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THE IMPACT OF THE ACA COST-SHARING ELIMINATION PROVISION ON THE UTILIZATION OF BREAST, CERVICAL, AND COLORECTAL CANCER SCREENING SERVICES AMONG INSURED INDIVIDUALS IN THE UNITED STATES

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UNITED STATES

by

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DEDICATION

This dissertation is dedicated to my dear husband, Amr, and my children, Yousef and Faisal. Without their love, sacrifice, and endless support, I would not have been able to complete this challenging five-year journey. They shared with me all aspects of this journey to earning a doctorate. I would like to also dedicate this dissertation to my parents, Salah and Fatena, and my siblings, Noura, Mansour, and Ahmad. I am blessed beyond measure and forever grateful for their love, support and encouragement. Last, but not least, I would like to thank my best friend Sara for helping me tremendously throughout the whole journey and being there whenever I needed help and making my life so much easier in Houston, Texas.

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UNITED STATES

by

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Preventive cancer screenings are essential to early detect cancer and subsequently save lives. However, out-of-pocket expenditures for cancer screening services deter individuals from obtaining them. In an effort to improve the utilization of cancer screening, the Affordable Care Act (ACA) implemented a cost-sharing elimination provision that removes all forms of cost-sharing including copayments, co-insurance and deductibles from certain preventive care services that are recommended by widely known scientific figures such as the United States Preventive Services Task Force (USPSTF).

This study evaluated the impact of the ACA cost-sharing elimination provision for preventive care services from 2008 through 2016 using a differences in differences (DID) approach. The approach compared utilization changes overtime between the insured (treatment group) and the uninsured (control group). This study investigated the impact of the ACA cost-sharing elimination provision on the utilization of three cancer prevention screenings, particularly, breast, cervical, and colorectal cancer screenings, among individuals who were privately insured and/or Medicare-insured, before and after the cost-sharing elimination provision enactment. This provision became effective for private health insurance plans, in 2010, and for Medicare, in 2011. A focus of this dissertation was to examine the influence of socio-economic and socio-

demographic factors on utilization changes. These factors were determined with the guidance of the Andersen Healthcare Utilization model which states that the usage of health services is determined by the three dynamics: predisposing, enabling, and need factors.

This study utilized data from the national Medical Expenditure Panel Survey (MEPS). The MEPS is a nationally representative survey of non-institutionalized United States (US) individuals and families. The results of this dissertation expand the current knowledge of the impact of the ACA cost-sharing elimination provision on increasing utilization of three cancer screenings and provides policy makers and health professionals with much needed information for decision-making.

The results of this study demonstrate that the ACA cost-sharing elimination provision did not have an impact on the utilization of the examined cancer screening services including mammography, Pap smear, FOBT, colonoscopy and sigmoidoscopy. However, there were some predisposing, enabling, and need factors that showed a significant effect on utilization rates, suggesting that future research is necessary to understand and evaluate the impact of cost-sharing on access to cancer preventive care services.

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INTRODUCTION

Increasing the uptake of preventive care screening services for breast, cervical, and colorectal (CRC) cancer is critical for improving the health of the population because of their high potential for decreasing the burden of cancer in the United States (US) (Maciosek et al, 2009). Despite the significant efforts that have been made to increase cancer screenings, screening rates for breast, cervical, and CRC cancer remain suboptimal with the current rates disappointingly low. The excessive economic costs of cancer create a burden on individuals and the overall society. In 2015, the Agency for Healthcare Research and Quality (AHRQ) estimated that the total of all health care costs for cancer in the nation were \$80.2 billion. Similarly, a study estimating the national total cost of cancer care from 2010 to 2020 projected costs to increase to \$157.77 billion in 2020 as a result of an aging population; assuming that incidence, survival, and costs for main cancer sites would remain constant (Mariotto et al, 2011). In addition to costs, cancer is a deadly disease, particularly when not identified early. In fact, cancer is the second most common cause of death in the US after heart disease. This year, about 606,880 Americans will die from cancer, which is more than 1,670 people a day (American Cancer Society, 2019; Siegel et al, 2019). Given the high death rate expected from cancer, the role of policy has become fundamental in implementing policies that promote cancer screenings. One major attempt was the implementation of the Affordable Care Act (ACA) that included a variety of provision aiming to increase cancer screening and eventually an early cancer diagnosis and treatment that can save many lives.

The ACA cost-sharing elimination provision for preventive services is one of the provisions that aims to increase screening rates through the elimination of financial barriers that are presumed to deter individuals from obtaining the screenings. These financial barriers were costs incurred by the individuals in various forms including co-payments, deductibles, and

coinsurance. This provision became effective for private health insurance plans, in 2010, and for Medicare in 2011. The impact of the ACA cost-sharing elimination policy provision can be assessed by evaluating the receipt of breast, cervical, and CRC cancer screenings among privately and Medicare insured adults pre-and post ACA implementation after controlling for certain socio-demographic and socioeconomic factors.

Although previous studies have established that cost-sharing elimination could potentially increase preventive health services utilization, many of these studies have not investigated socio-demographic and socioeconomic differences, or time trends in preventive services use (Han et al, 2015). Additionally, there are only a few studies which evaluated the effects of cost-sharing on use of cancer preventive services in national samples (Rezayatmand et al, 2013) and most of the studies examined only a short period after the ACA because of the unavailability of data. This dissertation expands the body of knowledge by examining a variety of socio-demographic and socioeconomic factors that could have a significant impact on the utilization of cancer screenings particularly, breast, cervical, and CRC cancer screenings, utilizing national data from 2008 through 2016. The study sought to demonstrate the effect of the ACA cost-sharing elimination provision on cancer screenings rates and disparities among different groups in an effort to provide information to policy makers and health professionals on the outcome of the cost-sharing elimination provision. Guided by the well-established Andersen's Behavioral Model of Health Services Use (BM) with supporting evidence from the literature, this study identified socio-demographic and socioeconomic factors associated with screening. If the evidence indicates better health coverage and enhanced access does not lead to the optimal utilization of preventive care services, exploration of reasons for suboptimal cancer screening rates are explored.

BACKGROUND AND LITERATURE REVIEW

Preventive health services are vital because they enable early detection of diseases before the development of clinical symptoms. Lower utilization of preventive services is a major public health concern especially with the growing number of chronic diseases that are very costly to manage. On a national level, Americans use only half of the recommended level of preventive care services (Centers for Disease Control and Prevention (CDC), 2017) attributing to the leading causes of death, with the first cause of death being the diseases of the heart followed by cancer (Table 1). In fact, heart diseases and malignant neoplasms are responsible for about half of total deaths in the nation (CDC, 2015). In total, chronic conditions are responsible for 7 out of 10 deaths among Americans yearly and account for approximately 75% of the total nation's health spending. By 2030, it is estimated that more than 81 million Americans will have at least one chronic illness (Wu and Green, 2000) with projected costs related to their rising from \$1.3 trillion in 2003 to \$4.2 trillion by 2023 (Bodenheimer and Bennett, 2009). The leading causes of deaths in the U.S. in 2015 are listed in Table 1.

Table 1. Leading Causes of Death and Number of Deaths: United States, 2015	
Cause of Death	Deaths
All causes	2,712,630
Diseases of heart	633,842 (23.4%)
Malignant neoplasms	595,930 (21.9%)
Chronic lower respiratory diseases	155,041 (5.7%)
Unintentional injuries	146,571 (5.4%)
Cardiovascular diseases	140,323 (5.2%)
Alzheimer's disease	110,561 (4.1%)
Diabetes Mellitus	79,535 (2.9%)
Influenza and pneumonia	57,062 (2.1%)

Nephritis, nephrotic syndrome, and nephrosis	49,959 (1.8%)
Suicide	44,193 (1.6%)

Source: Centers for Disease Control and Prevention [https://www.cdc.gov/nchs/data/16.pdf#019](https://www.cdc.gov/nchs/data/hus/16.pdf#019)

Chronic conditions can be largely preventable through appropriate preventive services and screenings. A study that examined the health benefits of using nine recommended clinical preventive services, including mammography, colonoscopy, and the pap smear test, reported that these screening could prevent the annual death of approximately 25,000 to 40,000 Americans under 65 years and 50,000 to 100,000 Americans under the age of 80 years (Farley et al, 2010). Cancer screening services had a lower probability to save lives, with colonoscopy having the probability to prevent the highest number of deaths, which is 1900 deaths to be avoided each year for a 10% increase in screenings. Preventive care services could lead to major savings in health care spending. A study conducted to measure the medical costs and life savings of a package of twenty evidence-based services including breast, cervical, and CRC cancer screenings showed that improving the utilization of preventive services to 90% can save the healthcare system \$3.7 billion and 2 million lives annually (Maciosek et al, 2010). It is evident that with increased utilization of effective preventive services including cancer screenings, many lives would be prevented and immense costs would be saved.

The Affordable Care Act Cost-Sharing Elimination Provision

Before the implementation of the ACA, many insurance plans required cost-sharing for preventive services. Insured individuals were responsible for various forms of cost-sharing, including copayments, co-insurance, and meeting plan deductibles; these charges were often substantial out-of-pocket expenses for some screening services. Medicare beneficiaries who did not have supplemental insurance were required to pay 20% of the cost of many preventive services,

whereas Medicare beneficiaries with supplemental plans (Advantage plans) were responsible to pay more than this amount (Pyenson et al, 2014). For mammogram, the average out-of-pocket charge for women with any type of insurance was approximately \$33, which was 14.1% of the total charge (\$266) (Lemasters and Sambamoorthi, 2008). Although a \$33-dollar charge seems to be trivial, research has shown that an expense exceeding \$10 can deter underserved women from obtaining screening services, specifically a mammogram (McAlearney et al, 2007). Prior to the ACA, women who were privately insured or without insurance were found to be more likely to pay a part or the total cost of a mammogram compared to women who had federal or state insurance such as Medicare and/or Medicaid (Pagan et al, 2008). Out-of-pocket expenses drastically vary among different types of cancer screenings. For the pap smear test, the average out-of-pocket charge for insured individuals ranged from \$3 to \$11 before the ACA, which was the lowest amount among the five cancer screenings examined in this study (Goodwin and Anderson, 2012). Colonoscopy, which is the most common type of CRC cancer screening test, was more expensive than both the FOBT test and sigmoidoscopy. In 2010, the average cost sharing requirement for colonoscopy was approximately \$334 for privately insured individuals and \$275 for Medicare insured individuals. These cost requirements were a small percent of the total screenings costs of \$2146 (15.6%) and \$1071 (25.7%), respectively (Pyenson et al, 2014). On the other hand, the out-of-pocket expenses before the ACA ranged from \$12 to \$23 for a the FOBT test and \$55-\$171 for sigmoidoscopy, which were considerably smaller amounts (Goodwin and Anderson, 2012).

A growing body of literature has shown that out-of-pocket expenditures are a major financial barrier in utilizing preventive care services (Cooper et al, 2016; Rezayatmand et al, 2013; Trivedi et al, 2008; Koh and Sebelius, 2010; Goodwin and Anderson, 2012). Accordingly, an emerging body of research has shown that eliminating cost-sharing for preventive services may be

essential to increase their utilization to recommended levels (Solanki et al, 2000). Researchers who estimated the direct and indirect effects of cost-sharing on pap smearing and mammography found that it negatively impacted the receipt of preventive care, suggesting that cost-sharing elimination increases preventive care service utilization (Solanki et al, 2000).

Past legislation has had similar goals as the ACA, aiming to make health care more accessible and more affordable. Many of these reforms were successful in improving preventive care utilization. An important example comes from the state of Massachusetts that expanded to a near-universal health insurance coverage in 2006. A study comparing the effects of the Massachusetts reform on mammograms and pap smear tests between 2002 and 2010 found a significant increase in their utilization, especially among low-income women (Sabik and Bradley, 2016). Goodwin and Anderson found that after the 1997 elimination of cost-sharing legislation, which provided a deductible waiver for Medicare beneficiaries, pap smear tests and mammograms significantly increased in their utilization (Goodwin and Anderson, 2012). Another study examining the effect of a provision under the 2003 Medicare Prescription Drug, Improvement, and Modernization Act, that expanded the coverage of preventive services, reported an increase in utilization of mammograms and pap smear tests, especially among individuals with lower deductible plans (Meeker et al., 2011). The success from previous reforms indicate that there is a high potential for the ACA to reach its intended outcomes, especially in cancer preventive care, over a long period of time.

Research has consistently shown that cost-sharing in all forms creates a financial barrier on individuals and reduces the utilization of preventive services and (Rubin and Mendelson, 1995). Therefore, in an effort to increase access and control costs, in 2010, the ACA mandated that private health plans should cover forty-five specific recommended preventive services and eliminate all

forms of cost-sharing such as copayments, deductibles and co-insurance. Since out-of-pockets payments are identified as a barrier to utilize preventive care services among both insured and uninsured individuals, they were eliminated under this provision to enhance access to preventive services, including breast, cervical and CRC cancer screenings.

The screening guidelines and recommendations for the recommended preventive services come from public medical and scientific organizations including the U.S. Preventive Services Task Force (USPSTF) and the Advisory Committee on Immunization Practices (ACIP). The USPSTF is volunteer panel of independent national experts who develops specific recommendations for clinical preventive services to the health care system in the US based on the most up-to-date scientific evidence. The USPSTF provides primary and secondary prevention recommendations that aim to monitor clinical and preventive care and are adopted by several federal and private groups as they are widely considered the best resource for preventive services management (Moyer et al., 2011; USPSTF, 2013). The USPSTF assigns a letter grade for each recommendation (an A, B, C, or D grade or an I statement; describe below) based on the strength of the scientific evidence supporting its benefits. The grade assigned to a service does not relate to the cost of that service. Along with the USPSTF recommendations, the ACIP provides recommendations that perform as a standard to guide safe use of vaccines among children and adults. The ACIP is a group of medical and public health experts who develops evidence based recommendations and standards of vaccinations among the US population.

Precisely, the ACA cost-sharing elimination provision mandates that health coverage plans eliminate cost-sharing of all forms for preventive services recommended by the USPSTF that have a rating of A or B (Shearer, 2010). These are new requirements specified by the ACA, as formerly private coverage plans were not required to comprehensively pay for an authorized group of

preventive services. For more information about the grades definitions from the USPTSF, refer to Table 2.

Table 2. USPSTF Ratings: What the Grades Mean and Suggestions for Practice		
Grade	Definition	Suggestions for Practice
A	The USPSTF recommends the service. There is high certainty that the net benefit is substantial.	Offer or provide this service.
B	The USPSTF recommends the service. There is high certainty that the net benefit is moderate or there is moderate certainty that the net benefit is moderate to substantial.	Offer or provide this service.
C	Clinicians may provide this service to selected patients depending on individual circumstances. However, for most individuals without signs or symptoms there is likely to be only a small benefit from this service.	Offer or provide this service only if other considerations support the offering or providing the service in an individual patient.
D	The USPSTF recommends against the service. There is moderate or high certainty that the service has no net benefit or that the harms outweigh the benefits.	Discourage the use of this service.
I Statement	The USPSTF concludes that the current evidence is insufficient to assess the balance of benefits and harms of the service. Evidence is lacking, of poor quality, or conflicting, and the balance of benefits and harms cannot be determined.	Read the clinical considerations section of USPSTF Recommendation Statement. If the service is offered, patients should understand the uncertainty about the balance of benefits and harms.
<i>Source: U.S. Preventive Services Task Force Ratings. U.S. Preventive Services Task Force. December 2013. https://www.uspreventiveservicestaskforce.org/Page/Name/us-preventive-services-task-force-ratings</i>		

The ACA cost-sharing elimination requirement was extended to all new and renewed private health plans after September 23, 2010. Private health plans must be individual plans, small

and large business plans, and self-insured plans. However, the provision did not apply to grandfathered plans, which are private coverage plans that were created or acquired before March 23, 2010. Cost-sharing was later eliminated for Medicare beneficiaries on January 1, 2011 (Koh and Sebelius, 2010) (Centers for Medicare & Medicaid Services). The aim for eliminating these costs was to improve utilization of preventive services by eliminating cost barriers that inhibit individuals from obtaining preventive services and thus increase access to eventually improve population health. For more information about the specifics of this provision for private coverage plans, refer to the Table 3 below, which was adapted from the U.S. Department of Health and Human Services (Health Policy Brief, Health Affairs, 2010).

Table 3. Preventive Services Required of New Group & Individual Health Plans Without Cost Sharing	
Evidence-based preventive services	Preventive services recommended by the U.S. Preventive Services Task Force based on the strength of the scientific evidence documenting their benefits. Includes breast and colon cancer screenings, screening for vitamin deficiencies during pregnancy, diabetes, high cholesterol, high blood pressure, and tobacco cessation counseling
Routine vaccinations	Sets of standard vaccines recommended by the Advisory Committee on Immunization Practices, ranging from routine childhood immunizations to periodic tetanus shots for adults
Preventive services for children	Preventive services recommended under the Bright Futures guidelines developed by the Health Resources and Services Administration and the American Academy of Pediatrics for children from birth to age 21. Includes regular pediatrician visits, vision and hearing screening, developmental assessments, immunizations, and screening and counseling to address obesity

Preventive services for women	Will also include services recommended under new guidelines expected to be issued by August 2011, in addition to services recommended by the Preventive Services Task Force
Source: Cassidy, Amanda. "Health Policy Brief: Preventive Services Without Cost Sharing." Robert Wood Johnson Foundation Health Policy Brief Series. Health Affairs, December 28, 2010.	

The Impact of the ACA on Preventive Care Services Utilization

Shortly after the implementation of the ACA cost-sharing elimination provision for preventive services, many researchers examined the impact on the prevalence of the preventive services that were covered. Some researchers examined a package of these services, while some only examined specific illness related screenings, such as cancer screening tests and cardiovascular related screening tests. Many studies found significant increases in the utilization of preventive services indicating a positive effect of the provision. A study conducted to examine the effects of the ACA provision on the receipt of preventive care among young adults between 2009 and 2011 found a significant increase in the receipt of preventive services, particularly in routine examination, blood pressure screening, cholesterol screening and the annual dental visit (Lau et al, 2014). Using a time series data method, an analysis of mammography utilization that examined patient level data from a large community-based health system from 2008 to 2012 showed that mammography usage increased significantly among women who were form the recommended age group of 50 to 74 (Nelson, 2015). A more recent study that was conducted to measure the impact of the ACA elimination of out-of-pocket payments on mammography and colonoscopy among Medicare beneficiaries between 2009/2010 and 2011/2012 found a significant increase in mammography utilization but not in colonoscopy (Cooper et al, 2016). Using the National Health Interview Survey data, an analysis of mammography utilization between 2010 and 2013 among

Medicare beneficiaries showed a modest increase (Sabatino, et al, 2016). A following study examining mammography rates between 2007 and 2012 among Medicare women, who were part of a large Medicare advantage health plan, found a slight increase in mammography utilization among women with no previous screenings (Jena et al, 2017). The previous studies suggest positive gains from the ACA cost-sharing elimination provision, however, the literature was mixed with different observations of the ACA effect.

There were other studies that found very little impact of the provision on cancer preventive screenings, or the impact being more prevalent in specific underprivileged groups including the poor and the elderly. For example, Fedewa and colleagues examined the utilization of mammography and CRC cancer screenings, (colonoscopy, FOBT, and sigmoidoscopy), between 2008 and 2013, among privately and Medicare insured individuals. The results showed a significant increase in CRC screenings among individuals with low socio-economic status or who were older. However, no change was found in the utilization of mammography (Fedewa et al, 2015). A similar study conducted to evaluate whether the ACA provision has resulted in an increased use of CRC cancer screenings found no significant change, however, colonoscopy utilization increased among Medicare beneficiaries who were poor and without additional Medicare coverage (Richman et al, 2016). Similarly, a study examining colonoscopy utilization among Medicare elderly men found a significant increase in utilization of colonoscopy, especially among the group of men who were from a lower socio-economic status, on the other hand, there was no significant change among elderly women that was explained to be related to other behavioral factors (Hamman and Kapinos, 2015). In a pre/post analysis using administrative data for Medicare beneficiaries from rural health clinics, increases in CRC cancer screening rates were observed (Wan et al, 2015). In the following section, we will discuss the observations of some

evidence based research that showed a null or negative impact of the ACA cost-sharing elimination provision for preventive care services.

There were several studies that found no evidence of a positive effect related to the ACA provision. Mehta and colleagues examined the impact of the ACA provision on colonoscopy and mammography, between 2008 and 2012, among an insured small business population (HUMANA) and found no significant change in utilization of both cancer screenings (Mehta et al, 2015). However, the study concluded that the null findings might be due to the short period after the policy implementation, which might have not been enough to allow for the intended results to appear (Mehta et al, 2015). Han and colleagues evaluated changes in the utilization of cervical, breast, and CRC cancer screenings, between 2009 and 2012 among the privately and Medicare insured individuals, and found no change in utilization after controlling for demographic variables, confounding variables, and stratification by insurance type (Han et al, 2015). Similarly, a study that evaluated the effects of the provision on mammography and CRC cancer screenings among Medicare seniors between 2008/2010 and 2012 found no change in utilization even among Medicare seniors without supplemental insurance (Jensen et al, 2015). A more recent study evaluating the impact of the provision among the privately insured found that changes in the utilization of mammograms, pap smears, and CRC cancer screenings were not a result of the ACA (Hong et al, 2017). The findings of these studies were not consistent with earlier ones. Studies with null findings attributed their results to several factors including the lack of data for long periods of time after the ACA (Jensen et al, 2015).

Utilization of Preventive Services Among Low-income Patients

Utilization of health services, in general, is more likely to differ among low-income patients as a result to changes in cost-sharing (Baicker and Goldman, 2011). In the RAND Health

Insurance Experiment (HIE), which examined the association between demand and behavior, low-income individuals who were sick had more adverse health outcomes attributable to increased cost-sharing. High mortality rates were higher for poor patients with low blood pressure when they had higher copayments (Manning et al, 1987). Another study reported that low-income individuals made fewer well-informed decisions because of poor communication skills between patients and physicians due to a positive correlation between education and income (Reeder and Nelson, 1985). In their study of health outcomes by socio-economic status (SES), Goldman and Smith showed that individuals with lower socio-economic status tend to have worse health outcomes because they are less likely to adhere to the treatment of their chronic conditions (Golden and Smith, 2002).

From an economics perspective, Chandra and colleagues mentioned three reasons that explain why low-income patients have differential effects. Based on their study, low-income individuals are more impacted by price because of their restricted budgets, indicating that they are expected to obtain less care with the lowest marginal benefit (Chandra et al, 2014). Secondly, low-income individuals were less likely to evaluate the benefit of their care than individuals with high income and, accordingly they are more prone to obtain less high marginal benefit care. Third, it was suggested that the effect of cost-sharing could be different for low-income individuals because they tend to have more chronic conditions (Chandra et al, 2014).

From the existing evidence, it is established that cost-sharing may result in a judicious utilization of health care services. Financial requirements tend to reduce the use of valuable care, especially for vulnerable groups such as low-income individuals (Chernew et al, 2007). Hence, it is imperative to understand the impact of cost-sharing on the use of specific preventive services that are identified as methods to improve health, especially amongst low-income individuals, who are more prone to adverse health effects because their sensitivity to price that leads lower health

care use (Manning et al, 1987). Baicker and Goldman suggested that there is little evidence that poor individuals have more elastic demand despite the high speculation in the research community (Baicker and Goldman, 2011). They commented that most of the conducted research concentrates on the impact of copayments for prescription medication under Medicaid (Stuart and Zacker, 1999; Reeder and Nelson, 1985).

Although previous studies have established that cost-sharing elimination could potentially increase preventive health services utilization, many of these studies have not investigated socioeconomic and socio-demographic factors related to preventive services usage. The effect of cost-sharing elimination on preventive service utilization among individuals with low socioeconomic status is limited (Han et al, 2015). To date, only a few studies evaluated the effects of cost-sharing on use of cancer preventive services in national samples that represent the population (Rezayatmand et al, 2013).

This study utilized a national sample from the MEPS, which has been extensively used in the literature for analysis to draw conclusions that are representative of the national population in the US. Furthermore, the inconsistency of previous research evaluating the ACA cost-sharing provision could be due to the lack of long periods of time at the time of analysis. The data available for preceding analysis was appropriate to assess short-term effects of the provision. Most of the studies mentioned in the literature review analyzed data until 2012. In this study, more up-to-date data, that was available until 2016, allowed assessment of the long-term effects of the provision. In addition, studies lacked methodological approaches that could draw solid conclusions. One example of these approaches is to compare changes in the utilization of services to a control group which can produce robust conclusions in regards to causality. A recent study examining cancer diagnosis among Medicare beneficiaries found a significant increase in early stage CRC cancer

diagnosis compared to a younger control group, without evidence of change in breast cancer diagnosis (Lissenden and Yao, 2017). Therefore, this study utilized the DID approach that allowed for comparison of utilization rates in the treatment group (the insured) to a control group (the uninsured) after validating the required assumptions of the DID approach. This study makes a significant contribution for policy makers and researchers about the effectiveness of cost related policies that could eventually help to increase access to cancer preventive screenings throughout the US.

Breast, Cervical and Colorectal Cancer Screening Rates

A main goal of the Healthy People 2020 is to: “reduce the number of new cancer cases, as well as the illness, disability, and death caused by cancer.” Apparently, Healthy People 2020 aims is to increase screening for breast, cervical, and CRC cancer as recommended by USPSTF (Office of Disease Prevention and Health Promotion, 2017). One way to achieve this goal is to compare current rates of screenings with established nationwide targets. An analysis utilizing the 2015 National Health Interview Survey (NHIS) data, tested trends from 2000 to 2015 and found that usage of certain cancer screening tests was significantly below the ideal national targets. These national targets were implemented by Health People 2020, which provides national goals to improve the health of Americans. The analysis found no increases for breast and cervical cancer screenings; however, CRC cancer screenings increased. Differences were found in utilization rates among individuals with different races and different socioeconomic backgrounds.

According to the Centers for Disease Control and Prevention (CDC), mammography usage was steady from 2000 to 2015. Mammography usage rate was found to be 71.5% during the last two years in 2015 for women aged 50 to 74. This rate remains below the national target of 81.1%.

Receiving a mammogram was lowest among American Indians/Alaska Natives with a rate of 56.7%. The results indicated that women who were educated and had a higher-income level received more mammograms. Women who were uninsured and who did not have a continuous source of health care reported the lowest mammography rates (White et al, 2015). Cervical cancer screening, particularly the pap smear test, declined from 2000 to 2015. In 2015, only 83% of women had cervical cancer screening. This rate remains beneath the Healthy People 2020 established target of 93.0%. The pap test utilization was the lowest among Asian women with a rate of 75.8%. Also, women of the age group between 21 and 30 years old had lowest cervical cancer screening usage. Like mammography, the results indicated that women who were educated and had a higher-income level received more cervical cancer screenings. Furthermore, women who were uninsured and who did not have a continuous source of health care reported the lowest cervical cancer screening rates (White et al, 2015).

CRC cancer screening increased from 2000 to 2015 to 62.4%; however, the rate remains beneath the Healthy People 2020 established target of 70.5%. CRC screening use was lowest among American Indians/Alaska Natives with a rate of 48.4%. Also, CRC screening was lower among individuals aged 50–64 years than among individuals aged 65–75 years even though the guidelines recommend screening starting at age 50. Moreover, the percentage of individuals who reported having a CRC cancer screening increased with increasing education and income levels. Moreover, individuals who were uninsured and who did not have a continuous source of health care reported the lowest CRC screening rates (White et al, 2015).

Despite forceful determination to increase mammography, cervical, and CRC cancer screenings during the last few years, test screenings proportions remain substandard. As mentioned earlier, one of the ACA goals is to increase the rates of screenings through total coverage of these

screening tests without any cost-sharing incurred by the patient. One of the strategies shown to increase utilization of preventive services is removing cost barriers that are incurred by patients to receive these services. Patients with private insurance and Medicare were responsible to bear some costs to their CRC screening services before the ACA through co-insurance, copayment, and deductibles. This cost responsibility created a burden on patients, especially with expensive procedures such as colonoscopy and sigmoidoscopy. The cost of cancer screening tests is usually very high. For example, Medicare charged patients in 2008 for mammograms between \$82 and \$115. Also, the permissible charge for patients under Medicaid was between \$642 and \$842 for colonoscopy in 2008. Medicare patients had a permissible charge for colonoscopy that ranged between \$642 to \$842 before the ACA (Fedewa et al, 2015). Furthermore, Medicaid patients had a permissible charge that ranged between \$130 to \$200 for sigmoidoscopy (Cokkinides et al, 2011). Therefore, identifying whether the cost-sharing elimination provision changed the utilization of breast, cervical, and CRC cancer screening is important to understand if it had the policy desired effects and if financial barriers are the main reason for suboptimal screening rates.

PUBLIC HEALTH SIGNIFICANCE

One of the central reasons of the ACA cost-sharing elimination provision is to promote awareness about the importance and effectiveness of preventive services in improving an individual's quality of life, wellness, and health outcomes. One of the primary long-term public health goals of the US health care system is to have better preventive care services that will eventually lead to improving population health and reduce health-related spending. This goal could be achieved by formulating and implementing policies that ensure continuous screenings and management of chronic conditions; by promoting access to preventive health services in removing financial barriers; and by monitoring the accessibility and quality of care.

Preventive care screening services for breast, cervical, and CRC cancer are imperative since they have a high capability to lessen the burden of cancer in the United States (Maciosek et al, 2009). Despite the significant efforts that have been made to increase cancer screenings, screening rates for breast, cervical, and CRC cancer remain suboptimal and disappointingly low (Office of Disease Prevention and Health Promotion, 2017). The monetary costs of cancer are high for both the individual with cancer and for the society as a whole. The Agency for Healthcare Research and Quality (AHRQ) estimates that the direct medical costs for cancer in the US in 2015 were \$80.2 billion. This year, around 609,640 Americans are predicted to die from cancer which is approximately 1,670 persons a day (American Cancer Society, 2018). After heart disorders, cancer is the second most common cause of death in the US. The implementation of the cost-sharing elimination provision will help address this through the elimination of financial barriers that prevent individuals from getting the screenings.

The main goals of public health are to promote and protect health, prevent death and injuries, and prolong lives (Munthe et al, 2008). The implementation of the ACA is a powerful step that could eventually help to achieve the three goals of public health by removing financial barriers and promoting access to preventive care. This dissertation will help to evaluate the effect of the recent cost-sharing elimination provision under the ACA on cancer screenings rates and disparities among different groups, which would provide information to policy makers and health professionals on whether the cost-sharing elimination provision produced the intended results. If that was not the case, other reasons for suboptimal cancer screening rates could be evaluated. It is evident that better health coverage and enhanced access are essential; however, they could not be adequate to achieve optimal utilization of preventive care services.

AIMS AND OBJECTIVES

This study investigated the impact of the ACA cost-sharing elimination provision on the utilization of three cancer prevention screenings. Specifically, the current study evaluated changes in breast, cervical, and CRC cancer screening utilization, among individuals who were privately insured and/or Medicare-insured, before and after the cost-sharing elimination provision was enacted. This provision became effective for private health insurance plans, in 2010, and for Medicare, in 2011. A focus of this dissertation was on the influence of socio-economic and socio-demographic factors on utilization changes. This study utilized the national Medical Expenditure Panel Survey (MEPS) data, from 2008 through 2016, for the analyses. The results of this dissertation expanded the current knowledge of the impact of the ACA cost-sharing elimination provision in increasing utilization of five imperative cancer screening services including mammography, pap smear, FOBT, colonoscopy and sigmoidoscopy.

Aims

Aim 1: To evaluate changes in receipt of breast cancer (i.e. mammography) and cervical cancer screening (i.e. pap smear) services pre-and post implementation of the ACA cost-sharing elimination provision, from 2008 through 2016, using MEPS.

- **Objective 1:** To determine whether the utilization of mammography and the pap smear test increased after the implementation of the cost-sharing elimination provision among private and/or Medicare-insured women in the United States.
- **Objective 2:** To examine whether differences in medical utilization of mammography and the pap smear test result from differences in socio-economic and socio-demographic factors, as measured by predisposing, enabling and need predictors of resource use.

Aim 2: To evaluate changes in receipt of colorectal cancer (CRC) screening services pre-and post implementation of the ACA cost-sharing elimination provision, from 2008 through 2016 using MEPS.

- **Objective 1:** To determine whether the utilization of CRC cancer screening increased after the implementation of the cost-sharing elimination provision among private and/or Medicare-insured individuals in the United States.
- **Objective 2:** To examine whether differences in medical utilization of CRC cancer screening services result from differences in socio-economic and socio-demographic factors, as measured by predisposing, enabling and need predictors of resource use.

CONCEPTUAL FRAMEWORK

The Health Behavior Model, or widely known as the Andersen's Behavioral Model of Health Services Use (BM), will be applied to examine the relationship between preventive services utilization and cost-sharing elimination with the focus on specific socioeconomic factors (Andersen et al, 2001). The BM was selected to guide independent variables selection for our analysis since it is a well-established model used in studies that investigate health care services utilization. It is a multilevel model that includes determinants of health services utilization at individual and contextual levels. The BM was developed by Ronal M. Andersen, Aday and others in 1968 and it explains the effect of the predisposing, enabling, and need factors on patient utilization of health care services (Andersen, 1995). The model will help to understand the factors that affect health utilization and is useful to assess the reasons for differences in utilization by socio-economic and socio-demographic factors.

For the study purposes, health behavior is identified as the utilization of preventive care services. Figure 1 represents the schematic view of our research model highlighting the dependent variable (health behavior), all explanatory variables, and control variables. The figure illustrates the BM model and the means in which the predisposing, enabling, and need factors impact health services utilization.

Next, the study explores the socio-economic and socio-demographic factors, deriving evidence from prior research conducted about utilization of preventive services and based on the work of Andersen & Davidson about these factors (Andersen and Davidson, 2001). Each of the aims of this dissertation will utilize the BM Model as the foundation to identify the factors that explain the use of cancer screening services, specifically, breast, cervical and CRC cancer screenings.

Predisposing factors

According to the BM model, predisposing factors comprise the factors that influence individuals to use health services including demographic characteristics such as age and sex, social factors such as education, employment, race, ethnicity, social relationships, health beliefs, and socio-economic characteristics. Socio-economic characteristics tend to have an influence on healthcare utilization in general. For example, patients of lower socioeconomic status have higher rates of chronic conditions, which implies a differential effect of cost-sharing policies on their utilization of services. Moreover, patients with low socioeconomic status were found to be less adherent to treatment protocols for their chronic conditions and thus have worse health outcomes (Goldman and Smith, 2002).

The literature usually measures socioeconomic disparities by income, education, and occupation. It is apparent that individuals with higher income, education, and better occupations

would have more access to resources that are connected to being healthier, such as healthcare services, healthier lifestyles, nutritious behaviors, and others (Zimmerman, Woolf & Haley, 2014). The cost-sharing provision is expected to reduce the socioeconomic disparities in health across those individuals.

There are disparities by race and socioeconomic factors that were documented in the literature in regards to utilization of preventive services. These disparities indicate that minorities, such as Hispanics and blacks were, in general, less likely than whites to receive preventive services such as cholesterol screening, blood pressure checks, and cancer screenings (Gornick, 2000). White women received more cervical and breast cancer screening services compared to women from other races including black Americans (Nadpara et al, 2012; Bhanegaonkar et al, 2012). Another study reported contradictory findings indicating that minority women in specific communities were more likely to receive cervical and breast cancer screenings (Cook et al., 2010; Coronado, Thompson, and Chen, 2009). Moreover, there were disparities by age that were documented in the literature. For example, it has been reported that age is negatively associated with mammograms and positively associated with pap smears, cholesterol, and blood pressure screenings (Holden, Chen and Dagher, 2015).

Education is also a factor that could impact preventive care service utilization. In a study of medication copayments under Medicaid, low-income individuals were found to make fewer well-informed decisions because of their poor communication skills with their physicians as a result of a positive correlation between education and income (Reeder and Nelson, 1985). Higher levels of education are associated with greater utilization of preventive health care services (Hewitt, Devesa and Breen, 2002).

Enabling/Impeding factors

In general, enabling/impeding factors are the resources available to individuals to utilize health services such as income, health insurance, and continuity of care. Enabling factors are also defined as the financing and organizational factors that enable conditions that influence health care utilization. The financing factors are specifically related to the income level of individuals that allow them to pay for health services. These factors are associated with health insurance coverage and cost-sharing requirements. Organizational factors involve the sources and continuity of care.

Chandra et al, (2014) argued that cost-sharing could have a different impact on low-income patients who sometimes tend to avoid care with the lowest marginal benefit because of their financial constraints. Several other studies showed that having a higher income is associated with increased preventive service use (Chernew et al, 2007). For example, out-of-pocket payments can enable or impede the use of health services depending on their amounts. Cost-sharing has been reported as an impediment to receive preventive services and thus removing this barrier is important to increase utilization (Solanki et al, 2000). Further, in a study about the utilization of preventive services recommended by the USPSTF, receipt of services was strongly positively associated with having insurance coverage and a constant source of care (DeVoe et al, 2003). Several studies also determined this positive association (Bednarek & Schone, 2003; Bandi et al, 2012; Allen et al, 2009).

Need factors

Need factors include individuals perceived need for health services such as their functional status, previous conditions, or health risks. Need factors include perceived or evaluated health complications that either patients or health care providers decide that they need medical service intervention (Andersen, 1995). Several studies showed that having certain risk factors could

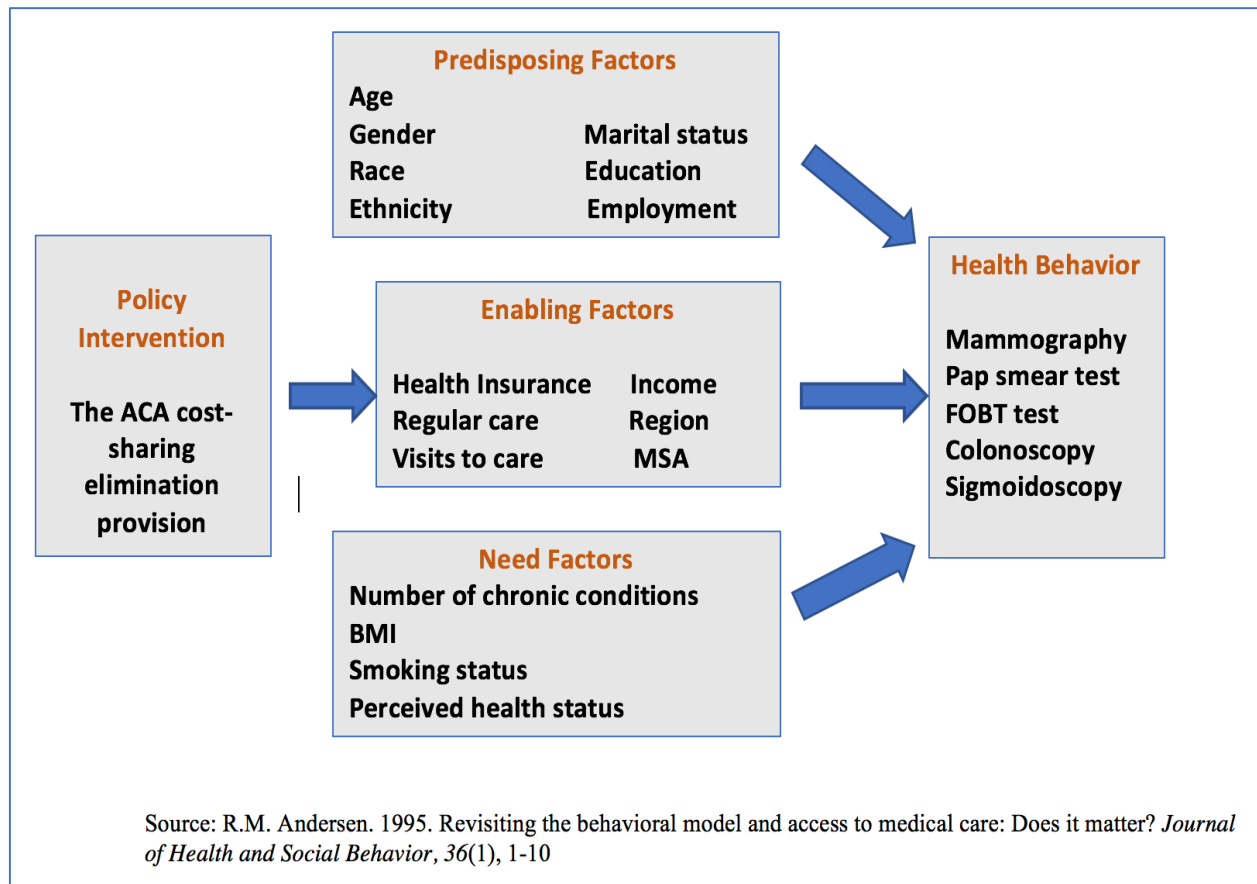
increase the probability of using some preventive services. For example, a study reported that overweight and obese men received more cholesterol and glucose screening but less CRC cancer screenings or prostate cancers screenings (Quinn et al, 2012). Another study found that an increasing body mass index (BMI) was associated with increased utilization of preventive services (Shires et al, 2012).

Although it might be projected that individuals with more risk factors are more likely to seek certain preventive services, several studies showed that individuals who have asthma and who are smokers were significantly less likely to receive an influenza vaccine despite their risky situations (Lu et al, 2009; Vander et al, 2012). Despite their increased risk of cancer, daily smokers were found to be less likely to receive cancer screening (Vander et al, 2012). Patients of lower socioeconomic status have higher rates of chronic conditions, which imply differential effect of cost-sharing policies on their utilization of services. A study examining the relationship between the and being up-to-date on cancer screenings found an increase in screenings with specific types of chronic conditions rather than the total number of conditions (Liu et al, 2014). Contrariwise, several studies have found that the number of chronic diseases is correlated with increased cancer screenings. For example, hypertensive individuals had more breast exams, pap smears, FOBTs, and a trend to have more mammograms (Heflin et al, 2002). Also, women with three or more chronic conditions were shown to have more mammograms, pap smears, and breast exams (Yasmeen et al, 2011; Zao et al, 2008).

In summary, prior studies have shown conflictive results for the impact of predisposing, need, and enabling factors on cancer preventive care usage. Therefore, to have more robust evidence, this study focuses on the inclusion of socio-demographic and socio-economic factors that had some evidence to impact utilization. By including all these factors, as covariates, in the

DID the model, they will provide more precise information about the change in the main outcomes of cancer screenings.

Figure 1. Study Model



METHODS

Data Source

This study utilized the Medical Expenditure Panel Survey (MEPS), which is a part of the US Department of Health and Human Services data that includes national and regional estimates of numerous aspects of healthcare. The MEPS is a nationally representative survey of non-institutionalized US individuals, their families, and their medical providers (physicians, hospitals, pharmacies, etc.), which is sponsored by the Agency for Healthcare Research and Quality (AHRQ). The MEPS has three main components: the primary Household Component, the Insurance/Employer Component, and the Medical Provider Component. This study utilized the Household Component that is publicly available (AHRQ, 2016). More information about the MEPS survey design and content is available from the MEPS website (AHRQ, 2016).

The MEPS is widely used by prominent medical researchers, as well as the government, to evaluate the health care system. One of the most important advantages of the MEPS survey is that it is done on a constant basis which delivers researchers with useful and timely information. The MEPS was created in 1996 to provide more opportune information about the developing health care system in the US. The MEPS initiates a new panel of households into the survey each year. The MEPS has a panel design that includes five series of interviews covering two full years. It collects data on the usage of health services, their costs, the ways these services are paid for, and health insurance coverage. It provides data, at the individual participant level, on the socio-economic and socio-demographic characteristics of survey participants (Ezatti-Rice, Rohde, and Greenblatt, 2008). The data is conveyed by a particular household respondent. Respondents answer questions over five interviews during a two-and-a-half-year period. Questions in the Household component include demographic characteristics, health conditions, health status,

utilization of medical care, charges and payments, access to care, insurance coverage, income, education and employment (Cohen et al, 2009).

The MEPS Household Component collects information about health insurance coverage by person and family-level characteristics. The MEPS contains a constructed variable that summarizes health insurance coverage for any individual with three different values: 1= any private (having any type of private insurance (including TRICARE/CHAMPVA), 2= public insurance, 3= uninsured. There are other insurance coverage variables that indicate the type of public health coverage that an individual has. For this study sample, all individuals with Medicaid coverage were excluded from the sample. Only individuals with private and/or with Medicare coverage were included in the study sample. The MEPS categorizes TRICARE as private coverage. In this study, TRICARE was categorized as a type of private coverage, similarly as in the MEPS data.

This study analyzed nine years of pooled MEPS data (2008 through 2016) and examined changes in the use of five cancer preventive screening services including mammography, pap smear, FOBT, colonoscopy and sigmoidoscopy, before and after the implementation of the ACA cost-sharing elimination provision, focusing on the effect of specific socio-demographic and socio-economic factors. The analysis was conducted in 2019.

Study Design

A quasi experimental difference-in-differences (DID) approach was used to estimate the effect of the ACA cost-sharing elimination provision on cancer preventive services by comparing the changes of breast, cervical and CRC cancer screening rates between individuals who benefitted from this provision (the insured) and individuals who did not (the uninsured). The DID approach has become an increasingly prevalent method to estimate causal relationships and it is used to

estimate the effect of a specific intervention (such as an enactment of a law, or a program implementation), by comparing the changes in outcomes over time between a population that is enrolled in a program (the intervention group) and a population that is not (the control group) (Dimick & Ryan, 2014).

DID is normally utilized in observational settings and it assumes that in absence of treatment, the unobserved differences between treatment and control groups are the same overtime (Dimick & Ryan, 2014). DID requires data from pre/post intervention period for both the treatment and control groups; it is a valuable method to use when randomization on the individual level is not possible (Wing et al, 2018). The DID technique calculates the effect of a treatment (independent variable) on an outcome (dependent variable) by comparing the average change over time in the outcome variable for the treatment group, compared to the average change over time for the control group (Dimick & Ryan, 2014). Thus, the DID technique was the best approach to improve the internal validity of our analysis and to account for possible secular trends.

One of the most important assumptions in the DID methodology is that trends in the outcomes before the intervention are parallel across the treatment and control groups (Wing et al, 2018). That means, in the nonexistence of the policy, the two groups would have continued to change with matching trends (Angrist & Pischke, 2009). For this study, the parallel trend assumption between insured (treatment) and uninsured individuals (control) was not violated for any of the cancer screening services examined (Figures 2, 3, 4, 5, and 6).

For this study, the DID approach was applied to the regression estimations by comparing results before and after the introduction of the independent variable in 2010, which is the ACA cost sharing-elimination provision for preventive care services, between insured and uninsured individuals. The USPSTF recommendations for the selected cancer preventive services were

adopted to measure odds of receipt by socio-demographic and socio-economic factors. The primary dependent variable and covariates representing the socio-demographic and socio-economic factors are discussed in the section below.

Study Measures

Primary Dependent Variables

The primary dependent variable for each logistic regression model is self-reported receipt of the cancer screening service. Five preventive cancer screenings were analyzed, including mammography for breast cancer screening, the pap smear for cervical cancer screening, FOBT, colonoscopy and sigmoidoscopy for CRC cancer screening. Receipt of each screening is defined as having the screening service within the interval period and age requirements set by the USPSTF guidelines.

In the MEPS survey, respondents were asked about the last time they received a screening test. The respondents had to choose an answer from a few given options including if they have received the screening test during the last year, two years, etc. Receipt of each cancer screening service had a binary outcome of (yes, no). Table 4 summarizes the examined cancer screening services by the recommended population, frequency of assessment, and the MEPS survey questions.

Table 4. Breast, Cervical, and CRC screening services recommended population, frequency of assessment, and the MEPS survey questions.			
Screening	Recommended Population	Frequency	MEPS Survey Questions
Breast Cancer (Mammogram)	Women aged 50-74	Every 2 years	How long since last mammogram?
Cervical Cancer (Pap Smear)	Women aged 21-65	Every 3 years	How long since last pap smear test?
Colorectal Cancer Fecal Occult Blood	Adults aged 50-75	FOBT yearly or,	When was last FOBT?

Test (FOBT)		Colonoscopy every 10 years, or	When was last colonoscopy?
Colonoscopy		Sigmoidoscopy every 5 years with FOBT every 3 years	When was last sigmoidoscopy?
Sigmoidoscopy			

Source: US Preventive Services Task Force Website

Independent Variables

Primary Independent Variables

The primary independent variables are *POST*, *INSURED*, and *POST*INSURED*. The variable *POST* is defined as the period after the implementation of the ACA provision (2008 to 2010 vs 2011 to 2016). The variable *POST* indicates whether the period is post or pre-ACA intervention, which is a key variable in every DID estimation model. Including *POST* in the equation manages the time trend problem and shows utilization differences among the uninsured (the control group) after the ACA provision. The variable *INSURED*, which is considered as an enabling factor, is a dummy variable that shows the differences between the treatment (insured individuals) and control (uninsured individuals) groups in the pre-period. Finally, the variable *POST*INSURED* is an interaction term that provides the actual estimated effect of the policy intervention. It is the difference in the treatment group before and after ACA implementation minus the difference in the control group before and after the ACA implementation. In other words, the interaction of post and insurance shows how insured individuals changed their utilization of the five examined cancer screenings after the ACA provision.

Covariates:

The choice of covariates, including other socio-demographic and socio-economic factors, was guided by the BM model and the preceding literature related to cancer screening determinants. Predisposing factors included age, gender (only for CRC cancer screening), race, ethnicity, marital

status, education, and employment. Enabling factors included income, insurance status, regular source of care, number of visits, region, and residence. Health needs factors included perceived health status, number of chronic conditions, smoking status and body mass index (BMI).

Table 5 lists all the independent variables that were perceived to have an impact on the dependent variables. The variables were categorized according to the BM model as predisposing, enabling, and/or need factors.

Table 5. Independent Variables		
Predisposing Factors		
Independent Variable	Definition	Measurement
Age	Person's age	Continuous
Gender*	Person's gender	Dichotomous, 1=Female, 0=Male
Race	Person's race	Categorical, 1=White, 2=Black, 3=American Indian/Alaska native, 4=Asian, 5=Native Hawaiian/Pacific islander, 6=Multiple races
Ethnicity	Person's ethnicity	Dichotomous, 1=Hispanic, 0=Non-Hispanic
Marital Status	Patients' marital status	Dichotomous, 1=Married, 0=Not married
Education	Person's educational attainment	Ordinal, 1=Less than high school, 2=High school, 3=Some college, 4=Four year of college or more

Employment	Person's employment status	Continuous
Enabling Factors		
Independent Variable	Definition	Measurement
Income	Indicates person's total Income	Continuous
Insured	Indicates whether a person is insured, or uninsured	Dichotomous, 1=Insured, 0=Not Insured
Regular source of care	Indicates whether there is a doctor's office, clinic, health center, or place that the individual usually goes to if he/she needs to	Dichotomous, 1=Yes, 2=No
No. of visits to care	Indicates number of office based provider visits	Numerical
Region	Indicates the Census region for the person	Categorical, 1=Northeast, 2=Midwest, 3=South 4=West
Residence	Indicates whether the person is found in a Metropolitan Statistical Area	Dichotomous, 1=MSA, 0=non-MSA
Need Factors		
Independent Variable	Definition	Measurement
Perceived Health Status	Person's perceived health status	Ordinal, 1=Excellent, 2=Very good, 3=Good, 4=Fair, 5=Poor An average of the results was considered
Number of chronic conditions	Indicates whether a doctor or other health professional ever told the person they had high blood pressure, heart disease (including coronary heart disease, angina, myocardial infarction,	Numerical

	and other unspecified heart disease), stroke, emphysema, high cholesterol, cancer (including cancer type), diabetes, arthritis, or asthma.	
Smoking Status	Person's smoking status	Dichotomous, 1=Yes, 2=No
BMI	Person's Body Mass Index	Continuous

* The gender variable was only included for the second aim

ANALYSIS

To address both aims, the study sample was summarized and descriptive statistics were computed (i.e. mean, standard deviation and/or proportion) on all predisposing, enabling, and need variables (independent variables). In addition, to determine if there was a significant difference between the means of the variables before and after the policy provision, two samples t-tests were conducted (Table 8). T-tests were performed under the assumption that variables fit a normal distribution. All the statistical analysis was conducted using STATA version 15. Approval for this study was obtained from the Committee for the Protection of Human Subjects at the University of Texas, Health Science Center at Houston.

Addressing Aim 1

Aim 1: To evaluate changes in receipt of breast (i.e. mammography) and/or cervical (i.e. pap smear) cancer screening services pre-and post implementation of the ACA cost-sharing

elimination provision, from 2008 through 2016, using MEPS.

- **Objective 1:** To determine whether the utilization of mammography and/or pap smear increased after the implementation of the cost-sharing elimination provision among private and/or Medicare-insured women in the United States.
- **Objective 2:** To examine whether differences in medical utilization of mammography and/or pap smear result from differences in socio-economic and socio-demographic factors, as measured by predisposing, enabling and need predictors of resource use.

Aim 1-Hypothesis

The utilization of mammography and/or pap smear increased after the implementation of ACA cost-sharing elimination among privately and/or Medicare insured women in the US as access to preventive care services increased under the ACA.

Aim 1-Sample

For mammography, the sample included women, aged 50 to 74 years, as per the 2009 USPSTF recommendations. For pap smear, the sample included women, aged 21 to 65 years, as per the 2012 USPSTF recommendations. Both groups were included because the provision directly applies to them. For the DID analysis, uninsured women with equivalent age groups for each cancer screening were included as a control group because they were not impacted by the provision. Women under Medicaid coverage were excluded since participating in Medicaid expansion under the ACA was optional for states (Wilensky and Gray, 2013). Women with breast and/or cervical cancer, had surgery, or were diagnosed with conditions related to breast and/or cervical cancer were excluded from the sample. In addition, women were excluded if they had missing responses for the required period. Table 6 lists specific guidelines, USPSTF recommendation grades, and the study target population for both mammography and pap smear.

Table 6. Specific Guidelines/Study Population for Mammography and Pap Smear

Preventive Service (year)	Recommendation (grade)	Study Target Population	Screening interval
Mammography (2009)	The USPSTF recommends mammography every two years for women aged 50 to 74. (B)	Women aged 50-74 and not diagnosed with breast cancer	Every 2 years (Biennial)
Pap Smear (2012)	The USPSTF recommends screening for cervical cancer in women age 21 to 65 years with cytology (Pap smear) every 3 years or, for women age 30 to 65 years who want to lengthen the screening interval, screening with a combination of cytology and human papillomavirus (HPV) testing every 5 years. (A)	Women aged 21-65, not diagnosed with cervical cancer, and who have a cervix	Pap smear every 3 years or pap smear and HPV testing every 5 years

Source: US Preventive Services Task Force Website

Aim 1-Analysis

To address objective 1, a proportions test was conducted to illustrate the proportion of women who received mammography and/or pap smear out of the number of women who were recommended to receive mammography and/or pap smear, before and after the ACA provision. In addition, to determine if there was a significant difference between the values before and after the policy provision, two samples t-tests were conducted. Table 9 shows the results of proportions test. Furthermore, a trend analysis was performed visualizing yearly rates of being up-to-date on mammogram and/or pap smear before and after the ACA provision to observe if there are changes overtime. Figure 2 and 3 demonstrate the change in mammography and pap smear utilization rates before and after the ACA provision.

To address objective 2, logistic regression models were estimated to measure the receipt of mammography and pap smear controlling for all the predisposing, enabling, and need variables

that are listed in table 5. Estimates of the impact of the policy on mammography and pap smear were estimated by fitting four logistic regression models for each screening service that incorporated a DID estimator. The first model was an unadjusted model that only controlled for insurance status and period of screening (whether it was pre-or post the ACA provision). The second model was an adjusted model that controlled for predisposing variables including age, race, ethnicity, marital status, education and employment. The third model was additionally adjusted by controlling for enabling factors including income, regular source of care, number of visits to care, region and residence. The fourth and final regression model was further adjusted by controlling for need factors including perceived health status, number of chronic conditions, smoking status, and BMI. In order to select the model with the best possible fit, AIC values were generated to show the quality of each model. The fourth model including all variables had the lowest AIC, indicating the best fit for the logistic regression estimation. The regression models estimated the odds ratios for all the independent variables and the corresponding 95% confidence intervals. The regression analysis tested all women who had at least one recommended mammography or pap smear against the independent variables that could have an influence on a women's decision to obtain the screenings. The primary variable of interest was the interaction term between the time variable *POST* and the treatment group variable, *INSURED*. The first DID model examined the receipt of mammography. The second DID model examined the receipt of pap smear.

Aim 1-Model Specifications

Model Specification 1 (for mammography):

$$Y = \beta_0 + \beta_1 * POST + \beta_2 * INSURED + \beta_3 * POST * INSURED + \sum X\beta_n + \varepsilon$$

For the model estimated in this analysis, the DID estimation is explained by *Y*, which is the

outcome of interest being the utilization rate of mammography, *INSURED* is a dummy variable equal to 1 when women were insured and 0 when women were uninsured, *POST* is a time dummy variable equal to 1 if the time is after the ACA policy intervention and equal to 0 if the time is before the ACA policy intervention, *X* is a vector of predisposing, enabling, and need variables. The coefficient β_0 is the *Y* intercept, the utilization for the pre-intervention period, for the control group, when all control variables are equal to zero. The coefficient β_1 is the time trend in the control group. It is equal to the difference in utilization among the uninsured (the control group) after the ACA provision. The coefficient β_2 is the difference between the control and treatment groups pre- intervention. The coefficient of the interaction (*POST*INSURED*) is the coefficient of interest β_3 which is the difference in differences term. It represents the difference of changes over time. β_3 is the DID estimator that measures the effect of the policy intervention on insured women. Finally, the coefficient β_n represents how *Y* changes when a single covariate changes holding other variables in the model constant.

Model Specification 2 (for the pap smear test):

$$Y = \beta_0 + \beta_1 * POST + \beta_2 * INSURED + \beta_3 * POST * INSURED + \sum X\beta_n + \varepsilon$$

For the model estimated in this analysis, the DID estimation is explained by *Y*, which is the outcome of interest being the utilization rate of pap smear, *INSURED* is a dummy variable equal to 1 when women were insured and 0 when women were uninsured, *POST* is a time dummy variable equal to 1 if the time is after the ACA policy intervention and equal to 0 if the time is before the ACA policy intervention, *X* is a vector of predisposing, enabling, and need variables. The coefficient β_0 is the *Y* intercept, the utilization for the pre-intervention period, for the control

group, when all control variables are equal to zero. The coefficient β_1 is the time trend in the control group. It is equal to the difference in utilization among the uninsured (the control group) after the ACA provision. The coefficient β_2 is the difference between the control and treatment groups pre- intervention. The coefficient of the interaction ($POST*INSURED$) is the coefficient of interest β_3 which is the difference in differences term. It represents the difference of changes over time. β_3 is the DID estimator that measures the effect of the policy intervention on insured women. Finally, the coefficient β_n represents how Y changes when a single covariate changes holding other variables in the model constant.

Addressing Aim 2

Aim 2: To evaluate changes in receipt of colorectal cancer (CRC) screening services pre-and post implementation of the ACA cost-sharing elimination provision, from 2008 through 2016 using MEPS.

- **Objective 1:** To determine whether the utilization of CRC cancer screening increased after the implementation of the cost-sharing elimination provision among private and/or Medicare-insured individuals in the United States.
- **Objective 2:** To examine whether differences in medical utilization of CRC cancer screening services result from differences in socio-economic and socio-demographic factors, as measured by predisposing, enabling and need predictors of resource use

Aim 2-Hypothesis

The utilization of CRC cancer screening tests including FOBT, colonoscopy and sigmoidoscopy, increased after the implementation of ACA cost-sharing elimination among

privately and/or Medicare insured individuals in the US as access to preventive care services increased under the ACA.

Aim 2-Sample

For CRC cancer screenings, the sample included survey respondents including individuals aged 50 to 75 years, as per the 2008 USPSTF recommendations. For the DID analysis, uninsured individuals with equivalent age groups for each CRC cancer screening were included as a control group because they were not impacted by this provision. Individuals under Medicaid coverage were excluded since participating in Medicaid expansion under the ACA was optional for states (Wilensky and Gray, 2013). Individuals with colon cancer, had surgery, or were diagnosed with conditions related to colon cancer were excluded from the sample. In addition, individuals were excluded if they had missing responses for the required period.

Table 7. Specific Guideline and Study Population for CRC Cancer Screening

Preventive Service (year)	Recommendation (grade)	Study Target Population	Screening interval
Colorectal cancer screening (2008)	The USPSTF recommends screening for CRC cancer using fecal occult blood testing (FOBT), sigmoidoscopy, or colonoscopy for adults aged 50 to 75 years. (A)	Adults aged 50-75 and not diagnosed with colon cancer	Colonoscopy: every 10 years Sigmoidoscopy: every 5 years when combined with FOBT Blood stool test: every year

Source: US Preventive Services Task Force Website

Aim 2-Analysis

To address objective 1, a proportions test was conducted to illustrate the proportion of individuals who received FOBT, colonoscopy and/or sigmoidoscopy out of the number of individuals who were recommended to receive them, before and after the ACA provision. In addition, to determine if there was a significant difference between the values before and after the

policy provision, two samples t-tests were conducted. T-tests were performed under the assumption that variables fit a normal distribution. Table 12 shows the results of proportions test for FOBT, colonoscopy, and sigmoidoscopy. Furthermore, a trend analysis was performed visualizing yearly rates of being up-to-date on these CRC cancer screenings before and after the policy in order to see if there were changes overtime. Figure 4, 5, and 6 demonstrate the change in FOBT, colonoscopy and/or sigmoidoscopy utilization rates before and after the ACA provision.

To address objective 2, logistic regression models were estimated to measure the receipt of FOBT, colonoscopy and sigmoidoscopy controlling for all the predisposing, enabling, and need variables that are listed in table 5. For the DID models, estimates of the impact of the policy were determined by fitting four logistic regression models for each screening service. The first model was an unadjusted model that only controlled for the insurance status and the period of screening (whether or not it was pre-or post the ACA). The second model was an adjusted model that controlled for predisposing variables including age, race, ethnicity, marital status, education and employment. The third model was further adjusted by controlling for enabling factors including income, regular source of care, number of visits to care, region and residence. The fourth and final regression model was further adjusted by controlling for need factors including perceived health status, number of chronic conditions, smoking status, and BMI. To select the model with the best possible fit, AIC values were generated to show the quality of each model. The fourth model, which is the full model, had the lowest AIC, indicating that it is the best fit for the logistic regression estimation. The regression models estimated the odds ratios for all the independent variables and the corresponding 95% confidence intervals. The regression analysis tested all individuals who had at least one recommended CRC screening against the independent variables that could have an influence on the individual's decision to obtain the screenings.

The logistic regression model was estimated using a DID method. The DID was implemented as an interaction term between the time variable, *POST*, and the treatment group variable, *INSURED* in the logistic regression model. By using this method, a comparison of utilization of CRC cancer screenings was conducted between insured and uninsured individuals, before and after the ACA. The first DID model examined the receipt of FOBT. The second DID model examined the receipt of colonoscopy. The third DID model examined the receipt of sigmoidoscopy.

Aim 2-Model Specifications

Model Specification 3 (for FOBT):

$$Y = \beta_0 + \beta_1 * POST + \beta_2 * INSURED + \beta_3 * POST * INSURED + \sum X\beta_n + \varepsilon$$

For the model estimated in this analysis, the DID estimation is explained by *Y*, which is the outcome of interest being the utilization rate of FOBT, *INSURED* is a dummy variable equal to 1 when individuals were insured and 0 when individuals were uninsured, *POST* is a time dummy variable equal to 1 if the time is after the ACA policy intervention and equal to 0 if the time is before the ACA policy intervention, *X* is a vector of predisposing, enabling, and need variables. The coefficient β_0 is the *Y* intercept, the utilization for the pre-intervention period, for the control group, when all control variables are equal to zero. The coefficient β_1 is the time trend in the control group. It is equal to the difference in utilization among the uninsured (the control group) after the ACA provision. The coefficient β_2 is the difference between the control and treatment groups pre- intervention. The coefficient of the interaction (*POST*INSURED*) is the coefficient of interest β_3 which is the difference in differences term. It represents the difference of changes over time. β_3 is the DID estimator that measures the effect of the policy intervention on insured

individuals. Finally, the coefficient β_n represents how Y changes when a single covariate changes holding other variables in the model constant.

Model Specification 4 (for colonoscopy):

$$Y = \beta_0 + \beta_1 * POST + \beta_2 * INSURED + \beta_3 * POST * INSURED + \sum X\beta_n + \varepsilon$$

For the model estimated in this analysis, the DID estimation is explained by Y , which is the outcome of interest being the utilization rate of colonoscopy, $INSURED$ is a dummy variable equal to 1 when individuals were insured and 0 when individuals were uninsured, $POST$ is a time dummy variable equal to 1 if the time is after the ACA policy intervention and equal to 0 if the time is before the ACA policy intervention, X is a vector of predisposing, enabling, and need variables. The coefficient β_0 is the Y intercept, the utilization for the pre-intervention period, for the control group, when all control variables are equal to zero. The coefficient β_1 is the time trend in the control group. It is equal to the difference in utilization among the uninsured (the control group) after the ACA provision. The coefficient β_2 is the difference between the control and treatment groups pre- intervention. The coefficient of the interaction ($POST * INSURED$) is the coefficient of interest β_3 which is the difference in differences term. It represents the difference of changes over time. β_3 is the DID estimator that measures the effect of the policy intervention on insured individuals. Finally, the coefficient β_n represents how Y changes when a single covariate changes holding other variables in the model constant.

Model Specification 5 (for sigmoidoscopy):

$$Y = \beta_0 + \beta_1 * POST + \beta_2 * INSURED + \beta_3 * POST * INSURED + \sum X\beta_n + \varepsilon$$

For the model estimated in this analysis, the DID estimation is explained by Y , which is the outcome of interest being the utilization rate of sigmoidoscopy, $INSURED$ is a dummy variable equal to 1 when individuals were insured and 0 when individuals were uninsured, $POST$ is a time dummy variable equal to 1 if the time is after the ACA policy intervention and equal to 0 if the time is before the ACA policy intervention, X is a vector of predisposing, enabling, and need variables. The coefficient β_0 is the Y intercept, the utilization for the pre-intervention period, for the control group, when all control variables are equal to zero. The coefficient β_1 is the time trend in the control group. It is equal to the difference in utilization among the uninsured (the control group) after the ACA provision. The coefficient β_2 is the difference between the control and treatment groups pre- intervention. The coefficient of the interaction ($POST*INSURED$) is the coefficient of interest β_3 which is the difference in differences term. It represents the difference of changes over time. β_3 is the DID estimator that measures the effect of the policy intervention on insured individuals. Finally, the coefficient β_n represents how Y changes when a single covariate changes holding other variables in the model constant.

RESULTS

Table 8 provides descriptive statistics of the predisposing, enabling, and need factors for the study sample before and after the implementation of the ACA cost-sharing elimination provision. For the total study sample, 228,777 eligible adults were identified, (77,381 before (2008 to 2010) and 151,396 after (2011 to 2016)) ACA. The majority of the sample were adults who are less than 65 years old, non-Hispanic white, living in metropolitan area and insured. An independent two sample t-test “equal variances assumed” to compare the means for all model variables before and after the ACA was conducted. The results indicated that there is a statistically significant

difference between the means of most model variables. The mean age for the pre-ACA sample was 38.64 years, while the mean age for the post sample was 40.10 years ($p < 0.001$). Females were 51% of the sample both pre-and post ACA. The percent of married individuals was 44% pre and 43% post ACA ($p < 0.001$). Although statistically significant differences exist in the means of most demographic variables, the differences are likely attributable to the large sample size hence these differences are not meaningful. In general, there were changes in proportions in the different race groups. The percentage of Whites decreased significantly post ACA (72% to 70%, ($p < 0.001$), while the percentage of Blacks increased (17% to 18% , $p = 0.0158$). Hispanics were 24% of the sample pre and 27% post ACA ($p < 0.001$). Education was significantly different on all levels, with a decrease for less than high school education from (31% to 29%, $p < 0.001$) and for high school education from (27% to 24%, $p < 0.001$), in contrast, there was an increase for some college education from (20% to 24%, $p < 0.001$) and for four-year of college or more from (21% to 23%, $p < 0.001$). For employment, 66% of the sample was employed for some part of the year. The mean income was \$25,338 pre and \$28,994 post ACA ($p < 0.001$). Insured individuals represented 77% of the sample in the pre ACA period and 78% post ACA ($p < 0.001$). Among all US regions, 20% of the sample lived in the Midwest pre and 19% post ACA ($p < 0.001$). There was no statistical significance observed for other regions. For residence, 86% lived in a metropolitan area pre ACA and 88% post ACA ($p < 0.001$). Of the participants, 66% thought they had excellent, very good health or good health pre-and post ACA, however, this was not statistically significant. Annually, a person visited their provider 4.10 visits during the pre ACA period and 4.38 visits post ACA ($p < 0.001$). Of the participants, 12% smoked before the ACA, and 10% smoked after the ACA ($p < 0.001$). The mean BMI of the sample was 27.71 pre-and 27.97 post ACA ($p < 0.001$), indicating individuals are typically overweight. Table 8 shows the means and/or proportions of all model

variables with t-test results from comparison of their means.

Table 8. Comparison of Means: T-test Results for Model Variables

	Pre-ACA (n=77,381)	Post ACA (n=151,396)	P-Value*
Predisposing Factors			
Age-mean (SD)	38.64 (21.17)	40.10 (21.17)	<0.001
Female- (%)	0.51	0.51	0.54
Race- (%)			
<i>White</i>	0.72	0.70	<0.001
<i>Black</i>	0.17	0.18	0.02
<i>Native</i>	0.01	0.01	<0.001
<i>Asian</i>	0.07	0.08	<0.001
<i>Pacific Islander</i>	0.00	0.00	<0.001
<i>Multiple</i>	0.02	0.03	<0.001
Hispanic- (%)	0.24	0.27	<0.001
Married (yes)- (%)	0.44	0.43	<0.001
Education- (%)			
<i>Less Than HS</i>	0.31	0.29	<0.001
<i>High School</i>	0.27	0.24	<0.001
<i>Some College</i>	0.20	0.24	<0.001
<i>4 years of college or</i> ⁺	0.21	0.23	<0.001
Employed	0.66	0.66	0.13
Enabling Factors			
Income-Mean (SD)	\$25,338 (\$31262)	\$28,994 (\$35526)	<0.001
Insured- (%)	0.77	0.78	<0.001
Region- (%)			
<i>Northeast</i>	0.14	0.14	0.46
<i>Midwest</i>	0.20	0.19	<0.001
<i>South</i>	0.38	0.39	0.004
<i>West</i>	0.27	0.27	0.48
Metropolitan Area (yes)- (%)	0.86	0.88	<0.001

Regular Source of Care (yes)- (%)	0.74	0.73	0.1005
No. of Annual Visits to Provider-mean (SD)	4.10 (8.35)	4.38 (9.37)	<0.001

Need Factors

Perceived Health Status-mean (SD)	2.19 (0.90)	2.19 (0.90)	0.67
No. of Chronic Conditions	1.02(1.53)	1.05(1.53)	<0.001
Smoker (yes)- (%)	0.12	0.10	<0.001
BMI-mean (SD)	27.71(6.05)	27.97(6.26)	<0.001

Standard errors in parentheses
+ p<.1, * p<.05, ** p<0.01, *** p<0.001
*Two-sample t-test

Results for Aim 1, Objective 1

Table 9 illustrates the number of women eligible and utilization proportions of mammography and pap smear before and after the ACA provision. An independent two sample t-test “equal variances assumed” to compare utilization rates before and after the ACA was conducted. The results are irrespective of all other variables that were later included in the regression analysis. Of the 10,240 eligible women for mammography who participated in the MEPS survey pre-ACA (2008 to 2010), 72% were considered up-to-date. After the ACA (2011 to 2016), 71% of the 21,967 eligible women were considered up-to-date on mammography, however, the reduction in mammography utilization was not statistically significant. For pap smear, 78% were considered up-to-date of the 25,114 eligible women pre ACA while 76% of the 49,679 eligible women were considered up to date post ACA ($p<0.001$). Surprisingly, utilization of the pap smear test decreased significantly post ACA.

Table 9. Mammogram and Pap Smear Proportions Test

	Pre-ACA Proportion (n) Recommended	Post ACA Proportion (n) Recommended	P-Value
Mammogram	0.72 (10240)	0.71 (21967)	0.2422
Pap Smear	0.78 (25114)	0.76 (49679)	<0.001

Temporal trends of the proportion of individuals utilizing mammography and pap smear, among insured and uninsured women, pre-and post ACA were examined using the longitudinal data file. Figure 2 demonstrates the change in utilization proportion of women over time that are considered “up-to-date” on mammography based on recommended guidelines. However, Figure 2 only illustrates the unadjusted rate of mammography use for both treatment and control groups over the period of the study. Rates of mammography have remained approximately the same during both periods for insured women, however, rates have slightly decrease post ACA among uninsured women. Figure 3 demonstrates the change in rates of pap smear use over time for insured and uninsured women. Rates of pap have slightly decreased post ACA among the both insured and uninsured women. The results illustrated in the trend figures 2 and 3 are surprisingly similar to the results from the *Procedure Proportions Test* in table 9. However, the effect that are detected in figures 2 and 3 could be biased by other factors that differentiate insured women from uninsured women, therefore, there is a need for adjusted analyses controlling for predisposing, enabling, and need factors that may impact the use of mammography and pap smear.

Figure 2. Rate of Mammography Use in Insured and Uninsured Women, 2008-2016

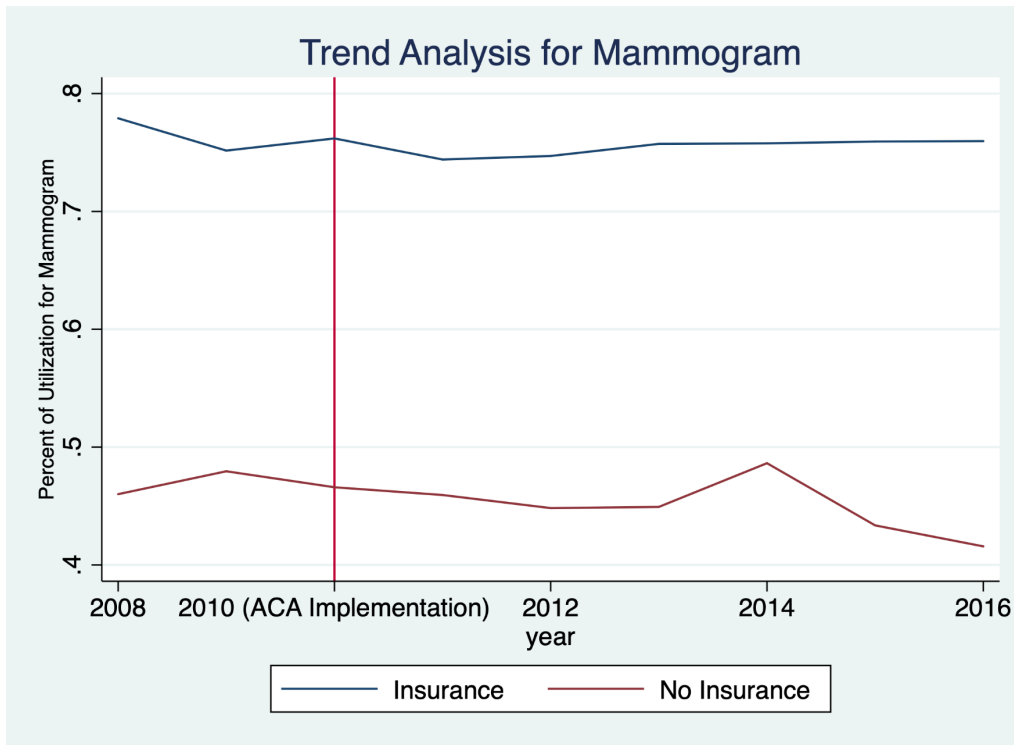
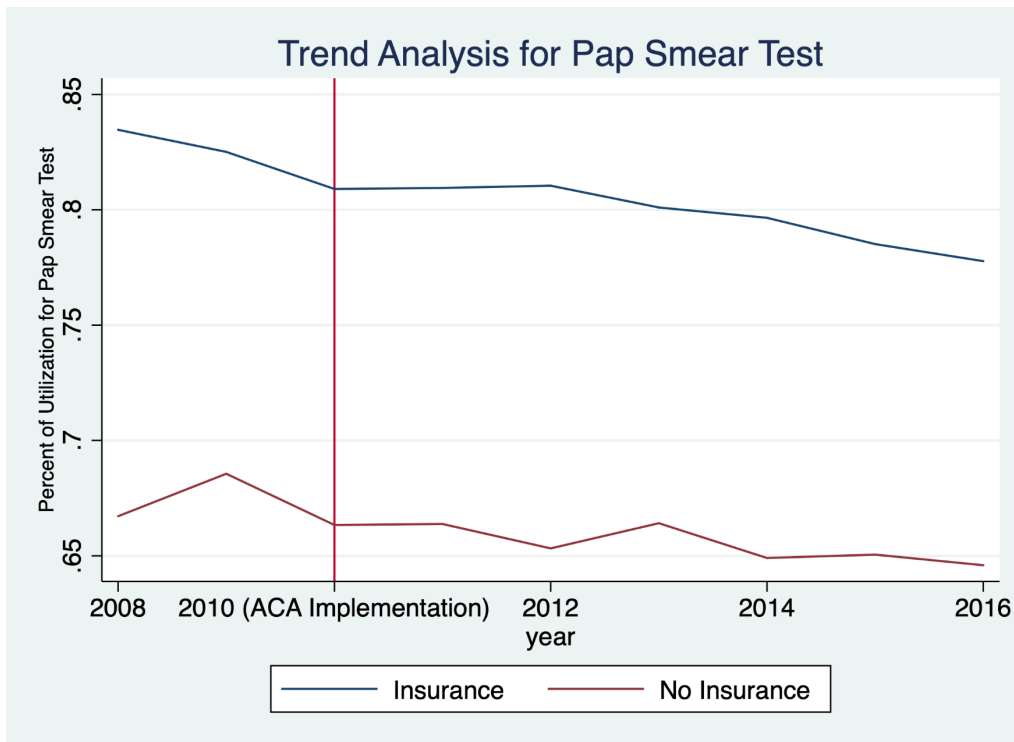


Figure 3. Rate of Pap Smear Use in Insured and Uninsured Women, 2008-2016



Results for Aim 1, Objective 2

To measure the receipt of mammography and pap smear, before and after the implementation of the ACA cost-sharing elimination provision, two logistic regressions were utilized. The models predict whether a woman received a mammography and/or pap smear based on the selected predisposing, enabling and need predictors. The results of the logistic regression models examining mammography and pap smear are presented in Tables 10 and 11, respectively. The tables include proportional odds ratios with the confidence intervals given the other model variables.

There were 13,128 women who received a mammogram during the expected interval. Insured women were 82% more likely to receive a mammogram than uninsured women at any point during the study period (OR=1.82, 95% CI=1.56, 2.13, $p=0.001$). There was no change in mammography screening rates among uninsured women before and after the ACA provision. After the ACA, insured women were 10% more likely than uninsured women to receive a mammogram, however, this was not statistically significant.

Predisposing Factors

After controlling for all other variables. For each year older, women were 16% more likely to receive a mammogram (OR=1.16, 95% CI=1.03, 1.30, $p<0.05$). Hispanic women were approximately 66% more likely than non-Hispanic women to receive a mammogram (OR=1.66, 95% CI=1.44, 1.91, $p<0.001$). For the variable race, black women were 53% more likely than white women to receive a mammogram (OR=1.53, 95% CI=1.35, 1.73, $p<0.001$), women from multiple races were 39% less likely than white women to get a mammogram (OR=0.605, 95% CI=0.43, 0.86, $p<0.01$); however, the results for all other races were not statistically significant. Married women were 34% more likely than non-married women to receive a mammogram

(OR=1.34, 95% CI=1.23, 1.47, $p<0.001$). For education, women with less than a high school education were 14% less likely than women with a high school education to get a mammogram (OR=0.86, 95% CI=0.76, 0.98, $p<0.05$). In addition, women with 4 years of college education or more were 26% more likely than women with a high school education to get a mammogram (OR=1.26, 95% CI=1.11, 1.42, $p<0.001$). The results for employment were not statistically significant.

Enabling Factors

After controlling for all other variables, women who lived in the Midwest were 19% less likely than women who lived in the Northeast to get a mammogram (OR=0.81, 95% CI=0.69, 0.94, $p<0.01$); however, results were not statistically significant for other regions and residence in a metropolitan area. If a woman's income was doubled, she was 12% more likely to get a mammogram (OR=1.12, 95% CI=1.08, 1.17, $p<0.001$). A woman with regular source of care was 172% more likely to receive a mammogram (OR=2.72, 95% CI=2.41, 3.06, $p<0.001$). Each additional annual visit to a health provider results in a woman being 9% more likely to receive a mammogram (OR=1.09, 95% CI=1.08, 1.1, $p<0.001$).

Need Factors

Interestingly, one unit increase in perceived health status decreased the likelihood that a woman received a mammogram by 31% (OR=0.69, 95% CI=0.65, 0.73, $p<0.001$). Each additional chronic condition increased the likelihood of a woman receiving a mammogram by 40% (OR=1.40, 95% CI=1.31, 1.50, $p<0.001$). A woman who smoked was about 40% less likely to get a mammogram than a woman who did not smoke (OR=0.6, 95% CI=0.53, 0.68, $p<0.001$). Results were not statistically significant for BMI.

Table 10. Logistic Regression Results for Mammography

Mammogram	Odds Ratio	95% CI	P-Value
Independent Variables			
Post	0.83	0.67,1.03	0.095+
Insurance	1.82	1.56,2.13	0.000***
Insurance * Post	1.10	0.87,1.40	0.436
Covariates:			
Predisposing Factors			
Age	1.16	1.03,1.30	0.012*
Age Squared	0.99	0.99,1.00	0.003**
Race (white base)			
<i>Black</i>	1.53	1.35,1.73	0.000***
<i>Native</i>	0.67	0.43,1.06	0.088+
<i>Asian</i>	0.84	0.71,1.01	0.066+
<i>Pacific Islander</i>	0.87	0.43,1.76	0.7
<i>Multiple</i>	0.61	0.43,0.86	0.006**
Hispanic	1.66	1.44,1.91	0.000***
Married	1.34	1.23,1.47	0.000***
Education (HS base)			
<i>Less Than HS</i>	0.86	0.79,0.98	0.027*
<i>Some College</i>	1.05	0.94,1.18	0.38
<i>Four-Year College</i> ⁺	1.26	1.11,1.42	0.000***
Employed	0.92	0.81,1.04	0.159
Enabling Factors			
Region (Northeast base)			
<i>Midwest</i>	0.81	0.70,0.94	0.005**
<i>South</i>	0.96	0.84,1.09	0.54
<i>West</i>	0.94	0.81,1.09	0.41
Metropolitan Area	0.94	0.83,1.06	0.28
ln(Income)	1.12	1.08,1.17	0.000***
Regular Source of Care	2.72	2.41,3.06	0.000***
Visits	1.09	1.08,1.10	0.000***
Visits Squared	0.99	0.99,1.00	0.000***
Need Factors			
Perceived Health Status	0.69	0.65,0.73	0.000***
Chronic Conditions Count	1.40	1.31,1.50	0.000***
Chronic Conditions Squared	0.96	0.95,0.97	0.000***

Smoker	0.6	0.53,0.68	0.000***
BMI	0.99	0.99,1.00	0.32
<i>N</i>	13,128		
AIC	12895.4		

Exponentiated coefficients; Standard errors in parentheses

+ $p < .1$, * $p < .05$, ** $p < 0.01$, *** $p < 0.001$

There were 30,945 women who received a pap smear during the expected interval. Women with insurance were 42% more likely to receive a pap smear than women without insurance at any point during the study period (OR=1.42, 95% CI=1.29, 1.56, $p < 0.001$). There was no effect on pap smear among uninsured women before and after the ACA provision. After the ACA, insured women were 1% more likely to receive a pap smear, however, this was not statistically significant.

Predisposing Factors

After controlling for all other variables. For the linear term of age, each year older, women were 10% more likely to receive a pap smear (OR=1.1, 95% CI=1.08, 1.12, $p < 0.001$). Hispanic women were 47% more likely than non-Hispanic women to receive a pap smear (OR=1.47, 95% CI=1.34, 1.59, $p < 0.001$). For the variable race, Black women were 66% more likely than White women to receive a pap smear (OR=1.66, 95% CI=1.52, 1.82, $p < 0.001$). Asian women were 45% less likely than White women to receive a pap smear (OR=0.55, 95% CI=0.49, 0.61, $p < 0.001$), however, the results for all remaining races were not statistically significant. Married women were 38% more likely than non-married women to receive a pap smear (OR=1.38, 95% CI=1.3, 1.5, $p < 0.001$). For education, women with some college education were 24% more likely than women with high school education to get a pap smear (OR=1.24, 95% CI=1.14, 1.34, $p < 0.001$). In addition, women with 4 years of college education or more were 49% more likely than women with a high school education to receive a pap smear (OR=1.49, 95% CI=1.36, 1.62, $p < 0.001$). The impact of employment was not statistically significant.

Enabling Factors

For enabling factors, region was not significant, however, women who lived in a metropolitan area were 22% more likely than women who did not live in a metropolitan area to receive a pap smear (OR=1.22, 95% CI=1.12, 1.34, $p<0.001$). In regards to income, when a woman's income was doubled, she was 7% more likely to get a pap smear (OR=1.07, 95% CI=1.04, 1.09, $p<0.001$). A woman with regular source of care was 104% more likely to receive a pap smear (OR=2.04, 95% CI=1.9, 2.19, $p<0.001$). With one more visit to a health care provider per year, a woman was 7% more likely to receive a pap smear (OR=1.07, 95% CI=1.06, 1.08, $p<0.001$).

Need Factors

For one unit increase in perceived health status, a woman was 19% less likely to get a pap smear (OR=0.81, 95% CI=0.78, 0.85, $p<0.001$). With having one more chronic condition, a woman was 17% more likely to receive a pap smear (OR=1.17, 95% CI=1.11, 1.24, $p<0.001$). A woman who smoked was about 14% less likely to get a pap smear than a woman who did not smoke (OR=0.86, 95% CI=0.79, 0.93, $p<0.001$). For one unit increase in BMI, a woman was 1% less likely to receive a pap smear (OR=0.99, 95% CI=0.99, 1.00, $p<0.05$).

Table 11. Logistic Regression Results for Pap smear

Pap Smear	Odds Ratio	95% CI	P-Value
Post	0.94	0.84,1.05	0.28
Insurance	1.42	1.30,1.56	0.000***
Insurance * Post	1.01	0.88,1.16	0.88
<hr/>			
Predisposing Factors			
Age	1.10	1.08,1.12	0.000***
Age Squared	0.99	0.99,0.99	0.000***
Race (White Base)			
<i>Black</i>	1.66	1.52,1.82	0.000***
<i>Native</i>	1.28	0.92,1.78	0.15
<i>Asian</i>	0.55	0.49,0.61	0.000***

<i>Pacific Islander</i>	0.90	0.57,1.40	0.63
<i>Multiple</i>	0.83	0.65,1.07	0.15
Hispanic	1.46	1.34,1.60	0.000***
Married	1.38	1.30,1.48	0.000***
Education (HS Base)			
<i>Less Than HS</i>	1.06	0.96,1.17	0.25
<i>Some College</i>	1.24	1.14,1.34	0.000***
<i>Four-Year College</i> ⁺	1.49	1.36,1.62	0.000***
Employed	0.93	0.84,1.03	0.17

Enabling Factors

Region (Northeast base)

<i>Midwest</i>	0.92	0.83,1.02	0.13
<i>South</i>	1.07	0.97,1.18	0.18
<i>West</i>	0.99	0.90,1.10	0.94
Metropolitan Area	1.22	1.12,1.34	0.000***
ln(Income)	1.07	1.04,1.10	0.000***
Regular Source of Care	2.04	1.90,2.20	0.000***
Visits	1.07	1.06,1.08	0.000***
Visits Squared	0.99	0.99,1.00	0.000***

Need Factors

Perceived Health Status	0.81	0.78,0.85	0.000***
Chronic Conditions	1.17	1.11,1.24	0.000***
Count			
Chronic Conditions	0.97	0.96,0.98	0.000***
Squared			
Smoker	0.86	0.79,0.94	0.001***
BMI	0.99	0.98,0.99	0.012*

N 30,945

AIC 27593.46

Exponentiated coefficients; Standard errors in parentheses

+ p<.1, * p<.05, ** p<0.01, *** p<0.001

Results for Aim 2, Objective 1

Table 12 illustrates the number of individuals eligible and utilization proportions of FOBT, colonoscopy and sigmoidoscopy before and after the ACA provision. An independent two sample t-test “equal variances assumed” was performed to compare utilization rates before and after the ACA. The results are irrespective of all other variables that were later included in the regression analysis. Of the 20,183 eligible individuals for FOBT, 12% were considered up-to-date pre-ACA

and 11% of 43,497 post ACA. For colonoscopy, 50% were considered up-to-date of the 13,841 eligible individuals pre-ACA while 54% of the 43,497 individuals were considered up-to-date post ACA. For sigmoidoscopy, 6% were considered up-to-date of the 13,841 eligible individuals pre-ACA while 4% of the 43,497 individuals were considered up-to-date post ACA. The results were not statistically significant for FOBT, however, they were statistically significant for colonoscopy and sigmoidoscopy ($p<0.001$). Surprisingly, utilization of sigmoidoscopy decreased significantly post ACA and the utilization of colonoscopy was the only CRC cancer screening procedure that increased significantly post ACA.

Table 12. FOBT, Colonoscopy and Sigmoidoscopy Proportions Test

	Pre-ACA Proportion (n) Recommended	Post ACA Proportion (n) Recommended	P-Value
Blood Stool	0.12 (20,183)	0.11 (43,497)	0.0730
Colonoscopy	0.50 (13,841)	0.54 (43,497)	<0.001
Sigmoidoscopy	0.06 (13,841)	0.04 (43,497)	<0.001

Figure 4, 5 and 6 illustrate the unadjusted utilization rate of FOBT, colonoscopy, and sigmoidoscopy for both treatment and control groups over the period of the study. Rates of FOBT have remained the same pre-ACA but suddenly decreased from 2011 to 2012 for both groups. Colonoscopy rates slightly increased for insured women compared to uninsured women post ACA. Sigmoidoscopy rates decreased similarly for both groups throughout the study period. The results illustrated in the figures 4,5 and 6 are surprisingly similar to the results from the *Procedure Proportions Test* in table 9. However, the effect that we detect in figures 4, 5 and 6 could be biased

by other factors that differentiate insured individuals from uninsured individuals, therefore, there was a need for adjusted analyses that controls for predisposing, enabling, and need factors that impact the use of CRC cancer screenings.

Figure 4. Rate of FOBT Use in Insured and Uninsured Individuals, 2008-2016

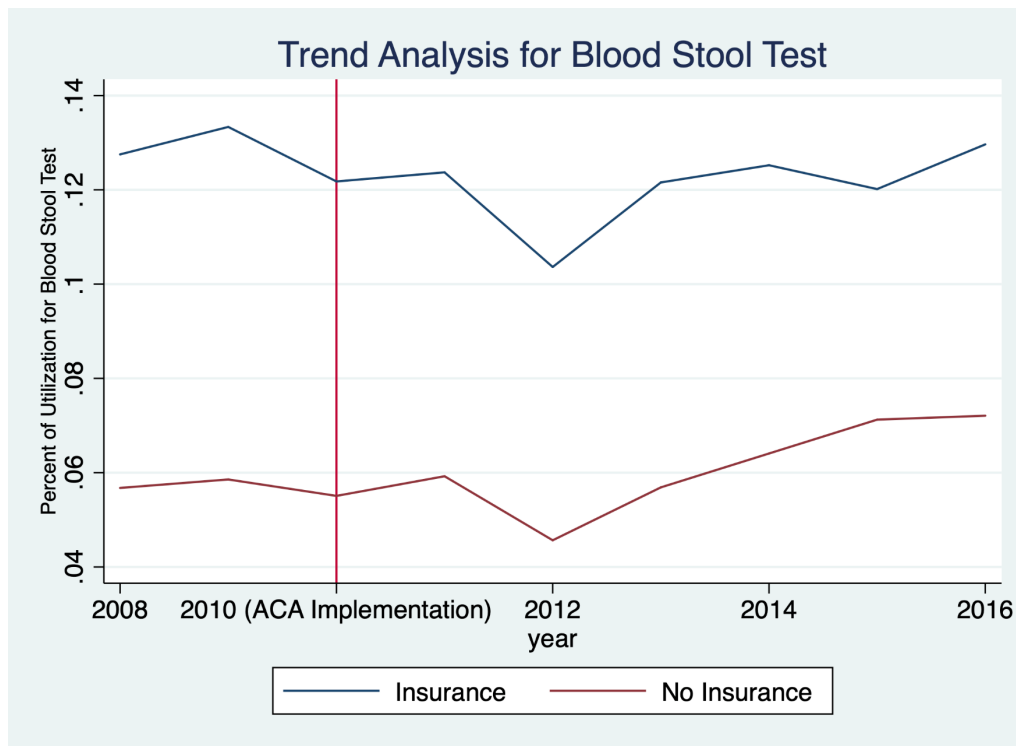


Figure 5. Rate of Colonoscopy Use in Insured and Uninsured Individuals, 2008-2016

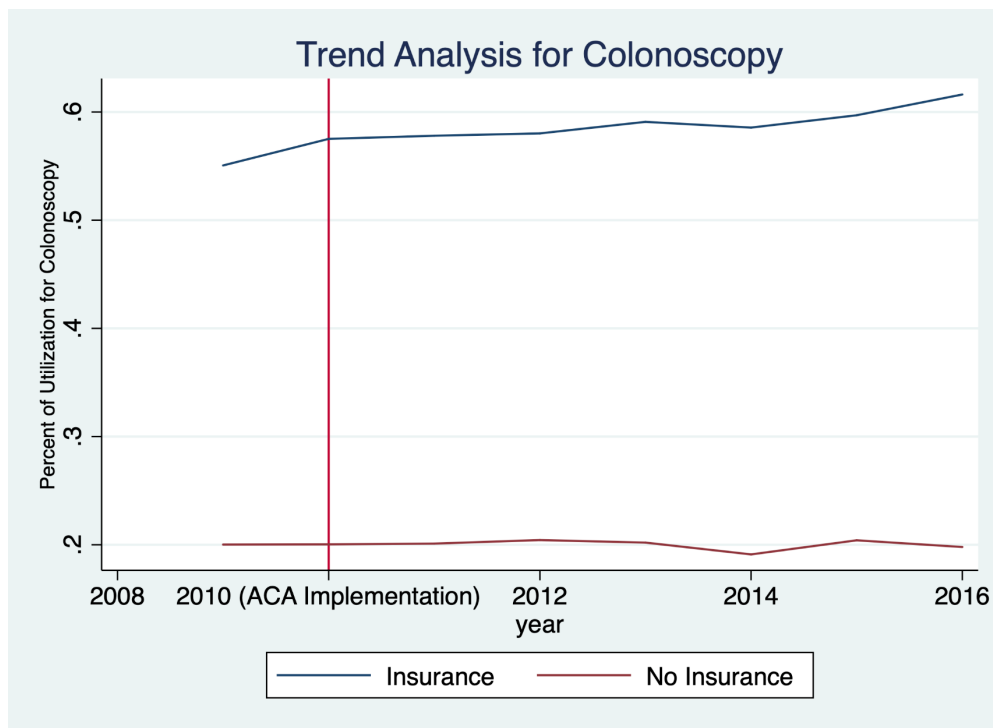
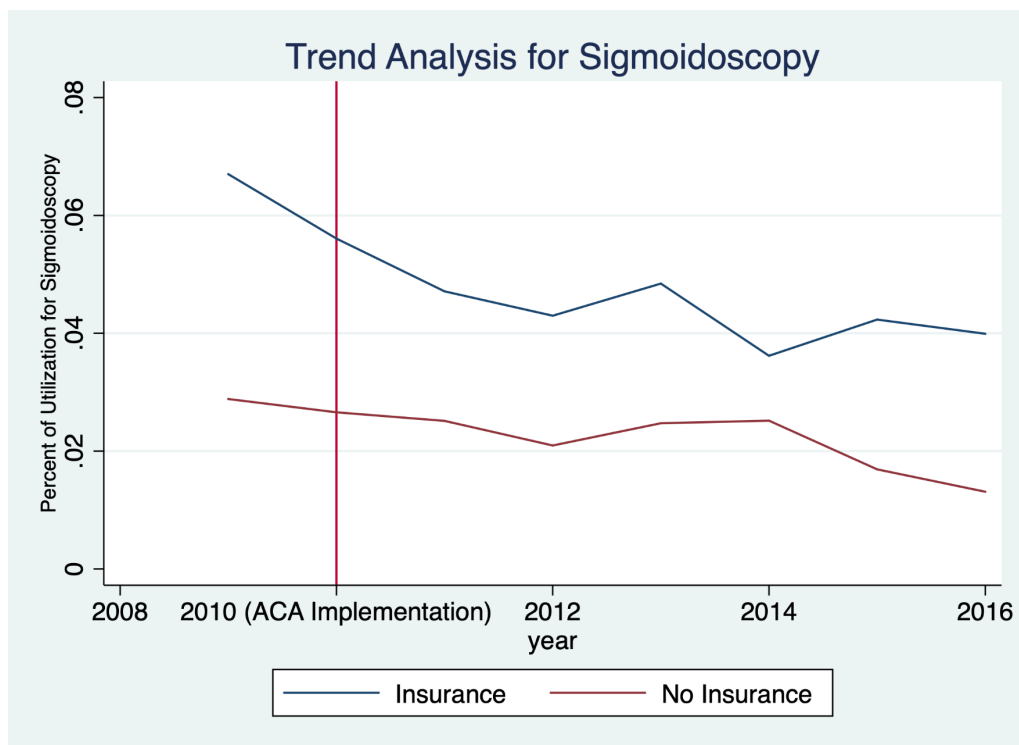


Figure 6. Rate of Sigmoidoscopy Use in Insured and Uninsured Individuals, 2008-2016



Results for Aim 2, Objective 2

To measure the receipt of FOBT before and after the implementation of the ACA cost-sharing elimination provision, a logistic regression was utilized. The model predicts whether an individual received a FOBT based on the selected predisposing, enabling and need predictors. The results of logistic regression model are presented in Table 13. The table includes proportional odds ratios for the model with the confidence intervals for the odds ratios knowing the other predictors are in the model.

In table 13, there were 26,728 individuals who were up-to-date on FOBT. There was no effect on FOBT among uninsured individuals before and after the ACA provision. Individuals with insurance were 47% more likely to get a FOBT than individuals without insurance at any point during the study period (OR=1.47, 95% CI=1.22, 1.78, $p<0.001$). After the ACA, insured individuals were approximately 4.3% more likely to get a FOBT, however, this was not statistically significant.

Predisposing Factors

After controlling for all other variables. For the linear term of age, each year older, individuals were 34% more likely to receive a FOBT (OR=1.34, 95% CI=1.2, 1.49, $p<0.001$). Women were 10% less likely than men to receive a FOBT (OR=0.90, 95% CI=0.83, 0.97, $p<0.01$). Hispanics were approximately 41% more likely than non-Hispanics to receive a FOBT (OR=1.41, 95% CI=1.25, 1.6, $p<0.001$). For the variable race, Black individuals were 39% more likely than White individuals to receive a FOBT (OR=1.39, 95% CI=1.25, 1.55, $p<0.001$), however, the results for all other races were not statistically significant. For education, individuals with less than high school education were 14% less likely than individuals with high school education to receive

a FOBT (OR=0.86, 95% CI=0.75, 0.98, $p<0.05$). In addition, individuals with some college education (OR=1.21, 95% CI=1.09, 1.35, $p<0.001$) and individuals with 4 years of college education or more (OR=1.19, 95% CI=1.07, 1.32, $p=0.001$) were more likely than individuals with high school education to receive a FOBT. Employed people were 18% less likely than unemployed people to receive a FOBT (OR=0.82, 95% CI=0.74, 0.92, $p<0.001$).

Enabling Factors

For enabling factors, individuals who lived in the South (OR=1.24, 95% CI=1.1, 1.4, $p=0.001$) and individuals who lived in the West region (OR=1.90, 95% CI=1.68, 2.15, $p=0.001$) were more likely than individuals who lived in the Northeast to receive a FOBT. Individuals who lived in a metropolitan area were 27% more likely to receive a FOBT (OR=1.27, 95% CI=1.13, 1.43, $p=0.001$). When an individual's income was doubled, he/she was 7% more likely to receive a FOBT (OR=1.07, 95% CI=1.03, 1.11, $p<0.01$). A person with regular source of care was 137% more likely to receive a FOBT than a person without regular source of care (OR=2.37, 95% CI=2.01, 2.8, $p<0.001$). With one more visit to a health provider per year, a person was 3% more likely to receive a FOBT (OR=1.03, 95% CI=1.02, 1.04, $p<0.001$), in other words, the more office visits individuals had the more likely they received FOBT.

Need Factors

For one unit increase in perceived health status, a person was 5% less likely to receive a FOBT, however, this was not significant. With having one more chronic condition, a person was 19% more likely to receive a FOBT (OR=1.19, 95% CI=1.12, 1.27, $p<0.001$). Results for smoking and BMI were not statistically significant.

Table 13. Logistic Regression Results for FOBT

Blood Stool	Odds Ratio	95% CI	P-Value
Post	0.83	0.61,1.14	0.25
Insurance	1.47	1.22,1.78	0.000***
Insurance * Post	1.04	0.75,1.45	0.80
<hr/>			
Predisposing Factors			
Age	1.34	1.19,1.49	0.000***
Age Squared	0.99	0.99,0.99	0.000***
Female	0.90	0.83,0.97	0.009**
Race (White Base)			
<i>Black</i>	1.39	1.25,1.55	0.000***
<i>Native</i>	1.29	0.84,1.97	0.24
<i>Asian</i>	1.14	0.97,1.34	0.12
<i>Pacific Islander</i>	1.19	0.68,2.07	0.54
<i>Multiple</i>	0.84	0.58,1.21	0.35
Hispanic	1.41	1.25,1.60	0.000***
Married	1.08	0.99,1.18	0.075+
Education (HS Base)			
<i>Less Than HS</i>	0.86	0.75,0.98	0.027*
<i>Some College</i>	1.21	1.09,1.35	0.000***
<i>Four-Year</i>	1.19	1.07,1.32	0.001**
<i>College or⁺</i>			
Employed	0.82	0.74,0.92	0.000***
<hr/>			
Enabling Factors			
Region (Northeast base)			
<i>Midwest</i>	1.02	0.89,1.18	0.73
<i>South</i>	1.24	1.09,1.40	0.001***
<i>West</i>	1.90	1.68,2.15	0.001***
Metropolitan Area	1.27	1.13,1.43	0.000***
ln(Income)	1.07	1.02,1.11	0.002**
Regular Source of Care	2.37	2.01,2.80	0.000***
Visits	1.03	1.02,1.04	0.000***
Visits Squared	1.00	1.00,1.00	0.000***
<hr/>			
Need Factors			
Perceived Health Status	0.95	0.90,1.00	0.051+
Chronic Conditions Count	1.19	1.12,1.27	0.000***

Chronic Conditions Squared	0.99	0.98,0.99	0.002**
Smoker	0.93	0.82,1.05	0.23
BMI	0.99	0.99,1.00	0.42
<i>N</i>	26,728		
AIC	18397.23		

Exponentiated coefficients; Standard errors in parentheses

+ $p < .1$, * $p < .05$, ** $p < 0.01$, *** $p < 0.001$

To measure the receipt of colonoscopy among individuals who were recommended to receive it, before and after the implementation of the ACA cost-sharing elimination provision, a logistic regression was utilized. The model predicts whether an individual received colonoscopy based on the selected predisposing, enabling and need predictors. The results of logistic regression model are presented in Table 14. The table includes proportional odds ratios for the model with the confidence intervals for the odds ratios knowing the other predictors are in the model.

In table 14, there were 21,206 individuals who were up-to-date on colonoscopy. There was no effect on colonoscopy among uninsured individuals before and after the ACA provision. Individuals with insurance were 111% more likely to receive a colonoscopy than individuals without insurance at any point during the study period (2008 to 2016) (OR=2.11, 95% CI=1.83, 2.42, $p < 0.001$). After the ACA, insured individuals were approximately 5.1% more likely to get a colonoscopy, however, this was not statistically significant.

Predisposing Factors

After controlling for all other variables. For the linear term of age, each year older, individuals were 57% more likely to receive a colonoscopy (OR=1.57, 95% CI=1.44, 1.70, $p < 0.001$). Women were 10% less likely than men to receive colonoscopy (OR=0.90, 95% CI=0.84, 0.95, $p = 0.001$). Hispanics were approximately 21% less likely than non-Hispanics to receive colonoscopy (OR=0.79, 95% CI=0.72, 0.87, $p < 0.001$). For the variable race, Blacks were

16% more likely than Whites to receive colonoscopy (OR=1.16, 95% CI=1.07, 1.27, $p=0.001$), whereas Asians (OR=0.58, 95% CI=0.51, 0.66, $p<0.001$) and Pacific Islanders (OR=0.51, 95% CI=0.32, 0.82, $p<0.05$) were less likely than Whites to receive a colonoscopy. For education, individuals with less than high school education were 16% less likely than individuals with high school education to receive colonoscopy (OR=0.84, 95% CI=0.76, 0.93, $p=0.001$). In addition, individuals with some college education (OR=1.18, 95% CI=1.09, 1.28, $p<0.001$) and individuals with 4 years of college education or more (OR=1.45, 95% CI=1.34, 1.58, $p<0.001$) were more likely than individuals with high school education to receive colonoscopy. Employed people were 21% less likely to get a colonoscopy than unemployed people (OR=0.79, 95% CI=0.73, 0.87, $p<0.001$).

Enabling Factors

For enabling factors, individuals who lived in the South (OR=0.90, 95% CI=0.82, 0.98, $p<0.0$) and the West (OR=0.73, 95% CI=0.67, 0.81, $p<0.001$) were less likely than individuals who lived in the Northeast to receive colonoscopy. Individuals who lived in a metropolitan area were 20% more likely to receive colonoscopy (OR=1.20, 95% CI=1.10, 1.31, $p<0.001$). When an individual's income was doubled, he/she was 14% more likely to receive colonoscopy (OR=1.14, 95% CI=1.10, 1.17, $p<0.001$). A person with regular source of care was 139% more likely to receive colonoscopy than a person without a regular source of care (OR=2.39, 95% CI=2.17, 2.63, $p<0.001$). With one more visit to a health provider per year, a person was 7% more likely to receive colonoscopy (OR=1.07, 95% CI=1.06, 1.07, $p<0.001$), in other words, the more office visits individuals had the more likely they received colonoscopy.

Need Factors

For one unit increase in perceived health status, a person was 14% less likely to get a colonoscopy (OR=0.86, 95% CI=0.83, 0.9, $p<0.001$). With having one more chronic condition, a person was 33% more likely to receive colonoscopy (OR=1.33, 95% CI=1.26, 1.39, $p<0.001$). A smoker was 71% less likely to receive a colonoscopy than a non-smoker (OR=0.71, 95% CI=0.65, 0.77, $p<0.001$). Results for BMI were not statistically significant.

Table 14. Logistic Regression Results for Colonoscopy

Colonoscopy	Odds Ratio	95% CI	P-Value
Post	1.02	0.84,1.23	0.87
Insurance	2.11	1.83,2.42	0.000***
Insurance * Post	1.05	0.86,1.29	0.63
Predisposing Factors			
Age	1.57	1.44,1.70	0.000***
Age Squared	0.99	0.99,0.99	0.000***
Female	0.90	0.84,0.96	0.001***
Race (White base)			
<i>Black</i>	1.16	1.07,1.27	0.001***
<i>Native</i>	0.73	0.51,1.03	0.076+
<i>Asian</i>	0.58	0.51,0.66	0.000***
<i>Pacific Islander</i>	0.51	0.32,0.82	0.005**
<i>Multiple</i>	0.94	0.72,1.24	0.67
Hispanic	0.79	0.72,0.87	0.000***
Married	1.25	1.17,1.33	0.000***
Education (HS Base)			
<i>Less Than HS</i>	0.84	0.76,0.93	0.001***
<i>Some College</i>	1.18	1.09,1.28	0.000***
<i>Four-Year College</i>	1.45	1.34,1.58	0.000***
or ⁺			
Employed	0.79	0.73,0.87	0.000***
Enabling Factors			
Region (Northeast base)			
<i>Midwest</i>	0.80	0.72,0.88	0.000***
<i>South</i>	0.90	0.82,0.98	0.018*
<i>West</i>	0.73	0.67,0.81	0.000***

Metropolitan Area	1.20	1.10,1.31	0.000***
ln(Income)	1.14	1.10,1.17	0.000***
Regular Source of Care	2.39	2.17,2.63	0.000***
Visits	1.07	1.06,1.07	0.000***
Visits Squared	0.99	0.99,1.00	0.000***
<hr/>			
Need Factors			
Perceived Health Status	0.86	0.83,0.90	0.000***
Chronic Conditions	1.33	1.26,1.39	0.000***
Count			
Chronic Conditions	0.97	0.96,0.98	0.000***
Squared			
Smoker	0.71	0.65,0.77	0.000***
BMI	1.00	0.99,1.01	0.90
<hr/>			
N	21,206		
AIC	24916.15		

Exponentiated coefficients;
+ p<.1, * p<.05, ** p<0.01, *** p<0.001

To measure the receipt of sigmoidoscopy before and after the implementation of the ACA cost-sharing elimination provision, a logistic regression was utilized. The model predicts whether an individual received sigmoidoscopy based on the selected predisposing, enabling and need predictors. The results of logistic regression model are presented in Table 15. The table includes proportional odds ratios for the model with the confidence intervals for the odds ratios knowing the other predictors are in the model.

In table 15, there were 21,206 individuals who were up-to-date on sigmoidoscopy. There was no effect on sigmoidoscopy among uninsured individuals before and after the ACA provision. Individuals with insurance were 40% more likely to get sigmoidoscopy than individuals without insurance at any point during the study period (OR=1.40, 95% CI=1.04, 1.89, $p<0.05$). After the ACA, insured individuals were 6% less likely to receive sigmoidoscopy, however, this was not statistically significant.

Predisposing Factors

Holding all other variables constant, for the linear term of age, each year older, individuals were 51% more likely to receive a sigmoidoscopy (OR=1.51, 95% CI=1.27, 1.8, $p<0.001$). Women were 13% less likely than men to receive sigmoidoscopy (OR=0.87, 95% CI=0.76, 0.98, $p<0.05$). Hispanics were approximately 36% more likely than non-Hispanics to receive sigmoidoscopy (OR=1.36, 95% CI=1.13, 1.65, $p=0.001$). For the variable race, Black individuals were 23% more likely than Whites to receive sigmoidoscopy (OR=1.23, 95% CI=1.03, 1.47, $p<0.05$). The results for all other races were not significant. For education, individuals with some college education (OR=1.29, 95% CI=1.09, 1.52, $p<0.01$) and individuals with 4 years of college education (OR=1.27, 95% CI=1.07, 1.50, $p<0.01$) were more likely than individuals with high school education to receive sigmoidoscopy. Employed people were 10% less likely than unemployed people to get a sigmoidoscopy, however, this was not significant.

Enabling Factors

For enabling factors, individuals who lived in the West were 44% more likely than individuals who lived in the Northeast to receive sigmoidoscopy (OR=1.44, 95% CI=1.52, 2.23, $p<0.001$). Individuals who lived in a metropolitan area were 35% more likely to receive sigmoidoscopy (OR=1.35, 95% CI=1.11, 1.64, $p<0.01$). Results for income were not statistically significant. A person with regular source of care was 84% more likely to receive a sigmoidoscopy (OR=1.84, 95% CI=1.44, 2.34, $p<0.001$). With one more visit to a health care provider per year, a person was 2% more likely to receive a sigmoidoscopy (OR=1.02, 95% CI=1.01, 1.03, $p<0.05$), in other words, the more office visits individuals had the more likely they received sigmoidoscopy.

Need Factors

For one unit increase in perceived health status, a person was 5% more likely to get a

sigmoidoscopy, however, this was not significant. With having one more chronic condition, a person was 13% more likely to receive a sigmoidoscopy (OR=1.13, 95% CI=1.03, 1.24, $p<0.05$).

Results for smoking and BMI were not statistically significant.

Table 15. Logistic Regression Results for Sigmoidoscopy

Sigmoidoscopy	Odds Ratio	95% CI	P-Value
Insurance	1.40	1.04,1.89	0.028*
Post	0.77	0.49,1.20	0.24
Insurance * Post	0.94	0.59,1.50	0.80
Predisposing Factors			
Age	1.51	1.27,1.80	0.000***
Age Squared	0.99	0.99,0.99	0.000***
Female	0.87	0.76,0.98	0.025*
Race (White Base)			
Black	1.23	1.03,1.47	0.020*
Native	1.08	0.54,2.15	0.82
Asian	1.05	0.82,1.34	0.72
Pacific Islander	0.30	0.07,1.24	0.096+
Multiple	0.67	0.35,1.28	0.227
Hispanic	1.36	1.13,1.65	0.001**
Married	0.93	0.82,1.07	0.30
Education (HS Base)			
Less Than HS	1.15	0.94,1.41	0.18
Some College	1.29	1.09,1.52	0.003**
Four-Year College or+	1.27	1.07,1.50	0.007**
Employed	0.90	0.77,1.07	0.23
Enabling Factors			
Region (Northeast base)			
Midwest	0.91	0.74,1.14	0.42
South	0.98	0.81,1.19	0.86
West	1.84	1.52,2.23	0.000***
Metropolitan Area	1.35	1.11,1.64	0.002**
ln(Income)	1.05	0.98,1.12	0.15
Regular Source of Care	1.84	1.44,2.34	0.000***
Visits	1.02	1.01,1.03	0.004**
Visits Squared	1.00	1.00,1.00	0.045*
Need Factors			

Perceived Health Status	1.05	0.97,1.14	0.22
Chronic Conditions Count	1.13	1.03,1.24	0.013*
Chronic Conditions Squared	0.99	0.98,1.01	0.56
Smoker	0.95	0.78,1.14	0.57
BMI	1.00	0.99,1.01	0.99
<i>N</i>	21,206		
AIC	8529.86		
Exponentiated coefficients; + p<.1, * p<.05, ** p<0.01, *** p<0.001			
+ p<.1, * p<.05, ** p<0.01, *** p<0.001			

DISCUSSION

Our findings show that utilization rates post the ACA cost-sharing elimination provision did not increase for the examined cancer preventive services including mammography, pap smear, FOBT, colonoscopy and sigmoidoscopy. Given the decreased cost-sharing, it was expected that utilization will increase; however, there were some predisposing, enabling, and need factors that were associated with a change in utilization rates.

The hypotheses for the study aims were that the utilization of cancer screenings will increase post the ACA cost-sharing elimination among privately and/or Medicare insured individuals as access to preventive care services increased under the ACA. The reasoning behind this hypothesis was that the elimination of all types of out-of-pocket would result in a greater probability of individuals obtaining cancer screenings; however, we did not detect statistically significant differences in utilization rates between insured and uninsured individuals in the DID estimation. Current findings agree with some previous studies that suggest lack of evidence of a positive gain from the ACA cost-sharing elimination provision. In 2015, three different studies evaluating the ACA provision found no significant change in utilization of breast, CRC and cervical cancer screenings among privately insured individuals (Mehta et al, 2015; Han et al, 2015; Jensen et al, 2015). Similarly, a recent study found that changes in the utilization of pap smear,

mammography, and CRC cancer screenings among the privately insured were not a result of the ACA (Hong et al, 2017). Prior studies with null findings blamed their results to several factors. First, many individuals involved in these studies held supplement insurance that covered a substantial amount or the full cost of cancer preventive services (Jensen et al, 2015). This applies to our study since the MEPS data does not contain additional information about supplemental coverage which could impact the results. Second, most of these studies did not have available data for long periods of time after the ACA. This was a problem because longer time is required to capture changes in utilization rates especially since all cancer screenings have screening intervals that are more than a year, however, this study contained data until 2016 which suggests enough time to observe changes in utilization. Third, cancer screening services are different than other screenings as they require more resources to be delivered including specialty equipment, professionals, and specific locations. In addition, from a patient's perspective, cancer screening services would require time, geographic accessibility, obtainability of such specialty screenings, health education and cultural awareness (Han et al, 2015). Lastly, several states already had existing policies to reduce cost-sharing on preventive care services before the ACA (Kirby et al, 2016). Therefore, there are other barriers that face cancer screenings that are not exclusively monetary in their types and are not related to cost-sharing.

This study did not consider many psychosocial variables that influence health behavior including knowledge, attitudes, cultural beliefs, self-efficacy, and perceived threat. These are all important determinants of screening and even with the removal of cost barriers, they could still represent important barriers. A few studies have examined the relationship between cultural beliefs and patterns of cancer preventive care services utilization. For example, research has shown that cultural beliefs greatly influenced the perceptions of African-American women about

breast cancer and mammography. A study of African-American and white cancer patients found that the elderly, less educated, and African-American women were more likely to believe in nontraditional cancer treatments including salves (a healing ointment) and vitamins (Loehrer et al, 1991). Another study surveying African-American women showed that the respondents explained having cancer as a result of a biological process or the will of God (Gregg and Curry, 1994). Finally, a study found that a substantial number of the African-American women were hesitant to obtain cancer treatment because of their fears about undesirable impacts on their relationships with their male partners, especially that they would not be physically attractive (Lannin et al, 1998). By evaluating various cultural barriers, cultural intervention strategies can be implemented to improve breast cancer screening utilization.

Although current findings agree with prior research that showed no positive association of the cost-sharing elimination provision and the utilization of preventive care services, they differ from findings of several studies that showed significant increases in the utilization of preventive care services after the ACA. Lau and colleagues found a significant increase in the receipt of routine examination, blood pressure screening, cholesterol screening and the annual dental visit among young adults (Lau et al, 2014). Similarly, a study of a large community-based health system found that mammography usage increased significantly among women (Nelson et al, 2015). In addition, several studies showed a significant increase in mammography utilization among Medicare beneficiaries after the ACA (Cooper et al, 2016, Sabatino, et al, 2016; Jena et al, 2017). Those studies suggest positive gains from the ACA cost-sharing elimination provision; however, many examined a package of preventive services or found a slight increase in cancer screenings rates. This study examined only cancer preventive screenings and individuals who were eligible for these screenings who had private or Medicare coverage.

As mentioned earlier, there were some predisposing, enabling, and need factors that were associated with a change in utilization rates. The predisposing factors of age, education, and being Black increased the likelihood of receiving all cancer screenings, with being older and more educated, individuals had higher rates of cancer screenings after controlling for the other covariates. Being Hispanic increased the likelihood of receiving all cancer screenings except for colonoscopy. These findings disagree with prior research as it has shown that minorities, such as Hispanics and blacks were, in general, less likely than whites to receive preventive services such as cholesterol screening, blood pressure checks, and cancer screenings (Gornick, 2000). This might be attributed to having newer policies that increased the access to preventive care for minority groups. With respect to mammography and pap smear, married women were more likely receive them. Evaluation of CRC screenings showed that being employed or female decreased the likelihood of utilizing them.

Enabling factors, such as having a regular source of care and more visits to a health care provider, increased the likelihood of receiving all cancer screenings. These findings agree with previous studies as many of them found that receipt of preventive care services was strongly positively associated with having a constant source of care (DeVoe et al, 2003; Bednarek & Schone, 2003; Bandi et al, 2012; Allen et al, 2009). After controlling for other covariates, higher income individuals were more likely to receive all cancer screenings except for sigmoidoscopy. This was expected as previous studies have found that financial requirements tend to reduce the use of valuable care, especially for vulnerable groups such as low-income individuals (Chernew et al, 2007; Chandra et al, 2014). Similarly, living in a metropolitan area increased the likelihood to receive all cancer screenings except for mammography, after controlling for other covariates.

The need factors in this paper included perceived health status, number of chronic conditions, smoking status and BMI. After controlling for other covariates, having more than one chronic condition increased the likelihood of receiving all cancer screenings while having a lower perceived health status decreased the likelihood of receiving all cancer screenings except for sigmoidoscopy. Prior research has shown that the number of chronic diseases is correlated with increased cancer screenings. For example, hypertensive individuals had more breast exams, pap smears, FOBTs, and a trend to have more mammograms (Heflin et al, 2002). Also, women with three or more chronic conditions were shown to have more mammograms, pap smears, and breast exams (Yasmeen et al, 2011; Zao et al, 2008). In our study, smokers were less likely to receive mammography, pap smear, and colonoscopy. Similarly, prior research has demonstrated that daily smokers were found to be less likely to receive cancer screening despite their increased risk of cancer (Vander et al, 2012). In regards to BMI, our study found that women with a higher BMI were less likely to receive a pap smear. This agrees with literature findings as studies have shown that obese women were less likely to receive breast, cervical, or CRC cancer screening than normal weight women (Reidpath et al, 2002; Wee et al, 2002).

This study had several limitations. The MEPS data contains self-reported answers to survey questions that are prone to recall error, however, since the error will have a similar effect throughout the different years, it will not significantly impact the outcomes of this study (Rauscher et al., 2008). In addition, the MEPS is cross-sectional panel data that only captures information at the point of the survey which might result in biased impact effects of some variables. Furthermore, the MEPS lacks data about supplemental coverage which might impact the results. Another limitation of this study is including uninsured individuals as a control group in the DID estimation. Uninsured individuals could be substantially different from insured individuals in utilization trends

of preventive care services before the implementation of the ACA provision. Those who are uninsured served as the control group because the implementation of the ACA provision did not affect them. The DID approach requires a control group that is very similar to the treatment group; however, there are some differences between the uninsured and insured individuals. The Uninsured are more likely to be low-income, Hispanic, and young (Kaiser Family Foundation, 2013). Nevertheless, since the implementation of the ACA has been a gradual system among all forms of insurance types, the uninsured were the single group that remained constant before and after the implementation of the ACA, which is the reason they were selected to serve as the control group.

CONCLUSION

Based on the findings of this study, the ACA cost-sharing elimination provision was not associated with an expected increase in utilization of preventive care services among Medicare and privately insured individuals. Despite the theories that out-of-pocket expenses are a barrier to preventative care utilization, the findings of this study and those of other researchers do not support them. Additional efforts might be necessary to complement the ACA cost-sharing elimination provision (Hong et al, 2017). These efforts would include enhancing the knowledge of people about the importance of preventive screenings in detecting cancer at an early stage, before symptoms appear, where treatment is easier and more successful to cure them and eventually save their lives. In addition, efforts in outreach and implementing educational campaigns to raise public awareness about the available health service benefits may increase awareness. In conclusion, the results of this study which supports the work of prior researchers suggest that future research is necessary to understand and evaluate the impact of cost-sharing on access to cancer preventive care services.

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