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Trends in Hospital Admissions for Myocardial Infarcts for Women in Arizona, Florida and Maryland in 2000 to 2010

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TRENDS IN HOSPITAL ADMISSIONS FOR MYOCARDIAL INFARCTS FOR WOMEN IN ARIZONA, FLORIDA AND MARYLAND IN 2000 TO 2010

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A doctoral project submitted to the faculty of the Medical University of South Carolina in partial fulfillment of the requirements for the degree Doctor of Health Administration In the College of Health Professions

Approved by:

Chair, Project Committee	Kit N. Simpson, DrPH	Date 8-2-2012
Member, Project Committee	Andrea W. White, PhD	Date August 2, 2012
Member, Project Committee	Christina Björklund, PhD	Date 8/24/2012
Dean, College of Health Professions	Lisa S. Saladin, PT, PhD	Date 8/6/2012

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Dedication

I would like to dedicate the doctoral project in honor of my mother and in memory of my father for their lifelong commitment to their family and incessantly revealing to me the value of an education.

This project is also dedicated to my family, Will, Andrew and Dylan for their love, strength and inspiration throughout the doctorate program for without them it would have been unobtainable.

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Abstract of Doctoral Project Report Presented to the
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In partial fulfillment of the requirements for the degree
Doctor of Health Administration

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Abstract

Coronary arterial disease is the leading cause of death and morbidity in developing countries. Acute myocardial infarction (AMI) has traditionally been considered a disease affecting mostly men, yet women are increasingly at risk due to obesity and diabetes. However, current trends in the AMI risk for women are not well understood. This study used archival data on hospital discharges from three states within the USA to examine the 10-year trend in presentations of patients to emergency rooms (ER) with a presenting diagnosis of chest pain and AMI, to document rate changes by gender over time. We observed a decreasing number of AMIs over time, but an increasing proportion of MI admissions being female, and an especially high rate observed for minority women. Women with an AMI also have a higher rate of comorbid obesity and/or diabetes than observed in men. In addition, women are more likely to have comorbid signs or diagnoses with symptoms that could mimic AMI symptoms, and thus

confuse the rapid diagnosis of an AMI. National guidelines stress the importance of a timely diagnosis of patients presenting with an AMI. To assure equity in access to quality care for AMI patients, both medical professionals and the public may need education focused on the increasing rate of AMI within the female population.

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ABSTRACT

Coronary arterial disease is the leading cause of death and morbidity in developing countries. Acute myocardial infarction (AMI) has traditionally been considered a disease affecting mostly men, yet women are increasingly at risk due to obesity and diabetes. However, current trends in the AMI risk for women are not well understood. This study used archival data on hospital discharges from three states within the USA to examine the 10-year trend in presentations of patients to emergency rooms (ER) with a presenting diagnosis of chest pain and AMI, to document rate changes by gender over time. We observed a decreasing number of AMIs over time, but an increasing proportion of MI admissions being female, and an especially high rate observed for minority women. Women with an AMI also have a higher rate of comorbid obesity and/or diabetes than observed in men. In addition, women are more likely to have comorbid signs or diagnoses with symptoms that could mimic AMI symptoms, and thus confuse the rapid diagnosis of an AMI. National guidelines stress the importance of a timely diagnosis of patients presenting with an AMI. To assure equity in access to quality care for AMI patients, both medical professionals and the public may need education focused on the increasing rate of AMI within the female population.

Problem Statement

In order to reduce the mortality and morbidity rate associated coronary artery disease within the population and predominantly for females the focal point should converge on how to improve the knowledge and interpretation of the signs and symptoms of females' presenting with a myocardial infarction, as well as those with increase risk factors of AMI. There are increase disparities among females at risk for AMI due to comorbidities and secondary risk factors which proceed to be undiagnosed and treated based on the obscure cardiac signs and symptoms of females. The AMI incident rate of females, and more so in minority females, will continue to escalate and outcomes worsen due to the unsuccessful public health awareness available representing the female high risk population.

Currently, the incidents of secondary risk factors associated with AMI are more prevalent in females than males. Females at a higher MI risk often have one or more comorbidities, such as diabetes or obesity, which will likely increase their morbidity and mortality. Physicians often incorrectly diagnose females presenting to the ER with an AMI due to the obscure signs and symptoms mimicking other diseases or conditions. Females improperly diagnosed will lack necessary treatment and lifesaving intervention merely to exacerbate the existing condition along with the possibility death. Technology and treatment are readily available to diagnose and aid the MI patients, however due to health disparities among females they are less likely to be diagnosed and treated as males with AMI.

Without an effective education program for health professionals and an improvement in public health awareness, heart disease will continue to be the leading

cause of death, particularly for females. Subsequently, if females do not recognize their personal signs and symptoms of an AMI they will not likely seek appropriate treatment as well as presence to the ER seeking treatment. The extent of time from the onset of the symptoms to the time of treatment is critical for enhanced positive outcomes. The awareness needs to be directed towards eliminating the disparities within the female population and heart disease. In acknowledging and recognizing the differences of AMI between the genders the healthcare professionals will be further competent towards accurately diagnosing and treating males and females in a consistent approach as a result of correctly diagnosing and providing timely intervention.

Glossary of Terms

Acute Myocardial infarction (AMI) - Often called heart attack when the blood flow supply to part of the heart muscle is reduced or stopped.

Acute Coronary Syndrome (ACS) - refers to any group of symptoms attributed to obstruction of the coronary arteries.

Angiogram-is a test utilizing special dye and camera to take pictures of blood flow in an artery. It can also be used as an intervention to open blocked blood vessels.

Angioplasty-procedure used to treat patients with a partial or completely occluded artery using a balloon-tip catheter which is inflated to compress the blockage and widens the artery for increase blood flow to the heart muscle.

Body Mass Index-body mass index (BMI), which is a person's weight (in kilograms) divided by the square of his or her height (in meters). A person with a BMI of 30 or more is generally considered obese. A person with a BMI equal to or more than 25 is considered overweight.

Electrocardiogram (ECG/EKG)-A recorded tracing of the electrical activity of the heart.

Catheterization Lab-A department in a medical facility that specializes in cardiac Catheterization.

Comorbid - presence of one or more diseases in addition to a primary disease that Exist

Door-to-Balloon Time-the amount of time the patient presents to the hospital to the time the patient receives an angioplasty or PCI.

Door-to-Needle Time-amount of time between the patient's arrivals to the hospital to the time the patient receives thrombolytic.

Emergency Medical Service (EMS)-A system of health care professionals providing services to persons in need of emergency care before arrival to hospital.

Fibrinolytic Therapy-use of pharmaceuticals to break up blood clots inside an artery or cavity of the heart to restore blood flow.

Gastroesophageal Reflux Disease GERD- and is also called Acid Reflux or Heartburn. It occurs when gastric acids in the stomach go up into the esophagus.

Micro vascular Angina-pain or discomfort in the chest due to inadequate blood flow in the very small cardiac blood vessels.

Monounsaturated fats-a type of fat found in mostly canola, olive, peanut, and other nut oils.

Mortality-total number of deaths from a given disease in a population during a given time.

Myocardial Infarction-damage or death of an area of the heart muscle due to an occluded vessel.

Myocarditis-inflammation of the heart muscle.

Myocardium-the muscular wall of the heart.

Non-ST Elevation Myocardial Infarction (NSTEMI)-A type of heart attack caused by a partially occluded blood supply to a portion of the heart.

Percutaneous Coronary Intervention (PCI)-medical procedures which mechanically treats patients with partial or completely occluded vessels.

Presenting Diagnosis-Subjective assessment of chief problem upon admission.

Primary Diagnosis-The condition requiring the most resources for treatment.

Principal Diagnosis- condition established after medical findings responsible for the patient admission to the hospital for care.

Reperfusion Therapy-One or more techniques used to restore blood to the heart.

Revascularization-procedure used to relieve severe chest pain in patients unable to undergo bypass surgery or angioplasty.

Secondary Prevention- a means to treat patients at a high risk for cardiovascular disease to assist in preventing or rehabilitating potential cardiac patients.

ST-Elevation Myocardial Infarction (STEMI)-a severe heart attack caused by a prolong decrease of blood flow to the heart muscle and may cause death or disability.

Stent-a wire mesh tube that is inserted into an artery to open or unblock in order for blood supply to increase to the heart muscle.

INTRODUCTION

Coronary arterial disease is the leading cause of death and morbidity in developing countries. Over 17 million people died from heart disease globally in 2008, and many of the cardiac victims who survive have permanent disabilities, and their quality of life is often greatly diminished. Heart disease (HD) is expected to remain the number one killer in the United States over the next decade, and the rate may increase because many associated risk factors for HD are becoming more common, and many more individuals are surviving to old age.

It has been the case for many years that heart disease afflicts predominantly males. Men and women presenting to the ED with symptoms suggestive of acute cardiac ischemia, the prevalence of AMI is approximately twofold higher in men than in women after controlling for presenting characteristics. However, the risk for women has been changing over the last decade due to the aging population as well as the growing percentage among women with acute myocardial infarction (AMI) associated risk factors, such as diabetes and obesity. However, the increasing trends in the AMI for women are not well understood in the general population, nor are they commonly recognized by emergency room clinicians who are the first contacts for women with AMI symptoms. The quality of care problems related to lack of recognition of the increasing AMI risk for women may be exacerbated by the fact that AMI may show substantially different symptoms in women that those which are commonly accepted for men. Thus it is

important to understand and document any increasing AMI risk for women who present to emergency rooms. A delay in a diagnosis of AMI increases a woman's risk of death, as well as the potential for her having substantial sequellae from the AMI.

This study used archival data on hospital discharges from three states to examine the 10-year trend in presentations of patients to emergency rooms (ER) with a presenting diagnosis of chest pain and MI, to document rate changes by gender over time. The research questions examined here are:

1) Have hospital admissions for MI in women increased over the last ten years, compared to the number of admissions for men?

   Hypothesis: Women constitute an increasing proportion of AMI admissions over time, controlling for age and racial risk factors. Women constitute an increasing proportion of AMI admissions over time, controlling for age and racial risk factors.

2) Are women more likely than men to have comorbid conditions of diabetes and obesity?

   Hypothesis: Women with an AMI have a greater prevalence of risk factors, such as obesity and diabetes than the rate observed for men.

3) Are women admitted to a hospital with an AMI in 2010 more likely than men to have a comorbid diagnosis of chest pain, muscle strain, heart burn, gastric reflux disease or vague complaints that could obscure a diagnosis of AMI than men?

   Hypothesis: A higher proportion of women than men with an AMI have a comorbid diagnosis or a complaint that could obscure AMI signs and

symptoms.

This study improves our understanding of the magnitude of the potential problem in timely diagnosis of AMI for women. While epidemiological reports on rates of AMIs for men and women are routinely published by the Centers for Disease Control (CDC), these do not examine the magnitude of the problem of delay in AMI diagnosis that females may face. A better understanding of this phenomenon is needed before guidelines can be developed on the use of recent laboratory tests routinely for women who present to the ER with symptoms related to an AMI which do not correspond to normal patterns observed in the male population.

Expectations for Heart Disease in Future Years

The rate of heart disease incidents is not expected to diminish in the near future. It is estimated that by 2030 the population of those 65 and older will triple compared to 1980. The increase in the aging population is a result of the "baby boomer" generation. These are people who were born between 1946 and 1964 (Nawrot, Perez, Kunzli, Munters, & Nemery, 2011; Roger, 2010).

Not only will the number of baby boomers triple in the next few decades, but six out of 10 will have two or more chronic illnesses. The American Heart Association indicates that over 65 percent will have a body mass index greater than 25 and over 30 percent will have a body mass index of more than 30, which is classified as obese.

Both men and women in the baby boomer generation face an increased risk of having a heart attack because of declining health. And due to ongoing research and development, as well as sophisticated medical technology and the growing number of health-care communities, the population's overall life expectancy has increased. This will result in more patients with multiple risk factors.

Baby boomers differ from previous generations in the number of females who have entered the work force. The lifestyles of women today are much different compared to previous generations, as more pursue careers in an effort to maintain a certain lifestyle and help support their family. There is evidence that suggests that an increase in work-

related stress among women may be a factor in the increased percentage of females having AMIs (Amsterdam & Robinson, 2008; Barchielli et al., 2010; Bhakta, Mookadam, & Wilansky, 2011).

Addressing outdated perceptions

Despite this trend, there is still the perception that heart disease does not affect women. Many women and health care professionals do not identify heart disease as a major health concern for women, and many women go undiagnosed and under-treated for heart disease. Moreover, many lack the knowledge to identify the onset of heart disease in women, as there is a general lack of knowledge in the gender-specific differences based on risk factors.

As baby boomers age, the ratio of females having cardiac episodes compared to males has expanded. One in two women in the United States will die of heart disease or stroke. Health issues such as obesity, addiction, depression, diabetes and smoking—all of which are triggers for MIs—are affecting females more so than males. But MI in women is often difficult to diagnose due to the nature of their presenting signs and symptoms (Poon et al., 2012; K. Schenck-Gustafsson, 2009; Shaw et al., 2006).

In years past, many patients went undiagnosed, especially females, due to the dissimilar signs and symptoms of MI. Furthermore, heart attacks were considered to predominately affect the male population. The delayed diagnosis and treatment of MI in females may have increased the morbidity and mortality rate in females.

As technology has improved, and tests are more accurate and readily available, health care professionals have more tools at their disposal, and are able to provide better

diagnosis and administer more appropriate and timely treatment compared to past decades. This is perhaps one reason why there's been an increase in the number of females diagnosed with heart disease. On the other hand, it may also be due to the increased baby boomer population and the rise of secondary risk factors associated with each person (Backus et al., 2010; Brannstrom, Hamberg, Molander, Lovheim, & Gustafson, 2011; Collins, 2011).

As the population continues to age and more people require medical care, the overall health care system is in jeopardy. This will put a financial strain on a system that is already struggling in today's turbulent economic environment. Over the next several decades hospitals will likely struggle to accommodate and adequately handle the increased number of emergency room visits. Constraints among hospital personnel and facilities may also impede the health care system's ability to correctly diagnose patients presenting with signs and symptoms of an AMI. Timely and accurate results will be critical for quality outcomes.

The situation presented is the increase in people acquiring medical care is not anticipated to decrease in the near future. Technological medical advances have assisted in the overall populations' longevity which will most likely constitute individuals having one or more risk factors associated with heart disease. The major problem is the disparities within the female population related to the onset of myocardial infarction and the correct diagnosis in the early stages. Females are at a greater risk of having two or more comorbidities as compared to males. Females are more prevalent for the disease of diabetes and they are often considered obese. Often females go untreated when presenting to the emergency department because of the variation in signs and symptoms unlike in the

male population. The delay in appropriate intervention causes undue increases in mortality in females.

Etiology of an MI

Myocardial infarction (MI), better known as heart attack, is the leading cause of death in the United States and in developing countries. It occurs when the flow of oxygenated blood to the heart is obstructed. If this blockage, or occlusion, is not corrected and the flow of oxygenated blood restored, the heart muscles begin to die.

Coronary heart disease (CHD) and coronary artery disease (CAD) are the leading causes of MI. CHD is caused by the build-up of plaque in the arteries, a condition known as atherosclerosis. When and if the plaque starts to break apart a blood clot is formed, and as the clot enlarges there is a risk of a partial or complete blockage of the coronary artery. The blockage will decrease or halt blood flow and cause the heart muscle to die. The blockage can cause chest pain and discomfort, which are categorized as unstable angina (UA), non-ST elevation myocardial infarction (NSTEMI), or ST elevation myocardial infarction (STEMI) (Radke, P.W. 2011).

Myocardial infarction may also present itself as UA, in which there is no noted occlusion and the biomarkers are negative. NSTEMI is indicative of a partial occlusion and biomarkers are elevated. The STEMI is considered more acute and is due to a complete blockage of the coronary artery. A patient suffering acute myocardial infarction (AMI) STEMI requires immediate intervention procedures in order to survive (Chong, Shen, Tan, & Poh, 2011).

Patients with ischemia may or may not reveal STEMI on the electrocardiogram

(ECG). ST-elevations are noted mostly during ongoing transmural myocardial injury. As described by Maziar Zafari, MD, if the ST-elevation goes untreated and reperfusion therapy is not performed in a timely manner, the STEMI develops Q waves, which is indicative of a dead zone within the myocardium and is considered irreversible. When the incident goes untreated or under-treated it increases the likelihood of long-term complications as well as other comorbidities (Canto et al., 2011; Heller, Babitsch, Gunster, & Mockel, 2008; Maziar, 2011).

Zafari states the main cause of ACS cases is atherosclerosis, which accounted for 90 percent of the MIs due to acute thrombus and the occlusion of the coronary artery. This occurs predominantly near or at the branching points of the vessels. Literature from the National Institute of Health (NIH), World Health Organization (WHO), and the American Heart Society (AHS) all indicate the MI risk factors include age, sex, family history, tobacco use, diabetes mellitus, hypertension, hypercholesterolemia, hypertriglyceridemia, dyslipidemia, obesity, sedentary lifestyle, lack of exercise, psychosocial stress, poor oral hygiene, and type A personality. These risk factors are considered to be non-modifiable and modifiable, however the odds of surviving a heart attack has doubled since 1979 (Pullon, R.2011; Bot, Pouwer, Zuidersma, van Melle, & de Jonge, 2012; Chong et al., 2011; Das et al., 2011).

Gender Differences in Heart Disease

Heart disease is the world's leading cause of death. According to the WHO, 17

million people will die from a MI incident. Each year approximately 1 million Americans experience a MI. The Centers for Disease Control and Prevention estimate over 400,000 die annually of coronary heart disease in an emergency department or en route to the hospital. These patients account for 60 percent of the cardiac-related deaths that occur in the United States annually, of which 250,000 are women (Tonstad, Sandvik, Larsen, & Thelle, 2007).

Both healthcare professionals and lay people believe more women die from cancer-related illnesses than cardiac-related diseases, but women are in fact five times more likely to die from heart disease than cancer (Bhakta et al., 2011).

Heart disease must be documented and communicated. While both men and women are at risk if they exhibit factors associated with heart disease, women may be more likely to suffer an AMI if they have two or more risk factors than men. There should be an overall desire in the inquiry for improved methods in assessing and detecting AMI in the female population (Amsterdam & Robinson, 2008).

One of the main disparities between men and women as it relates to coronary heart disease is that women go under-diagnosed and untreated, whereas men, historically, will more likely be accurately diagnosed with a MI based on the traditional signs and symptoms. These include pressure, burning, squeezing in the center of the chest, discomfort in the arms, shoulders, neck, jaw, stomach and back, shortness of breath, fatigue, cold sweats, nausea, and weakness.

Women often have different symptoms, such as pain in the upper back, jaw, or neck, shortness of breath, flu-like symptoms, nausea, vomiting, cold sweats, fatigue and general weakness, anxiety, loss of appetite, and overall discomfort (Rudnicka, Rumley,

Whincup, Lowe, & Strachan, 2011).

A Berlin study looking at the mortality rate of patients with AMI between 1999 and 2005 indicated that the overall mortality among women was 18.6 percent compared to 8.4 percent in men. The study, which focused on patients in 25 Berlin hospitals, also indicated that this disparity exists despite the fact that there have been technological advances in the early diagnoses of AMI, along with public health initiatives and campaigns aimed at both genders.

The study concluded the median age among women was 72 compared to 62 in men. It also noted that women took longer to receive healthcare once they arrived at the hospital, even though they presented to the ED and exhibited more risk factors than the men. Furthermore, the study indicated the women received less aggressive treatment than their counterparts (Backus et al., 2010; Blomkalns et al., 2005). Rollini and Duenas discussed similar findings in another study that revealed a lack of knowledge of the signs and symptoms of AMI as well as the delay of women presenting to the emergency department. Rollini also suggested women are more acute than men upon arrival, and it's often too late for successful intervention. The prolonged delay from when women first show signs and symptoms to when they present in the ED increases the likelihood that irreversible, extensive damage to the cardiac muscle could occur (Duenas, Ramirez, Arana, & Failde, 2011; Rollini, Mfeukeu, & Modena, 2009).

There are several factors at work as to why there's an increased rate of MI in women and a postponement of diagnosis and treatment. Women are usually 10 years older than men when presenting with the first onset of cardiac disease or MI. During their childbearing years women are unlikely to present with a MI and CHD and many believe

there is an element, known as estrogen, which may protect women from coronary events. However, the risk of a coronary event increases drastically among women within menopausal and post-menopausal age ranges (Gloria-Bottini et al., 2009). The incident of MI in women between the ages of 30 to 34 is 2 per million, and for women 40-44, the rate increases to 20 per million (Chakhtoura, Canonico, Gompel, Scarabin, & Plu-Bureau, 2011).

The use of oral contraceptives increases the risk of a MI. Also, if the subject smokes, the incident rate increases after 35 years of age. There are older studies that indicate there was a reverse or decrease in the number of cardiac incidents from 1960 to 1984, which was believed to have been a result of the first use of oral contraceptives, which included progesterone.

Additional research was performed to include an "intended use" claim for oral contraceptives, and the prevention of heart disease in women who were administered the hormone. However, the studies seeking to prove the decline of cardiac incidents were observational, and resulted in questionable findings in lab animals. The Food and Drug Administration halted the study and progesterone oral contraceptives received the "black box" warning, indicating they were not to be used for any purpose other than the original intended claim (Chakhtoura et al., 2011).

Hormone replacement therapy is controversial as the negatives sometimes outweigh the benefits, and some literature suggests the therapy in and of itself is a primary indication or independent factor of CHD. Due to the potential negative effects and associated risk factors, hormone therapy should only be administered when there is no other option (Idris et al., 2011).

Pregnancy is another unique risk factor associated with heart disease in women. Women who have complicated pregnancies due to preeclampsia and gestational hypertension are two to three times more likely to suffer from heart disease. In addition, women with gestational diabetes are seven times more likely to develop type II diabetes, which relates directly to heart disease. This may be due to the fact that women on average live longer than men, and the complications associated with a complicated pregnancy may be independent of age and other comorbidities (Skilton et al., 2011; Wenger, 2011).

Epidemiology of Heart Disease

Risk factors leading to heart disease and AMI among both men and women can be non-modifiable and modifiable, based on behavior. Many of the risk factors may be out of the control of the individual, such as family genetics, age and race. However, race has not been proven to be independent of other risk factors (Backus et al., 2010).

Factors considered to increase the risk of a cardiac incident that can be modified by the individual include smoking, obesity, depression, alcohol and illegal drug intake, exercise, hypertension, diabetes, healthy diet, and high cholesterol levels.

The European Prospective Investigation into Cancer and Nutrition (EPIC) in Heidelberg is one of the largest cohort studies about what kind of impact diet and lifestyle have on chronic diseases. Subjects for the study, which included men from 40 to 64 and women from 35 to 64, were recruited over a four-year period. The subjects were provided a questionnaire about receiving a diagnosis of MI or stroke, along with other questions about education levels and occupation. The study determined that male and female subjects with lower levels of education and job status suffered more MIs and

strokes compared to subjects with higher education levels and more professional occupations (Braig et al., 2011).

Epidemiological studies have also observed in subjects a connection between social economic and social demographic factors and obesity rates. Obesity is a major public health concern. Overall, 68 percent of the United State's population is considered overweight or obese. A prominent tool used to measure obesity is the body mass index (BMI) plus the Waist Circumference (WC) and the Waist to Hip Ratio (WHR) are other methods to define obesity as well as determine cardiovascular risk within many ethnic groups. However, a study performed by Akil and Ahmad and the relation of obesity and CVD in four southern states showed a low association when obesity was calculated on the WHR. The ability to obtain the BMI is more easily achieved than the WC or WHR and is considered a reliable indicator. Subjects with a BMI greater than 25 are considered overweight, while a BMI of 32 or more is considered obese. Data were obtained from the Centers for Disease Control and Prevention's (CDC) Behavioral Risk Factor Surveillance System (BRFSS) (Lockyer, L.,2005).

Obesity is becoming increasingly prevalent within the U.S. population, and social demographic factors play a big role in this trend among both adults and adolescents (Braig et al., 2011; Akil,L. 2011; Ahmed,W.A. 2011; Grace,S.L. 2005; Jonas,B.S. 1997;Gafarov,V.V. 2011).

A National Longitudinal Study revealed that adolescents who lived in households where the parents didn't have a high school education were more likely to be overweight or obese .Obesity rates also differ greatly between males and females in different ethnic groups. For instance, among the black population with a low education level, 45.4

percent of the women were obese, compared to 16.7 percent of the men. At higher education levels among blacks, 28 percent of the men were obese, compared to 31 percent of the women (Braig et al., 2011; Brannstrom et al., 2011).

Within the white population, there was little overall difference in the obesity rates between men and women with the same levels of education. It's estimated that between 60 to 80 percent of blacks, Hispanic, and whites are overweight, and 30 percent are obese. The continued increase in the obesity rate is expected to result in an increased number of vascular and heart disease cases, as well as escalating healthcare costs (Iakovlev, Golofeevskii, & Sotnikov, 2010;Abstracts of the fourteenth congress of chest pain centers.2011; Chong et al., 2011).

Obesity is a major risk factor for fatal heart attacks, and has been associated with other risk factors such as diabetes and hypertension. However, a study conducted in Scotland indicated obesity could be an independent factor as well. Inflammation has been a serious factor in fatal MIs and it is now believed obesity is an inflammation condition (Jennifer Logue, 2011).

One of the major impacts of heart disease among both overweight and obese individuals is diabetes mellitus II (DM2). Diabetes mellitus is a chronic disease with many complications if not treated appropriately. The complications include hypertension, hyperglycemia, coagulation abnormalities and endothelial dysfunction. While diabetes does not discriminate, the disease is three to five times more prevalent among women. The disparity in the incidents of heart disease among men and women of the same age is linked to endogenous sex hormones such as estrogen and progesterone, which influence the vasculature (Vaccarino et al., 2011)).

Among premenopausal women with diabetes, the post-mortem reveals the coronary arteries resemble a postmenopausal female without diabetes. There is a direct relation to endogenous sex hormones and diabetes. Women with diabetes in their childbearing years are more at risk of heart disease and less protected compared to women of the same age without diabetes (Meyer, Clegg, Prossnitz, & Barton, 2011).

The intervention and treatment of patients presenting to the emergency room is of utmost importance, particularly among women presenting with multiple risk factors such as diabetes and hypertension. The patient, especially the STEMI patient, can be treated with primary percutaneous coronary intervention, triple-anti-platelet therapy, and thrombus aspiration. When treated properly, the short ischemic time was associated with better myocardial reperfusion and decreased mortality, whereas if STEMI diabetic patients are treated more than five hours after onset, the mortality rate increases (Fokkema et al., 2011).

The need to understand the signs and symptoms, determine a diagnosis, and administer aggressive treatment is very important in both men and women. One study indicated that even if females are diagnosed correctly, they are often less aggressively treated. The higher morbidity and mortality rate among women can be explained to some extent by the fact that diabetic women are receiving aggressive risk-factor modifications, which are decrease in aspirin usage, less frequent screening and treatment for dyslipidemia, as well as treatment for hypertension. This is mainly due to the biological variation in cholesterol levels, HDL, coagulation and platelet in associating with the micro- and macro-vascular complications of dysfunction and imbalance and the mean blood pressure differences (Brannstrom et al., 2011; Jensen et al., 2011).

Concerns over the early and late onset of diabetes mellitus and the overall effect in the outcomes of heart disease illustrate some interesting findings. A study was performed on subjects with early onset and late onset of diabetes. Both types of subjects exhibited a greater risk for heart disease; however, the ones with the late onset were at greater risk (Nurmohamed & Kitas, 2011)).

Emphasis has been placed on the risk factors that heighten the potential for diabetes and increase mortality in men and women. However, women with diabetes are at least three times more likely to die from a MI both during the earlier and later years of life (Knopp, 1997;Wannamethee, Shaper, Whincup, Lennon, & Sattar, 2011).

There are nine risk factors that are of particular concern when it comes to MIs and the mortality rate of patients with heart disease. One is the psychosocial factor, such as depression. Depression is a medical illness that causes a persistent feeling of sadness and a loss of interest. Depression does not only affect the mental being but the physical being as well. Both men and women with depression often go untreated due to the stigma associated with the disease, and in some cases a lack of motivation to seek treatment is in itself a symptom of the disease (Schenck-Gustafsson,K, Anderson,A., 2010;Canto et al., 2011).

The correlation between cardiovascular disease and psychosocial conditions has been under investigation for years, and it has been determined there is a direct relationship between the two. Proietti and Strik both indicated adverse emotional stress, personality traits, chronic stress, and social behaviors trigger both depression and anxiety. These psychosocial factors can induce myocardial episodes mainly due to the effect of stressors on the sympathetic nervous system and hypothalamus neuroendocrine axis. This

is indicative of the heart and brain traveling along the same path and the effect of one over the other (Laskey et al., 2010; Proietti, R., Mapellli, D., Volpe, B., 2011; Strik et al., 2000)).

The strength of the brain and mind is linked to the interconnectedness between depression and MIs. Severe depression if not medically treated can increase the patient's risk of a cardiac event if the depression initiates the onset of cardiac arrhythmias. Abnormalities in heart rate, increase levels of inflammatory markers, platelet activation and plasma norepinephrine are all indicators of the potential risk associated with a cardiac episode (William Whang, MD, Laura D. Kubzansky, PhD, Ichiro Kawachi, MD, PhD, Sathryn Rexrode, MD, 2009).

During the onset of a cardiac event, many patients don't realize they've exhibited psychosocial behaviors, which may be due to an unchanging social and economical status within their lives. Often depression has become ever presence in the person and their ability to recognize critical cardiac symptoms are diminished. Depression can be a chronic condition and can manifest itself in both man and women; however women appear to have a higher incident which can obscure a cardiac event due to mimicking symptoms of both diseases. (Bot et al., 2012).

Post MI depression can develop during the first 18 months following the incident, and occurs in 15 to 30 percent of the cardiac patients both men and women. These patients should be assessed after the incident and before leaving the hospital for any signs or symptoms of depression. If the patient does not exhibit any symptoms of depression, they should be made aware of what to look for and encouraged to do a weekly self-assessment. The importance of reviewing the clinical profile of a patient, especially with

women, may be a preventive measure to ensure improved one-year outcomes. If the subject goes undiagnosed or untreated, there is an increase in morbidity and mortality (Strik J., Honig A., Maes, M., 2001).

There are three phases that can assist in providing the appropriate treatment for women who are at risk of suffering depressive episodes. The first is the diagnostic phase, during which the healthcare professional should ask the patient questions about previous and present stress factors as well as stress symptoms. The healthcare professional should use this information to make a diagnosis. A useful resource for this phase is the Beck Depression Inventory, which provides scores as to the severity of the depression (Francois Lesperance, Nancy Frasure-Smith, Mario Talajic, & Martial Bourassa, 2002).

The second phase is educational, and it's designed to increase a patient's awareness and understanding of how stress, anxiety and other psychological factors are related to cardiac health (Lesperance,F. 2002; Laskey,Warren 2010).

The third phase is intervention and secondary prevention. This phase is intended to initiate and support improvements in the patient's lifestyle and psychosocial environment at home and work (Heart Failure Executive Committee et al., 2008; Schiele et al., 2011;Francois Lesperance et al., 2002))

One study out of Spain reviewed the number of MIs in relation to seasonal variations, but was not able to consistency correlate the variables to support the theory as to the relationship of seasonal changes and deaths due to ischemic heart disease (Dominguez-Rodriguez & Abreu-Gonzalez, 2010).

Many patients undergoing a cardiac event often obtain rehabilitation services to improve psychological health, restore self-confidence, lighten anxiety levels, and to

increase the likelihood of participation in normal daily living. When the psychosocial behaviors are modified and treated, the mortality rate is more likely to decrease. However, the female population is less likely to obtain the necessary services, such as cardiac rehab, and is more likely to drop out if they do seek services. This is due to the increased number of responsibilities women are now taking on as they juggle families and careers (Schenck-Gustafsson,K, Anderson,A., 2010; Veronesi et al., 2011).

A study in Iran stated that depression was independently associated with an acute myocardial infarction, however other studies have shown that while it may be independent, depression is directly linked to other risk factors such as hypertension, diabetes, and inflammatory diseases (Hashemian,F. 2006; Jonas,B.S. 1997).

The mental state of individuals may cause negative behaviors such as overeating, smoking, self-prescribing medications, and substance abuse. Many individuals, as in Iran, are directly impacted by stressful living conditions brought on by war and political unrest. These factors are difficult to change and may bring about feelings of impending doom (Yary et al., 2010).

Most of the studies used the same baseline variables for cases and controls as well as categorical variables based on depression levels. All literature indicated a direct link between depression and cardiac events, and that the outcome measures associated with depression if not treated or diagnosed will have an overwhelming effect based on the increase in morbidity and mortality (Apostolopoulos et al., 2011; Bot et al., 2012; Scherrer et al., 2012).

Smoking is another contributing factor of heart disease. The Centers for Disease Control and Prevention (CDCP) reported in the first half of 2010 that in the United States

22 percent of men and 18 percent of women smoked tobacco.

The use of tobacco has decreased by nearly half since the 1960s due to anti-smoking policies and public health campaigns. Tobacco has been linked to cancer, heart disease, hypertension, chronic obstructive pulmonary disease (COPD) as well as other serious health related diseases. In 2008, smoking was associated with 8.1 percent of deaths in the United States. There is a statistically significant increase in the number of individuals who smoke tobacco and who have cardiovascular diseases compared to those who don't smoke (Schroetter, S., & Peck, S.,2008).

There were four related studies comparing states that participated in smoking ordinances and the impact on MI and asthma-related hospital stays. The four states all had positive outcomes related to hospital discharge summaries for the diagnosis of MI and asthma from before and after the non-smoking ordinance. The results showed a statistically significant decrease in incidences of AMI and asthma compared to the non-state and in-state residents (Asthana et al., 2012).

A prospective study was performed based on 600 subjects and the long-term effects of smoking and smoking cessation based on markers relating to cardiovascular disease. A treadmill stress test was performed and it suggested that individuals abstaining from smoking might have an improved prognosis from CVD compared to smokers (Underner & Perriot, 2011).

There are also the consequences of secondhand smoke, which is believed to influence CVD and the onset of AMI. Individuals exposed to secondhand smoke are at the same risk as smokers themselves (Veronesi et al., 2011). A study by Thelle (2011) indicated that in looking at both men and women who smoke, women are at a greater risk

for a MI. (308 Thelle, Dag S. 1976)

The research and literature reviews all agree the effects of smoking are directly related to an increase in heart disease and higher morbidity and mortality rates in both women and men. The roles of socioeconomics and education levels are directly related to the smoking and non-smoking populations as well. The less educated a population is, the more likely it is to smoke. Less educated individuals are less likely to modify their behavior, even though there have been extensive campaigns concerning the negative effects of smoking (Underner & Perriot, 2011).

Some studies show moderate alcohol consumption, most notably wine, can have positive health benefits, such as lowering the risk of heart disease and decreasing mortality (Lindberg,M.L. 2008; Crouch,Rosanne 2011; Lindschou Hansen,J. 2011).

But alcohol and excessive drinking is also associated with hypertension, which has a considerable negative effect on cardiac health. Hypertension is also a serious public health issue in developing countries. Hanson et al (2011) performed a study to examine the effects of whether middle-aged men and women with hypertension who consumed moderate amounts of alcohol were at a greater risk of ACS than those without hypertension.

The study's conclusion indicated there was not an increased risk of ACS in either the hypertensive or non-hypertensive subjects. However, if subjects with hypertension exceeded moderate levels of alcohol consumption, there was an increase in ACS and mortality (Lindschou Hansen et al., 2011).

Signs and Symptoms of a MI.

ACS is common in both men and women. The onset of ACS in women often appears 10 to 15 years later than men plus the signs and symptoms of women differ (Maas, Lagro-Janssen, & de Boer, 2011).

Based on literature reviews, the most common signs and symptoms of ACS among women are chest pain (78 percent), unusual fatigue (67 percent), breathing difficulties when exercising (58 percent), and radiating pain in the back, jaw, and arm (50 percent). The less common symptoms are feeling flush, or cold sweats (40 percent), dizziness (39 percent), and nausea (38 percent).

The prodromal or early signs and symptoms of MI as stated by women are fatigue (70 percent), anxiety (31 percent), chest discomfort (37 percent), along with indigestion, shortness of breath, and sleeping difficulties (40 percent) (Waller, 2006) (Sharobaro, Zhenchevskaia, & Ivanova, 2011).

In 2004, the American Heart Association (AHA) offered practical guidelines based on evidence and communicated the unique risks women confront and the importance of recognizing signs and symptoms independently. Since 2004, several campaigns have helped increase public awareness about heart disease. The most recognized campaign is the "Heart Truth," which is signified by "wear red day" during February to express the ongoing need for education. Over the years the campaign has been updated and revised, including in 2011, when "Effectiveness-Based Guidelines for Prevention of Cardiovascular Disease in Women-2011" was introduced. Again, the guidelines are recommendations based on evidence and clinical observations (Thanavaro, Thanavaro, & Delicath, 2010;O'Keate-McCarthy).

Norwegian authors provided statistics on CHD incidences among both men and

women based on age and sex. The study showed an increase of incidences in women compared to men, much like studies in Scotland and the United States. The Finnish authors suggested this trend was due to the limited awareness of CHD in women and diagnostic sensitivity, as well as pathological differences associated with more fatal outcomes in older and younger women. The studies noted CHD is a dynamic process and is influenced by lifestyle changes, social conditions, and external factors. These trends should increase the demand for public health awareness of both younger and older females. (Backus et al., 2010; Duenas et al., 2011; Heller et al., 2008; Jankowski et al., 2011; Thanavaro et al., 2010; Legto, H., Lehto, S., & Havulinna, A.,2007).

In exploring diagnostic experiences in women relating to ACS and MI several themes emerged, including that the women were unaware of the condition, did not seek treatment, or experienced frustration and anger when they did due to lack of interest from the healthcare professionals. This inadequate diagnosis also plays a role in increased cases of morbidity and mortality. This is mainly due to the multiplicity of symptoms that were not reported or recognized as cardiac in nature. Women often have a higher rate of functional disability and a lower prevalence of obstructive CHD as noted by coronary angiogram (Lee, Betsy Chang, Anna Marie Matsuura,Asako C. & Marcoon, 2011; Lichtman et al., 2010; Mosca, Barrett-Connor, & Wenger, 2011;).

The global perception pertaining to women and heart disease is still a problem. Studies reveal women still lack the knowledge to make informed decisions to better prevent heart disease and related risk factors.

Breast cancer is currently identified as the leading cause of death in females between 25 and 44. Women 65 and older indicated a lack of information on heart disease

and 70 percent have never spoken to their physician regarding risk factors.

Interestingly enough, 44 percent of all women surveyed did not believe they would suffer an AMI, and they all rated themselves as being educated on heart disease (Mosca et al., 2011).

Another study interviewed a mix of white, African American, and Hispanic women based on age. According to the literature, 61 percent of the respondents thought cancer was the greatest health problem among women, and only eight percent declared heart disease to be an issue. Only 16 percent of women of age 25-34 recognized heart disease to be the leading cause of death, and only four percent believed it was the greatest health problem (Gutierrez,N. 2011; Hamner,J. 2008; Crouch,R.,2011; Framinghamheartstudy).

When the data was separated based on ethnicity, it was revealed that among all groups, the majority still considered cancer to be the leading cause of death; smoking and immunodeficiency disease were rated next. There was also little difference in the subjects' ability to make informed decisions concerning heart disease within the different age and ethnicity groups.

When asked what the most common symptoms were for women, 67 percent indicated chest pain and 10 percent indicated shortness of breath, arm pain, tightness, and nausea. The younger women associated an increase in blood pressure to heart disease, whereas all cited excess weight, lack of exercise, smoking, and high cholesterol as contributing to the disease. The percentage was low in linking menopause and heart disease. The study also showed African Americans communicated with their physicians more often than whites or Hispanics, and only 14 percent of the women between ages 25-

34 ever talked to their doctors (Mosca,L. 2011; Mieres,J.H. 2011).

A national survey indicated 60 percent of women between ages 25-34 received information on heart disease, compared to 82 percent of women between 45-64, and 71 percent of women 65 and older. The leading media source for delivering the information was magazines, according to the survey, with 24 percent of the respondents saying they received information from television, while 18 percent gathered information from health professionals. Women 65 and older noted the newspaper as their main source of information. Ethnic groups and younger women were the largest consumers of magazines (Mieres et al., 2011).

It is not unusual for women, as well as health professionals, to acknowledge the various pathophysiologic mechanisms related to females. The diagnostic model of chest pain is indicative of the focus of significant obstruction within the large coronary arteries. The disparities lie in the lack of understanding. The model of chest pain in females may look at the endothelial dysfunction, estrogen deficiency, and abdominal nociception in understanding the issues of microvascular angina (MVA)
(Vaccarino,Viola 2011;Tsang,Teresa S.M. 2000;Nugent,Lynn 2011).

Again, increasing knowledge of the pathophysiologic mechanism among women and its relation to heart disease is of great importance. Current diagnostic strategies stratify chest pain according to cardiac and non-cardiac utilizing measures aimed at underlying etiologies. Gender differences can make this complicated and can lead to misdiagnosis or mismanagement. Some indicate the disparities are due to how women report or cope with chest pain, but more data is pointing to the pathophysiologies such as MVA. MVA represents coronary obstructions, which is significant to CAD, non-

obstructive chest pain, and these women may be triaged incorrectly and go untreated.

However, women were more frequently diagnosed with AMI from the 1990s to 2002. The reasons for this could be more educated health professionals, improved testing, patient information, and improved national guidelines. Many believe breast cancer is the leading cause of death in women which is often associated with ongoing campaigns concerning breast health and the need for preventative screenings. The question remains: Is enough focus, energy, and time being committed to communicating to women the risks and disparities associated with heart disease (Daugherty et al., 2011; Lee, Betsy Chang, Anna Marie Matsuura,Asako C. & Marcoon, 2011; Lichtman et al., 2010)?

Effects of Population Changes on MI

The number of patients over the age of 65 will triple between 1980 and 2030. Persons born between 1946 and 1964, called "baby boomers," started turning 65 in 2011. This increase in the aging population will magnify the stress on the United State's healthcare system, impacting the industry for decades. Not only are the baby boomers reaching 65, but there is also an increase in life expectancy in both men and women. Longevity is not necessarily directly related to quality of life due to comorbidities which many of these individuals possess. The American Heart Association (AHA) believes this is just the beginning, and over the next decade the percentage of persons having two or more diseases will increase. Currently healthcare costs and accessibility are under review to ensure proper healthcare is provided to everyone.

The demand for increased health services will exacerbate the need for wellness and preventive care. It is estimated that 14 million people, or 1 in 4, will have diabetes,

and at least half of those will have arthritis. Moreover, at least 21 million people, or 1 in 3, will be obese.

Literature reviews indicate more individuals of the current generation will die of heart disease at a greater rate than previous ones. Literature suggests the population is now less likely to smoke, however heart disease remains a problem. The other concern is the ongoing necessity for healthcare and the essential demand for healthcare providers. The need for healthcare is increasing and the caregivers are aging out faster than they are being replaced. This means signs and symptoms are more likely to go undiagnosed or be incorrectly treated, and result in increased morbidity and mortality (Kihara, 2011; Mieres et al., 2011).

Intervention for MI

Cardiac intervention is the same for women as it is for men. However, intervention measures are not performed as frequently with women. The most routinely recommended treatment for primary prevention of cardiac disease is aspirin. Aspirin is often prescribed for men, while women are less likely to receive it due to the contraindications. There is a greater risk for gastric-bleeding among women, and it is recommended aspirin only be prescribed on an individual basis.

There may be some relevance as to the reasons the incidents of AMI have plateau or decreased in men and not in women. There are also the determination and prognosis factors associated with the guidelines in determining when an intervention measure should occur in the cardiac patient.

Women and men differ in the ECG and vasodilator stress test calculated

outcomes. Women have a lower prevalence of obstructive coronary artery disease than men, which in part is due to the micro-vascular issues. Men more often appear with large obstructions during the testing phase and are more likely to receive intervention procedures. Women will go untreated or receive a lesser intervention, which will increase their overall mortality and morbidity. Evidence-based intervention decisions should be based on many factors such as symptoms, risk profiles, and testing measures. There is also a decrease in beneficial therapies and rehabilitation referrals with women due to a lack of knowledge and extensive damage prior and post MI (Nugent,L. 2011).

Thrombolytic era and patient management provided evidence of increases in women less than 65. Younger women were less likely to be thrombolytic than men their same age. However, due to various educational campaigns supported by the National Heart, Lungs, and Blood Institute, a division of the U.S. Department of Health and Human Services, awareness has increased overall. In 1997, 30 percent of the women were aware. Awareness increased in 2009 to 69 percent, the highest level to date. The level of awareness decreased the following year to 62 percent. The campaign has lost some of its momentum and the percentage is at a level that may put some women in jeopardy.

While not performed as often to women as compared to men, more invasive interventions such as cardiac catheterization, cardiac angiogram, and percutaneous coronary intervention will continue as heart disease risk factors increase and awareness decreases among women.

Two out of three women with heart disease are projected to have more than one comorbidity, and the potential of healthcare providers to improperly diagnose the

condition increases the likelihood of a myocardial incident. Laboratory testing is an important modality in the basic cardiac workup. Laboratory testing can be performed at the patient's bedside with a blood analysis to include cardiac biomarkers to determine the presence or absence of a myocardial infarction, early or late complications, and the prognosis (De Luca et al., 2010; Gutierrez, 2011; Jensen et al., 2011; Johnston, Schenck-Gustafsson, & Lagerqvist, 2011).

Laboratory testing is also useful in detecting comorbidities and assisting in the care of the patient. The ACC and AHA state the biomarker troponin is the criterion standard for defining and diagnosing myocardial infarction. A positive troponin is indicative of a myocardial infarction and is measured in most EDs. A positive troponin is an independent indicator of increased risk of a cardiac event. The administration of therapy with LMWHs and/or GP IIb/IIIa inhibitors appears to bestow the most advantage for patients with elevated cardiac troponin levels according to the evidence in the PRISM, PURSUIT, and TACTICS-TIMI 18 trial. Laboratory testing is not all inclusive of early determination of an MI when various other comorbidities exist and other modalities must also be considered (De Luca, G., Gibson, C., & Gyongyosi, M. (2010);Veronesi,G. 2011; Gafarov,V.V. 2011).

Cardiac-related incidents and deaths among males and females are a major public health issue. The AHA established evidence-based guidelines and Door-to-Balloon (D2B) national standards. Many medical centers in their strategic objectives initiated the established quality measures to include ED staffing, cardiac catheterization laboratory (CCL), emergency medical services (EMS), cardiologists, pharmacists, and others in order to seek and gain the chest pain center accreditation. This was also due to the Center

for Medicare/Medicaid Services meeting their specified core measures or STEMI criteria.

The overall goal is to diagnose and start treating the cardiac patient within 90 minutes. Since the start of D2B there have been great improvements in patient outcomes. The need for a proper triage process within the ED is essential for both genders, however an understanding of the differences in the pathophysiology in females is of utmost importance in administering treatment according to the national standard guidelines (Heart Failure Executive Committee et al., 2008; Johnston et al., 2011; Sbarouni, Georgiadou, & Voudris, 2011; Sheridan et al., 2011; Collins, S. (2010).).

There are both retrospective and prospective studies alluding to outcomes of men and women upon presenting to the ED with chest pain and the statistical data concerning the mortality rate between the two. A German study analyzed data from pre-hospital, first day of hospitalization, and days 2-28, which revealed the first-day mortality rate for women was significantly higher than for men, although only slightly increased during the later phases. Another European study indicated some of the same findings, however it indicated this was probably related to the increase in comorbidities in women, such as diabetes mellitus and hypertension, as compared to men (Bush,N. 2011; Chong,E. 2011; Fabijanic,D. 2006; Flores-Mateo,G. 2011; Kostis WJ. Deng Y. Pantazopoulos JS. Moreyra AE. Kostis JB. Myocardial Infarction Data Acquisition System (MIDAS14) Study Group 2010; Schiele,F. 2011).

There is evidence due to heart awareness national campaigns and other public health initiatives concerning cardiac disease that women are more aware of the signs and symptoms of a heart attack or MI, and are more proactive in presenting to the ED. From 1990 to 2002 there was an increase in women diagnosed with ICD-9-CM 410.

Myocardial infarction is the leading cause of death in the United States. The etiology derives from a buildup of plaque in the arteries, or atherosclerosis, and when the plaque begins to break apart a clot is formed. There is a high risk of the clot enlarging and causing a partial to complete occlusion of blood flow to the heart. The decreased blood flow to the heart affects cardiac oxygenation which causes the heart muscle to die. Subjects often have signs and symptoms consisting of chest pain and discomfort. An acute myocardial infarction is diagnosed as UA, NSTEMI, or STEMI, and requires prompt diagnosis and treatment for patient survival. Risk factors associated with heart disease are considered non-modifiable and modifiable (Radke, 2011; Waller, 2006; Wang et al., 2012; Yiadom, 2011; Yiu et al., 2012).

Summary of Issues Identified in the Literature

Population changes expected over the next decade will result in more women presenting to ERs with an AMI within the US. However, symptoms of MIs in women may be quite different from those presented by men. Timely use of new medical interventions can prevent or limit severe damage to the heart. However, women may be at risk for delayed diagnosis because many of their presenting AMI symptoms are not part of the normally accepted indicators of AMI. Use of new laboratory tests may improve early diagnosis of AMI in women, but the use of such tests will add to the cost of care. Thus, discussions of changes in practice guidelines to expand the use of testing to screen for AMI in women requires us to have estimates of the magnitude of the increase in the population for which these tests are used, and the number of women who may have the potential for benefiting from increased preemptive testing. This study will provide

scientific data needed to inform the discussion of expansion of testing for AMI in women presenting in the ER.

METHODS

This study used a retrospective analysis of archival data on hospital discharges from three states to examine the 10-year trend in hospital admissions of patients with a primary diagnosis of AMI, to document rate changes by gender over time. The research questions examined are:

1) Have hospital admissions for MI in women increased over the last ten years, compared to the number of admissions for men?

Hypothesis: Women constitute an increasing proportion of AMI admissions over time, controlling for age and racial risk factors.

2) Are women more likely than men to have comorbid conditions of diabetes and obesity?

Hypothesis: The percent of women with an AMI with obesity and diabetes risk factors has increased more than the percent observed for men.

3) Are women admitted to a hospital with an AMI in 2010 more likely than men to have a comorbid diagnosis of chest pain, muscle strain, heart burn, gastric reflux disease or vague complaints that could obscure a diagnosis of AMI than men?

Hypothesis: A higher proportion of women than men with an AMI have a comorbid diagnosis or a complaint that could obscure AMI signs and symptoms.

Hospital Discharge Data

State Hospital Discharge Record data sets from Arizona (AZ), Florida (FL), and Maryland (MD) for the years 2000 through 2010 were examined. These states were selected due to geographical location within the United States based on the diverse

population and the complete hospital discharged records from at least 2001 to 2010. We extracted all hospital admissions with a primary diagnosis of ICD-9-CM 410.0 to 410.92. The ICD-9-CM is the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) is based on the World Health Organization's Ninth Revision, International Classification of Diseases (ICD-9). ICD-9-CM is the official system of assigning codes to diagnoses and procedures associated with hospital utilization in the United States. ICD-9-CM 410. 0 to 410.92 is to identify Acute Myocardial Infarction.

Presence of Diabetes and Obesity and Other Risk Factors

Each hospital admission record was examined for the presence of diagnosis codes for diabetes (ICD-9 250.xx) and obesity (ICD-9 codes 278.xx, 259.9 and V85.xx). We compared the likelihood of AMI patients with a comorbid diagnosis of diabetes and obesity being female using a logistic regression to predict the presence of comorbid diagnoses of obesity and diabetes by gender.

Statistical Analysis

We used multi variable logistic regression analysis to predict females' gender for admissions for AMI over time. This approach avoided the necessity of calculating annual population rates for AMI weighted by the state's population of adult males and females over age 50 for each year. This is an important innovative application of regression that avoids the need to use inter-censal state population predictions to calculate a population rate for each study year.

RESULTS

The examination of hospital discharge data from the years 2000-2010 included three states; Arizona, Maryland, and Florida. We examined a total of 781,995 discharges with a principal diagnosis of AMI, as well as the trend in discharges over time based on the presence of a primary diagnosis of AMI in the electronic summary derived from the UB04 Hospital Discharge Record. A decreasing trend in the number of MIs was observed over time. In year 2000 Florida's rate was 55343 compared to 44278 in 2010, a decrease of 20% as compared to Arizona, which in 2000 had 11130 patients diagnosis with MI with only a 1% decrease to 10985 in 2010. Maryland had the largest decrease of 30%, however due to lack of discharge data for them in 2000 the percentage was based on 2001 of 14109 and in 2010 there was 9889 patients with the discharge diagnosis of MI as noted in table 1 below. The average decrease for the three states from 2001 to 2010 indicated a 20% decrease of MIs. Furthermore, the only year with an increase number of MI discharges was in 2001. Both Florida and Arizona Increased by less than 1%; Maryland was excluded due to lack of data for year 2000. The results of this descriptive analysis are presented in Table 1 below.

Table 1: Number of Discharges with MI in FL, MD and AZ from 2000 through 2010.

Year	Florida	Maryland	Arizona	Total in study
2000	55343	NA	11130	66473
2001	55586	14109	11704	81399
2002	54977	13908	10752	79637
2003	54412	13984	10752	79148
2004	52999	12645	11213	76857
2005	50883	11888	10815	73586
2006	47549	2730	10643	60922
2007	46307	10171	10560	67038
2008	46155	10183	10854	67192
2009	43748	10174	10658	64580
2010	44278	9889	10985	65152

The number of patients with the discharge diagnosis of AMI decreased over the time of the study. This is especially important to note because the adult population over age 65 in the three states increased from 4,074,743 in 2001 to 4,848,075 in 2010 over that time. However, as the number of patient AMI discharges decreased the percentage of males and females stayed relatively the same from 2001 to 2010. Florida percentage of females with AMI was 40% during this period, whereas Arizona had 36%-38% variability distributed from 2001 to 2010. Maryland had the highest percentage of females compared to the other two states from 41% to 44% in Table 2.

Table 2: Percent of MI admissions for men and women with MI in FL, SC and MD from 2001 through 2010.

Year	FL Women	FL Men	MD Women	MD Men	AZ Women	AZ Men
2001	40%	60%	44%	56%	36%	64%
2002	40%	60%	42%	58%	37%	63%
2003	40%	60%	43%	57%	38%	62%
2004	40%	60%	43%	57%	38%	62%
2005	40%	60%	42%	58%	37%	63%
2006	39%	61%	41%	59%	37%	63%
2007	40%	61%	44%	56%	38%	62%
2008	40%	60%	42%	58%	38%	62%
2009	39%	61%	41%	59%	37%	63%
2010	39%	61%	42%	58%	36%	64%

The overall decrease in AMI admissions from 2001 to 2010 in the population based on the Hospital Discharge Summary does not reflect trends observed for the minority populations. The African American population has increased as a proportion of patients with AMI. Maryland has had the largest increase of 6.7% as compared to Florida with 2.6%. The rates in Arizona were calculated for black, Native American, and Hispanic populations, because this state has a high proportion of Native American and Hispanic citizens. We observed an increased less than 1% for minority groups in AZ from 2001 to 2010. Table 3 shows that the percentage of African Americans having an AMI is increasing as a proportion of the total population over time.

Table 3: Percent increase in number of MI Discharges for African American with AMI in FL, MD, and AZ from 2001 through 2010 using 2000 as base Year.

Year	FL Black	MD Black	AZ Black/Native American/ Hispanic
2001	6.61	17.46	1.73
2002	6.91	18.85	1.86
2003	7.83	19.31	2.01
2004	8.20	19.68	2.14
2005	7.89	19.87	2.51
2006	8.02	17.22	2.31
2007	8.42	21.22	2.45
2008	8.76	21.83	2.66
2009	9.24	21.87	2.70
2010	9.45	24.16	2.66

The mean age based on discharges of all persons with AMI for 2000-2010 in the three states was 66.7 to 69.8. The mean age decreased from 2001 to 2010 by 9 months with the highest mean in Florida and the lowest in Maryland as in Table 4.

Table 4: The mean age of patients with AMI based on Hospital Discharge Summary from Florida, Maryland, and Arizona in 2000 to 2010. There are no data for Maryland in 2000.

Year	Florida	Maryland	Arizona	Mean
2000	69.8	NA	67.9	69.5
2001	69.8	68.1	67.9	69.2
2002	69.5	67.6	67.8	69.7
2003	69.5	67.7	68.0	68.9
2004	69.6	67.8	68.0	69.0
2005	69.2	67.6	68.0	68.8
2006	69.0	66.6	67.5	68.6
2007	69.0	67.4	68.0	68.6
2008	69.1	67.0	67.6	68.6
2009	68.8	66.7	67.9	68.3
2010	68.9	66.9	67.6	68.4

We examined the data for all three states for the process used to diagnose and treat an MI. Specifically we identified each individual discharge record for use of an angiogram, as indicated by a procedure code of 36.03, 36.09 or 00.66. Angiograms (open or percutaneous) were rarely coded for hospital admissions with MI prior to 2005. After that year we observe that women who were admitted with a principal diagnosis of MI were much less likely than male MI patients to have a record of having received an angiogram. Since an angiogram provides a definitive diagnosis of an MI, this is an important difference in the process used for diagnosing MIs in men and women. Because of this

difference we will control for the use of angiography in the logistic modeling used to predict changes in the male-female proportions of MI patients over time as noted in Table 5.

Table 5: Percent MI Hospital Admissions in AZ, FL and MD with Angiogram Record by Year and Gender*

Year	AZ Females	AZ Males	MD Females	MD Males	FL Females	FL Males
2000	<1%	<1%	<1%	<1%	<1%	<1%
2001	<1%	<1%	<1%	<1%	<1%	<1%
2002	<1%	<1%	<1%	<1%	<1%	<1%
2003	<1%	<1%	<1%	<1%	<1%	<1%
2004	<1%	<1%	<1%	<1%	<1%	<1%
2005	10.2%	12.4%	7.2	9.8	7.5%	10.0%
2006	42.0%	54.6%	45.8	54.1	32.1%	43.8%
2007	41.3%	52.5%	31.4	42.0	31.6%	44.6%
2008	41.7%	54.7%	31.7	44.3	32.0%	45.8%
2009	42.7%	56.1%	31.1	45.0	35.5%	48.4%
2010	45.3%	56.3%	31.0	45.6	36.6%	49.2%

*Male vs. female rates p<.0001

The age, race and/or ethnicity of MI patients also varied across time and across the states, as noted in Table 6. Thus we controlled for age, race/ethnicity in the logistic regressions used to assess the changes in proportions of women with MI over time. The results of modeling the change in the proportion of MI patients who are women, controlling for age and race/ethnicity changes are provided in Table 6 below.

Table 6: Logistic model predicting the likelihood of being female for all admissions with a primary diagnosis of MI for AZ, MD and FL from 2000 through 2010.

	AZ	AZ Odds Ratio	MD	MD Odds Ratio	FL	FL Odds Ratio
Intercept	-34.1692		-19.4253		-25.1114	
Year	0.0156	1.016	0.00829	1.008*	0.0111	1.011
Age	0.0338	1.034	0.0359	1.037	0.0339	1.034
Angioplasty	-0.2370	0.789	-0.2601	0.771	-0.2477	0.781
Black	0.5453	1.722	0.5574	1.746	0.6220	1.863
Native American	0.2809	1.324	NA	NA	NA	NA
Hispanic	0.1691	1.184	NA	NA	NA	NA

Note: all unmarked variables significant at p<.0001; * significant at 0.0005

Hypothesis 1 Supported

The results of the logistic regressions predicting being female among all MI discharges clearly indicate that the likelihood that a person admitted with a primary diagnosis of MI is female increases over time. For AZ the likelihood of being female if you have an MI admission increases by 1.5% per year; in MD it increases by 0.8% per year, and in FL it increases by 1.1% per year from 2000 through 2010. This is after we have controlled for any changes in the composition of the MI populations that may be due to race, ethnicity or age. It also controls for the likelihood of being diagnosed or treated by angiography. While the "raw" frequencies in tables 1 and 2 shows that the overall number of admissions with a primary diagnosis of MI has been decreasing over time, the results of the logistic models indicate that females make up an ever increasing proportion of MI admissions. Thus, the data supports our hypothesis that the proportion of female MI patients is increasing, and that this increase is not simply due to ageing.

Presence of Diabetes and Obesity and Other Risk Factors

Each hospital admission record was examined for the presence of diagnosis codes for diabetes (ICD-9 250.xx) and obesity (ICD-9 codes 278.xx, 259.9 and V85.xx). The results of the descriptive analysis of the data are presented in Figures 1-3 below.

Figure 1a: Percent Women and Men with MI and Comorbid Obesity in AZ

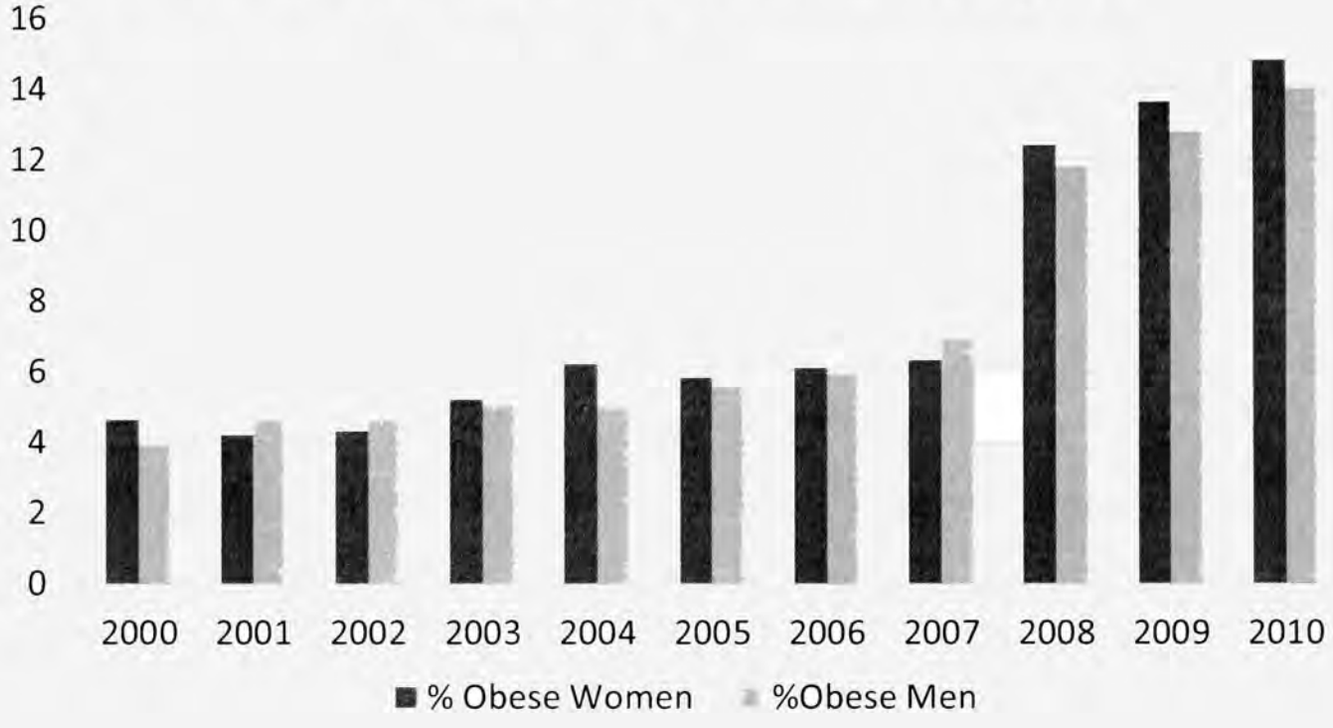


Figure 1b: Percent Women and Men with MI and Comorbid Obesity in FL

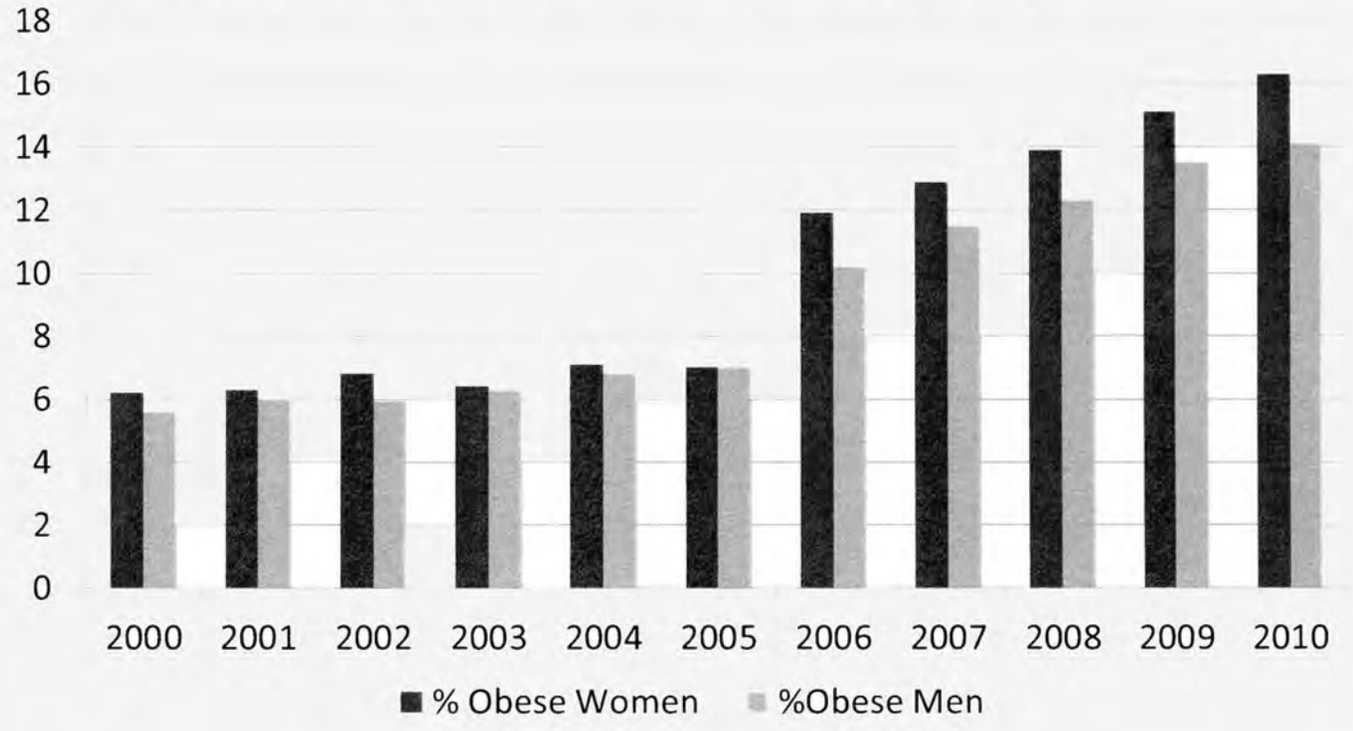


Figure 1c: Percent Women and Men with MI and Comorbid Obesity in MD

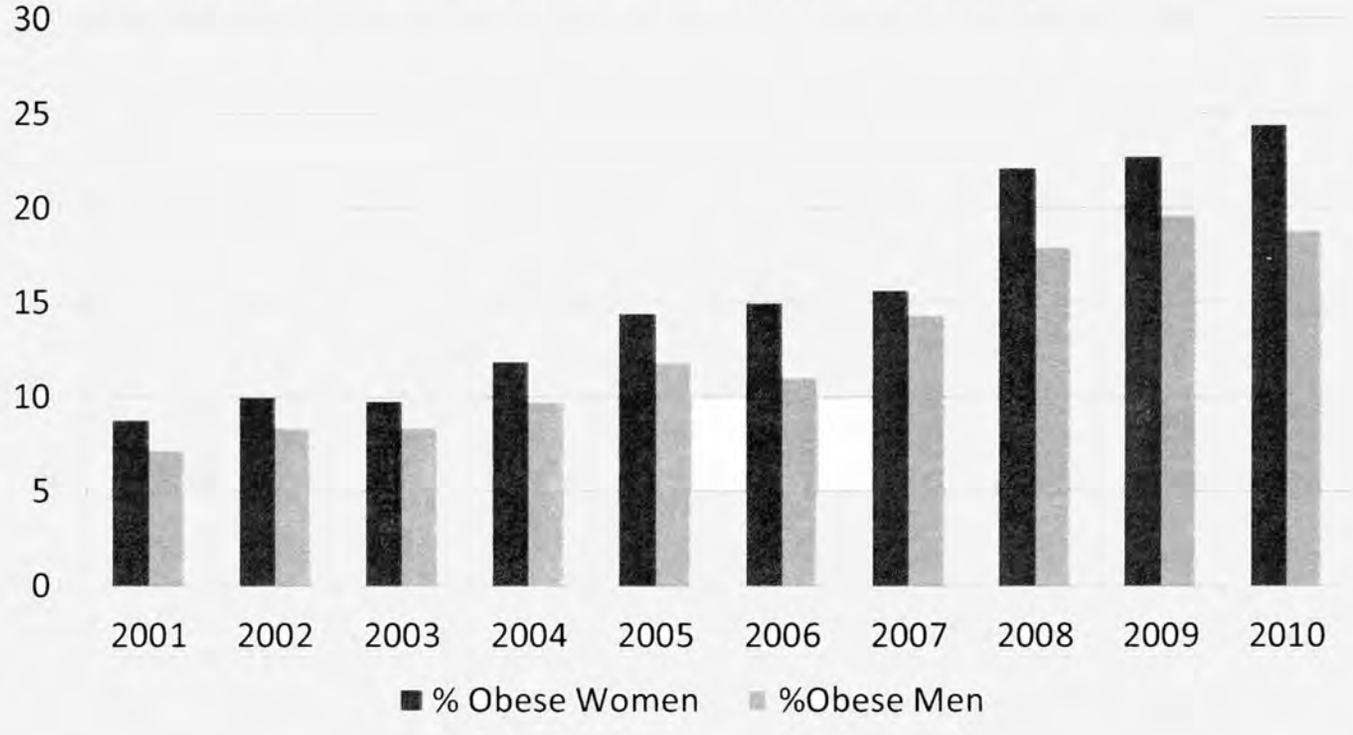


Figure 2a: Percent Women and Men with MI and Comorbid Diabetes in AZ

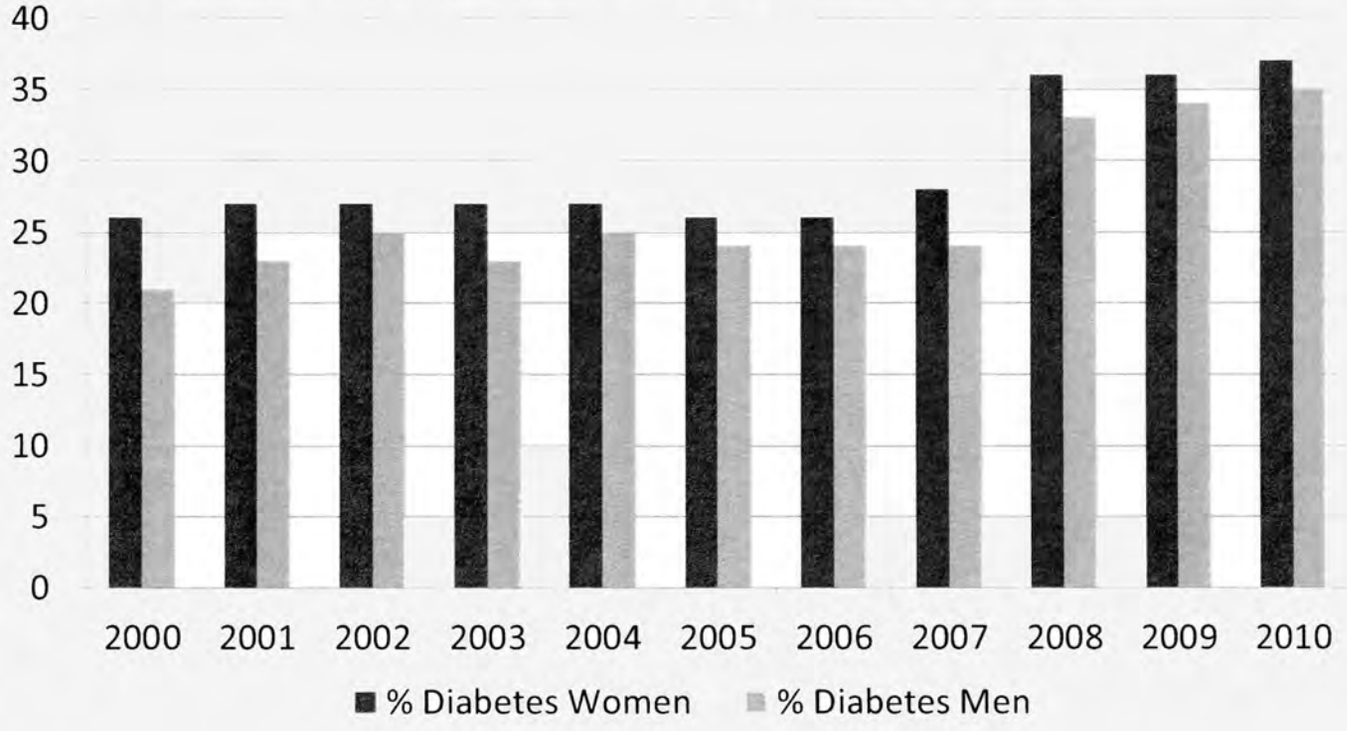


Figure 2b: Percent Women and Men with MI and Comorbid Diabetes in FL

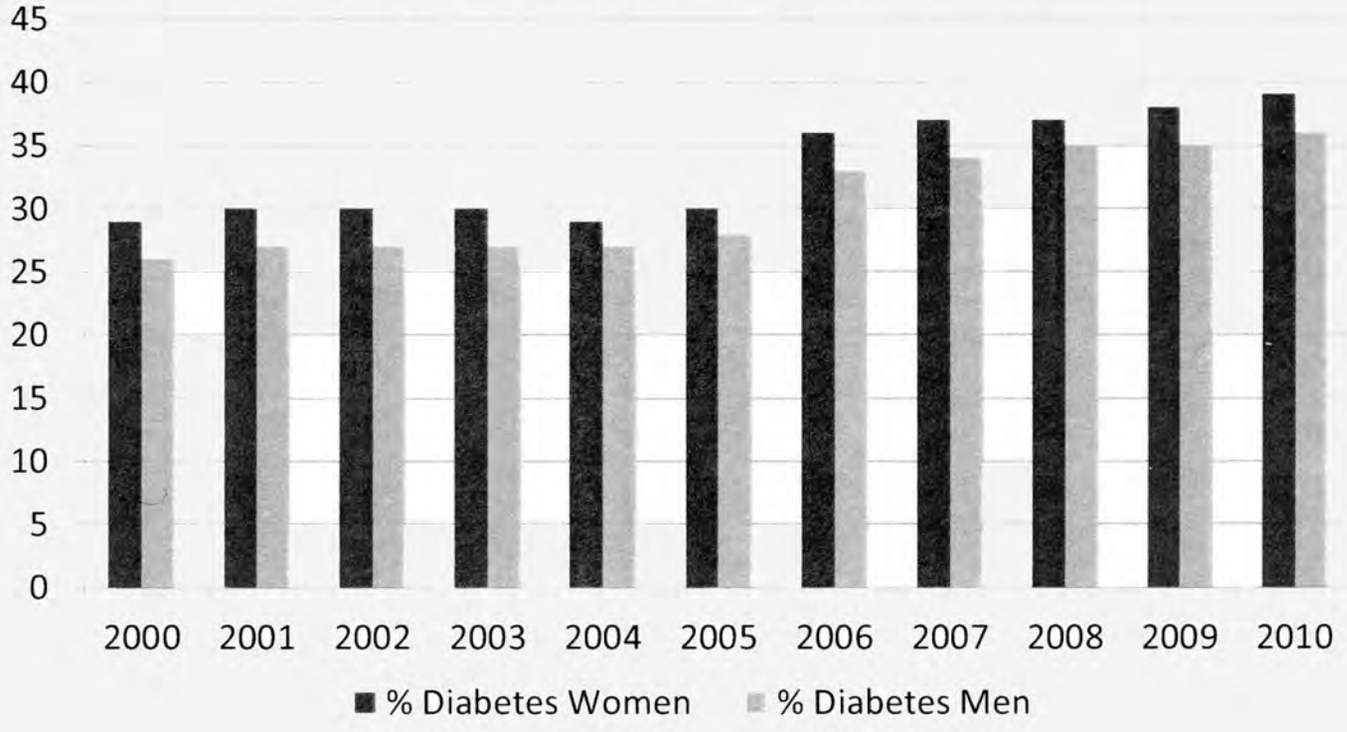


Figure 2c: Percent Women and Men with MI and Comorbid Diabetes in MD

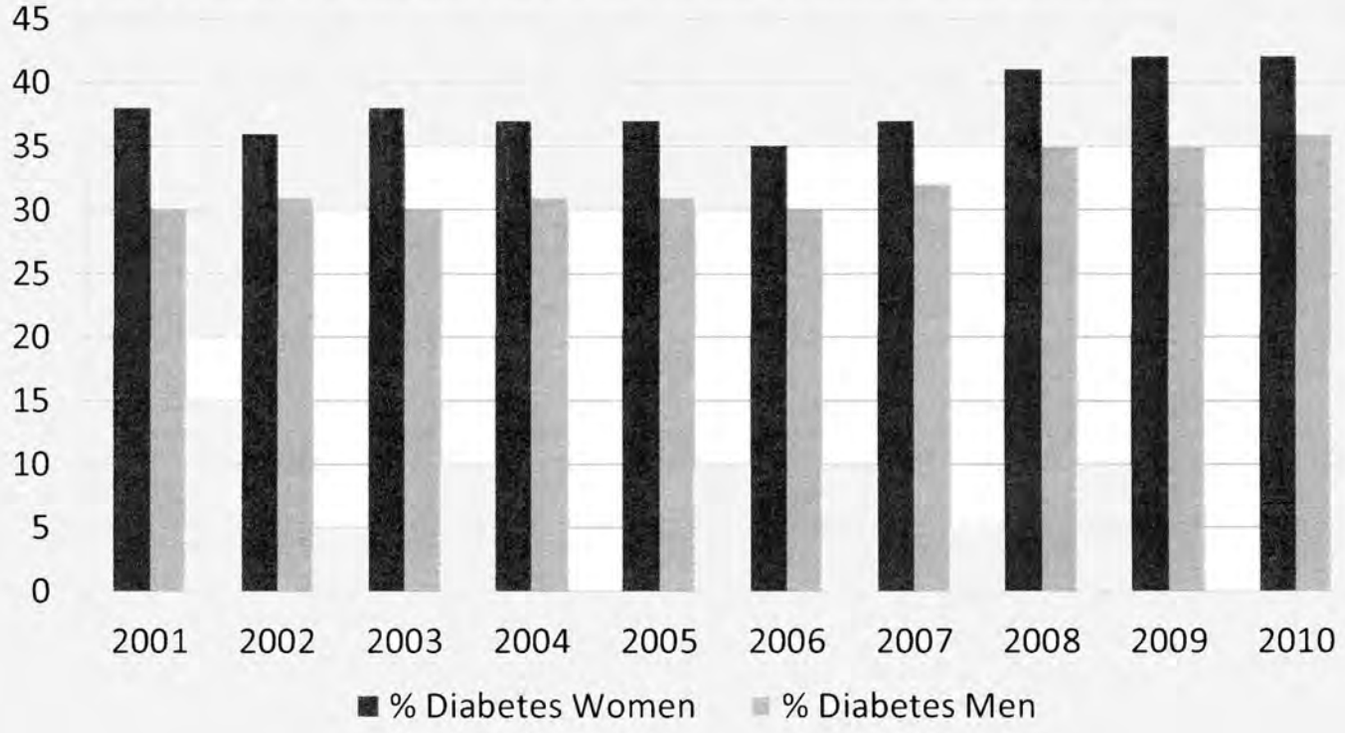
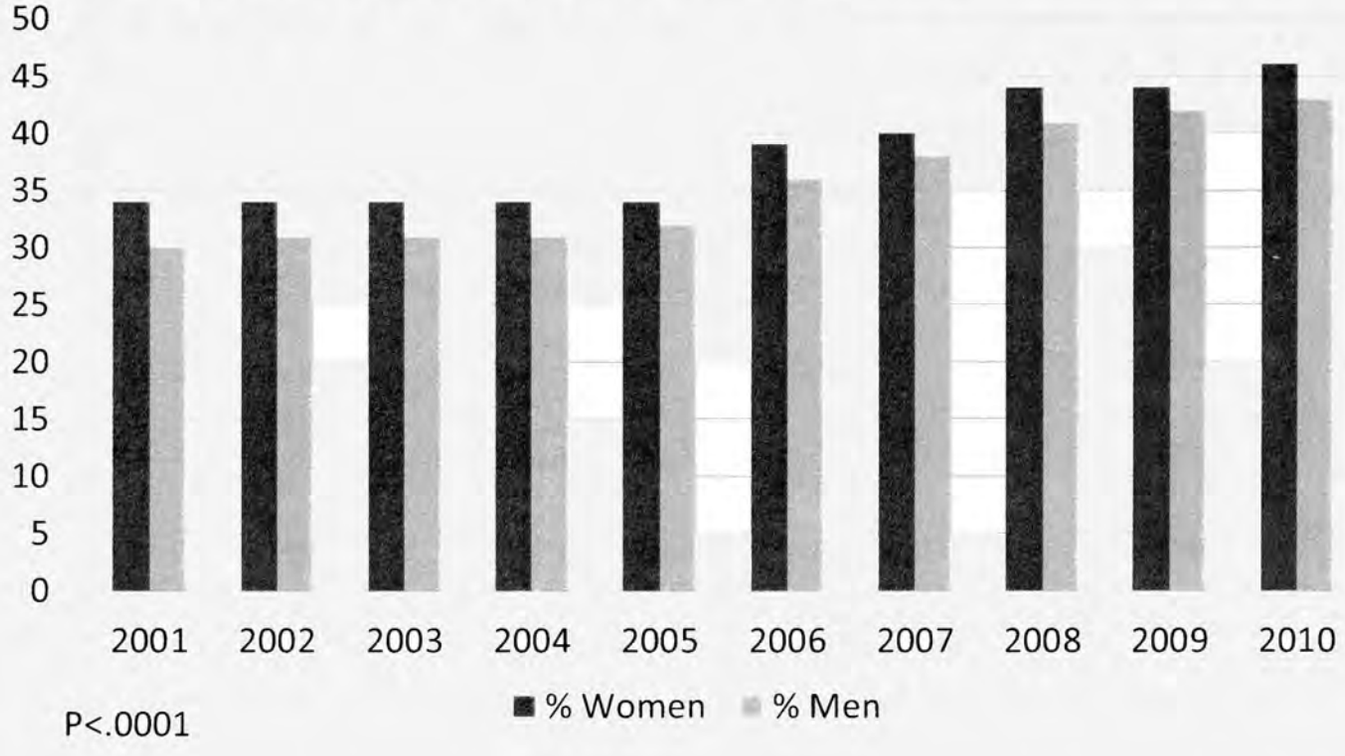


Figure 3: Percent Male and Female MI Patients with a Comorbid Diagnosis of Obesity, Diabetes or Both in AZ, FL, and MD from 2001 through 2010



We compared the likelihood of AMI patients with a comorbid diagnosis of diabetes and obesity being female using a logistic regression to predict the presence of comorbid diagnoses of obesity and diabetes by gender. The individual modeling results

for the three states are presented in Table 7 below.

Table 7: Logistic regression models predicting the presence of an obesity or diabetes comorbid diagnosis by gender, controlling for year of hospital admission, age, race, ethnicity and receipt of angioplasty surgery or diagnostic procedure.

	AZ	AZ Odds Ratio	FL	FL Odds Ratio	MD	MD Odds Ratio
Intercept	-180.3		-145.2		-123.5	
Female	0.1663	1.181	0.1316	1.141	0.2706	1.311
Year	0.0899	1.094	0.0724	1.075	0.0616	1.064
Age	-0.0125	0.988	-0.00807	0.992	-0.00742	0.993
Angiogram	-0.1878	0.829	-0.1834	0.832	-0.2185	0.804
Black race	0.4334	1.542	0.4368	1.548	0.4122	1.510
Hispanic	0.7394	2.095	NA	NA	NA	NA
Native Am.	1.1912	3.291	NA	NA	NA	NA

All variables significant at $p<.0001$

Hypothesis 2 Supported

The results of the logistic regressions predicting the comorbid conditions of obesity or diabetes in patients admitted with a primary diagnosis of MI increases over time. For AZ the likelihood of having obesity or diabetes if you have an MI admission increases by 9.4% per year. In MD it increases by 6.4% and in FL the increase is 7.5% per year from 2000 through 2010. This is after we controlled for any changes in the composition of the diabetes or obesity in the MI population that may be due to race, ethnicity, or age. It also controls for the likelihood of being diagnosed or treated by an angiogram. Females in AZ are 18.1% more likely than males to have the comorbid disease of obesity or diabetes; women in FL are 14.1% more likely than men to be obese

or have diabetes, while in MD the percentage is 31.1%. The AMI patients with a diagnosis of obesity or diabetes are 17.1% less likely to receive an angiogram in AZ, 16.8% less likely in MD, and 19.6% less likely in FL. As expected, black patients across the three states are approximately 50% more likely than Caucasian patients to have a diagnosis code of diabetes or obesity. The prevalence of obesity and diabetes codes for Hispanic and Native Americans in AZ is even higher than the prevalence noted for black patient.

Presence of a comorbid condition in year 2010 that could obscure the AMI diagnosis.

We examined the data from all three states for the presence of a comorbid diagnosis of chest pain, muscle strain, heart burn, gastric reflux disease or vague complaints that could obscure a diagnosis of MI. Our hypothesis was that a higher proportion of women with an MI than men have a comorbid diagnosis of a complaint that could obscure MI signs and symptoms. Descriptive data are presented in Table 8 and Table 9 and the 2010 AMI percentages. We also used a logistic modeling approach to test this hypothesis noted in Table 10.

Table 8: The percent of men and women in 2010 with a comorbid diagnosis based on ICD-9-CM diagnosis codes describing females' signs and symptoms of MI in the states of AZ, FL, and MD.

COMORBID ICD-9-CM DIAGNOSIS CODE ADMISSION FOR MI PATIENTS IN 2010	DESCRIBED SIGNS AND SYMPTOMS	FL MEN	FL WOMEN	MD MEN	MD WOMEN	AZ MEN	AZ WOMEN
786.0	Dyspnea and respiratory abnormalities	54%	46%	55%	45%	63%	37%
786.5	Chest Pain	57%	43%	54%	46%	66%	34%
780.7	Malaise and Fatigue	46%	54%	46%	54%	49%	51%
787.02	Nausea alone	50%	50%	50%	50%	50%	50%
719.41	Pain in Joint, Shoulder Region	54%	46%	62%	38%	58%	42%
729.5	Pain in Limb	44%	56%	48%	52%	53%	47%
780.96	Generalized Pain	17%	83%	67%	33%	33%	67%
338.1	Acute Pain	60%	40%	100%	0%	0%	0%
724.5	Backache, Unspecified	62%	38%	48%	52%	59%	41%
780.4	Dizziness and Giddiness	47%	53%	57%	43%	50%	50%
787.1	Heartburn	57%	43%	16%	84%	0%	100%
530.81	Esophageal Reflux/GERD	54%	46%	52%	48%	58%	42%
300.00	Anxiety State, Unspecified	43%	57%	45%	55%	52%	48%

Table 9: The percent of men and women in 2010 with the Principal ICD-9-CM Diagnosis Code 410- for MI in FL, SC, and MD.

PRINCIPAL ICD-9-CM DIAGNOSIS CODE for 2009	DESCRIBED SIGNS AND SYMPTOMS	FL MEN	FL WOMEN	MD MEN	MD WOMEN	AZ MEN	AZ WOMEN
410-	Acute Myocardial Infarction	61%	39%	58%	42%	64%	36%

Table10: Logistic regression models predicting the presence of a comorbid diagnosis in 2010 admissions that could obscure the diagnosis of an AMI, for males and females, controlling for age, race and use of angiography.

	AZ	AZ OR	FL	FL OR	MD	MD OR
Intercept	-1.5593		-1.4667		-1.3049	
Female	0.3341	1.397	0.4243	1.528	0.3979	1.489
Age	0.00313	1.003	0.00237*	1.002	0.00480	1.005*
Angiogram	-0.521	0.949	-0.1808	0.835	-0.1670	0.846*
Black race	-0.1253	0.882	-0.3236	0.724	-0.2600	0.771
Hispanic	NA	NA	NA	NA	NA	NA
Native Am.	NA	NA	NA	NA	NA	NA

* p<.0050; all other variable significant at p<.0001

Hypothesis 3 Supported

The results in Table 10 above show a consistent effect of gender across the model for the three states. Women with an AMI in AZ in 2010 are 39.7% more likely than men to have one or more recorded diagnoses that could make it difficult to diagnose the AMI. The rate for women in FL is 52.8% higher than for males, and in MD the rate for women is 48.9% higher than the rate for males. This is after controlling for the variation in the presence of these comorbidities due to age, use of an angiogram, and black race. The variables that controlled for Hispanic culture and Native American race were not significant.

DISCUSSION

The research project was to determine if our speculations concerning the age-specific female AMI rates increased more than males over the years. However, the data indicated the trend of AMIs were decreasing in both males and females, but based on the proportional percentage of women, AMI increased year over year as compared to the males. We also concluded that the African American females were more likely to have an AMI at a much higher percentage than the Caucasian females. The research did support our hypothesis, and it was significant that the percent of women with comorbid conditions of both diabetes and obesity was increasing at a faster rate than men presenting with these same risk factors. Women are more likely to have one or more of these comorbidities; moreover African American women are even at a greater risk than Caucasian women. Other findings pertaining to our research questions were in relation to the signs and symptoms of AMI in women which are often overlooked when presenting to the ER. The signs and symptoms of women may mimic other conditions or diseases. We reviewed and analyzed the ICD-9-CM codes as determined in the literature review that best described the signs and symptoms often indicative of those in the female population. The findings were significant according to table 10 and women were more likely than men to possess one or more of these diagnoses so as to make it difficult to diagnose an AMI. The research did conclude that AMI women often present to the ER with GERD, fatigue, anxiety, and general pain which may go undiagnosed due to the obscure complaint. However, men present with the traditional AMI signs and symptoms, such as chest pain, dyspnea, shoulder and joint pain which are more easily identified and treated. One of the most remarkable findings was the percentage of women diagnosed

with an AMI and yet they were still less likely to receive an angiogram as compared to AMI positive men. These findings are meaningful as discussed in some of the literature; however literature does not indicate the critical number of women which go untreated. We wanted to test our hypotheses and we chose to use the UB04 Hospital Discharge Record. According to the literature and our hypotheses, it was important to review data over time. We wanted 10 years of data to include sex, race, ethnicity, diagnosis codes, procedure codes and age. The data were available for three states that met our criteria, which were Arizona, Florida, and Maryland.

The first analysis was to determine if there was an increase in the number of patients presenting to the ER over the last ten years, and if women increased more than the rate observed in men. The hospital discharge data from the three states listed above indicated the trend of AMI had actually decreased from 2000 to 2010. We speculated that because heart disease is the leading cause of death for males and females, there would have also been an increase in hospital discharges of patients diagnosed with AMI. However, over the last decade there was a 20 percent decrease in the number of patients diagnosed with AMI in the three states indicated between 2001 and 2010. The average age of these patients was from 66.7 to 69.8, and the average age decreased by nine months from 2001 to 2010. Maryland had the lowest mean age of AMI diagnosis of 66.7 as noted in Table 4. This held true for both males and females, however, the AMI rate in proportion to females increased year over year, a trend that was compounded by secondary risk factors, which resulted in an even great number of diagnoses year over year.

The overall decrease in the AMI rate over the last decade may be associated with the public-health initiatives which started in 2002 to educate the general public on cardiac health and encouraged healthy lifestyles. During this period individuals became more aware of heart disease and the need for proper nutrition and regular exercise to help improve overall fitness.

The general public, as well as healthcare professionals were more aware of the traditional signs and symptoms of a heart attack and the critical compromise it places on an individual. In understanding the importance of seeking medical treatment for improved outcomes, it became apparent to some individuals to go to an ER, which at times assisted in preventing or decreasing the MI due to pharmacological therapy.

The improvement in the primary prevention over the last decade with pharmacological therapy has lowered the incidence of CVDs and AMIs in patients, which may have been at a greater risk for an AMI or subsequent AMIs.

The American College of Cardiology (ACC) and the AHA have during the last 10 years presented guidelines for the emergency care of patients entering the hospital with a possible AMI. The guidelines stated that the patient within 90 minutes of arrival into the ED should be diagnosed and treated, which is often called "door-to-balloon".

Research has determined the faster the patient is diagnosed and treated, the more likely he or she will have improved outcomes. The decline in the number hospital discharge diagnoses of AMI is likely due to factors in process improvement initiatives with a more defined standard of care. The patients presenting to the ER with ACS are much more likely to receive the same treatment in Arizona, Florida, and Maryland.

However, hospitals may vary and establish their unique standards but generally follow the recommendations of the ACC and AHA of the appropriate treatment or procedure based on the patient's classification. The use of pharmacological therapy such as thrombolytic therapy and PCI are now more often received as indicated in the cardiac patient, particularly in the AMI male population. However, female patients are often misdiagnosed and go untreated, whereas males are more likely to be treated as recommended in the guidelines for "Chest Pain". The standard treatment and procedures recommended by the ACC and AHA assist in decreasing the mortality rate (Braunwald et al., 2000).

Although the overall number of admissions with the primary diagnosis of AMI has been decreasing over time, the likelihood of being female plus the primary diagnosis of MI are increasing over time.

In Table 6, the logistic regression model predicted the likelihood of being female for all admissions with a primary diagnosis of MI in the three states from 2000 to 2010. Moreover, we controlled for changes in the composition of the MI population, and the results indicated women with the primary diagnosis of AMI upon admission increased in all three states as follows: Arizona, 1.5 percent per year; Maryland, 0.8 percent per year; and Florida, 1.1 percent per year. This logistic model supports our hypothesis by determining the proportion of AMI female patients is growing year over year and not due simply to aging.

The presence of diabetes and obesity has become a public health issue in the young, adolescent, middle age, and elderly population. A descriptive analysis of the data from the three states describe the female population diagnosed with AMI based on

hospital admission records as having a higher percentage of diabetes and obesity upon presentation to the hospital than men. The AZ descriptive analysis for men and women with AMI from 2000 to 2010 along with comorbidity of obesity had a higher percentage of females than males for eight out of 11 years. However, in Florida and Maryland the percentage of females with obesity was greater than males every year. In all three states the percentage of MI patients with the comorbid condition of obesity had at least doubled or tripled from 2000 to 2010.

The percent of females with a diagnosis of AMI and the comorbidity of diabetes were always greater than the male population within these states. Maryland had the highest with 42 percent in 2009 and 2010.

When combining the three states for the AMI patients with obesity, diabetes or both comorbidities from 2001 to 2010, the females again exceeded the males every year. Figure 1-3 indicates females diagnosed with AMI will more likely have additional risk factors or comorbidities than their male counterparts.

The analysis also describes both the AMI female and male population with diabetes increasing in 2008, in some cases by at least 5 percent more than the previous year. Although there has not been an increase in the AMI diagnosis rate over the last 10 years, the patients who are diagnosed may be sicker than before, plus requiring more medical care.

The decrease in the number of AMI diagnoses by the hospital discharge data from 2001 to 2010 does not imitate trends observed within the minority population. The percentage of the African American population diagnosed with AMI increased. Maryland had the highest percentage increase, from 17.46 percent in 2001 to 24.16

percent in 2010, whereas Florida increased from 6.61 percent to 9.45 percent, and the percent of Arizona's minority population diagnosed with AMI, including blacks, Native Americans and Hispanics, increased from 1.73 percent to 2.66 percent. We included these races due to a higher Native American and Hispanic population in Arizona compared to the other two states.

Black patients are more likely to receive the diagnosis of obesity or diabetes or both, which increases their risk factors of having an AMI. In Arizona, Hispanics and Native Americans are more likely than the black population to be diagnosed with obesity or diabetes or both, which increases the overall risk factors associated with AMI.

As the overall population trends decrease, the minority population increases over time. The future trends of AMI may increase rather than decrease within the entire population as the minority population increases. According to the 2010 U.S. Census Bureau, the black population had a 12.3 percent increase in the number of AMI diagnoses, compared to a 5.7 percent increase among Caucasians.

It has been determined in this study that the female population within the three states of Florida, Maryland and Arizona, as based on the Hospital Discharge Summary, indicates females diagnosed with AMI are more likely to have a comorbid condition, which often can obscure signs and symptoms of AMI when presenting to the ER.

The signs and symptoms of women often differ from those of men. Women may experience back, jaw or neck pain, shortness of breath or dyspnea nausea, vomiting, fatigue, general weakness, anxiety, GERD, heartburn and overall discomfort. Men, on the other hand, have traditional symptoms such as chest pain, discomfort in the arm, shoulder and neck, as well as shortness of breath. Women are more likely to be

misdiagnosed and sent home only to become more acute as the condition exacerbates, thus decreasing the chance of survival.

We examined the data from these states for the presence of a comorbid diagnosis of chest pain, muscle strain, heart burn, gastric reflux disease or vague complaints which may mask the diagnosis of MI.

It was determined from Table 8 that the described signs and symptoms of fatigue, pain in limb, heart burn, anxiety and generalized pain and nausea, were noted to present in women upon admission to the ER compared to the men presenting to the ER. MD had the greater percentage of 84 percent as compared to men at 16 percent. The comorbid diagnoses of malaise and fatigue were indicated in 51 to 54 percent of women across the states, along with anxiety from 48 to 57 percent, as shown in Table 8.

Men presented with the classical signs and symptoms of chest pain, dyspnea, and shoulder pain. Chest pain and dyspnea presented in 54 to 66 percent of men, followed by shoulder and back pain (48 to 66 percent), within the AMI male population.

It was interesting to note the population with the highest percentage of AMI admissions for women in 2010 was MD at 42 percent, which also had the highest consistent percentage of women presenting with heartburn, at 84 percent, along with fatigue (54 percent) and anxiety (55 percent).

Arizona had the greatest percentage of men with MI, at 64 percent, in addition to the most men with the comorbid diagnosis of chest pain (66 percent), plus dyspnea (63 percent), as well as a high percentage of shoulder (58 percent) and back pain 59 percent). This was described in table 2 and table 8. These findings accept the hypothesis that a

higher proportion of women with an AMI have a comorbid diagnosis of complaints, which could obscure the signs and symptoms of an AMI.

According to the logistic regression model (Table 10), which predicted the presence of a comorbid diagnosis in the 2010 admissions obtained from the discharge summary data, the comorbid diagnosis might possibly obscure the diagnosis of AMI in both men and women across the three states. However, the analysis indicated women are more likely to have one or more diagnoses, which would make diagnosis and AMI difficult. The women in Arizona are 39.7 percent more likely than men to have one or more obscure diagnoses, and in Florida it is 52.8 percent higher, along with the MD rate of 48.9 percent. Women are more likely than men to have one or more diagnoses which would hinder the diagnosis of AMI. These findings are significant at $p<.0001$.

The proportion of female MI patients has increased over time in all three states, plus the female is more likely to have one or more obscure diagnoses, which makes diagnosis of an AMI more complex. Not only is the diagnosis difficult to assess, but it is increasing yearly in women with obesity, diabetes or both. The populations' risk among both men and women is increasing in order to achieve a well-timed diagnosis of AMI upon presentation to the ER and the ability to provide life-saving treatment according to the AHA and ACC guidelines. The likelihood that women will receive the necessary treatment is lower than men, even if they are diagnosed with AMI.

We observed from the data that women who are admitted with the primary diagnosis of AMI are much less likely than the AMI males to receive an angiogram. It was also determined that women diagnosed with AMI, along with obesity or diabetes, were less likely to obtain an angiogram. We did limit our study to analyzing the data

based on one procedure which is more often indicative of a STEMI. It would be interesting to also review AMI patients undergoing pharmacological therapy first and to note the disparities. In Arizona, women are 17.1 percent less likely to receive an angiogram, compared to 16.8 percent in Maryland and 19.6 percent in Florida. It is also noted across the three states that black patients are 50 percent more likely to be diagnosed with diabetes and obesity compared to Caucasian patients, a difference that is even more pronounced in Arizona, where Hispanic and Native American patients outnumber black patients, as indicated in Table 7. Much of the findings in the literature stated much of the same, however there was not as much evidence of disparities as noted in this study.

In summary, the "raw" frequencies data as presented in Tables 1 and 2 show the overall primary AMI admissions diagnoses are decreasing over time by approximately 20 percent. However, the number of females in proportion of AMI admissions diagnosis is increasing over time, a trend that is linked to not just the aging female population, but also lifestyle changes over the past decades. Women are under more stress than ever before due to the country's economic climate as well as the burden of juggling family, work and social responsibilities. These components can affect their general well-being, which has its associated health implications.

The descriptive analysis of the three states indicated the prevalence of patients with diabetes and obesity has increased from 2000 to 2010 for both males and females. The number of females diagnosed with AMI is exceeding the number of males based on hospital admission records in all three states with the presence of diabetes, obesity or presenting with both comorbidities. The percent of male and female MI patients with the comorbid diagnosis of obesity, diabetes, or both was significant $P<.0001$ in all states

from 2001 to 2010. The logistic regression models indicated patients diagnosed with AMI will more than likely over time present with one or more comorbities, plus females are at a greater risk than men.

As the potential risk for AMI in females increases, the ability to correctly diagnose and treat females decreases. The signs and symptoms within the female population with AMI differ compared to men and are often not recognized. When these symptoms go unnoticed the female is improperly diagnosed and does not receive appropriate treatment. However, even if the female is properly diagnosed, she is less likely to receive PCI as compared to men. Minorities are at a greater risk than female patients diagnosed with AMI. African American AMI patients have a greater chance of one or more comorbidities, which places them at a greater risk for AMI. Furthermore, Hispanic and Native Americans exceed the African American population for comorbidities and their risk will be larger.

Limitations

Some of the limitations of this study were utilizing the secondary data of only three states as compared to the entire country. We were able to provide a snapshot based on the three states 10 year hospital discharge records to determine the disparities in females and AMI diagnosis, treatment, and intervention. We must now enhance our understanding of the critical needs and extract data based on the social and economic demographics due to the high risk factors. We did not determine the mortality rate of females as compared to males as to the overall lack of treatment or intervention. We did limit our research to only the overall trends, comorbidities risk factors, treatment and

intervention for females. There is yet another question as to trend of mortality in the female and minority population. The study also did not take into account the geographic location with the highest increase incidence of AMI by region and population within each state based on gender, race, and ethnicity, economic and social factors. The study would have benefited in acknowledging the time between females presenting to the ER with signs and symptoms of an AMI to the time the female received intervention or treatment for the AMI to determine the average length of time as compared to the males preening based on the ACC guidelines. However, due to the limits within the secondary data set we were unable to determine if there is a disparity for females to receive the intervention or treatment within the 90 minute timeline for increase quality outcomes.

Project Significance

The percentage of females diagnosed with AMI is increasing year over year, as is the percentage of comorbidities; thus far females remain at a higher risk for an AMI and will often go undiagnosed and treated. Due to these findings it may be assumed females have a higher mortality rate than men diagnosed with AMI. Additional data are needed to improve our understanding and provide implications based on lack of AMI intervention within the female population in relation to the mortality rates. The ongoing increase in the incident of obesity and diabetes as communicated by the CDC along with other government and state agencies must be a public focus in order to adequately provide medical management to subjects with an increased risk of AMI. The ability to recognize the signs and symptoms is imperative for healthcare professionals, females, and minorities to achieve prevention, treatment, intervention and quality outcomes.

We must acknowledge and understand the differences in cardiac health risk factors among males and females in order to provide the necessary measures for improvement when females present with an AMI to the ER. Both the ACC and AHA have established guidelines and noted the importance of a timely diagnosis of those presenting with an AMI, especially a STEMI. We must first rekindle and impart a consistent message on initiatives such as the NHLBI's "The Heart Truth" in order to educate the public on critical awareness within the female population and heart disease. There must be a proactive approach on the local, state and federal level by means of public policies with reference to health equities for women and minorities. Minority females exceed the risk of the general female population and often have the least accessibility to healthcare within the United States.

There is a need for preventive screening, education, programs, and advocates working through public policy to make changes as well as provide innovate technology for the improvement of public health. The population with the most needs is often the one with the least amount of access to medical care.

In proactively communicating, advocating and expressing concerns over these healthcare disparities, we are also addressing other public health issues, such as obesity and diabetes. Both conditions are a public health risk and contribute to negative cardiac health for females. There is a need to promote a healthy lifestyle and not limit the focus to a single condition or risk factor. Advocating for the well-being of the whole person is imperative in order to improve quality of life and decrease demands of an already overstressed healthcare system.

Future Significance

Healthcare professionals must be accountable and stay abreast of the current and future state of healthcare. Educating oneself about heart disease is important in understanding the risks posed to females. The use of the mainstream media as well as social networking will enable the heart health message to cross the border both socially, demographically and socioeconomically. Partnering with physicians, healthcare professionals, academic and community medical centers, public health agencies, and vendors will only enhance our ability to reach more females by providing the most up-to-date concepts, trends, research, and innovative technology to manage the overall quality of life within the female population.

There is much to be determined in order to implement a strategy for increased outcomes and reduce the year over year increase of AMI in particular population groups as we have noted in the project. In continuing to better understand I would regionally segment the United States and review extensively the social demographics to determine the areas that have the highest prevalence of comorbidities within the female population.

Also needed is a closer examination of the regions with the greatest increase in percentage of AMI diagnosis over time in order to determine what if any changes occurred within the population during the period in question, and if this change occurred in other areas as well. I would like to examine the mortality rate of females and any information on the risk stratification within the female and minority female population and readmission rates within the first year of discharge as compared to males. It would also be important to determine the number of females diagnosed and undergoing

appropriate treatment within the 90-minute AHA and ACC guidelines and their outcomes as compared to males.

CONCLUSION

We observed a decreasing number of AMIs over time, but an increasing proportion of AMI admissions being female, and an especially high rate observed for minority women. Women with an AMI also have a higher rate of comorbid obesity and/or diabetes than observed in men. In addition, women are more likely to have comorbid signs or diagnoses with symptoms that could mimic AMI symptoms, and thus confuse the rapid diagnosis of an AMI. National guidelines stress the importance of a timely diagnosis of patients presenting with an AMI. To assure equity in access to quality care for AMI patients, both medical professionals and the public may need education focused on the increasing rate of AMI within the female population, and that minority females greatly exceed the AMI risk of the general female population. Furthermore, a change in guidelines to increase the use of laboratory tests for AMI for women with comorbid conditions that could obscure MI symptoms should be considered, especially for minority women.

In conclusion, the study was based and analysis was performed on the states; AZ, FL, and MD due to limited availability based on ten years of State Hospital Discharge Records. The findings included in this study are not necessary indicative of the entire United States but of these three states.

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