...

	Not at all Confident	Not Confident	Somewhat Confident	Confident	Extremely Confident
..interpret information from a CVD pharmacogenetics test?	○	○	○	○	○
...identify patients who could benefit from CVD pharmacogenetics testing?	○	○	○	○	○
...comprehensively answer patient's questions about CVD pharmacogenetics testing?	○	○	○	○	○
...identify CVD medications that require pharmacogenetics testing?	○	○	○	○	○
...educate patients on the risks and benefits of CVD pharmacogenetics testing?	○	○	○	○	○
...utilize information from pharmacogenetics testing to guide CVD patient care?	○	○	○	○	○

Nurses' Survey on CVD Pharmacogenetics Testing

Risk for CVD

14. Please think about your own risk for CVD and then answer the following questions.

	Strongly Disagree	Disagree	Agree	Strongly Agree
There is a possibility that I currently have heart disease.	○	○	○	○
People who don't get heart disease are just plain lucky.	○	○	○	○
My lifestyle habits do not put me at risk for heart disease.	○	○	○	○
There is a good chance I will get heart disease during the next 10 years.	○	○	○	○
I feel sure that I will get heart disease.	○	○	○	○
The causes of heart disease are unknown.	○	○	○	○
I am very healthy so my body can fight off heart disease.	○	○	○	○
People like me do not get heart disease.	○	○	○	○
I am not worried that I might get heart disease.	○	○	○	○
It is likely that I will get heart disease in my lifetime.	○	○	○	○
I am risk of getting heart disease.	○	○	○	○
Healthy lifestyle habits are unattainable for me.	○	○	○	○
People my age do not get heart disease.	○	○	○	○
It is possible that I will eventually be diagnosed with heart disease.	○	○	○	○

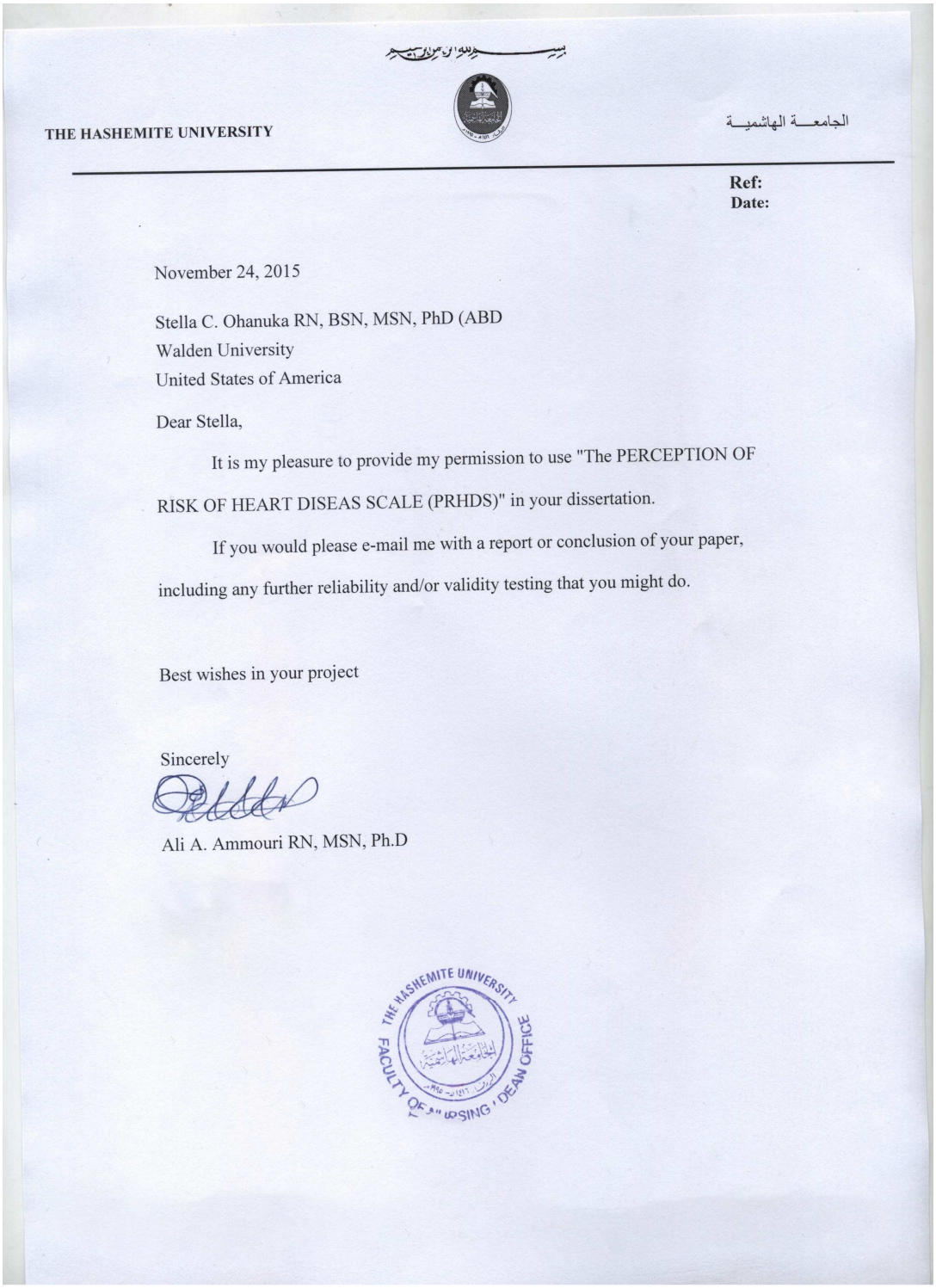
17. Do you currently take any of the following medications?

	No	Yes
Estrogen Replacement Therapy	○	○
Estradiol/Birth Control Pills	○	○
Prednisone	○	○
Diuretics	○	○
Non-Steroidal Anti-Inflammatories	○	○
Beta Blockers	○	○
Statins	○	○
Calcium Channel Blocking Agents	○	○
Proton Pump Inhibitors	○	○
Asthma Inhaler/Medication	○	○
Thyroid Replacement Therapy	○	○

18. What is the highest level of education you have completed?

- ○ Associate's Degree
- ○ Bachelor's Degree
- ○ Bachelor's Degree plus Additional Training/Certification
- ○ Master's Degree
- ○ Master's Degree plus Additional Training/Certification
- ○ Doctoral Degree

Appendix B: Permission to use the Perception of Risk of Heart Disease Scale



بسم الله الرحمن الرحيم

THE HASHEMITE UNIVERSITY

الجامعة الهاشمية

Ref:
Date:

November 24, 2015

Stella C. Ohanuka RN, BSN, MSN, PhD (ABD
Walden University
United States of America

Dear Stella,

It is my pleasure to provide my permission to use "The PERCEPTION OF RISK OF HEART DISEAS SCALE (PRHDS)" in your dissertation.

If you would please e-mail me with a report or conclusion of your paper, including any further reliability and/or validity testing that you might do.

Best wishes in your project

Sincerely

Ali A. Ammouri RN, MSN, Ph.D

THE HASHEMITE UNIVERSITY
FACULTY OF NURSING - DEAN OFFICE

Appendix C: Permission to use the Pharmacogenomics Knowledge Scale

Stella Ohanuka
to LAY

Hello Dr. Kek,

My name is Stella Ohanuka, I emailed you before concerning a permission to use your instrument for my dissertation. I am really sorry to boarder you but this is very important to me. If I fail to get your permission to use your instrument, I might not continue with my study until i find another instrument. Your instrument is a perfect fit for my study. In case if you decide to permit me to use it. can you please make the permit official and provide the validity of the instrument. Please help me to accomplish my goal.

Thanks for your understanding

Stella Ohanuka

LAY XEK TEH ! 1/20115 to me

Dear Stella,
Sorry for the delay in getting back. I have no problem in granting you the use of the instrument. All the best for your study.

TEH LAY KEK, RPh, MClinPharm, PhD

Stsua onanuxa to LAY

Hello Dr.Kek,
Thanks so much for granting me the permission to use The Attitudes, knowledge, and adoption of pharmacogenomics by healthcare professionals scale. I sincerely appreciate you for doing that. Please can you make the permission official and send the validity of the instrument including the actual questionnaire or any pertinent information about the instrument.
Thank you so much for being so kind and understanding

Stella Ohanuka

Appendix D: National Institutes of Health Certificate of Completion

Certificate of Completion

The National Institutes of Health (NIH) Office of Extramural Research certifies that **stella ohanuka** successfully completed the NIH Web-based training course "Protecting Human Research Participants".

Date of completion: 03/25/2012.

Certification Number: 894379.