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Trends in the Use of Preventive Care by Women in the U. S. General Population

Erin Bennett
University of Rhode Island, erinbennett@my.uri.edu

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TRENDS IN THE USE OF PREVENTIVE CARE BY WOMEN IN THE U.S.
GENERAL POPULATION

BY

ERIN L. BENNETT

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF
MASTER OF SCIENCE
IN
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UNIVERSITY OF RHODE ISLAND

2013

MASTER OF SCIENCE THESIS
OF
ERIN L. BENNETT

APPROVED:

Thesis Committee:

Major Professor	Dr. Brian J. Quilliam, Ph.D.
	Dr. Stephen J. Kogut, Ph.D.
	Dr. Rachel L. DiCioccio, Ph.D.

Nasser H. Zawia, Ph.D.
DEAN OF THE GRADUATE SCHOOL

UNIVERSITY OF RHODE ISLAND
2013

ABSTRACT

Statement of the Problem: The disease burden of breast cancer remains strong as the second leading cause of cancer death among women in the United States.¹ Despite this, the rate of women receiving a mammogram has shown little improvement since 2000.² As health insurance will provide expanded coverage for mammography through the Affordable Care Act, it is essential to identify and describe women who have a lower probability of receiving the recommended breast cancer screening.

Objective: To describe trends in receipt of biennial mammography in women in the United States, and to further identify independent sociodemographic and clinical predictors of women not receiving a mammography as recommended by national guidelines.

Methods: Using data from the 2008-2010 Medical Expenditure Panel Survey (MEPS), I conducted a cross-sectional study and selected women forty years of age or older who had identified the time since their last mammogram as asked in the *Preventive Care supplement*. Within the final sample of 20,796 women, I assessed trends in mammography use in the previous two years, and differences in sociodemographic, clinical and type of usual source of care (creating 2 groups: no mammography, yes mammography). For analytic purposes, this study was analyzed as a case control study comparing women without a mammogram to women who had received a mammogram in the past 2 years. An unconditional logistic regression model was used to identify predictors of missed mammography and the data were weighted using SUDAAN software to account for the complex survey design and the nationally representative sampling scheme.

Results: Overall, in the weighted sample of 210,485,707 women, 26.9% (n=56,532,799) did not receive a mammogram in the previous 2 years. Women in the case group (absence of recommended mammography) were of similar age and race/ethnicity as women in the control group (presence of recommended mammography). Overall, the study population consisted mostly of women aged 40-59 comprised by 60.1% of the cases and 57.9% of the controls. In multivariable modeling, the strongest predictor of missing a recommended mammogram was not having a usual source of care (OR=2.86; 95% CI, 2.52-3.25) and women without insurance during the study period (OR=2.34; 95% CI, 2.07-2.65).

Conclusions: More than 1 in 4 women, or approximately 57 million women, did not receive the recommended biennial mammogram screening. Women without a usual source of care were less likely to receive the recommended screening, but variation across type of usual source of care was not apparent in my study. Age, race/ethnicity and other demographic and clinical characteristics were related to lack of receipt of mammography. With the passage of the Affordable Care Act, targeted interventions to reach the population subgroups less likely to receive the recommended mammography screening are essential.

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PREFACE

This thesis has been prepared in the manuscript format and therefore was prepared to conform to the *Uniform Requirements for Manuscripts Submitted to Biomedical Journals*. This work has not been previously published and is currently not under consideration for publication. The study conducted for my thesis was unfunded research.

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MANUSCRIPT

To be submitted to the *Journal of Women's Health*

Trends in the Use of Mammography by Women in the US General Population

Erin L. Bennett,¹ Stephen J. Kogut PhD,¹ Rachel L. DiCioccio PhD,² Brian J.

Quilliam PhD¹

¹ College of Pharmacy, University of Rhode Island, Kingston, RI

² Harrington School of Communication and Media, Department of Communication
Studies, University of Rhode Island, Kingston, RI

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Corresponding Author:

Brian J. Quilliam, PhD
University of Rhode Island
College of Pharmacy
7 Greenhouse Road
Kingston, RI 02881
(401) 874-2030 [phone]
(401) 874-5014 [fax]
bquilliam@uri.edu

ABSTRACT

Background: As health insurance will provide expanded coverage for mammography through the Affordable Care Act, it is essential to identify and describe women who have a lower probability of receiving the recommended breast cancer screening.

Methods: Using data from the 2008-2010 Medical Expenditure Panel Survey (MEPS), we identified women forty years of age or older who had identified the time since their last mammogram and assessed trends in mammography use in the previous two years, and differences in sociodemographic, clinical and type of usual source of care (creating 2 groups: no mammography, yes mammography). We developed an unconditional logistic regression model to identify predictors of missed mammography.

Results: Overall, in the weighted sample of 210,485,707 women, 26.9% (n=56,532,799) did not receive a mammogram in the previous 2 years. Women without mammogram were of similar age and race/ethnicity as women reporting a mammogram. In multivariable modeling, the strongest predictor of missing a recommended mammogram was not having a usual source of care (OR=2.86; 95% CI, 2.52-3.25) and women without insurance during the study period (OR=2.34; 95% CI, 2.07-2.65).

Conclusion: More than 1 in 4 women, or approximately 57 million women, did not receive the recommended biennial mammography. Women without a usual source of care were less likely to receive mammography, but variation across type of usual source of care was not apparent in my study. With the passage of the Affordable Care

Act, targeted interventions to reach the population subgroups less likely to receive recommended mammography screening are essential.

CHAPTER 1

INTRODUCTION

Cancer is the second leading cause of death in the United States and it is estimated that 1 in 3 women will develop cancer during their lifetime.³ For women, breast cancer is the second leading cause of cancer related death.¹ From 2005-2009, the age adjusted death rate from breast cancer was 22.5 per 100,000 women.¹ The National Cancer Institute (NCI) estimates that 226,870 women will be diagnosed with breast cancer and 39,510 women will die from cancer of the breast in 2012.⁴ Mammograms can provide early detection of breast cancer, potentially leading to earlier treatment before the cancer proceeds to advanced stages. In a study by Howlader and colleagues, 5-year survival ranged from 84-99% for earlier stages of breast cancer compared to 23% for later stages of breast cancer.^{5,6} For women ages 40-80, mammography has been shown to help reduce the number of deaths from breast cancer.⁷ As a result, the NCI recommends a screening mammography every 1 to 2 years for women over the age of 40.⁷ Similarly, the US Preventative Service Task Force recommends women aged 50 to 74 years old receive a mammogram every two years.⁸

Previous studies demonstrate that having a usual source of care (USC) increases the likelihood of receiving preventative services,⁹ including mammography.¹⁰ While having a USC is predictive of use of preventative services, disparities remain, including a lack of data identifying how the type of USC may influence the use of

preventative services. Effective September 23, 2010, mammography screening is covered under the Affordable Care Act thus reducing barriers related to cost for receiving this preventive service. Despite this, the disease burden of breast cancer remains strong and the rate of women receiving a mammogram has shown little improvement since 2000.² As health insurance will provide expanded coverage for mammography, it is essential to identify and describe women who have a lower probability of receiving the recommended breast cancer screening. This knowledge is crucial in developing and implementing effective and targeted health initiatives, mitigating disease, and reducing mortality. This thesis research was conducted to provide valuable insight into current rates of mammography and further identify population subgroups at higher risk of failing to receive routine mammogram screening. The specific aims of my thesis were:

1. To describe trends in receipt of mammography in women in the United States through the Medical Expenditure Panel Survey (MEPS), overall and stratified by type of usual source of care.
2. To identify independent sociodemographic and clinical predictors of lack of receipt of mammography as recommended by national guidelines.

The study hypotheses were twofold; 1) Receipt of mammogram would be variable across type of usual source of care and 2) Women that report their usual source of care as an office setting (medical doctor), are more likely to receive a recommended mammogram, than those with other reported types of usual source of care.

CHAPTER 2

REVIEW OF LITERATURE

Role of Prevention

Each year, injuries and chronic diseases are responsible for millions of premature deaths; representing 66% of all causes of death.¹¹ Five of the six leading causes include heart disease, cancer, stroke, chronic lower respiratory disease, and unintentional injuries, all of which can be mitigated through preventive actions. In women's health, breast cancer is the second-leading cause of cancer death among women in the United States. It is stated that over the course of a lifetime, 1 in 8 women will be diagnosed with breast cancer.¹² Mammograms have been shown to lower the risk of dying from breast cancer by 25-30% when the disease is detected early. The overall 5 year survival rate for all breast cancer (regardless of stage) has improved tremendously from 63% in the 1960's to 90% in recent years.¹³ However, when identified and treated earlier, better mortality rates are reported. For localized breast cancer (an early stage of the disease), the 5 year relative survival rate is 99%.¹³ Concurrently, the death rate for breast cancer has decreased over time. From 2004-2008 death rates for breast cancer dropped 3.1% per year from women under the age of fifty and 2.1% per year for women aged fifty and over.¹³ The increase in survival rates and decrease in death rates can be attributed to prevention efforts such as early detection and improved screenings.¹³ Prevention services and screenings play an

important role in providing direct and indirect health benefits and lowering health care costs.

Variability in Prevention

Multi-faceted environmental and socioeconomic factors are known to have a significant impact on variability in chronic disease rates and access to preventive care. For chronic conditions such as diabetes, obesity, and hypertension, data from the Centers for Disease Control and Prevention (CDC) shows that the black non-Hispanic population has the highest disease rate followed by Hispanic and American Indian/Alaskan native in 2009.¹¹ More recently, the National Health Interview Survey (NHIS) reported on ten year trends (2000-2010) of adults 45 years of age and older with multiple chronic conditions. The survey suggests racial and ethnic disparities in the prevalence of two or more chronic conditions more non-Hispanic black adults had two or more chronic conditions than adults in other racial and ethnic groups.¹⁴ Disparities not only exist among race/ethnicity but also among income levels. The NHIS found that the prevalence of two or more chronic conditions in the 45-64 age group significantly decreased as family income increased; those below 100% of the poverty line had a prevalence rate four times those 400% above the poverty line. The percentage of adults that did not receive or delayed medical care due to cost in the 45-64 age group increased 36% in the last ten years. In contrast, the percentage of the 65 and older age group that delayed or did not receive medical care due to cost remained unchanged. Regarding age disparities, a study in 2005, determined that less than half of older adults ages 50-64 were up to date on recommended clinical preventive

services such as screenings and immunizations.¹¹ Based on data from 2005-2009, the median age of breast cancer diagnosis is 61 years of age.⁴ Since the median diagnosis age is also within the age group identified as being behind on recommended clinical screenings, there is a gap in knowledge to understand the population group not receiving routine mammograms. Identifying trends and disparities in health outcomes is essential in identifying population groups at risk in order to properly implement effective health intervention programs.

Recommended Breast Cancer Screening

Both the U.S. Preventive Services Task Force (USPSTF) and the National Cancer Institute (NCI) publish expert recommendations on breast cancer screening. The USPSTF is an independent panel of national experts comprised of sixteen volunteers from preventive medicine and primary care fields with the goal of providing evidence based recommendations on preventive services. The USPSTF provides recommendations in screening for breast cancer using film mammography categorized by age. For women aged 40-49 years, they state “Individualize decision to begin biennial screening according to the patient's circumstances and values.”⁸ For women aged 50-74 years, USPSTF recommends screening every 2 years.⁸ Although it is stated that increased age is often the most important risk factor for breast cancer, among women aged 75 years or older there is no recommendation for screening based on lack of evidence supporting the benefit in this age group.⁸ It is important to note that in addition to the timing of screening recommendations, the USPSTF also goes further to say that patients should utilize facilities certified under the Mammography

Quality Standards Act (MQSA).⁸ Although moderate, the USPSTF addresses the potential harms in screening with film mammography as psychological, radiation exposure, and false-positive results causing additional medical visits, imaging, and biopsies in women without cancer.⁸ The National Cancer Institute also provides recommendations for routine mammography. Their recommendation varies slightly from USPSTF in that biennial mammography is recommended starting at the age of forty onward.⁷ The NCI states that studies have not shown a benefit of regular screening women under the age of forty or from baseline, but goes further to state that women under the age of forty who are at a higher than average risk of breast cancer should talk to their healthcare provider about getting a mammogram. Similar to the USPSTF, the NCI also provides information regarding MQSA certified facilities. The NCI addresses the same potential harms as that of the USPSTF also adding that false negatives can occur. According to the NCI, mammograms miss an estimated 20% of breast cancers that are present when screened, which can lead to delays in necessary treatments.⁷

Variability in Breast Cancer

Breast cancer is the second leading cause of cancer death among women, at an age adjusted death rate of 22.5 per 100,000.¹ It is estimated by the National Cancer Institute (NCI) that 226,870 women will be diagnosed with a breast cancer and 39,510 women will die from cancer of the breast in 2012.⁴ White women have the highest incidence rate of 127.3 per 100,000 followed by African American women at 121.2 per 100,000.⁴ Despite the fact that African American women do not have the highest

incidence rate, they have the highest death rate at 31.6 per 100,000 exceeding the death rate of 22.4 per 100,000 for white women.⁴ The incidence rates in the Hispanic population are 92.7 per 100,000 women while the death rates are the second lowest at 14.9 per 100,000.⁴ Not only do survival and incidence rates show disparities, but data from the National Health Interview Survey (1987-2010) on use of mammography in women aged 40 years and over show variance for screenings also.² When comparing the two races with the highest incidence and death rates, from 1987-2000, the percent of African American women utilizing mammography was consistently lower than in white women.² However, 2003-2010 shows an improvement in the utilization of mammography as the percent of African American women was aligned with the percentage of white women (with the exception of 2005).² From 1987-2010, the percent of Hispanic women having a mammogram in the past 2 years was consistently lower than non-Hispanic women.² When looking at usage by age, women aged 50-64 have consistently shown the highest percentage over the time period evaluated, followed by women aged 65-74.² By percent of poverty level, the proportion of women having a mammogram was directly related to the percent of poverty, as the percent of poverty increased (or becomes wealthier) the percent of women receiving a mammogram also increased.² Similarly, each level of higher education (categorized as no high school, high school, college or more) resulted in a higher percentage of mammography screening.² When looking at insurance, individuals with private insurance had the highest usage of mammography while the uninsured had the lowest.² Although select disparities have improved over time, the overall rate of women

receiving a mammogram has not improved since in the last decade and variability in prevention remains.

Usual source of care for Prevention

Previous data demonstrated a statistically significant benefit of having both a usual source of care and insurance on the likelihood of receiving preventive care. This trend was also true for receipt of a mammogram among women aged 40-69 years old.⁹ Having either usual source of care or insurance, but not both, gave inconclusive results in the receipt of mammogram. The study also determined that the uninsured group without a usual source of care was more predominant in Hispanic and non-white subgroups and in households without a high school education.⁹ According to a study using the NHIS database in 1999, having a 'usual place' or 'usual place and provider' was associated with increased likelihood of having received preventive service or screening.¹⁵ A similar 1996 NHIS study found that women having a usual source of care were 4 times as likely to receive Pap smears, 2 times as likely to receive breast exam, and 3 times as likely to receive mammogram.¹⁰

Affordable Care Act and Increased Coverage of Mammography

The Affordable Care Act, which was signed into law in March 2010, will reach full implementation by 2014. As part of this act, preventive health care services including mammography, are covered with no cost sharing (such as copayments, co-insurance, and deductibles) when offered by a provider in network. Mammography, among other preventive services deemed eligible, is also covered under Medicare with no out of

pocket costs for women at least forty years of age, as long as the provider accepts assignment.¹⁶

Summary

As full implementation of the Affordable Care Act approaches, the rate of women receiving a mammography screening as recommended according to national guidelines remains suboptimal. In 2010, only about 67% of women aged 40 or older received a mammogram in the last two years.² It is estimated that if 90% of women 40 and older received a mammography, 3,700 lives would be saved annually.¹⁷ While previous studies suggest that having a usual source of care is associated with an increased likelihood of receiving recommended preventive services, little is known about variations across types of usual source of care. The aim of this study is to further disentangle usual source of care by type in order to evaluate characteristics of women not receiving recommended breast cancer mammography screening.

CHAPTER 3

METHODOLOGY

Study Design: To achieve my specific aims; I utilized the Medical Expenditure Panel Survey (MEPS) and conducted a cross-sectional study to describe mammography rates and identify independent predictors of reduced likelihood of receiving the recommended mammography screening.

Medical Expenditure Panel Survey

For this study, I utilized a national probability sample collected by the National Center for Health Statistics, the MEPS dataset.¹⁸ The MEPS data surveys approximately 31,000 participants annually using a complex sampling scheme. The survey first identifies four geographic areas in the country (Northeast, Midwest, South, and West) to be included in the sample and then identifies 15,000 households for study inclusion. Within these households, individuals meeting inclusion criteria are selected for computer assisted personal interviewing and typically complete five rounds of interviews over the next two full calendar years.¹⁹⁻²¹ After data collection, these data are stripped of all unique identifying characteristics of individuals and made public available for analysis. As the MEPS data collects information on health service utilization and insurance coverage, it is a rich source of data to estimate the prevalence of use of these services and identify trends throughout time. However, MEPS does not routinely collect information on health conditions that have not been diagnosed

and therefore does not provide reliable estimates on the prevalence of disease as undiagnosed disease is not captured via the survey.²²

Study Population: The MEPS survey collects data on the US civilian non-institutionalized population.¹⁸ To identify a population eligible for mammography screening biennially,^{7,8} I restricted this larger population to women, equal to or greater than forty years old, in the 2008, 2009, and 2010 Medical Expenditure Panel Survey. To increase the sample size for analyses, the use of 3 years of data was necessary.

Study Definitions

Use of Mammography (Outcome Variable): The U.S. Preventive Task Force recommends women aged 50 to 74 years old receive a mammogram every two years.⁸ The National Cancer Institute recommends biennial screening mammography for women aged 40 or older.⁷ For this study, I defined the outcome as a dichotomous variable using the question from the preventive care supplement, focusing on lack of recommended mammography screening. The survey collects data from individuals through the preventive care supplement on when the individual last received a mammogram, coded 'MAMOGR53'. During the MEPS survey, women were asked details regarding their receipt of mammogram, specifically:

When did (PERSON) have (PERSON)'s most recent mammogram?

(With the potential interviewer prompt of: A mammogram is an x-ray taken only of the breast by a machine that presses against the breast.)

Within past year (1), Within past 2 years (2), Within past 3 years (3), Within past 5 years (4), More than 5 years (5)²³

Utilizing this question, I created a dichotomous outcome variable, defined as lack of receipt of a mammogram in the past 2 years (1 if yes; 0 otherwise).

Within the 2010 MEPS dataset, I utilized several sources of information to characterize women's usual source of care, their sociodemographic characteristics and their receipt of mammography, including: *Usual Source of Care*: MEPS collects data on an individual's access to care.¹⁸ Questions regarding the status of usual care, provider location, and personal characteristics of providers were used to determine exposure status. For this study, I defined usual source of care exposure as having one or more than one place as reported in the Access to Care questionnaire. I further defined exposure by the type of provider.

Usual Source of Care Definition: Within the MEPS survey, status of usual source of care is defined into three categories: 1) having a usual source of care; 2) having multiple sources of care; and 3) having no source of care. Usual source of care is further defined by place and type. Place of provider is defined as office, hospital, or hospital non emergency room; type of provider is defined as medical or non medical

doctor. Primary care is defined as a medical doctor in an office location.¹⁸ Using this information, I created four mutually exclusive groups of women to describe trends in mammography to achieve my first specific aim. The five groups were: 1) Office setting; 2) Hospital setting; 3) No Usual source of care; and 4) Missing.

Independent Predictors: For this study, I explored independent predictors of mammography identified in previous studies as well as other factors collected specifically within the MEPS survey. Based on previous research,²⁴⁻²⁸ I assessed age (categorized as 40-59; 60-79, and 80+ years), education (categorized as <high school; >high school), race/ethnicity (categorized as non-Hispanic white, non-white), marital status (categorized as married; widowed, divorced, separated or never married), poverty status (categorized as negative or poor, low income, middle or high income), and insurance status (categorized as yes or no for being insured any time during the survey period). I assessed additional predictors available through MEPS, including physical activity level (categorized as having a regular exercise routine; no regular exercise routine), all of which may contribute to use of mammogram.

STATISTICAL METHODOLOGY:

Data Cleaning: As this is a publicly available, de-identified dataset collected by the National Center for Health Statistics, the data undergo several rounds of cleaning and error checking internally prior to be released for use by the public. I identified instances of missing data resulting from data inconsistencies, participant refusal or

participant's responding "Don't Know". For each variable I utilized, I evaluated the extent of missing data and worked to identify solutions. In cases where the amounts of missing data were trivial, I noted this in the presentation of data. For instances where missing data were more substantial, I further evaluated the utility of analyzing this variable or describing the extent of missing data in my presentation of results if it revealed interesting trends.

The MEPS sample survey includes stratification, clustering, multiple stages of selection, and disproportionate sampling.¹⁸ Sampling weights reflect adjustments for survey non response and adjustments to population control totals from the Current Population Survey. The survey design and estimation complexities need to be taken into consideration when analyzing MEPS data. An estimate is considered to be reliable if it has a relative standard error of 30 percent or less. Estimates based on fewer than 30 records are considered unreliable, regardless of the magnitude of the relative standard error.¹⁸ During data cleaning, I evaluated relative standard errors by running frequency estimates for each of the variables I utilized to achieve my specific aims. In some instances, sparse data necessitated collapsing levels of categorical variables to ensure the relative standard error fell within the 30% threshold for providing reliable estimates.

Analysis: To meet the specific aims, I conducted two distinct phases of analyses. First, I described trends in the use of mammography overall as well as across sociodemographic (age and race/ethnicity) and by type of Usual source of care (office,

hospital, no usual source of care). Within each of these categories, I estimated the prevalence of mammography use in the previous 2 years. I calculated proportions of women self-reporting receipt of mammography. To compare differences between groups (i.e. across type of usual source of care or age groups), I utilized chi-square testing or Fisher's exact test (when the expected count was less than 5).²⁹

Next, I conducted bivariate analyses to identify differences in socio-demographic, clinical and type of usual source of care across mammography groups (i.e. created two groups of women, those receiving mammography and those who did not). I utilized these bivariate analyses to identify factors that preliminarily warranted further investigation as potential independent predictors of missed mammography in the previous 2 years. I evaluated between group differences (did not receive mammogram versus did receive mammogram) in each of the categorical potential independent predictors using chi-square testing (or Fisher's exact test where appropriate).

To further identify independent predictors and calculate adjusted odds ratios, I developed an unconditional logistic regression model with the logistic model taking the form:

$$E(Y/x) = \frac{e^{B_0 + \dots + B_n X_n}}{1 + e^{B_0 + \dots + B_n X_n}}$$

Initially, I included all individual variables identified as potential independent predictors during bivariate analyses (>5% difference between groups or p-value > 0.20) in an initial model. Factors found to be non-predictors in the initial model

($P > 0.05$) were then removed from the model in a sequential, non-computer generated fashion using backward elimination, creating nested models as factors were eliminated. After individual factors that were deemed to not contribute to the model, a new nested model without the factor was refit and I verified the removal of the variable using likelihood ratio testing. After all non contributing factors were removed from the model a final working model was achieved. After a final model was fit containing all factors, I conducted model diagnostics. The final model was then evaluated for co linearity using Variance Inflation Factor (VIF) testing and overall model fit was assessed using the Hosmer and Lemeshow Goodness of Fit test. From the final model, I derived odds ratios (OR) and 95% confidence intervals (CI) to determine strength of the association for independent predictors. The results are presented from the final model as crude (unadjusted) and multivariable (adjusted) odds ratios, with their respective 95% confidence intervals and significance levels. All statistical tests were conducted with a two-tailed alpha of 0.05.

All preliminary analyses were performed using SAS (SAS Institute Inc., Cary, NC, Version 9.2.1). To account for the complex survey design and oversampling included as part of the MEPS data collection procedures, all final analyses were weighted using SUDAAN software (RTI International, Research Triangle Park, NC, Version 11.0.0).

CHAPTER 4

FINDINGS

A total of 20,796 women (weighted estimate 210,485,707) years of age were eligible for inclusion in my study. More detailed information on final sample selection is presented in Figure 1. Amongst the eligible sample, 26.9% (n=56,532,800) did not report receiving a mammogram in the previous 2 years. Several demographic and clinical differences were identified between women not receiving a mammogram and those women receiving a mammogram in the previous 2 years. As presented in Table 1, women in the case group (absence of recommended mammography) were of similar age and race/ethnicity as women in the control group (presence of recommended mammography). Overall, the study population consisted mostly of women aged 40-59 comprised by 60.1% of the cases and 57.9% of the controls. The prevalence of women aged 80 years or older was higher in the cases, 13.9% compared to 6.8% in the controls. Cases were more likely to have less than a high school education (20.4% in cases and 11.0% in controls), be widowed, divorced, separated or never married (52.1% in cases and 39.0% in controls), and have a negative/poor income (16.2% in cases and 8.7% in controls) or have a low income (25.6% in cases and 15.6% in controls). As presented in Table 2, controls had a slightly elevated history of any cancer (17.5% in controls compared to 13.4% in cases) as well as a history of breast cancer (5.1% in controls compared to 3.2% in cases). The prevalence of women that did not engage in moderate to vigorous physical activity was higher in the cases

(53.1% in cases and 45.8% in controls). Cases were also more likely to have a fair/poor perception of their own health status (22.7% in cases and 16.0% in controls).

Patterns of mammography utilization by usual source of care are detailed in Table 3. Overall, cases were less likely to have a usual source of care when compared to the controls (23.7% in cases and 8% in controls). Of women who did have a usual source of care, the cases were less likely to have a primary care provider (38.5% in cases and 49.8% in controls). However, women citing their usual source of care as a specialist or non-medical doctor were similar when it came to receipt of mammography. Provider type presented a significant amount of missing data in both groups (34.9% in cases and 39.8% in controls) and therefore further analyses were not possible. Overall, the majority of women in the study population (> 75% in both groups) answered yes to being insured any time during the survey period. However, cases were less likely to have insurance than controls (22.6% in cases and 7.7% in controls).

The results of the logistic regression model designed to identify independent predictors of missed mammography are presented in Table 4. The strongest predictor of missing a recommended mammogram was not having a usual source of care (OR=2.86; 95% CI, 2.52-3.25). Similarly, women without insurance during the study period had a ~2-fold increase in the odds of missing a recommended mammogram (OR=2.34; 95% CI, 2.07-2.65). Women that identified their usual source of care as a hospital were not significant as a predictor as they were similar to those reporting their usual source of care as an office setting (OR=0.92; 95% CI, 0.79-1.06). Women who

had a usual source of care but did not specify type of care were therefore considered missing data (0.8%) and were also non-significant in predicting lack of mammogram (OR=0.98; 95% CI, 0.63-1.54).

Other factors were also associated with lack of receipt of the recommended mammography screening. After adjusting for all other factors, age was associated as being protective for women aged 60-79 (OR=0.81; 95% CI, 0.72-0.90), as they were 19% more likely to receive a recommended mammogram than the reference group (women aged 40-59). Conversely, women aged 80 years or older were a predictor of missed mammogram, with a ~2-fold increase in the odds when compared to the reference group (OR=2.09; 95% CI, 1.77-2.47). Non white women had an 18% lower rate of missing a recommended mammogram than white non Hispanic women (OR=0.82; 95% CI 0.74-0.90) thus making white non Hispanic women a predictor of missed mammogram. Women with at least a high school degree had a 27% lower rate of missing a recommended mammogram than women with less than a high school degree (OR=0.73; 95% CI, 0.65-0.81). Women who were widowed, divorced, separated, or never married had a 1.34 increase in the odds of missed mammogram than women who were married (OR=1.34; 95% CI, 1.21-1.49). All women that were below 200% of the poverty line (negative, poor, or low income) were associated with an increased rate of missing a recommended mammogram. Women with negative/poor income status had 1.51 higher odds of missed mammogram (OR=1.51; 95% CI, 1.32-1.73), while low income status was associated with a similar odds of 1.52 for missed mammogram (OR=1.52; 95% CI, 1.36-1.70). Overall, women who did

not have a recommended mammogram had increased odds of a self-reported fair/poor perceived health status (OR=1.24; 95% CI, 1.12-1.38) and did not partake in moderate to vigorous physical activity at least three times per week (OR=1.20; 95% CI, 1.10-1.31). No history of cancer was associated with a ~40% increase in the risk of not receiving a recommended mammogram (OR=1.39; 95% CI, 1.21-1.60).

CHAPTER 5

CONCLUSION

I conducted a cross sectional study utilizing the U.S. Medical Expenditure Panel Survey with a population based sample from 2008-2010. The study aimed to identify predictors of missed recommended mammography screening among women aged forty years and older. Overall, 1 in 4 women did not receive a recommended mammogram. This staggering result represents an estimated 57 million women nationally during the study period, some of which were found to be predisposed to missing a recommended mammogram. During the study period, the Affordable Care Act was implemented to cover screening mammography with no cost-sharing for eligible health plans on or after September 23, 2010. As full implementation of health care reform is underway, and the cost barrier for screening mammography has been minimized, the findings of this study emphasize important areas for health care intervention for women at risk of missed screening. With breast cancer as the second leading cause of cancer death among women¹³, the results of the study also serve as a reminder for disease and preventive care awareness, especially when predispositions exist.

One of the strongest findings from my study was the increased odds among women without a usual source of care or insurance. Women without a usual source of care were ~3 times more likely than those with a usual source of care to miss a

recommended mammogram. Similarly, women without insurance during the study period were ~2 times more likely than those with insurance to miss a recommended mammogram. In my study, 1 out of 4 did not have a usual source of care. Of women who did have a usual source of care, those who did not receive a mammogram were also less likely to have a primary care provider. These results are consistent with previous data that has demonstrated a statistically significant benefit of having both a usual source of care and insurance on the likelihood of receiving preventive care (e.g. mammogram, breast examination, Papanicolaou test, dental checkup, physical examination, cholesterol and blood pressure check).^{9,10,15} In a study by Swan et al³⁰ utilizing the National Health Interview Survey, women without a usual source of care were less likely to report a mammogram (54.0%, CI 49.6-58.3) than those with a usual source of care (67.9%, CI 66.7-69.2).³⁰ Additionally, Swan et al found that those with private or military insurance (69.4%, CI 68.1-70.7) or public insurance (63.8%, CI 60.8-66.8) were more likely to report a recent mammogram than women without any insurance (55.5%, CI 51.7-59.3). As the Affordable Care Act implementation will remove barriers of cost and expand insurance coverage, focus should be placed on reaching newly eligible women. Additionally, continued emphasis should be placed on programs such as the National Breast and Cervical Cancer Early Detection Program (NBCCEDP) which services underinsured and underserved women with access to screenings such as mammography.³¹

Receipt of mammogram was hypothesized to be variable across different types of usual source of care. In my study, women that reported having a primary care provider

were 11% more prevalent in women reporting recent receipt of a mammogram. However, for women reporting their usual source of care as specialists or non-medical doctors, results were similar between the two. Additionally, the results yielded no significant difference between a hospital setting (OR=0.92; 95% CI, 0.79-1.06) and an office setting. A study by Blewitt et al¹⁵, found that women with both a usual place for care and a usual provider had nearly five times higher odds (OR=4.8, 95% CI 3.7–6.4) of having had a mammogram in the past year compared with women who had no usual place for preventive care.¹⁵ Direct comparison of other studies assessing type of usual source of care in detail, and specifically to mammography screening, was problematic as usual source of care can be defined in various ways. My study evaluated usual source of care at a deeper level and specific to mammography, thus filling gaps in knowledge. While the results of this study confirmed previous studies of the impact of having a usual source of care on receipt of mammography, they did not support the hypothesis that variability in lack of receipt of mammogram would exist across type of usual source of care. As the sample size available for analyses in my study was limited, the overly simplified classification (i.e. office versus hospital based) may have obscured the effect of more subtle differences in type of usual source of care (e.g. emergency department). Additional large scale studies of women are needed to further evaluate potential differences in receipt of mammography by provider type.

Within my study, I assessed age as an independent predictor of not having received a mammography within the previous two years. After adjusting for all other factors, women aged 60-79 were 19% more likely to receive a recommended mammogram

than women aged 40-59. Women aged 80 years or older had nearly 2 times higher odds of having missed a recommended mammogram (OR=2.09; 95% CI, 1.77-2.47). In a population based study evaluating cancer screenings in women aged forty years and older, women 50-64 were more likely (predicted margin 71.7%, 95% CI, 70.1-73.3) to report a mammogram in the last two years than other age groups.³⁰ In the same study, the age group 65 years or older were not far behind (predicted margin 68%, 95% CI, 66.4-70.1),³⁰ which contradicts the findings in my study. This discrepancy could be attributed to the study data timeframe being several years earlier from 1992-2005, the methods used to calculate associations as predictive margins versus odds ratios, or the categorization of age as 65 years or older compared to my study which divides the age group by 60-79 and 80 years or older.

Although white non Hispanic women historically have had the highest screening mammography rates as shown in data from the Centers for Disease Control (CDC), more recent data suggests that non white women have made great strides in increasing screening rates.² When looking at trends from 2000-2010, African American women screening rates not only align with white women by 2003 but slightly surpass the rates in 2010 at 67.9% to 67.4%.² Similarly, American Indian or Alaskan Native screening rates went from below ~20% white women in 2000, to ~4% above in 2010.² Among Hispanic women, screening mammography rates went from a deficit of ~11% in 2000 when compared to white non Hispanic women, to ~4% in 2010; closing the gap nearly 7% over the decade.² Within my study, non white women had an 18% lower rate of missing a recommended mammogram than white non Hispanic women (OR=0.82;

95% CI 0.74-0.90) thus making white non Hispanic women a predictor of missed mammogram. A study by Swan et al³⁰ in 2005 found no significant differences in mammography use by race/ethnicity in evaluating predictive margins. Another study Blewett et al¹⁵, using the same data source as Swan et al³⁰ (NHIS), found African American women and Hispanic women to have a 1.3 greater likelihood of receiving a mammogram than white women.¹⁵ The Morbidity and Mortality Weekly Report shows that mammography screening rates in women aged 50-74 in 2010 were slightly higher in African American women (73.2%) than in white women (72.8%).³² Overall, continued focus should be put towards areas of progress in screening rates over the last decade among non white women, while public health efforts for white non Hispanic women should be revisited.

Within the study, I assessed additional predictors based on previous research,²⁴⁻²⁸ including education, marital status, poverty status, and physical activity level, all of which may contribute to use (or lack of use) of mammogram. Women with at least a high school degree were 27% more likely to report having a recent mammogram than women with less than a high school education. Women who were widowed, divorced, separated, or never married had 34% higher odds of missed mammogram than women who were married (OR=1.34; 95% CI, 1.21-1.49). All women that were below 200% of the poverty line (negative/poor or low income) were associated with an increased rate of missing a recommended mammogram (OR=1.51; 95% CI, 1.32-1.73; OR=1.52; 95% CI, 1.36-1.70). Overall, women who did not have a recommended mammogram had increased odds of a self-reported fair/poor perceived health status

(OR=1.24; 95% CI, 1.12-1.38) and did not partake in moderate to vigorous physical activity at least three times per week (OR=1.20; 95% CI, 1.10-1.31). No history of cancer was associated with a ~40% increase in the risk of not receiving a recommended mammogram (OR=1.39; 95% CI, 1.21-1.60). A study using 2005 NHIS and 2000 U.S. census tract-level data to ascertain repeat mammography trends by Dailey et al²⁵, shows odds ratios for education level less than high school, marital status of widowed/divorced/separated/never married, and annual family income <\$75,000 as having lower odds of receiving repeat mammograms than their respective reference groups.²⁵

Study Limitations: The data utilized for this study comes from self-reported responses through interviews administered through Computer Assisted Personal Interviewing (CAPI) technology. As the demographic and clinical diagnoses were self-reported, some of the conditions (e.g. history of cancer) may have been underestimated. History of breast cancer was not retained in the final multivariable model (based on *a priori* selection factors), though prevalence was low (3.2% in cases, 5.1% in controls) and it was highly correlated with history of cancer which was included in the final model. The interviews provide estimates of respondents' health status, demographic and socio-economic characteristics, and access to care among other factors. The sociodemographic and clinical factors evaluated in my study are widely known and were validated against previous studies. In addition, the study originally utilized 2010 data only which yielded too small of a sample size (n=6,769) for the analyses. As a result, two additional years (2008-2009) were merged to achieve satisfactory sample

size increasing it ~3 fold (n=20,796). Regardless, more refined categorization of data (e.g. expanded categories of race/ethnicity) was not possible. Lastly, some independent predictors were dropped from the analyses due to significant amounts of missing data. Provider type was one of these groups, yielding 35% missing data. Despite these limitations, the present study utilizes a large nationally representative sample of women at least 40 years of age.

Conclusions: More than 1 in 4 women, or more than 57 million women, did not receive the recommended biennial mammogram screening. Women without a usual source of care were less likely to receive the recommended screening, but variation across type of usual source of care was not apparent in my study. Age, race/ethnicity and other demographic and clinical characteristics were related to lack of receipt of mammography. With the passage of the Affordable Care Act, targeted interventions to reach the population subgroups less likely to receive the recommended mammography screening are essential.

Table 1. Demographic Characteristics among Women 40 and older not Receiving Recommended Mammography Screening compared to Women Receiving Recommended Mammography Screening in the 2008-2010 Medical Expenditure Panel Survey.

Characteristic	Mammography-No (n=5,967) (Weighted n=56,532,800)	Mammography-Yes (n=14,829) (Weighted n=153,952,907)	Chi-Square Test Statistic (P-value)
Age Category (years)			$\chi^2=52.9$ (p=<0.001)
40-59	60.1%	57.9%	
60-79	26.0%	35.3%	
80+	13.9%	6.8%	
Race/Ethnicity			$\chi^2=0.5$ (p=0.5)
White Non Hispanic	82.6%	83.0%	
Non White	17.4%	17.0%	
Education			$\chi^2=146.8$ (p=<0.001)
< High School	20.4%	11.0%	
=>High School	79.6%	89.0%	
Marital Status			$\chi^2=127.3$ (p=<0.001)
Married	47.9%	61.0%	
W/D/S Never	52.1%	39.0%	
Income/Poverty Status			$\chi^2=108.4$ (p=<0.001)
Negative or Poor	16.2%	8.7%	
Low Income	25.6%	15.6%	
Middle/High Income	58.2%	75.7%	

Table 2. Indicators of Health Status among Women 40 and older not Receiving Recommended Mammography Screening compared to Women Receiving Recommended Mammography Screening in the 2008-2010 Medical Expenditure Panel Survey.

Characteristic	Mammography- No (n=5,967) (Weighted n=56,532,800)	Mammography- Yes (n=14,829) (Weighted n=153,952,907)	Chi-Square Test Statistic (P-value)
Physical Activity Level (moderate to vigorous activity three times per week)			$\chi^2=52.9$ (p=<0.001)
Yes	46.9%	54.2%	
No	53.1%	45.8%	
Perceived Health Status			$\chi^2=65.5$ (p=<0.001)
Excellent/Very Good/Good	77.3%	84.0%	
Fair/Poor	22.7%	16.0%	
History of Cancer			$\chi^2=24.2$ (p=<0.001)
Yes	13.4%	17.5%	
No	86.6%	82.5%	
History of Breast Cancer			$\chi^2=15.4$ (p=<0.001)
Yes	3.2%	5.1%	
No	96.8%	94.9%	

Table 3. Characterization of Usual Source of Care among Women 40 and older not Receiving Recommended Mammography Screening compared to Women Receiving Recommended Mammography Screening in the 2008-2010 Medical Expenditure Panel Survey.

Characteristic	Mammography- No (n=5,967) (Weighted n=56,532,800)	Mammography- Yes (n=14,829) (Weighted n=153,952,907)	Chi-Square Test Statistic (P-value)
Usual Source of Care			$\chi^2=148.4$ (p=<0.001)
Yes	75.6%	91.2%	
No	23.7%	8.0%	
Missing	0.7%	0.8%	
Usual Source of Care Type			$\chi^2=99.7$ (p=<0.001)
Office	64.4%	78.2%	
Hospital	11.1%	13.0%	
None	23.7%	8.0%	
Missing	0.8%	0.9%	
Provider Type			$\chi^2=79.2$ (p=<0.001)
None	23.7%	8.0%	
Primary Care Provider	38.5%	49.8%	
Specialist	1.7%	1.4%	
Non-Medical Doctor	1.3%	1.0%	
Missing	34.9%	39.8%	
Insurance Status			$\chi^2=273.8$ (p=<0.001)
Yes	77.4%	92.3%	
No	22.6%	7.7%	

Table 4. Independent Predictors of Lack of Receipt of Recommended Mammography Screening among Women 40 and older in the 2008—2010 Medical Expenditure Panel Survey

Independent Predictor	Crude OR (95% CI)	Adjusted OR* (95% CI)
<i>Demographic</i>		
Age		
40-59	1.00 (n/a)	1.00 (n/a)
60-79	0.71 (0.64-0.78)	0.81 (0.72-0.90)
80+	1.96 (1.66-2.31)	2.09 (1.77-2.47)
Race/Ethnicity		
White Non Hispanic	1.00 (n/a)	1.00 (n/a)
Non White	1.03 (0.94-1.14)	0.82 (0.74-0.90)
Education		
< High School	1.00 (n/a)	1.00 (n/a)
=>High School	0.48 (0.44-0.53)	0.73 (0.65-0.81)
Marital Status		
Married	1.00 (n/a)	1.00 (n/a)
W/D/S Never	1.70 (1.55-1.86)	1.34 (1.21-1.49)
Income/Poverty Status		
Negative or Poor (<100%)	2.41 (2.12-2.73)	1.51 (1.32-1.73)
Low Income (100-199%)	2.14 (1.93-2.38)	1.52 (1.36-1.70)
Middle/High Income (>199%)	1.00 (n/a)	1.00 (n/a)
<i>Health Status</i>		
Physical Activity Level (moderate to vigorous activity three times per week)		
Yes	1.00 (n/a)	1.00 (n/a)
No	1.34 (1.24-1.45)	1.20 (1.10-1.31)

Table 4 (continued)

Perceived Health Status		
Excellent/Very Good/Good	1.00 (n/a)	1.00 (n/a)
Fair/Poor	1.54 (1.40-1.70)	1.24 (1.12-1.38)
History of Cancer		
Yes	1.00 (n/a)	1.00 (n/a)
No	1.37 (1.19-1.56)	1.39 (1.21-1.60)
Type of Care		
Usual Source of Care Type		
Office	1.00 (n/a)	1.00 (n/a)
Hospital	1.03 (0.89-1.19)	0.92 (0.79-1.06)
None	3.61 (3.21-4.06)	2.86 (2.52-3.25)
Missing	1.15 (0.76-1.73)	0.98 (0.63-1.54)
Insurance Status		
Yes	1.00 (n/a)	1.00 (n/a)
No	3.48 (3.10-3.89)	2.34 (2.07-2.65)

* Adjusted for all factors listed in the table

Figure 1. Inclusion/Exclusion Criteria

Figure 2. Overall Trends in Mammography* Screening among Women 40 and older in the 2008-2010 Medical Expenditure Panel Survey

Figure 2. Overall Trends in Mammography* Screening among Women 40 and older in the 2008-2010 Medical Expenditure Panel Survey

* Women Self-reporting not receiving a Mammogram in the Previous 2 years

Source: Medical Expenditure Panel Survey, 2008-2010

Figure 3. Trends in Mammography* Screening among Women 40 and older by Age Category (years) in the 2008-2010 Medical Expenditure Panel Survey

Figure 3. Trends in Mammography* Screening among Women 40 and older by Age Category (years) in the 2008-2010 Medical Expenditure Panel Survey

* Women Self-reporting not receiving a Mammogram in the Previous 2 years

Source: Medical Expenditure Panel Survey, 2008-2010

Figure 4. Trends in Mammography* Screening among Women 40 and older by Race/ethnicity in the 2008-2010 Medical Expenditure Panel Survey

* Women Self-reporting not receiving a Mammogram in the Previous 2 years

Source: Medical Expenditure Panel Survey, 2008-2010

Figure 5. Trends in Mammography* Screening among Women 40 and older by Usual Source of Care in the 2008-2010 Medical Expenditure Panel Survey

Figure 5. Trends in Mammography* Screening among Women 40 and older by Usual Source of Care in the 2008-2010 Medical Expenditure Panel Survey

* Women Self-reporting not receiving a Mammogram in the Previous 2 years.

Source: Medical Expenditure Panel Survey, 2008-2010

Note: Missing data accounted for 0.8% of the study population from 2008-2010.

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