2018

The Impact Of The Medicaid Coverage Expansion And The Removal Of Cost-Sharing Under The Affordable Care Act On Mammography And Pap Tests

Abeer Alharbi
University of South Carolina - Columbia

THE IMPACT OF THE MEDICAID COVERAGE EXPANSION AND THE REMOVAL OF COST-SHARING UNDER THE AFFORDABLE CARE ACT ON MAMMOGRAPHY AND PAP TESTS

by

Abeer Alharbi

Bachelor of Science
King Saud University, 2003

Master of Health Administration
King Saud University, 2011

Submitted in Partial Fulfillment of the Requirements

For the Degree of Doctor of Philosophy in

Health Services Policy and Management

The Norman J. Arnold School of Public Health

University of South Carolina

2018

Accepted by:

Mahmud Khan, Major Professor

Ronnie Horner, Committee Member

Cole Chapman, Committee Member

Heather Brandt, Committee Member

Cheryl L. Addy, Vice Provost and Dean of the Graduate School

DEDICATION

I dedicate this work to my mother, Maryam Zaher, for her support and encouragement during my graduate studies at the University of South Carolina Health Services Policy and Management program in the Arnold School of Public Health. I would not have made it to graduation without her support. Thank you for your love, concern, and encouragement.

ACKNOWLEDGEMENTS

I would like to acknowledge the support and encouragement I received from my committee chair, Dr. Muhmod Khan. His support during my dissertation process is greatly appreciated. I would also like to thank Dr. Brandt, Dr. Chapman, and Dr. Horner for being part of my committee and their continued support.

ABSTRACT

Background: The Affordable Care Act (ACA) aimed at making health care affordable and accessible including the use of preventive care services. To achieve these aims, the ACA expanded Medicaid coverage to population with income below 138% of FPL and removed cost-sharing when using preventive care services recommended by the USPSTF. This study tried to assess the impact of these provisions on the rate of mammography and Pap tests among women. **Methods**: Data was obtained from the Medical Expenditure Panel Survey - Household Component MEPS-HC. A difference-in-difference design was used to determine the effect of Medicaid eligibility expansion on the outcomes and a counterfactual analysis was used to determine the effect of removing cost-sharing from preventive care services on the outcomes. **Results**: The difference-in-difference estimate show that likelihood of utilizing mammograms did not change significantly among low-income women after the implementation of the Medicaid expansion (DID coefficient -0.0476 with t-statistics at -1.26), Pap test decreased (coefficient -0.0615, t-statistics -2.76), and Medicaid enrollment has increased significantly among low-income women living in expansion states (coefficient 0.0889 with t-value of 3.68). The counterfactual analysis show that the utilization of mammogram and pap test did not improve following the ACA. **Conclusion**: The ACA was associated with increased Medicaid enrollment but did not yield near-term improvement in use of mammography and Pap tests among women. Factors beyond health insurance coverage may be important in determining the likelihood of obtaining

these screening procedures and policy makers should try to identify other barriers to cancer screening services utilization among the low-income women in the USA.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

ACA ..... Affordable Care Act

CDC ..... Center for Disease and Control

CMS ..... Centers for Medicare and Medicaid Services

DID ..... Difference-in-Difference

MEPS-HC ..... Medical Expenditure and Patient Services – Household Component

NCI ..... National Cancer Institute

POST-ACA ..... After the Affordable Care Act

PRE-ACA ..... Before the Affordable Care Act

USPSTF ..... U.S. Preventive Services Task Force

CHAPTER 1
INTRODUCTION

In March 2010, the Patient Protection and Affordable Care Act, often shortened to the Affordable Care Act (ACA) was signed into law. Major aims of the ACA were to make health care affordable and to increase the use of preventive care services, and in turn, reduce costly events from poorly or unmanaged chronic conditions. To achieve these aims, the ACA expanded Medicaid coverage to include the entire population aged 18-64 with income below 138% of the federal poverty line and removed cost-sharing when using preventive care services recommended by the US Preventive Services Task Force (USPSTF) (1). The percentage of American women who receive mammograms and pap tests has been suboptimal in the years before the ACA (2). It has been documented in the literature that cost-sharing or health insurance are associated with the use of medical services including preventive care services (3–15). This study tried to assess the impact of these ACA's provisions on mammograms and Pap tests rates among women.

1.1 BACKGROUND

Mammography

Breast cancer is the most commonly diagnosed cancer among American women, besides skin cancer (16). Death rates from breast cancer are higher than those for any other cancer, besides lung cancer. In 2018, there will be an estimated 266,120 new cases

of invasive breast cancer diagnosed in women and 41,400 deaths in the US (16). Women who appropriately screen for breast cancer are likely to receive more timely diagnosis and treatment (16–21). Mammography is the most widely used screening modality for the detection of breast cancer. Results from randomized controlled trials and observational studies found that mammography reduces the risk of dying from breast cancer (19–21). However, mammograms do have risks. Sometimes mammograms find false positives that carry risks including pain, anxiety, and other side effects. Experts make trade-offs between benefits and risks when making recommendations about who should be screened. Establishing age-appropriate guidelines for screening women for breast cancer is debated by experts in the medical field. There is evidence that mammogram decrease breast cancer mortality among women aged 50-69 but the benefit of mammography for women aged 40-49 years is uncertain (22,23). The American cancer society recommends beginning annual mammography at the age of 40. This was updated in 2015 to increase the starting age to 45. The 2002 guidelines by the US Preventive Services Task Force (USPSTF) suggests mammography for women of age 40 years or more, with or without clinical breast examination, every 1 to 2 years. This was updated in 2009 which recommends mammogram for women aged 50-75 every two years. The ACA utilizes the 2002 US Preventive Services Task Force (USPSTF) recommendation on breast cancer (24).

Pap tests

Cervical cancer incidence rates declined by half between 1975 and 2014 due to the widespread uptake of the Pap test. However, declines have slowed down in recent years. In 2018, there will be an estimated 13,240 new cases of invasive cervical cancer

diagnosed in women and 4,170 deaths in the US (16). Many women getting regular pap tests, which can find cervical precancer before it turns into cancer, have reduced the number of cases of cervical cancer and the number of deaths from cervical cancer (25,26). Similar to mammograms, pap tests sometimes come with harm when abnormal results lead to vaginal bleeding, pain, infection, and anxiety. However, the USPSTF concludes that for women aged 21 to 65 years, there is high certainty that the benefits of screening with pap test every three years substantially outweigh the harms (27). The American cancer society and the USPSTF recommend pap tests for women aged 21-65 every 3 years or if aged 30-65 pap test combined with HPV screening is recommended every 5 years.

Despite evidence that screening greatly improves health outcomes, rates of mammography and pap test screenings remained suboptimal in the United States in the years preceding the ACA (2). The percentage of American women who receive mammograms has remained steady whereas the percentage of women who receive Pap tests has declined slightly. In 2015, 65.3% of women aged 40 and older had a mammogram within two years, while 69% of women aged 18 and older had a pap test within three years (2). Within the low-income women, 54.9% received mammography while 60% received pap test (2). The National Cancer Institute's (NCI) goals include increasing the proportion of women who get regular mammograms to 80%, and similar goals have been issued for pap tests.

There are disparities in breast and cervical cancer screenings, diagnosis, and outcomes in terms of income, education, race, and health insurance (16,28–36). For example, black and Hispanic women and women without private insurance are less likely

than white women and women with private insurance to obtain high-quality mammography screening (33). A study showed that black and Hispanic women continue to be diagnosed at a later stage of breast cancer compared to white women (34). Regardless of race, people with lower income status have higher cancer death rates than those with higher income (16). Women who are uninsured or low-income are less likely to receive possibly lifesaving recommended cancer screenings (35). Despite the CDC funded Breast and Cervical Cancer Early Detection Program that provides screening and diagnostic services for uninsured and low-income women, evidence shows limited success reaching the targeted population (37).

Health Insurance and Cost-sharing

Health insurance is critical to whether people get necessary medical care, when and where they get their care, and finally how healthy they are (38). Evidence shows that a lack of health insurance coverage is one of the reasons people skip care, particularly preventive screenings (3–14). For example, a study found that disparities in cancer screenings by health insurance status and type of insurance exist among U.S. adults (3). Other previous observational studies show strong associations between health insurance coverage and the receipt of mammography and pap tests (10–13,33). Also, some evidence exists that show cost-sharing reduces the use of recommended procedures such as preventive interventions and cancer screenings (15).

ACA provisions: (A) Medicaid Expansion

To reduce the number of the uninsured population and improve access to care among the low-income population, the ACA expanded the coverage of Medicaid to include the entire population aged 18-64 with income below 138% of federal poverty

line. States participation in Medicaid expansion became optional after the national federation of independent business vs Sebelius supreme court ruling in 2012 (39). The Medicaid expansion took effect for most states on January 2014. As of September 2018, 34 states have adopted Medicaid expansion, 3 states are considering expansion, and 14 states did not expand Medicaid (40). In 2013, the poor population had the highest level of un-insurance (41). As most uninsured population before the ACA were low-income, Medicaid coverage expansion has the potential to improve access for low-income population to high quality health care including mammography and Pap tests (41,42). In 2016, there were 11 million individuals newly eligible in Medicaid as a result of the Medicaid expansion according to a report from Centers for Medicare & Medicaid Services (CMS) (43).

ACA provisions: (B) Removing Cost-Sharing for preventive care Services

To increase the use of preventive care services, the ACA required private insurers and Medicare to cover all preventive services recommended by US Preventive Services Task Force (USPSTF) with a rating of A (strongly recommended) or B (recommended) without any cost sharing. The policy became effective on September 23, 2010 for private health insurers and on January 2011 for Medicare. Medicaid was not required to cover preventive services without cost-sharing. However, in 2013, incentives were offered to state Medicaid to cover preventive services for adults with no cost sharing.

1.2 PURPOSE AND SIGNIFICANCE OF THE STUDY

Assessing the impact of the ACA's provisions on health cost, health care utilization, and access is critical to provide timely feedback on this important health

reform, especially when uncertainty continuous to surround it at both the state and federal levels. The ACA contained several strategies aimed at reducing health cost and un-insurance rate as well as increasing access to needed health care including cancer preventive screenings among low-income population. However, to date, there is limited evidence as to the effectiveness of the policy in improving the uptake of mammograms and Pap tests among women.

Given the previously discussed advantages of mammography and Pap tests in reducing the risk of cancer mortality, the suboptimal screening rates, and the established association between health coverage and utilization, this study tried to assess the impact of the ACA on mammography and Pap test rates among women in general as well as low-income women in particular. The findings from this study will provide scientific evidence that will add to or confirm the existing body of knowledge on this topic and it will advance our understanding of the potentials of the Medicaid expansion and the removal of cost-sharing in improving the delivery of healthcare.

CHAPTER 2
LITERATURE REVIEW

2.1 THEORETICAL FRAMEWORK

Because mammograms and Pap tests are effective in identifying possible cancer cases and can help improve quality and length of life, women will demand these services. Real demand is when women's desire to have good health is backed up by their ability and willingness to pay. In economics, the Demand Theory suggests that demand for health services (i.e. mammograms and pap tests) is a function of price paid for the services, prices of other complementary and substitute services and products, income of household, underlying preference structure, and risk-attitude (44). Preference structure and risk-attitudes may be modified by education, health insurance, health campaigns, marital status, smoking status, regular exercise, alcohol use, etc. The ACA provisions such as expanding Medicaid coverage and removing cost-sharing will affect variables from the demand function such as prices and health insurance status.

When health care services are not purchased directly from providers but rather obtained at subsidized prices due to health insurance, the out-of-pocket prices faced by consumers are typically much lower than the market price. This distinction is often described under "ex-post moral hazard". In this case, moral hazard is considered an efficient tool in increasing demand for preventive care that results in reduced future cost. The term "Moral Hazard" was first introduced into the modern academic literature by

Kenneth J Arrow in 1963 when he defined moral hazard in health insurance as the idea that "medical insurance increases the demand for medical care" (45). The notion of moral hazard was highlighted in the landmark RAND Health Insurance Experiment (RAND HIE) conducted between 1974-1977 (14). The RAND experiment randomly assigned a representative sample of families with adults under the age of 62 to health insurance plans with different levels of cost sharing, ranging from full coverage (zero cost sharing) to plans that provided almost no coverage. The experiment showed that when faced with cost-sharing, people reduce the use of all types of health care services particularly preventive care. Before the RAND experiment, the general idea was that health care utilization is affected only by health need. The experiment proved that seeking health is sensitive to price and therefore obtaining health insurance increase demand for health care.

Mammography and Pap tests receipt were shown in a number of observational studies to be associated with health insurance coverage (10–13,33). For example, a study found that women without private insurance are less likely than women with private insurance to obtain high-quality mammography screening (46). Another study found that women who are uninsured are less likely to receive possibly lifesaving recommended cancer screenings (35). A study examined the role of health insurance on pap test and mammography utilization among immigrant and nonimmigrant women and found that women took the screenings as long as they had health insurance or a regular source of care (10). Another study used longitudinal survey data to examine the effect of insurance coverage on the rates of mammography and pap testing, and found that the rates decreased with an increasing occurrences of un-insurance (11). Preventive services

utilization was found to be associated with having health insurance, as insurance coverage increased the receipt of mammography and pap test increased (12). A study examined the effect of Medicaid expansion of 1996 on taking pap smear test, and found that previously uninsured women took the test after becoming eligible (13).

2.2 MEDICAID EXPANSION

Evidence from Pre-ACA

In 2006, the state of Massachusetts passed a health care reform law that contained Medicaid expansion and subsidized private health insurance. The components of this legislation have been considered by many to serve as the blueprint for the ACA of 2010. Several quasi-experimental studies found the Massachusetts health reform to be associated with improved access and utilization of health care services among adults in general (47–49) and low-income population in particular (50–52). A study on the Massachusetts reform, anticipated large increases in coverage rates and access to care for low-income childless adults in the states expanding Medicaid under the ACA (50).

In 2008, in the state of Oregon, a group of uninsured low-income adults were selected randomly by lottery to enroll for the Medicaid program. This created a chance to conduct a randomized control trial (RCT) that would examine the impact of expanding health coverage on access, utilization, and health outcomes among poor population. The Oregon Health Insurance Experiment (OHIE) showed increased health services use including mammography and pap tests (53). Another study took advantage of the randomized controlled trial setting to investigate the impact of the coverage expansion on cancer preventive screenings and found that the Medicaid expansion provided access to

important care and screenings that could help to detect cancers earlier especially among women (54).

Evidence from Post-ACA

Overall, 20 million uninsured adults gained insurance under the ACA (55). 11 million were newly eligible in Medicaid as a result of the Medicaid coverage expansion (43). In 2016, Medicaid enrollment increased by 36% from 2014 among the states that had expanded Medicaid, compared with less than 12% in the non-expansion states (56). The reduction in un-insurance rate was larger in expansion states compared to non-expansion states (57). Low-income population, the group targeted by the policy, experienced coverage rate increases (58–60). A recent study found that low-income population who have previously lacked coverage, experienced increased coverage by a 7.5 percent in the sates that expanded Medicaid (60). In addition to improvements in coverage rate, improvements have been observed in health care access, utilization, affordability, and preventive care following the 2014 Medicaid expansion (61–69). However, some studies found no significant impact of the expansion on some certain outcomes such as length-of-stay, mortality, self-reported health, and doctor visits (57,70–72). In subgroup analysis, early findings of the ACA indicate that there has been significant impact among the poor, low-educated adults, those living in rural areas, and racial and ethnic minorities live in Medicaid expansion states (41,73–78). However, a study suggests that large gaps remain in access and affordability, particularly for low-income adults (79). Disparities in cancer screening by race and socioeconomic status may widen as women remain uninsured in non-expansion states and others gain coverage (80,81). As for mammography and pap tests, early post-ACA evidence gave mixed

results, particularly among low-income adults. Cole et al. (82) compared changes among federally funded community health centers in expansion versus non-expansion states from 2011 to 2014. Those centers were likely to be particularly affected by this expansion because many of their patients were uninsured and low income. Their study results found that, compared to centers in non-expansion states, centers in expansion states had significant improvements in for pap tests use (82). However, other studies did not find significant improvement from the Medicaid expansion on mammography and pap tests. For example, Simon et al. (83) examined data of low-income adults from 2010 to 2015 and found that the expansion increased access to certain types of preventive care but no significant impact was found on mammography and pap tests (83). Miller et al. (57) looked at the first two years of the expansion and found no significant changes in the rates of mammography. A recent study by Cawley et al. (84) observed the impact of Medicaid expansion three years after the expansion and found no detectable impact on pap tests or mammograms.

2.3 REMOVAL OF COST-SHARING

The removal of cost-sharing for recommended preventive care services was believed to increase the use of those services. Evidence exists that show cost-sharing reduces the use of recommended procedures such as preventive interventions and cancer screenings (15). A study used data from 1995 to 2003 to examined the cost-sharing waiver on elderly women, anticipated that eliminating cost-sharing under the ACA may be an effective strategy for increasing preventive services use (85). Post-ACA, studies reported mixed results on the impact of removing cost-sharing on mammography and pap test (85–94). Hong et al. (94) evaluated the impact of removing cost-sharing in being up-

to-date on mammography and Pap tests and found decreased rates of being up-to-date on women's cancer screening among those with private insurance. Other studies examined the initial impact of the policy on privately insured women and found no change in mammography and Pap tests after the ACA (88–90). Other studies, however, yielded positive results. For example, a recent study found the policy to be associated with improved mammography and Pap tests among Hispanics and African Americans (95). Also, a study that assessed the policy from a health system level found that removing cost-sharing under the ACA to be associated with increased screening volumes among women age 50-74 (93). Studies that looked at Medicare population gave mixed results regarding mammography utilization. For example, Jensen et al (92) found minimal change in mammography among older women, while other studies found a statistically significant increase in mammography uptake after the ACA among elderly women (86,87).

After this extensive literature review, it remains uncertain what would be the impact of the health coverage expansion through Medicaid and the removal of cost-sharing on mammograms and Pap tests. Based on the demand theory in economics, I hypothesized that Medicaid coverage expansion and the removal of cost-sharing when using preventive services will be associated with improved rates of mammograms and Pap tests.

CHAPTER 3
METHODS

3.1 DATA SOURCE

Data for this study was obtained from the Medical Expenditure Panel Survey - Household Component MEPS-HC (96). The MEPS is a set of large-scale surveys of families and individuals, their medical providers (doctors, hospitals, pharmacies, etc.), and employers across the United States. MEPS collects data on the specific health services that Americans use, how frequently they use them, the cost of these services, and how they are paid for, as well as data on the cost, scope, and breadth of health insurance held by and available to U.S. workers. This study utilizes the Household Component (HC) of the MEPS, which collects data from a sample of families and individuals in selected communities across the United States, drawn from a nationally representative subsample of households that participated in the prior year's National Health Interview Survey (conducted by the National Center for Health Statistics). During the household interviews, MEPS collects detailed information for each person in the household on the following: demographic characteristics, health conditions, health status, use of medical services, charges and source of payments, access to care, satisfaction with care, health insurance coverage, income, and employment. MEPS contains the data on health care utilization, health insurance status, coverage source, and cost that are required to answer the research question.

3.2 DESIGN

Difference-in-Differences design (Medicaid expansion study)

This analytic design tests a comparison of the change in trends of outcomes before and after Medicaid expansion across expansion states vs non-expansion states, controlling for other covariates representing risk attitudes and preference structure. The treatment group includes women living in Medicaid expansion states and control group includes women living in non-expansion states. Only the states that expanded Medicaid between January 2014 and January 2016 were included in the treatment group (appendix A). The states that already provided Medicaid or similar coverage to low-income adults before 2014 were excluded (District of Columbia, Delaware, Massachusetts, New York, and Vermont) (see appendix A). For estimating the DID parameters, pre-ACA period is defined as the years 2012-13 and the post period is defined as the years 2015-16.

The following multivariate linear regression was estimated to find the effect of the policy change on the outcome variables, the likelihood of receiving mammography and pap smears:

$$Y_{ist} = \beta_0 + \beta_1\, Treatment + \beta_2\, Post + \beta_3\, (Treatment*Post) + \beta_x\, Covariates + \mathcal{E}$$

Where "Y_{ist}" represents outcome for individual "i" living in state "s" at time 't". β_0 is the baseline average. The term "Treatment" is a dummy variable equal to 1 if the individual resides in a treatment group (expansion state). β_1 is the difference between the two groups pre-intervention. The term "Post" is a dummy variable equal to 1 if the time is after the Medicaid expansion. β_2 is the time trend in control group. The term "Treatment*Post" is an interaction term of intervention and time, β_3 represents the

difference-in-differences estimator capturing the effect of Medicaid expansion. Covariates are added to the model to control for preference structure and risk attitudes.

This regression model, in theory, will be able to indicate the effect of treatment if the intervention and control groups are identical at the baseline or show similar pattern of change over the years. In the real world, the intervention and control groups in pre-intervention period are never identical and therefore differences between the groups need to be explicitly considered and incorporated in the analysis. The effect of program change can be estimated if the assumption of similar pattern of changes over the years in pre-intervention years may be assumed in post-intervention periods as well. This is known as the "parallel assumption" in DID analysis. Since the parallel assumption must hold for an unbiased DID estimator, we can test the parallel movements or trend in the outcomes prior to policy change in treatment and control groups over a number of years. To assess the validity of this assumption, we regressed each outcome for the years 2005 to 2013 on variables indicating years, state expansion status and an interaction term of year and state expansion status. If the coefficient of the interaction term is not statistically different from zero, it implies that the rate of change of the dependent variables is not different between the intervention and control areas confirming the parallel movement of the outcome over the years prior to the implementation of the intervention.

Counter-factual design (Cost-sharing study)

We used a counterfactual analysis to determine the impact of ACA on the preventive screenings rate. Counterfactual analysis helps to understand what would have happened in post-ACA year if ACA was not there. This was done by estimating a model that examines determinants of the dependent variable for pre-ACA (year 2009). Then, the

estimated model was used to predict the dependent variable using post-ACA characteristics of individuals (the determinants from the model) (year 2016). The model basically works as pseudo control group allowing estimation of the utilization of screenings if ACA policy changes were absent. Effect of ACA is then estimated as: rate of dependent variable post-ACA minus the predicted rate of dependent variable in the same post-ACA year using counterfactual (that there was no ACA in that year). We chose determinants that we believe may modify the demand for the screening tests and the potential variables incorporated in the model are: age, race, income, education, marital status, region, health insurance type, physical activity, smoking status, comorbidity, routine medical checkup, metropolitan area, out-of-pocket expenses, and the availability of a usual source of care. It is important to note that there are few determinants of cancer screenings are likely to change due to the introduction of ACA, implying that incorporating these variables for the post-ACA sample to define the counterfactual will underestimate the effect of ACA because some of these determinants that are affected by ACA will pick-up some of the changes happened due to the implementation of ACA. Most important variables likely to change due to the implementation of ACA are coverage rate of health insurance and types of insurance people have. To ensure that the counterfactual estimates are not biased, insurance type and coverage rates should be kept the same in the post-ACA year as it was in the pre-ACA year. This was done through adjusting the sampling weights so that pre- and post-ACA insurance coverage and types of insurance coverage are the same.

3.3 OUTCOME

The outcomes are the self-reported receipt of mammogram and Pap tests. For each preventive service, respondents were asked "About how long has it been since you had this mammogram/Pap test?" with possible responses being "within past year," "within past 2 years," etc. In accordance with screening guidelines, a dummy variable was created for mammogram utilization equal to 1 if the test was taken within 1 to 2 years, and a dummy variable for pap test utilization equals to 1 if the test was taken within 1 to 3 years.

We controlled for variables that we believe may modify the preference structure and risk attitude of women in the sample. According to the Demand Theory, demand for health services is a function of prices of the services, household income, preference structure, and risk-attitude. We chose covariates that may modify the preference structure and risk attitude, making individuals more risk averse and therefore more likely to undergo screening tests. The covariates chosen are: age, race, marital status, education, health insurance status, comorbidity, physical activity, smoking status, and metropolitan area (Table 3.1).

3.4 SAMPLE

Medicaid expansion sample

Figure 3.1 shows the inclusion and exclusion criteria for the study samples that assessed the impact of the Medicaid expansion. From the 2012-16 MEPS datasets, the sample extracted consists of nonelderly low-income women living in the U.S. Women living in states that already provided Medicaid or similar coverage to low-income adults

before ACA's Medicaid expansion in 2014 were excluded from the analysis (District of Columbia, Delaware, Massachusetts, New York, and Vermont). Women aged 65 years or older were excluded because they are eligible for Medicare. Women belonging to low-income households, as defined by the ACA, were selected for the analysis as this group is eligible for participation in Medicaid after the policy change, if they were not enrolled in Medicaid at the time of expansion. In accordance with screening guidelines, the mammography cohort will include women aged 40-64 and the Pap test cohort will include women aged 21-64. Women with concurrent or past diagnoses with breast or cervical cancer were excluded from the analysis to focus on utilization of screening services for preventive or early diagnosis purposes (Figure 3.1).

Cost-sharing sample

Figure 3.2 shows the inclusion and exclusion criteria for the study samples that assessed the impact the removal of cost-sharing for preventive care services. From the MEPS 2009 and 2016 data set, there were two separate cohorts for mammography and pap test. In accordance with the USPSTF screening guidelines, the mammography cohort will include women aged 40 and older and the pap test cohort will include women aged 21-65. Although the recent USPSTF guidelines regarding breast cancer recommends mammography for women aged 50-74 every 2 years, our mammography cohort included women aged 40 and older because the ACA still utilizes the 2002 guidelines. Women with concurrent or past diagnoses with breast or cervical cancer were excluded from the analysis to focus on screening for preventive purposes (Figure 3.2).

3.5 STATISTICAL ANALYSIS

Difference-in-Differences analysis

First, univariate analysis was done to produce baseline descriptive statistics of the low-income women living in treatment (expansion states) and control groups (non-expansion states). Second, we tested the parallel trends assumption across expansion and non-expansion states by regressing each outcome for the years 2005 to 2013 on variables indicating years, state expansion status and an interaction term of year and state expansion status. Third, a difference-in-differences regression model was estimated by linear ordinary least squares. A linear model was chosen to allow a direct interpretation of the coefficients and avoid interpretive issues inherent to interaction terms in nonlinear models (97,98). The key parameter of interest from the DID model was the parameter associated with the interaction between treatment and time. This parameter represents the estimated difference in outcome rates between pre- and post-policy change, across states that were and were not affected by the policy change. Differences were considered statistically significant if P-value of t-statistics <0.05. Finally, a sub-group analyses was done using linear regression and univariate analysis to explain the effect of different demographics, socioeconomics, and geographic determinants on screening use. All analyses were carried out using STATA software version 14 (2015; Stata 14.0 Statistical Software, College Station, TX, USA). The analyses accounted for probability weighting in the MEPS (99,100) to obtain national estimates of effects of the policy change.

Counter-factual analysis

Univariate analyses will be done to produce descriptive statistics of women's characteristics before and after the implementation of ACA in the sample. The main statistical modeling will be based on a regression equation explaining the variability of the dependent variables in pre-ACA period using a number of determinants or explanatory variables. The equations estimated can be written as:

$Y_{i0} = \beta_0 + \sum \beta_j X_{ij0}$, where Y_{io} is the value of dependent variable for individual i for the pre-ACA year 0 and [Xj] is a set of potential determinants of Y. This estimated model was then used to predict the dependent variable for the post-ACA years using the values of determinants in the post-ACA data set. In other words, we have predicted the values of Y for the post-ACA year t using the estimates of b from the pre-ACA year.

$$Y_{it} = \widehat{\beta_0} + \sum \widehat{\beta_J} X_{ijt}$$

The estimated coefficients b obtained for pre-ACA year will be used to predict the values of dependent variable for individuals in post-ACA year, the year t. Another regression model was estimated to predict the values of Y in post-ACA year using post-ACA data. The effect of ACA will be estimated as the value of dependent variable in the post-ACA year minus the predicted value of the dependent variable in the post-ACA year using the regression model obtained using pre-ACA year (the counterfactual). A positive difference means that women in post-ACA used more mammography and pap tests compared to pre-ACA year given various determinants of the dependent variable. Since a number of potential determinants of dependent variable may be affected by the introduction of ACA-triggered changes, these variables should be kept constant at the

pre-ACA level. These variables are related with insurance coverage and types of insurance under which the individuals are covered. We have kept the values of these determinants constant in relative terms at the pre-ACA level by changing the sampling weights proportionately. To assess the diagnostic/predictive accuracy of our logistic model, we used the area under the ROC curve measure. Third, we regressed the difference of the dependent variable, the estimated effect of ACA adoption, on some population characteristics to examine how different individual characteristics affect the outcome. Differences were considered statistically significant if P-value of the t-statistics <0.05. All statistical analysis will be carried out using STATA software version 14 (2015; Stata 14.0 Statistical Software, College Station, TX, USA The analyses accounted for probability weighting in the MEPS (99,100).

Table 3.1 List of covariates (controls)

Variable	**Categorization**
Age	>= 18 (health costs cohort) 21-64 (pap test cohort) >= 40 (mammogram cohort)
Income	Low Middle High
Health Insurance type	Any private Public only Uninsured
Race	White Black Other
Education	Some school High school College
Marital status	Married Widowed Divorced Separated Never Married
Region	Northeast Midwest South West
Usual source of care	Available Not available
Physical activity	Exercise frequently Does not exercise frequently
Smoking status	Smoker Non-smoker
Comorbidity	0 chronic disease 1 chronic disease 2 chronic diseases or more
Routine medical checkup	Within last year More than a year ago

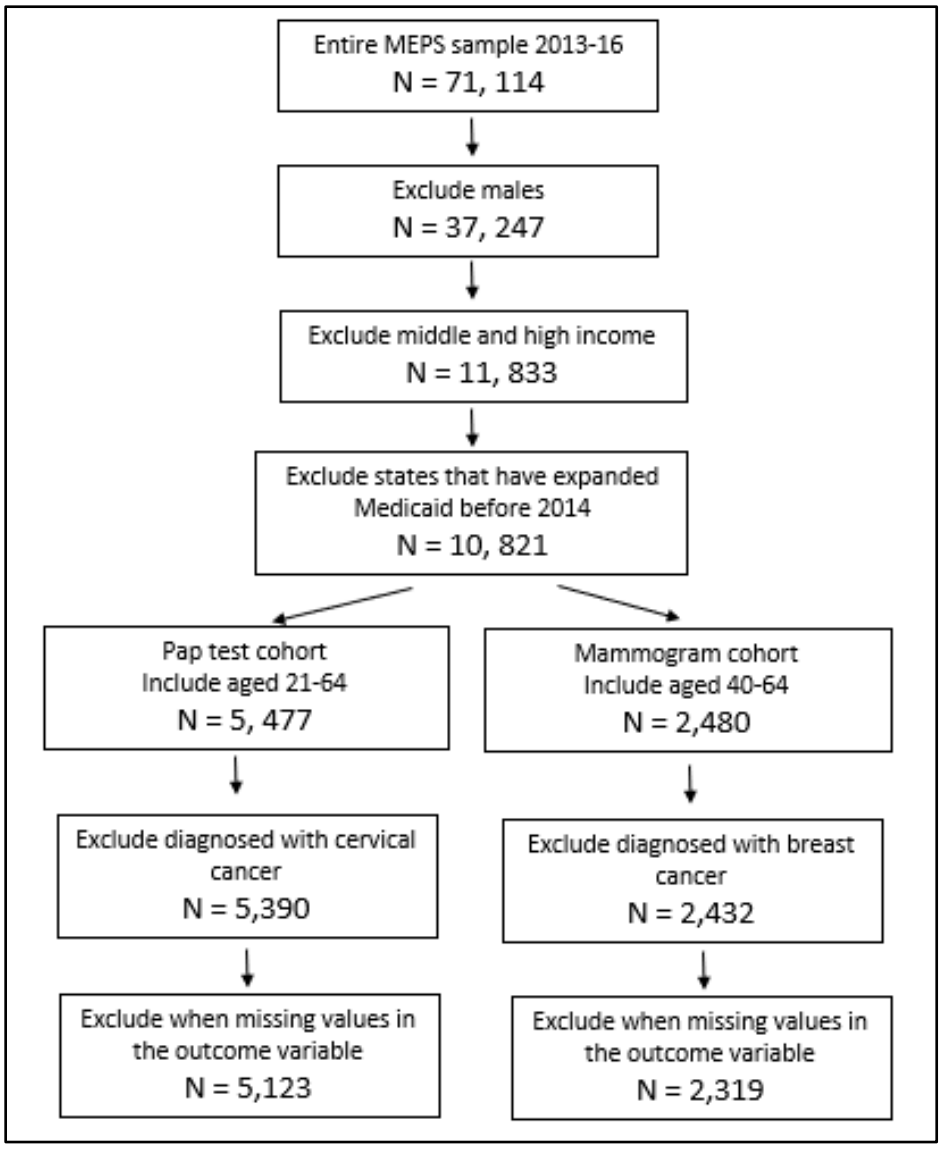

Figure 3.1 Inclusion and exclusion criteria (Medicaid expansion)

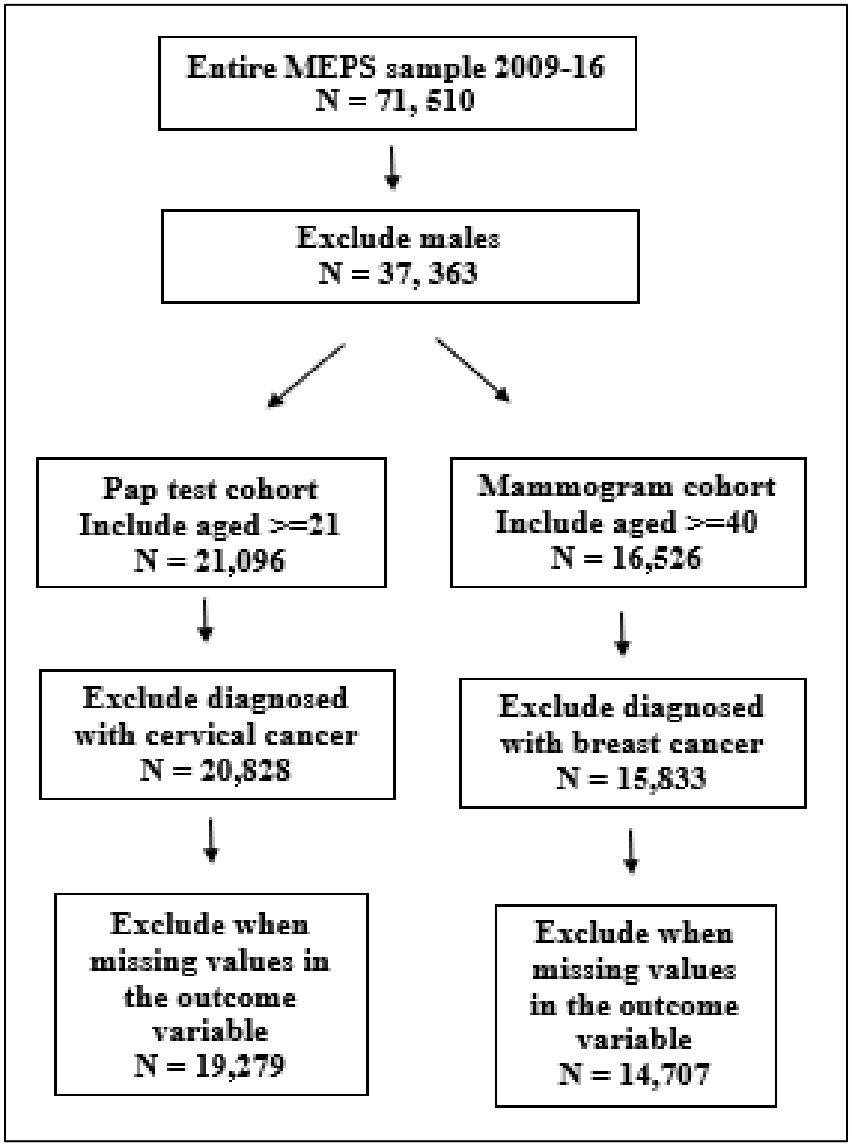

Figure 3.2 Inclusion and exclusion criteria (Cost-sharing)

CHAPTER 4

MANUSCRIPT I

THE IMPACT OF MEDICAID EXPANSION UNDER THE ACA ON MAMMOGRAPHY AND PAP TESTS AMONG LOW-INCOME WOMEN[1]

Abstract

Background: The ACA expanded the coverage of Medicaid to include entire population with income below 138% of federal poverty line which took effect on January 1, 2014. It remains unclear whether this policy change has improved access to and utilization of health care, particularly use of mammography and Pap tests among poor women.

Methods: We used a difference-in-difference design to estimate the impact of Medicaid expansion under the ACA on mammography and Pap tests utilization among low-income women. In the DID model, expansion states are the treatment group and non-expansion states are the control group. The years 2012-13 are the pre-expansion period and 2015-16 are the post-expansion period for the purpose of estimating the DID parameters. **Results**: The difference-in-difference estimate show that likelihood of utilizing mammograms did not change significantly among low-income women after the implementation of the Medicaid expansion (DID coefficient -0.0476 with t-statistics at -1.26), Pap test decreased (coefficient -0.0615, t-statistics -2.76), and Medicaid enrollment has increased

[1] Alharbi, A., Khan, M., Horner, R., Brandt, H., Chapman, Cole. To be submitted to *American Journal of Preventive Medicine*

significantly among low-income women living in expansion states (coefficient 0.0889 with t-value of 3.68). **Conclusion**: Expansion of Medicaid was associated with increased Medicaid enrollment but did not yield near-term improvement in use of mammography and Pap tests among low-income women. Factors beyond health insurance coverage may be important in determining the likelihood of obtaining these screening procedures and policy makers should try to identify other barriers to cancer screening services utilization among the low-income women in the USA.

Introduction

Breast cancer is the most commonly diagnosed cancer among American women, and the second most common cause of death from cancer besides lung cancer (101,102). Cervical cancer incidence rates declined by half between 1975 and 2014 due to the widespread uptake of the Pap test, but declines have slowed down in recent years (101,102). Evidence show that women who appropriately screen for breast and cervical cancer are likely to receive more timely diagnosis and treatment (16–21,25,26) and yet, rates of mammography and Pap test screenings remained suboptimal in the United States (103). Low-income women utilize less screenings than middle or high income women. In 2015, 54.9% of low-income women received mammography while 60% received Pap test (103). The National Cancer Institute's goals include increasing the proportion of women who get regular mammograms to 80%, and similar goals have been issued for Pap tests. There are several possible reasons for the suboptimal screening rates, among which lack of health insurance coverage is considered an important one. There is evidence that health insurance is associated with uptake of mammogram and Pap test use (10–13,33).

The Patient Protection and Affordable Care Act of 2010 (ACA) expanded the coverage of Medicaid to include the entire population aged 18-64 with income below 138% of the federal poverty line (104). Since uninsured adults were more likely to be low-income, Medicaid expansion has the potential to improve access to health care among this poor segment of the population (105–107). Under ACA, participation of States in Medicaid expansion became optional after a supreme court ruling in 2012 (39) but many states decided to participate in Medicaid expansion immediately after the policy change and by September 2015, majority of the states have expanded Medicaid. As of September 2018, 34 states have adopted Medicaid expansion, 3 states are considering expanding, and 14 states did not expand. Appendix A lists the states with Medicaid expansion status as of September 2018 (40).

Previous evidence gave mixed results regarding the impact of Medicaid expansion on utilization of mammography and Pap tests (108–111). Since no conclusive evidence is available, this study made an attempt to understand the effect of Medicaid expansion on probability of obtaining screening tests like mammography and Pap tests among low-income women. Since the study is using nationally representative data set, the results would indicate the effects of policy change for the country as a whole. Nationally representative data will also allow identification of factor affecting utilization rates.

Methods

Data source

Data for this study was obtained from the Medical Expenditure Panel Survey - Household Component MEPS-HC (96). The MEPS is a set of large-scale surveys which collects data from a sample of families and individuals in selected communities across

the United States, drawn from a nationally representative subsample of households. The MEPS contains the data on health care utilization, health insurance status, and coverage source that are required to answer the research question. The combined average response rate for the years 2012-2016 was 50.7% (112).

Sample

From the 2012-16 MEPS datasets, the sample extracted consists of nonelderly low-income women living in the U.S. Women living in states that already provided Medicaid or similar coverage to low-income adults before ACA's Medicaid expansion in 2014 were excluded from the analysis (District of Columbia, Delaware, Massachusetts, New York, and Vermont). Women aged 65 years or older were excluded because they are eligible for Medicare. Women belonging to low-income households, as defined by the ACA, were selected for the analysis as this group is eligible for participation in Medicaid after the policy change, if they were not enrolled in Medicaid at the time of expansion. In accordance with screening guidelines, the mammography cohort will include women aged 40-64 and the Pap test cohort will include women aged 21-64. Women with concurrent or past diagnoses with breast or cervical cancer were excluded from the analysis to focus on utilization of screening services for preventive or early diagnosis purposes.

Design

This study used a difference-in-difference (DID) design in a regression framework. This analytic design tests a comparison of the change in trends of outcomes before and after Medicaid expansion across expansion states vs non-expansion states, controlling for other covariates representing risk attitudes and preference structure. The

treatment group includes women living in Medicaid expansion states and control group includes women living in non-expansion states. Only the states that expanded Medicaid between January 2014 and January 2016 were included in the treatment group (appendix A). The states that already provided Medicaid or similar coverage to low-income adults before 2014 were excluded (District of Columbia, Delaware, Massachusetts, New York, and Vermont) (see appendix A). For estimating the DID parameters, pre-ACA period is defined as the years 2012-13 and the post period is defined as the years 2015-16.

The following multivariate linear regression was estimated to find the effect of the policy change on the outcome variables, the likelihood of receiving mammography and pap smears:

$$Y_{ist} = \beta_0 + \beta_1 Treatment + \beta_2 Post + \beta_3 (Treatment*Post) + \beta_x Covariates + \mathcal{E}$$

Where "Y_{ist}" represents outcome for individual "i" living in state "s" at time 't". β_0 is the baseline average. The term "Treatment" is a dummy variable equal to 1 if the individual resides in a treatment group (expansion state). β_1 is the difference between the two groups pre-intervention. The term "Post" is a dummy variable equal to 1 if the time is after the Medicaid expansion. β_2 is the time trend in control group. The term "Treatment*Post" is an interaction term of intervention and time, β_3 represents the difference-in-differences estimator capturing the effect of Medicaid expansion. Covariates are added to the model to control for preference structure and risk attitudes.

This regression model, in theory, will be able to indicate the effect of treatment if the intervention and control groups are identical at the baseline or show similar pattern of change over the years. In the real world, the intervention and control groups in pre-intervention period are never identical and therefore differences between the groups need

to be explicitly considered and incorporated in the analysis. The effect of program change can be estimated if the assumption of similar pattern of changes over the years in pre-intervention years may be assumed in post-intervention periods as well. This is known as the "parallel assumption" in DID analysis. Since the parallel assumption must hold for an unbiased DID estimator, we can test the parallel movements or trend in the outcomes prior to policy change in treatment and control groups over a number of years. To assess the validity of this assumption, we regressed each outcome for the years 2005 to 2013 on variables indicating years, state expansion status and an interaction term of year and state expansion status. If the coefficient of the interaction term is not statistically different from zero, it implies that the rate of change of the dependent variables is not different between the intervention and control areas confirming the parallel movement of the outcome over the years prior to the implementation of the intervention.

Outcome

The outcomes for this study are the self-reported receipt of mammogram, Pap test, and Medicaid enrollment status. For the preventive services, respondents were asked "About how long has it been since you had this mammogram/Pap test?" with possible responses being "within past year," "within past 2 years," etc. In accordance with screening guidelines, a dummy variable was created for mammogram utilization equal to 1 if the test was taken within 1 to 2 years, and a dummy variable for pap test utilization equals to 1 if the test was taken within 1 to 3 years.

Covariates

We controlled for variables that we believe may modify the preference structure and risk attitude of women in the sample. According to the Demand Theory, demand for

health services is a function of prices of the services, household income, preference structure, and risk-attitude. We chose covariates that may modify the preference structure and risk attitude, making individuals more risk averse and therefore more likely to undergo screening tests. The covariates chosen are: age, race, marital status, education, health insurance status, comorbidity, physical activity, smoking status, and metropolitan area.

Statistical analysis

First, univariate analysis was done to produce baseline descriptive statistics of the low-income women living in treatment (expansion states) and control groups (non-expansion states). Second, we tested the parallel trends assumption across expansion and non-expansion states by regressing each outcome for the years 2005 to 2013 on variables indicating years, state expansion status and an interaction term of year and state expansion status. Third, a difference-in-differences regression model was estimated by linear ordinary least squares. A linear model was chosen to allow a direct interpretation of the coefficients and avoid interpretive issues inherent to interaction terms in nonlinear models (97,98). The key parameter of interest from the DID model was the parameter associated with the interaction between treatment and time. This parameter represents the estimated difference in outcome rates between pre- and post-policy change, across states that were and were not affected by the policy change. Differences were considered statistically significant if P-value of t-statistics <0.05. Finally, a sub-group analyses was done using linear regression and univariate analysis to explain the effect of different demographics, socioeconomics, and geographic determinants on screening use. All analyses were carried out using STATA software version 14 (2015; Stata 14.0 Statistical

Software, College Station, TX, USA). The analyses accounted for probability weighting in the MEPS (99,100) to obtain national estimates of effects of the policy change.

Results

Table 4.1 shows the baseline characteristics of the nonelderly low-income women living in expansion and non-expansion states. Majority of the low-income women were white in both expansion and non-expansion states, however, more black women lived in non-expansion states (37.38%) compared to expansion states (23.94%). In both treatment and control groups, majority of low-income women did not have a college degree (Table 4.1). In expansion and non-expansion states, majority of low-income women had public health insurance, however, more women had public health insurance in expansion states (53.22%) as compared to non-expansion states (41.67%). Majority of the low-income women lived in metropolitan areas in both treatment and control groups (Table 4.1). Women in treatment and control groups had a similar age mean (37). Therefore, states deciding to expand Medicaid were different from the states deciding not to expand in terms of percent of low income population not white, level of coverage of public insurance program and percent of poor women living in metro areas.

Figure 4.1 shows trends in mammogram and Pap tests rates across expansion and non-expansion state for the years 2005 to 2013. Results from the regression that tested the parallel assumption of the time trend of outcome variable show that the slope of the trend functions were similar for these two groups of states prior to the implementation of the ACA policy on Medicaid expansion (Appendix B).

Table 4.2 reports the results from the univariate analysis that examined screening rates among women living in expansion states post-ACA by different sub-groups. The results show majority of low-income women who used mammograms and Pap tests were high-income (76.20%, 85.73%) high-educated (72.93%, 83.88%), Black (73.61%, 87.91%), with private insurance (74.20%, 84.13%), living in metropolitan areas (71.36%, 83.13%), and reported having a usual source of care (74.52%, 83.92%), for mammograms and Pap tests respectively.

Table 4.3 reports the results from the difference-in-difference adjusted regression model. The DID estimates indicate that the probability of enrolling to Medicaid has increased significantly among the low-income women after the implementation of Medicaid expansion (estimated coefficient 0.0889 with t-value 3.68). The DID estimates indicate that the probability of utilizing mammograms did not change significantly among low-income women after the implementation of the Medicaid expansion (estimated coefficient -0.0476 with t-value -1.26). For the Pap tests, the DID estimate indicate that the probability of utilizing the test has decreased significantly among low-income women after the implementation of the Medicaid expansion compared to non-expansion states (estimated coefficient -0.0615, t-value -2.76).

Table 4.4 shows the results on the likelihood of receiving mammograms and Pap tests among low-income women using a number of possible determinants of utilization of the screening tests. The sub-group analysis shows that poor women with higher age were more likely to receive mammograms (estimated coefficient 0.0102, t-value 4.16) and less likely to receive Pap tests (estimated coefficient -0.174, t-value -5.08). Black women were more likely to receive mammograms (estimated coefficient 0.0812, t-value 3.87)

and Pap tests (estimated coefficient 0.0686, t-value 5.75) as compared to white women. The table also indicates that women from other minority population groups were less likely to receive Pap tests as compared to white women (estimated coefficient -0.0646, t-value -2.90). Women with a college degree were more likely to receive mammograms (estimated coefficient 0.0605, t-value 2.56) and women who were divorced were less likely to receive mammograms (coefficient -0.0875, t-value -3.47) and Pap tests (coefficient -0.0385, t-value -2.00) compared to married women. Women with public health insurance were less likely than those with private insurance to receive mammograms (estimated coefficient -0.0654, t-value -2.55) but no difference was detected for Pap test use (estimated coefficient -0.00391, t-value -0.26). Uninsured women were less likely to receive mammograms (estimated coefficient -0.250, t-value -8.97) and Pap tests (estimated coefficient -0.110, t-value -6.61). Women living in non-metropolitan areas were less likely than those in metropolitan areas to receive Pap tests (estimated coefficient -0.0615, t-value -3.41) but no difference was detected for mammogram use (estimated coefficient -0.0489, t-value -1.62). Women who reported not having a usual source of care were less likely to receive mammograms (estimated coefficient -0.141, t-value -4.03) and Pap tests (estimated coefficient -0.0562, t-value -3.02) compared to those who have a usual source of care. Non-smokers were more likely to receive mammograms (estimated coefficient 0.0706, t-value 3.15) and Pap tests (estimated coefficient 0.0446, t-value 3.30) as compared to smokers. Women with two or more chronic diseases were more likely to receive mammograms (estimated coefficient 0.133, t-value 5.22) but no differences were detected for Pap test use (estimated coefficient 0.0251, t-value 1.58).

Discussion

The affordable care act (ACA) expanded Medicaid eligibility coverage to the entire low-income population in order to improve access and utilization among this disadvantage section of the population. In the years before the ACA, rates of mammograms and Pap tests showed declining trends among women and more so among poor women (103). This study examined the impact of expanding health coverage through Medicaid on the rates of mammograms and Pap tests among poor women. The difference-in-difference (DID) estimates indicate that Medicaid enrollment has increased significantly among low-income women after the implementation of the Medicaid expansion (see Table 4.3). This is a proximate measure of success of ACA in terms of providing coverage to poor women through Medicaid. Other studies also found increased Medicaid enrollment in expansion states compared to non-expansion states (113). However, the increase in Medicaid enrollment among low-income women did not translate into increased rates of mammograms or Pap test utilization. Other studies also found little impact of Medicaid expansion on mammography and Pap tests rates (84,113,114).

Although the difference-in-differences estimate did not show increase in mammograms and Pap tests rates, low-income women living in expansion states used more screenings than their counterparts in non-expansion states (Table 4.3). Historically, mortality rates of breast and cervical cancer were lower in the states that elected to expand Medicaid compared to those who elected not to expand (115). We compared cancer burden in expansion vs non-expansion states in pre and post-ACA using data from the National Cancer Institute (NCI) and found that women in expansion states had lower

mortality rates compared to women in non-expansion states (breast cancer: 20.13 vs 20.50; and cervical cancer: 1.97 vs 2.41) per 100,000 resident (115). A previous study found that Southeastern states without Medicaid expansion tended to have higher cancer and lower screening rates and therefore disparities in cancer screening that already disfavor states with high cancer rates may widen in states that have chosen not to expand Medicaid (116).

A number of possible explanations can be advanced for this lack of improvements in mammograms and Pap tests rates among the low-income women despite gaining insurance coverage through Medicaid. First, our analysis show that low-income women with private insurance were more likely to receive mammograms than those with public insurance (Table 4.4). Also, in expansion states, the proportion of low-income women with private insurance used more mammograms and Pap tests than those with public insurance (Table 4.2). Another study also found that women with employer-based insurance/Medicare were more likely to get breast and cervical cancer screenings (117). According to a survey conducted by the National Center for Health Statistics, only two out of three primary care physicians surveyed in 2011 were willing to accept new Medicaid patients (118). Our analysis showed that women who reported having a usual source of care were more likely to receive mammograms and Pap tests than those without a usual source of care (Table 4.4). In expansion states, the proportion of low-income women who have a usual source of care used more mammograms and Pap tests than their counterparts (Table 4.2). Therefore, the type of insurance and the availability of a usual source of care may have the most effect on access and receiving theses screenings.

Second, there are previous studies that found that Medicaid expansion was effective in improving rates of certain preventive services such as glucose testing, cholesterol testing, and annual check-up, but not for cancer screenings (108,109). This is probably because mammograms and Pap tests come with side effects that may discourage women in accepting the tests (119–122). Mammograms show relative high false positivity which creates significant loss of wellbeing and quality of life including pain and suffering, anxiety, and other side effects. Similar to mammograms, Pap tests may come with harm when abnormal results lead to vaginal bleeding, pain, infection, and anxiety. Physicians make trade-offs between benefits and risks when making recommendations about who should be screened (123). Also, the guidelines for mammograms and Pap tests were updated around the time of the ACA's provisions. The guidelines for mammograms were updated in 2009 to recommend mammograms for women aged 50-75 every 2 years from the previous guidelines that recommended screening every 1-2 years for women aged 40 or older (124). The guidelines for cervical cancer screenings was updated in 2012 to recommend the Pap test for women aged 21-65 every three years from the previous guidelines that recommended screening annually for women who are sexually active. These guideline changes occurred around the same time as the expansion of Medicaid under ACA which may explain the overall decline in cancer screenings. However, the effect of changing the recommendation guidelines is universal across expansion and non-expansion states and therefore may not explain the lack of effect on mammograms and Pap tests in expansion states in our difference-in-difference design.

Third, the results from the difference-in-difference may have been biased or equalized because of the possibility that a significant number of poor women received screenings through other national programs such as the CDC's National Breast and Cervical Cancer Early Detection Program (NBCCEDP). The program was established in 1990 to provide free and/or reduced cost mammograms and Pap tests to women with limited incomes and those who lack health insurance. Although number of women receiving those services through the NBCCEDP has decreased in 2015-16 compared to 2013 (125), low-income women still benefit from this program which may have negated the impact of ACA on mammograms and Pap tests rates in our difference-differences analysis. Between 2012 and 2017 the NBCCEDP program provided 740,108 Pap tests and 902,751 mammograms to low-income women (125). In expansion states between 2012 and 2017 there were 441,206 Pap test provided (452 screenings per 100,000 woman) and 498,659 mammograms (511 screenings per 100,000 woman) while in non-expansion states the rates were 398 per 100,000 woman for Pap test and 573 per 100,000 woman for mammography (125). Mammograms provided to women in non-expansion states was about 12% higher than the rate in expansion states and the opposite is true for Pap tests (12% lower in non-expansion states). Such differences can potentially bias the estimation of the effect of ACA on the uptake of mammograms and Pap tests.

Fourth, our analysis showed that the majority of screenings occurred among the high-income high-educated women while low-income women had the least utilization rates (Table 4.2). Before the ACA, a study found low-income women were less likely to receive possibly lifesaving recommended cancer screenings (35). A post-ACA study examined the impact of Medicaid expansion on disparities in cancer screenings and found

that large gaps remain in access, particularly for low-income adults (79). Our analysis showed that disparities in terms of using mammograms and Pap tests remained and may have actually become worse. This possibly implies that other factors beyond the insurance coverage provided through Medicaid should be examined in order to reduce socioeconomic disparities.

Finally, our sub-group analyses helped shed light on the likelihood of receiving mammograms and Pap tests among low-income women using a number of possible determinants of utilization of the screening tests. As women got older they were more likely to receive mammograms and less likely to receive pap tests (Table 4.4). This is expected as evidence suggests benefits from mammograms are more evident for older women while benefits from Pap tests are more evident for younger women (126,127). Low-income women living in metropolitan areas were more likely to receive mammograms and Pap tests (Table 4.4). Also, in expansion states, the proportion of low-income women living in metropolitan areas used more mammograms and Pap tests (Table 4.2). This is expected as metropolitan areas have more medical care providers than non-metro or rural areas. Black women were more likely than white women to receive a Pap test (Table 4.4). Also, in expansion states, the proportion of black women used more mammograms and Pap tests than white women (Table 4.2). Historically, black women in the U.S. are more likely to be diagnosed and die from breast and cervical cancer than white women, which may explain the increased use of the screenings (128).

Conclusion

Our study shows that expansion of Medicaid under the ACA was associated with increased Medicaid enrollment but did not yield near-term improvements in the use of

mammography and Pap tests among low-income women. Although the difference-in-differences did not show improvements in mammograms and Pap tests due to Medicaid expansion under ACA, low-income women living in expansion states used higher level of screenings than their counterparts in non-expansion states. In DID, lack of any positive results is due to pattern of changes happened in screening rates in expansion and non-expansion states. In expansion states, the increase in screening rates were either lower or negative. Since Medicaid expansion did not affect these screening tests, policy makers need to examine other factors that may act as barriers in improving access and utilization. Some possible explanations for this lack of impact of the Medicaid expansion on mammograms and Pap tests are presented in the discussion section but we have no concrete evidence to conclusively say which factors have affected access to screening tests adversely in the expansion states compared to non-expansion states. It is also possible that a longer timeframe will be needed for a change to be manifested but this study only looked at three years after the policy change. Future research on provider availability and characteristics, insurance types, and geographical variations is warranted for a better understanding of the use of cancer screening procedures by the poor women in the USA.

We acknowledge some important limitations of this study. First, information about outcomes relied on self-reported survey responses which might be subject to recall error. However, the MEPS follow up with health providers to reduce the reporting errors but some errors may still remain, especially for procedures and tests requiring longer recall time frame. Second, the data used in the analysis are cross-sectional and comparison of cross-sectional data at different years is not same as observing changes in

the outcomes with the implementation of ACA. The study design made an attempt to tease-out the effect of policy changes through DID and in most cases DID approach can identify the effect of policy change even when the starting characteristics of the control and intervention groups are significantly different. Third, since repeated cross-sectional survey data were used, it was not possible to show the pathways of outcome variation, i.e., the effect of ACA on Medicaid enrollment and effect of Medicaid enrollment on the outcomes of interest. Fourth, this study examined the initial 3-year period after the ACA Medicaid expansion provision and a longer time frame may be needed to be able to see the effects of policy changes on outcomes. Finally, there were changes in the USPSTF guidelines for breast cancer and cervical screening that occurred around the same time as the ACA provisions which may have led to overall declines in cancer screening. In 2009 the guidelines for breast cancer screenings was updated to recommend biennial screening instead of every 1-2 year screenings. Also, in 2012 the USPSTF guidelines for cervical cancer was updated to recommend the test every 3 years instead of every year. National programs providing these tests to poor women may have dampen the effect of the policy change and if the national program in post-policy change years provided more emphasis on covering screenings in non-expansion states, it can potentially offset any positive effects of Medicaid expansion when estimated through DID modeling. In any case, this lack of relative improvements in cancer screenings in the Medicaid expansion states (compared to non-expansion states) is perplexing and would require supplementing the national data with other program effects and other structural differences between these two groups of states.

Table 4.1 Baseline characteristics of low-income women aged 18-64, living in expansion and non-expansion states, pre-ACA (2012-13), MEPS dataset

Characteristic	Non-expansion states N= 3,729	Expansion states N= 3,459	P value
Age	37 (mean)	37 (mean)	0.0839
Race			0.000
White	57.39	67.07	
Black	37.38	23.94	
Other minorities	5.23	8.99	
Education			0.000
Some school	34.51	38.90	
High school	34.54	31.17	
College	30.95	29.94	
Health insurance			0.000
Private	18.10	16.48	
Public	41.67	53.22	
Uninsured	40.23	30.30	
Metropolitan area			0.000
Metro	82.38	87.80	
Non-metro	17.62	12.20	

Table 4.2 Rates of mammograms and Pap tests use in different groups in expansion states, results univariate analysis (2012-16), MEPS dataset

	Mammogram			Pap test		
	% in post-ACA	change	P value	% in post-ACA	change	P value
Low-income	64.69	+ 2.03	0.337	80.19	-1.71	0.151
Middle-income	70.08	- 3.14	0.178	81.05	-0.71	0.633
High-income	76.20	-3.1	0.094	85.73	-1.16	0.351
White	70.10	-0.99	0.497	81.49	-0.97	0.289
Black	73.61	-1.34	0.645	87.91	-.04	0.979
Other	69.02	+1.22	0.715	79.77	-2.36	0.251
Some school	65.23	+0.20	0.943	80.93	-0.56	0.760
High school	69.24	+1.32	0.594	79.51	+0.33	0.832
College	72.93	-2.31	0.150	83.88	-1.7	0.076
Metro	71.36	-0.87	0.496	83.13	-0.96	0.213
Nonmetro/rural	61.42	-2.12	0.610	73.33	-3.14	0.259
Private insurance	74.20	-3.49	0.015	84.13	-1.99	0.30
Public insurance	67.10	-4.03	0.122	80.86	-4.9	0.001
Uninsured	52.87	+2.04	0.597	73.72	+0.93	0.706
Available USC	74.52	-1.91	0.135	83.92	-2.08	0.012
Not Available USC	48.96	+0.83	0.80	75.64	+0.47	0.793

Table 4.3 Results from the difference-in-differences adjusted regression model, nonelderly low-income women (2012-16), MEPS dataset

Outcome	Expansion states		Non-expansion states		Difference-in-differences
	Pre-ACA rate	Post-ACA rate	Pre-ACA rate	Post-ACA rate	
Mammogram	62.66 %	64.69 %	58.87 %	61.77 %	-0.0476 (-1.26)
Pap tests	81.90 %	80.19 %	78.80 %	79.36 %	-0.0615** (-2.76)
Medicaid enrollment	38.10 %	52.31 %	21.12 %	25.03 %	0.0889*** (3.68)

Table 4.4 Likelihoods of receiving mammograms and Pap tests using a number of determinants, results from adjusted linear regression model (2012-16), MEPS dataset

Determinants	Mammogram	Pap tests
Age	0.0102*** (4.16)	0.000137 (0.11)
21-39		0 (.)
40-49	0 (.)	-0.0789*** (-3.59)
50-64	-0.00818 (-0.23)	-0.174*** (-5.08)
White	0 (.)	0 (.)
Black	0.0812*** (3.87)	0.0686*** (5.75)
Other minorities	-0.0588 (-1.59)	-0.0646** (-2.90)
Some school	0 (.)	0 (.)
High school	0.0419 (1.82)	-0.00437 (-0.33)
College	0.0605* (2.56)	-0.0120 (-0.85)
Married	0 (.)	0 (.)
Widowed	-0.103* (-2.56)	-0.0883* (-2.47)
Divorced	-0.0875*** (-3.47)	-0.0385* (-2.00)
Separated	-0.0799* (-2.37)	-0.00593 (-0.27)
Never Married	-0.0749** (-2.86)	-0.0277* (-2.03)
Private insurance	0 (.)	0 (.)
Public insurance	-0.0654* (-2.55)	-0.00391 (-0.26)
Uninsured	-0.250*** (-8.97)	-0.110*** (-6.61)
Metro area	0 (.)	0 (.)
Non-metro area	-0.0489 (-1.62)	-0.0615*** (-3.41)
Usual source of care available	0 (.)	0 (.)
Usual source of care not available	-0.141*** (-4.03)	-0.0562** (-3.02)
Exercise regularly	0 (.)	0 (.)
Do not exercise regularly	-0.00171 (-0.09)	-0.0102 (-0.92)
Smoker	0 (.)	0 (.)
Non-smoker	0.0706** (3.15)	0.0446*** (3.30)
No chronic diseases	0 (.)	0 (.)
1 chronic disease	0.0479 (1.68)	0.0223 (1.63)
+2 chronic diseases	0.133*** (5.22)	0.0251 (1.58)

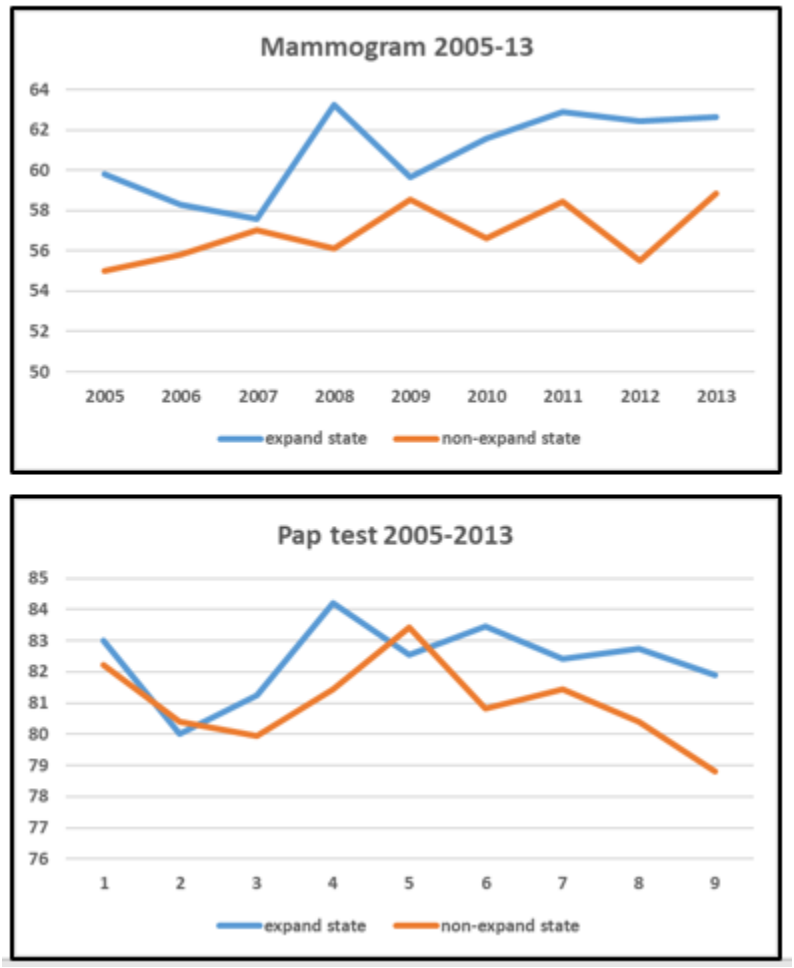

Figure 4.1 Trends in mammogram and Pap across expansion and non-expansion states among low-income women, MEPS 2005-13

CHAPTER 5

MANUSCRIPT II

THE IMPACT OF REMOVING COST SHARING UNDER THE AFFORDABLE CARE ACT (ACA) ON MAMMOGRAPHY AND PAP TEST USE[2]

Abstract

Background: The ACA required private insurers and Medicare to cover preventive services recommended by the USPSTF without any cost sharing to improve utilization of these services. This study tried to identify the impact of removing cost sharing on mammography and pap test utilization rates. **Methods**: Counterfactual analysis was used to predict what would have been the screening rates in post-ACA if ACA was not there. This was done by estimating a model that examines determinants of dependent variable for the pre-ACA year (pre-ACA year is 2009). The estimated model was then used to predict the dependent variable for the post-ACA year using individual characteristics and other relevant variables unlikely to be affected by ACA (post-ACA year is 2016). Effect of ACA is defined as the difference between the values of dependent variables in post-ACA and the predicted values of dependent variables in the post-ACA year using counterfactual. **Results**: The counterfactual analysis show that the utilization of mammogram and pap test did not improve following the ACA. **Conclusion**: following

[2] Alharbi, A., Khan, M., Horner, R., Brandt, H., Chapman, Cole. To be submitted to *American Journal of Preventive Medicine*

the removal of cost-sharing under the ACA, no improvement in mammography or pap tests rate was observed. It appears that financial barrier was not an important factor in affecting utilization of the screening tests and policy makers would have to focus on other non-financial barriers in order to improve coverage of the tests.

Introduction

Cancer is among the leading causes of death in the United States. An estimated 41,400 deaths from invasive breast cancer and 4,170 deaths from cervical cancer will occur in 2018 (16). Mammography and pap test screenings allow early detection of the diseases leading to potentially successful treatment (17–20,26,129,130). Despite evidence of screening effectiveness in improving health outcomes, rates of mammography and pap test screenings remained suboptimal in the United States (103). The US Preventive Services Task Force (USPSTF) recommends mammography for women aged 50-74 years every two years, and pap test for women aged 21-65 years every three years (24). According to the Centers for Disease Control and Prevention (CDC), in 2015, 65.3% of women aged 40 years and older had a mammogram within previous two years, while 69% of women aged 18 years had a pap test within three years (103). Suboptimal rates of screenings may have resulted from financial barriers women face such as cost-sharing, the amount of money individuals required to pay when seeking medical care. There is evidence that cost-sharing reduces the use of health services, particularly preventive services (15,131).

The Patient Protection and Affordable Care Act (ACA) required private insurers and Medicare to cover the preventive services recommended by US Preventive Services Task Force (USPSTF) with a rating of A (strongly recommended) or B (recommended)

without cost sharing. The policy became effective on September 23, 2010 for private health insurers and on January 2011 for Medicare (132). The goal was to increase the use of preventive services and, in turn, reduce costly events from poorly or unmanaged chronic conditions. Previous research reported mixed results regarding the impact of removing cost sharing on mammography and pap test utilization (85–94). As the effect of removing cost-sharing on mammography and pap test utilization are still unclear, this study aims to generate evidence on the impact of changes brought about by the ACA on mammography and pap tests rates.

Methods

Data

Data for this study was obtained from the Medical Expenditure Panel Survey - Household Component MEPS-HC (96). The MEPS is a set of large-scale surveys which collects data from a sample of families and individuals in selected communities across the United States, drawn from a nationally representative subsample of households. MEPS contains the data on health insurance status and coverage source, utilization, and cost that are required to answer the research question. The MEPS contains the data on health care utilization, health insurance status, coverage source, and cost that are required to answer the research question. The combined average response rate for the years 2009 and 2016 was 51.6% (112).

Sample

Figure 5.1 shows the inclusion and exclusion criteria for the study samples that assessed the impact the removal of cost-sharing for preventive care services. From the MEPS 2009 and 2016 data set, there were two separate cohorts for mammography and

pap test. In accordance with the USPSTF screening guidelines, the mammography cohort will include women aged 40 and older and the pap test cohort will include women aged 21-65. Although the recent USPSTF guidelines regarding breast cancer recommends mammography for women aged 50-74 every 2 years, our mammography cohort included women aged 40 and older because the ACA still utilizes the 2002 guidelines. Women with concurrent or past diagnoses with breast or cervical cancer were excluded from the analysis to focus on screening for preventive purposes (Figure 5.1).

Design

We used a counterfactual analysis to determine the impact of ACA on the preventive screenings rate. Counterfactual analysis helps to understand what would have happened in post-ACA year if ACA was not there. This was done by estimating a model that examines determinants of the dependent variable for pre-ACA (year 2009). Then, the estimated model was used to predict the dependent variable using post-ACA characteristics of individuals (the determinants from the model) (year 2016). The model basically works as pseudo control group allowing estimation of the utilization of screenings if ACA policy changes were absent. Effect of ACA is then estimated as: rate of dependent variable post-ACA minus the predicted rate of dependent variable in the same post-ACA year using counterfactual (that there was no ACA in that year). We chose determinants that we believe may modify the demand for the screening tests and the potential variables incorporated in the model are: age, race, income, education, marital status, region, health insurance type, physical activity, smoking status, comorbidity, routine medical checkup, metropolitan area, out-of-pocket expenses, and the availability of a usual source of care. It is important to note that there are few

determinants of cancer screenings are likely to change due to the introduction of ACA, implying that incorporating these variables for the post-ACA sample to define the counterfactual will underestimate the effect of ACA because some of these determinants that are affected by ACA will pick-up some of the changes happened due to the implementation of ACA. Most important variables likely to change due to the implementation of ACA are coverage rate of health insurance and types of insurance people have. To ensure that the counterfactual estimates are not biased, insurance type and coverage rates should be kept the same in the post-ACA year as it was in the pre-ACA year. This was done through adjusting the sampling weights so that pre- and post-ACA insurance coverage and types of insurance coverage are the same. The dollar value in the out-of-pocket variable was adjusted for inflation using MCPI with 2016 as the base year.

Outcome

The outcomes are the self-reported receipt of mammogram and pap test as measured in the MEPS database. For each preventive service, respondents were asked "About how long has it been since you had this mammogram/Pap test?" with possible responses being "within past year," "within past 2 years," etc. In accordance with screening guidelines, a dummy variable was created for mammogram utilization equal to 1 if the test was taken within 1 to 2 years, and a dummy variable for pap test utilization equals to 1 if the test was taken within 1 to 3 years.

Statistical analysis

Univariate analyses will be done to produce descriptive statistics of women's characteristics before and after the implementation of ACA in the sample. The main

statistical modeling will be based on a regression equation explaining the variability of the dependent variables in pre-ACA period using a number of determinants or explanatory variables. The equations estimated can be written as:

$Y_{i0} = \beta_0 + \sum \beta_j X_{ij0}$, where Y_{io} is the value of dependent variable for individual i for the pre-ACA year 0 and [Xj] is a set of potential determinants of Y. This estimated model was then used to predict the dependent variable for the post-ACA years using the values of determinants in the post-ACA data set. In other words, we have predicted the values of Y for the post-ACA year t using the estimates of b from the pre-ACA year.

$$Y_{it} = \widehat{\beta_0} + \sum \widehat{\beta_J} X_{ijt}$$

The estimated coefficients b obtained for pre-ACA year will be used to predict the values of dependent variable for individuals in post-ACA year, the year t. Another regression model was estimated to predict the values of Y in post-ACA year using post-ACA data. The effect of ACA will be estimated as the value of dependent variable in the post-ACA year minus the predicted value of the dependent variable in the post-ACA year using the regression model obtained using pre-ACA year (the counterfactual). A positive difference means that women in post-ACA used more mammography and pap tests compared to pre-ACA year given various determinants of the dependent variable. Since a number of potential determinants of dependent variable may be affected by the introduction of ACA-triggered changes, these variables should be kept constant at the pre-ACA level. These variables are related with insurance coverage and types of insurance under which the individuals are covered. We have kept the values of these

determinants constant in relative terms at the pre-ACA level by changing the sampling weights proportionately.

To assess the diagnostic/predictive accuracy of our logistic model, we used the area under the ROC curve measure. Third, we regressed the difference of the dependent variable, the estimated effect of ACA adoption, on some population characteristics to examine how different individual characteristics affect the outcome. Differences were considered statistically significant if P-value of the t-statistics <0.05. All statistical analysis will be carried out using STATA software version 14 (2015; Stata 14.0 Statistical Software, College Station, TX, USA The analyses accounted for probability weighting in the MEPS (99,100).

Results

Table 5.1 shows descriptive statistics of the women's characteristics in pre and post ACA. Women in pre-ACA and post-ACA seem to have similar distribution of the demographic characteristics including age, income, education, race, and insurance status, and the availability of usual source of care (Table 5.1). Figure 5.2 shows the results from the area under the ROC curve measure for our estimation models which indicate that both estimating models had an area under the curve was above 74%. Tables 5.2 shows the counterfactual analysis results which found that the utilization of mammogram and pap test did not increase following the ACA. Women in post-ACA used less mammography and pap tests than the same period post-ACA counterfactual (Table 5.2). The difference for mammography is -2.31 and for pap test is -5.65 (Table 5.2). Table 5.3 and 5.4 breaks down those differences by age, race, income, education, and health insurance type. A positive difference indicates that this particular group decreases the difference while a

negative difference indicate that this particular group increases the difference. For most categories, the difference was negative except for women aged 50-64 and women with public insurance the difference was positive which means that women in post-ACA aged 50-64 or have public insurance used more mammogram and pap test than those in pre-ACA (Table 5.3). Similarly, women in post-ACA used less pap tests in all sub-groups when compared to the same period post-ACA counterfactual (Table 5.4). Table 5.5 shows that difference in probabilities was statistically significant.

Discussion

Because cost-sharing was found reducing the use of medical care services, particularly preventive care services, the ACA required private health insurers and Medicaid to cover preventive screenings recommended by the USPSTF without cost-sharing to increase the use of these services. This study used a counterfactual analysis to try to understand if the ACA's cost-sharing provisions impacted mammograms and Pap tests rates. In the years preceding the ACA, there was a trend of decline in both mammogram and Pap test use among women in the U.S. (103). Our results show that the introduction of free preventive services did not change the overall declines in mammograms and Pap tests. These results are consistent with previous studies that found little impact of the cost-sharing provision on mammography and pap tests rates. For example, Hong et al. (94) found decreased rates of being up-to-date on mammograms and Pap tests among those with private insurance after the ACA. Several other studies examined the initial impact of the removing cost-sharing on privately insured women and found no change in mammography and pap test (88–90). Our results show no impact on mammography use among women with Medicare (Table 5.3). Previous studies that

looked at Medicare population gave mixed results regarding mammography utilization after the ACA. For example, Jensen et al. (92) found minimal change in mammography use among older women, while other studies found statistically significant increase in mammography uptake after the ACA (86,87). Our analysis show positive results in mammogram rates for women aged 50-64 (Table 5.3). This is consistent a previous study that that assessed the policy from a health system level and found the ACA provisions were associated with increased screening volumes among women age 50-74 (93). There is evidence that mammogram decrease breast cancer mortality among women aged 50-69 but the benefit of mammography for women aged 40-49 years is uncertain (22,23). Our results show that younger women used more Pap tests than older women (Table 5.4). This is consistent with the guidelines and the evidence suggesting benefits from Pap tests are more evident for younger women (127). Our results show that black women had the lowest decline in mammography and women from other minorities had the lowest decline Pap test use as compared to white women (Table 5.3 and Table 5.4). A recent study found the ACA provision to be associated with improved mammography and pap tests among Hispanics and African Americans (95). Looking at overall utilization, black women had the highest rate of mammogram and pap tests use (mammogram: 81.48%, pap tests: 74.73%) (Table 5.3 and Table 5.4). Evidence show that black women in the U.S. are more likely to diagnosed and die from breast and cervical cancer as compared to white women, which may explain the increased use of screenings among this group (128,133).

There are some possible explanations for the little impact of the ACA cost-sharing provision on improving the declining rates of mammography and pap tests. First, it is

important to recognize that the ACA cost-sharing provision was found to be effective in improving other kind of preventive services such as blood pressure check, cholesterol check, and flu vaccination, but not cancer screenings (134). This is probably because the guidelines for mammograms and Pap tests were updated around the time of the ACA's provisions. The guidelines for mammograms were updated in 2009 to recommend mammograms for women aged 50-75 every 2 years updating the previous guidelines that recommends screening every 1-2 for women aged 40 and older. The guidelines for cervical cancer screenings was updated in 2012 to recommend the Pap test for women aged 21-65 every three years updating the previous guidelines that recommended screening annually for women who are sexually active. These guidelines updates that occurred around the same time as the ACA provisions may have led to overall declines in cancer screenings. In addition to the changing guidelines, the very nature of mammograms and Pap tests that some women find toxic or painful may discourage them from getting the tests (119–122). Sometimes mammograms find false positives that carry risks including pain, anxiety, and other side effects. Similar to mammograms, Pap tests may come with harm when abnormal results lead to vaginal bleeding, pain, infection, and anxiety. Physicians make trade-offs between benefits and risks when making recommendations about who should be screened.

Second, the impact of removing cost-sharing may have been alleviated because mammography and Pap tests were likely to be covered by some private insurance plans with no or minimal cost-sharing before ACA. The amount of cost-sharing under Medicare was also small (20% cost sharing). Also, women were likely to get the screenings through national programs such as CDC's National Breast and Cervical

Cancer Early Detection Program (BCCEDP). The program was established in 1990 to provide free and/or reduced cost mammograms and pap test to women with limited incomes and those who lack health insurance. The program remained providing large number of screenings to women in the years following the ACA (135).

Third, in the years before the ACA, women who are low-income were less likely to receive possibly lifesaving recommended cancer screenings (35). A new study found that the ACA was associated with improvements in health care-related financial strain (136). However, socioeconomic disparities remained in term of mammograms and Pap tests utilization. In our cohort, the majority of screenings occurred among the high-income high-educated women (Table 5.3 and Table 5.4). This is probably due to better health literacy, awareness, and availability of time and transportation. Our analysis show that the proportion of women who reported having a usual source of care used more mammogram and Pap tests than those with no usual source of care (Table 5.3 and Table 5.4). Therefore, factors related to provider availability and access may be more effective in improving utilization rates.

Finally, it is important to recognize that, although screening numbers did not improve following the ACA, disease burden from breast and cervical cancer has been declined over the years. Breast cancer rates have been declining steadily in the past decade. Similarly, cervical cancer cases have declined rapidly in past 40 years due to wide use of Pap tests, however, declines in cervical cancer cases have slowed down in recent years.

Conclusion

Following the removal of cost-sharing under the ACA, no improvement was observed in mammography or pap tests rate. It is important to recognize that rates of mammograms and Pap tests were already in a declining trend in the years before the ACA. The introduction of the ACA provision did not help change the decline. The rationale behind the ACA was built on the notion that cost-sharing hinders the use of preventive care services. Several post-ACA studies found positive impact on certain kind of preventive care services such as blood pressure check, cholesterol check, and flu vaccination, but not cancer screenings. In the discussion section above we provided some possible explanation for the lack of impact of cost-sharing removal provision on mammograms and Pap tests rates.

It appears that financial barrier was not the most important factor in affecting utilization of these screening tests. The results indicate - as well as previous studies - that the higher level of utilization rates are observed among the wealthiest and most educated women even after the services became free after the policy change. Therefore, policy makers should focus efforts on facilitating access, health promotion, and awareness which may help improve screening rates. Future research is recommended to look at indicators of access to care, provider availability and characteristics, physician compliance to guidelines to better understand the reasons for lack of effects of cost reductions on utilization of cancer screenings.

We acknowledge several limitations of this study. First, information about outcomes relied on self-reported survey responses which might be subject to recall error. However, the MEPS follow up with health providers to reduce measurement errors but

some errors may remain, especially for procedures and tests requiring longer recall. Second, the data used in the analysis are cross-sectional and comparison of cross-sectional data of different years is not same as observing changes in the outcomes of the same set of individuals over the years with the implementation of the ACA. The study design made an attempt to tease-out the effect of policy changes. Third, a longer time frame may be needed to be able to see the effects of the policy changes on these outcomes. Fourth, for the privately insured population, there is no information on the coverage of screenings as health plans that were grandfathered were not subject to the ACA provision. Because the elimination of cost-sharing is not universal for the privately insured, full effect of removal of cost sharing will not be observable for this population group.

Another important factor for the lack of positive effect of cost-sharing removal may be due to changes in the USPSTF guidelines for breast cancer and cervical screening that occurred around the same time as the ACA provisions. The change in the guidelines may have led to overall declines in cancer screening. In 2009 the guidelines for breast cancer screenings was updated to recommend biennial screening instead of every 1-2 years. Also, in 2012 the USPSTF guidelines for cervical cancer was updated to recommend the test every 3 years instead of every year. If the physicians start using the new guidelines, mammogram and Pap test screenings may appear lower if prior guideline based utilization rates are calculated and compared. Counterfactual analysis will not be able to correct for the changes in screening guidelines unless a control group can be identified for comparative purposes.

In any case, the analysis raises the concern that implementation of ACA's cost share removal has not been effective in improving cancer screening rates and longitudinal survey data would be needed to understand why the removal of out of pocket costs failed to show the intended effects. Unfortunately, the data we have are repeated cross-sectional. Longitudinal data covering a period of four to five years are not available to conduct an analysis to find out how the utilization of cancer screening tests changed for the same individual over the years.

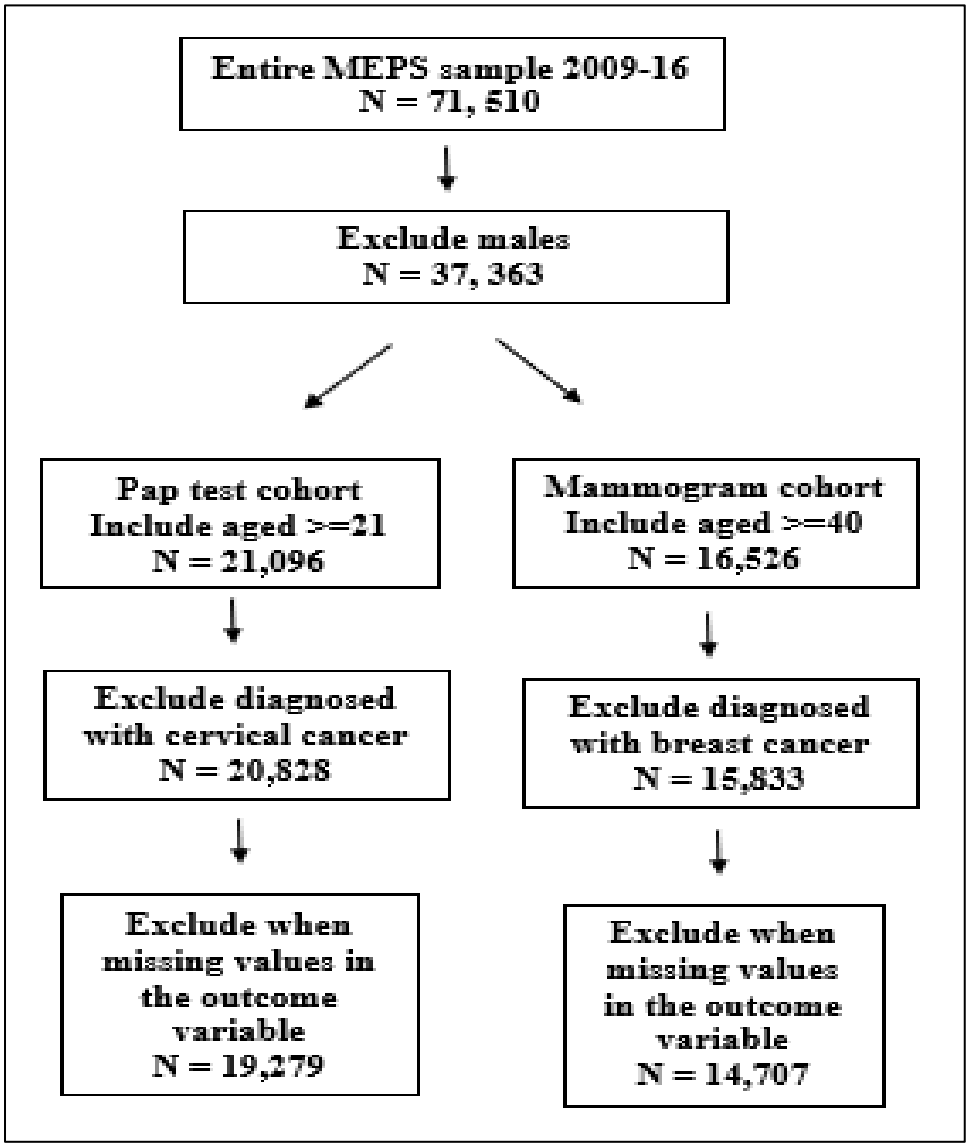

Figure 5.1 Inclusion and exclusion criteria flow chart

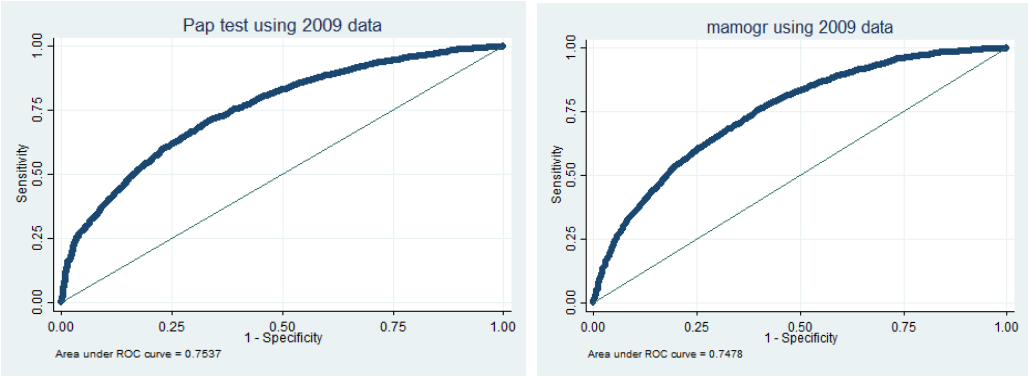

Figure 5.2 Area under the ROC curve for the estimating models

Table 5.1 Descriptive statistics of the characteristics of women aged >= 21 in pre-ACA (2009) and post-ACA (2016), MEPS database

Characteristics		Pre-ACA n = 13,146	Post-ACA n = 12,786
		%	%
Age	Mean	47	48
Race	White	68	68
	Black	21	20
	Other	9	11
Education	Some school	21	19
	High School	31	29
	College	47	50
Income	Low	42	42
	Middle	29	27
	High	27	29
Insurance	Private	57	57
	Public	24	30
	Uninsured	18	11
Usual source of care	Available	77	77
	Not available	22	22

Table 5.2 The difference in mammography and Pap tests use between post-ACA and post-ACA counterfactual

	Post-ACA counterfactual Predicting probabilities using 2009 model	**Post-ACA** Predicting probabilities using 2016 model	**Difference**
Mammogram	71.67%	69.36 %	-2.31
Pap test	79.42%	73.77%	-5.65

Table 5.3 The difference in mammography use between post-ACA and post-ACA counterfactual, by different population groups

Category	**Post-ACA counterfactual** Predicting probabilities using 2009 model	**Post-ACA** Predicting probabilities using 2016 model	**Difference**
Low income	62.29%	60.62%	-1.67
Middle income	71.15%	69.82%	-1.33
High income	82.40%	78.56%	-3.84
Some school	60.61%	57.23%	-3.38
High school	68.31%	68.08%	-0.23
College	78.33%	75.21%	-3.12
White	70.56%	68.46%	-2.1
Black	76.24%	74.73%	-1.51
Other	70.73%	65.57%	-5.16
40-49	65.50%	60.96%	-4.54
50-64	74.98%	75.52%	+0.54
>=65	72.49%	69.38%	-3.11
Private insurance	77.70%	74.92%	-2.78
Public insurance	66.64%	66.70%	+0.06
Uninsured	42.75%	39.50%	-3.25
Available USC	76.03%	72.82%	-3.21
Not available USC	45.33%	49.96%	-4.63

Table 5.4 The difference in Pap tests use between post-ACA and post-ACA counterfactual, by different population groups

Category	**Post-ACA counterfactual** Predicting probabilities using 2009 model	**Post-ACA** Predicting probabilities using 2016 model	**Difference**
Low income	76.24%	70.22%	-6.05
Middle income	78.52%	72.68%	-5.84
High income	84.85%	79.92%	-4.93
Some school	70.46%	66.56%	-3.9
High school	75.76%	69.22%	-6.54
College	84.94%	79.14%	-5.8
White	78.16%	71.62%	-6.54
Black	85.32%	81.48%	-3.84
Other	76.71%	73.46%	-3.25
21-39	89.26%	86.17%	-3.09
40-49	86.04%	84.51%	-1.53
50-64	78.29%	73.74%	-4.55
Private insurance	83.52%	79.09%	-4.43
Public insurance	73.89%	65.44%	-8.45
Uninsured	73.13%	68.96%	-4.17
Available UCS	86.84%	83.77%	-3.07
Not available USC	79.18%	75.47%	-3.71

Table 5.5 Likelihood of the difference between post-ACA and post-ACA counterfactual to increase/decrease explained by different determinants

Category	Difference in mammogram	Difference in Pap test
Low income	0 (.)	0 (.)
Middle income	0.0256*** (37.05)	0.000804 (0.95)
High income	-0.00406*** (-5.58)	0.0345*** (34.70)
Some school	0 (.)	0 (.)
High school	0.0298*** (37.44)	-0.0204*** (-19.26)
College	0.0120*** (15.32)	-0.0280*** (-28.37)
White	0 (.)	0 (.)
Black	-0.0196*** (-24.37)	0.0249*** (33.66)
Other	-0.0386*** (-38.73)	0.0155*** (17.02)
21-39		0 (.)
40-49	0 (.)	0.00758*** (9.81)
50-64	0.0554*** (67.09)	-0.0303*** (-35.82)
>=65	0.0284*** (32.22)	
Private insurance	0 (.)	0 (.)
Public insurance	0.0285*** (42.36)	-0.0187*** (-20.24)
Uninsured	-0.0279*** (-19.43)	-0.0191*** (-13.70)
Cons_	-0.0651*** (-36.92)	-0.0149*** (-8.80)
N	6364	8924
t statistics in parentheses * p<0.05, ** p<0.01, *** p<0.001		

CHAPTER 6
CONCLUSION

The Patient Protection and Affordable Care Act of 2010 aimed at making health care affordable for different sectors of the population and improving access to the needed health care services including the use of preventive care services. Increased use of preventive care services will in turn reduce costly events from poorly or unmanaged chronic conditions. Among the strategies adapted by the ACA to achieve these aims; the Medicaid coverage expansion and the removal of cost-sharing for recommended preventive care services. To reduce the number of the uninsured population and improve access to care among the low-income population, the ACA expanded the coverage of Medicaid to include the entire population aged 18-64 with income below 138% of federal poverty line (1). In the years before the ACA, most uninsured population were low-income and therefore the Medicaid coverage expansion has the potential to improve access for low-income population to the needed health care services. As a result of the Medicaid coverage expansion, 11 million were newly eligible in Medicaid (43). There are many post-ACA studies that found the expansion associated with improved coverage, access, and affordability (61–69). In addition, the ACA required private health insurers and Medicare to cover recommended preventive screenings without cost-sharing. In years before the ACA, the percentage of American women who receive mammograms and pap tests has been suboptimal (2). It has been documented in the literature that health care coverage or cost-sharing were associated with the use of medical services including

preventive care services (3–15). The removal of cost-sharing from recommended preventive services has the potential to improve the use of these services. There are many post-ACA studies that found the cost sharing provision associated with improved preventive care use. The impact of both provisions on mammograms and Pap tests were mixed (108–111,134,137–145).

Medicaid expansion

The difference-in-differences analysis showed that expansion of Medicaid under the ACA was associated with increased Medicaid enrollment but did not yield near-term improvements in the use of mammography and Pap tests among low-income women. Although the difference-in-differences did not show improvements in mammograms and Pap tests due to Medicaid expansion under ACA, low-income women living in expansion states used higher level of screenings than their counterparts in non-expansion states. In DID, lack of any positive results is due to pattern of changes happened in screening rates in expansion and non-expansion states. In expansion states, the increase in screening rates were either lower or negative. Since Medicaid expansion did not affect these screening tests, policy makers need to examine other factors that may act as barriers in improving access and utilization. Some possible explanations for this lack of impact of the Medicaid expansion on mammograms and Pap tests are presented in chapter four but we have no concrete evidence to conclusively say which factors have affected access to screening tests adversely in the expansion states compared to non-expansion states. It is also possible that a longer timeframe will be needed for a change to be manifested but this study only looked at three years after the policy change. Future research on provider availability and characteristics, insurance types, and geographical variations is warranted

for a better understanding of the use of cancer screening procedures by the poor women in the USA.

Cost-sharing removal

Following the removal of cost-sharing under the ACA, no improvement was observed in mammography or pap tests rate. It is important to recognize that rates of mammograms and Pap tests were already in a declining trend in the years before the ACA. The introduction of the ACA provision did not help change the decline. The rationale behind the ACA was built on the notion that cost-sharing hinders the use of preventive care services. Several post-ACA studies found positive impact on certain kind of preventive care services such as blood pressure check, cholesterol check, and flu vaccination, but not cancer screenings. In chapter five we provided some possible explanation for the lack of impact of cost-sharing removal provision on mammograms and Pap tests rates.

It appears that financial barrier was not the most important factor in affecting utilization of these screening tests. The results indicate - as well as previous studies - that the higher level of utilization rates are observed among the wealthiest and most educated women even after the services became free after the policy change. Therefore, policy makers should focus efforts on facilitating access, health promotion, and awareness which may help improve screening rates. Future research is recommended to look at indicators of access to care, provider availability and characteristics, physician compliance to guidelines to better understand the reasons for lack of effects of cost reductions on utilization of cancer screenings.

Limitations

We acknowledge some important limitations of this study. First, information about outcomes relied on self-reported survey responses which might be subject to recall error. However, the MEPS follow up with health providers to reduce the reporting errors but some errors may still remain, especially for procedures and tests requiring longer recall time frame. Second, the data used in the analysis are cross-sectional and comparison of cross-sectional data at different years is not same as observing changes in the outcomes with the implementation of ACA. In the Medicaid expansion study, the design made an attempt to tease-out the effect of policy changes through DID and in most cases DID approach can identify the effect of policy change even when the starting characteristics of the control and intervention groups are significantly different. Third, since repeated cross-sectional survey data were used, it was not possible to show the pathways of outcome variation, i.e., the effect of ACA on Medicaid enrollment and effect of Medicaid enrollment on the outcomes of interest. Fourth, there were changes in the USPSTF guidelines for breast cancer and cervical screening that occurred around the same time as the ACA provisions which may have led to overall declines in cancer screening. In 2009 the guidelines for breast cancer screenings was updated to recommend biennial screening instead of every 1-2 year screenings. Also, in 2012 the USPSTF guidelines for cervical cancer was updated to recommend the test every 3 years instead of every year. Fifth, national programs providing these tests to poor women may have dampen the effect of the policy change and if the national program in post-policy change years provided more emphasis on covering screenings in non-expansion states, it can potentially offset any positive effects of Medicaid expansion when estimated through

DID modeling. In any case, this lack of relative improvements in cancer screenings in the Medicaid expansion states (compared to non-expansion states) is perplexing and would require supplementing the national data with other program effects and other structural differences between these two groups of states. Sixth, for the privately insured population, there is no information on the coverage of screenings as health plans that were grandfathered were not subject to the ACA provision. Because the elimination of cost-sharing is not universal for the privately insured, full effect of removal of cost sharing will not be observable for this population group. Finally, the data we have are repeated cross-sectional. Longitudinal data covering a period of four to five years are not available to conduct an analysis to find out how the utilization of cancer screening tests changed for the same individual over the years.

REFERENCES

1. Patient Protection and Affordable Care Act [Internet]. 2010 p. 393. Available from: http://housedocs.house.gov/energycommerce/ppacacon.pdf

2. National Center for Health Statistics. Health, United States, 2016: With Chartbook on Long-term Trends in Health. Hyattsville, MD. [Internet]. 2017 [cited 2017 Jul 20]. Available from: https://www.cdc.gov/nchs/data/hus/hus16.pdf#070

3. Zhao G, Okoro CA, Li J, Town M. Health Insurance Status and Clinical Cancer Screenings Among U.S. Adults. Am J Prev Med. 2018 Jan;54(1):e11–9.

4. Davidoff AJ, Hill SC, Bernard D, Yabroff KR. The Affordable Care Act and Expanded Insurance Eligibility Among Nonelderly Adult Cancer Survivors. J Natl Cancer Inst. 2015 Sep;107(9).

5. Centers for Disease Control and Prevention (CDC). Vital signs: health insurance coverage and health care utilization --- United States, 2006--2009 and January-March 2010. MMWR Morb Mortal Wkly Rep. 2010 Nov 12;59(44):1448–54.

6. MICHAEL McWILLIAMS J. Health Consequences of Uninsurance among Adults in the United States: Recent Evidence and Implications. Milbank Quarterly. 2009 Jun 1;87(2):443–94.

7. Institute of Medicine (US) Committee on Health Insurance Status and Its Consequences. America's Uninsured Crisis: Consequences for Health and Health Care [Internet]. Washington (DC): National Academies Press (US); 2009. Available from: http://www.ncbi.nlm.nih.gov/books/NBK214966/

8. Weaver KE, Rowland JH, Bellizzi KM, Aziz NM. Forgoing medical care because of cost: assessing disparities in healthcare access among cancer survivors living in the United States. Cancer. 2010 Jul 15;116(14):3493–504.

9. Kilbourne AM. Care without Coverage: Too Little, Too Late. J Natl Med Assoc. 2005 Nov;97(11):1578.

10. Carrasquillo O, Pati S. The role of health insurance on Pap smear and mammography utilization by immigrants living in the United States. Preventive Medicine. 2004 Nov 1;39(5):943–50.

11. Sudano JJ, Baker DW. Intermittent Lack of Health Insurance Coverage and Use of Preventive Services. Am J Public Health. 2003 Jan 1;93(1):130–7.

12. Meer J, Rosen HS. Insurance and the utilization of medical services. Social Science & Medicine. 2004 May 1;58(9):1623–32.

13. Busch SH, Duchovny N. Family coverage expansions: Impact on insurance coverage and health care utilization of parents. Journal of Health Economics. 2005 Sep;24(5):876–90.

14. Aron-Dine A, Einav L, Finkelstein A. The RAND Health Insurance Experiment, three decades later. J Econ Perspect. 2013;27(1):197–222.

15. Brot-Goldberg ZC, Chandra A, Handel BR, Kolstad JT. What Does a Deductible Do? The Impact of Cost-Sharing on Health Care Prices, Quantities, and Spending Dynamics [Internet]. National Bureau of Economic Research; 2015 Oct [cited 2017 May 2]. Report No.: 21632. Available from: http://www.nber.org/papers/w21632

16. American Cancer Society. Cancer Facts & Figures 2018 [Internet]. 2018 [cited 2018 Feb 18]. Available from: https://www.cancer.org/content/dam/cancer-org/research/cancer-facts-and-statistics/annual-cancer-facts-and-figures/2018/cancer-facts-and-figures-2018.pdf

17. Institute of Medicine (US) and National Research Council (US) National Cancer Policy Board. Fulfilling the Potential of Cancer Prevention and Early Detection [Internet]. Curry SJ, Byers T, Hewitt M, editors. Washington (DC): National Academies Press (US); 2003. Available from: http://www.ncbi.nlm.nih.gov/books/NBK223926/

18. Maciosek MV, Coffield AB, Flottemesch TJ, Edwards NM, Solberg LI. Greater Use Of Preventive Services In U.S. Health Care Could Save Lives At Little Or No Cost. Health Aff. 2010 Sep 1;29(9):1656–60.

19. Coldman A, Phillips N, Wilson C, Decker K, Chiarelli AM, Brisson J, et al. Pan-Canadian Study of Mammography Screening and Mortality from Breast Cancer. J Natl Cancer Inst [Internet]. 2014 Nov 1 [cited 2017 Jul 20];106(11). Available from: https://academic-oup-com.pallas2.tcl.sc.edu/jnci/article/106/11/dju261/1496367/Pan-Canadian-Study-of-Mammography-Screening-and

20. Hofvind S, Ursin G, Tretli S, Sebuødegård S, Møller B. Breast cancer mortality in participants of the Norwegian Breast Cancer Screening Program. Cancer. 2013 Sep 1;119(17):3106–12.

21. Shapiro S, Strax P, Venet L. Evaluation of periodic breast cancer screening with mammography. Methodology and early observations. JAMA. 1966 Feb 28;195(9):731–8.

22. Moss SM, Cuckle H, Evans A, Johns L, Waller M, Bobrow L, et al. Effect of mammographic screening from age 40 years on breast cancer mortality at 10 years' follow-up: a randomised controlled trial. Lancet. 2006 Dec 9;368(9552):2053–60.

23. Moss SM, Wale C, Smith R, Evans A, Cuckle H, Duffy SW. Effect of mammographic screening from age 40 years on breast cancer mortality in the UK Age trial at 17 years' follow-up: a randomised controlled trial. Lancet Oncol. 2015 Sep;16(9):1123–32.

24. USPSTF A and B Recommendations. U.S. Preventive Services Task Force [Internet]. 2017 Apr. Available from: https://www.uspreventiveservicestaskforce.org/Page/Name/uspstf-a-and-b-recommendations/

25. American Cancer Society. Key Statistics for Cervical Cancer [Internet]. 2018 [cited 2018 Feb 18]. Available from: https://www.cancer.org/cancer/cervical-cancer/about/key-statistics.html

26. Burd EM. Human Papillomavirus and Cervical Cancer. Clin Microbiol Rev. 2003 Jan;16(1):1–17.

27. US Preventive Services Task Force, Curry SJ, Krist AH, Owens DK, Barry MJ, Caughey AB, et al. Screening for Cervical Cancer: US Preventive Services Task Force Recommendation Statement. JAMA. 2018 21;320(7):674–86.

28. Mobley LR, Kuo T-M. Demographic Disparities in Late-Stage Diagnosis of Breast and Colorectal Cancers Across the USA. J Racial and Ethnic Health Disparities. 2017 Apr 1;4(2):201–12.

29. Nelson AR, Stith AY, Smedley BD, others. Unequal treatment: confronting racial and ethnic disparities in health care (full printed version) [Internet]. National Academies Press; 2002. Available from: https://books-google-com.pallas2.tcl.sc.edu/books?hl=ar&lr=&id=i8WbAgAAQBAJ&oi=fnd&pg=PT17&dq=Institute+of+Medicine.+Unequal+Treatment:+Confronting+Racial+and+Ethnic+Disparities+in+Health+Care.+Washington,+DC:+National+Academies+Press%3B+2002.&ots=0br9vLTfmL&sig=a9dIQH4pmCQJlTNIrfVlHLUnhzQ

30. ACA and Addressing Disparities [Internet]. RWJF. 2011 [cited 2017 Jul 16]. Available from: http://www.rwjf.org/en/library/research/2011/12/how-does-the-affordable-care-act-address-racial-and-ethnic-dispa.html

31. Peek ME, Han JH. Disparities in Screening Mammography. Journal of General Internal Medicine. 2004 Feb 1;19(2):184–94.

32. Ross JS, Bradley EH, Busch SH. Use of Health Care Services by Lower-Income and Higher-Income Uninsured Adults. JAMA. 2006 May 3;295(17):2027–36.

33. Rauscher GH, Allgood KL, Whitman S, Conant E. Disparities in Screening Mammography Services by Race/Ethnicity and Health Insurance. J Womens Health (Larchmt). 2012 Feb;21(2):154–60.

34. Sassi F, Luft HS, Guadagnoli E. Reducing Racial/Ethnic Disparities in Female Breast Cancer: Screening Rates and Stage at Diagnosis. Am J Public Health. 2006 Dec 1;96(12):2165–72.

35. Swan J, Breen N, Graubard BI, McNeel TS, Blackman D, Tangka FK, et al. Data and trends in cancer screening in the United States. Cancer. 2010;116(20):4872–4881.

36. The Henry J. Kaiser Family Foundation. Health Coverage by Race and Ethnicity: The Potential Impact of the Affordable Care Act [Internet]. The Henry J. Kaiser Family Foundation. 2013 [cited 2017 Jul 16]. Available from: http://www.kff.org/disparities-policy/issue-brief/health-coverage-by-race-and-ethnicity-the-potential-impact-of-the-affordable-care-act/

37. Tangka FKL, O'Hara B, Gardner JG, Turner J, Royalty J, Shaw K, et al. Meeting the cervical cancer screening needs of underserved women: the National Breast and Cervical Cancer Early Detection Program, 2004-2006. Cancer Causes Control. 2010 Jul;21(7):1081–90.

38. Kaiser Family Foundation. The Uninsured And The Difference Health Insurance Makes [Internet]. The Henry J. Kaiser Family Foundation. 2012 [cited 2018 Jan 22]. Available from: https://www.kff.org/health-reform/fact-sheet/the-uninsured-and-the-difference-health-insurance/

39. National Federation of Independent Business v. Sebelius 567 US ___ (2012) [Internet]. Justia Law. [cited 2017 Jul 30]. Available from: https://www.supremecourt.gov/opinions/11pdf/11-393c3a2.pdf

40. Kaiser Family Foundation. Current Status of State Medicaid Expansion Decisions [Internet]. The Henry J. Kaiser Family Foundation. 2018 [cited 2018 Jan 22]. Available from: https://www.kff.org/health-reform/slide/current-status-of-the-medicaid-expansion-decision/

41. Smith J, Medala C. Health Insurance Coverage in the United States: 2014. Current Population Reports [Internet]. 2015 [cited 2017 Jul 19]. Available from: https://www.census.gov/content/dam/Census/library/publications/2015/demo/p60-253.pdf

42. Rowland D. Profiles in coverage: Medicaid, CHIP, and the uninsured. Presented at "On the Road to 2014: Medicaid and CHIP Eligibility and the Uninsured" [Internet]. 2011 [cited 2017 Jul 19]. Available from: https://www.medicaid.gov/State-Resource-Center/downloads/0907_CB_1215_1_Profiles_in_Coverage_508.pdf

43. Cent. Medicare Medicaid Serv. Total Medicaid Enrollees - VIII Group Break Out Report March-2016 [Internet]. 2016 [cited 2017 Jun 16]. Available from: https://www.medicaid.gov/medicaid/program-information/downloads/cms-64-enrollment-report-jan-mar-2016.pdf

44. Grossman M. The Demand for Health: A Theoretical and Empirical Investigation [Internet]. National Bureau of Economic Research, Inc; 1972 [cited 2018 Feb 23]. Available from: https://ideas.repec.org/b/nbr/nberbk/gros72-1.html

45. Arrow KJ. Uncertainty and the welfare economics of medical care. 1963. Bull World Health Organ. 2004 Feb;82(2):141–9.

46. Rauscher GH, Allgood KL, Whitman S, Conant E. Disparities in Screening Mammography Services by Race/Ethnicity and Health Insurance. J Womens Health (Larchmt). 2012 Feb;21(2):154–60.

47. Sommers BD, Long SK, Baicker K. Changes in mortality after Massachusetts health care reform: a quasi-experimental study. Ann Intern Med. 2014 May 6;160(9):585–93.

48. Kolstad JT, Kowalski AE. The Impact of Health Care Reform on Hospital and Preventive Care: Evidence from Massachusetts(☆). J Public Econ. 2012 Dec 1;96(11–12):909–29.

49. Pande AH, Ross-Degnan D, Zaslavsky AM, Salomon JA. Effects of healthcare reforms on coverage, access, and disparities: quasi-experimental analysis of evidence from Massachusetts. Am J Prev Med. 2011 Jul;41(1):1–8.

50. Long SK, Dahlen H. Expanding coverage to low-income childless adults in Massachusetts: implications for national health reform. Health Serv Res. 2014 Dec;49 Suppl 2:2129–46.

51. Long SK, Stockley K, Nordahl KW. Coverage, access, and affordability under health reform: learning from the Massachusetts model. Inquiry. 2013;49(4):303–16.

52. Long SK, Stockley K. The impacts of state health reform initiatives on adults in New York and Massachusetts. Health Serv Res. 2011 Feb;46(1 Pt 2):365–87.

53. Finkelstein A, Taubman S, Wright B, Bernstein M, Gruber J, Newhouse JP, et al. The Oregon Health Insurance Experiment: Evidence from the First Year*. Q J Econ. 2012 Aug 1;127(3):1057–106.

54. Wright BJ, Conlin AK, Allen HL, Tsui J, Carlson MJ, Li HF. What does Medicaid expansion mean for cancer screening and prevention? Results from a randomized trial on the impacts of acquiring Medicaid coverage. Cancer. 2016 Mar 1;122(5):791–7.

55. Uberoi N, Finegold K, Gee E. Health Insurance Coverage and the Affordable Care Act, 2010 - 2016 [Internet]. ASPE. 2016 [cited 2017 Jul 19]. Available from: https://aspe.hhs.gov/pdf-report/health-insurance-coverage-and-affordable-care-act-2010-2016

56. Cent. Medicare Medicaid Serv. Monthly Medicaid and CHIP Application, Eligibility Determination, and Enrollment Reports and Updated Data [Internet]. 2016 [cited 2017 Jul 19]. Available from: https://www.medicaid.gov/medicaid/program-information/downloads/june-2016-enrollment-report.pdf

57. Miller S, Wherry LR. Health and Access to Care during the First 2 Years of the ACA Medicaid Expansions. N Engl J Med. 2017 09;376(10):947–56.

58. Courtemanche C, Marton J, Ukert B, Yelowitz A, Zapata D. Early Impacts of the Affordable Care Act on Health Insurance Coverage in Medicaid Expansion and Non-Expansion States. J Policy Anal Manage. 2017;36(1):178–210.

59. Frean M, Gruber J, Sommers BD. Premium subsidies, the mandate, and Medicaid expansion: Coverage effects of the Affordable Care Act. J Health Econ. 2017 May;53:72–86.

60. Decker SL, Lipton BJ, Sommers BD. Medicaid Expansion Coverage Effects Grew In 2015 With Continued Improvements In Coverage Quality. Health Aff (Millwood). 2017 May 1;36(5):819–25.

61. Klein EY, Levin S, Toerper MF, Makowsky MD, Xu T, Cole G, et al. The Effect of Medicaid Expansion on Utilization in Maryland Emergency Departments. Ann Emerg Med. 2017 Nov;70(5):607-614.e1.

62. Sommers BD, Maylone B, Blendon RJ, Orav EJ, Epstein AM. Three-Year Impacts Of The Affordable Care Act: Improved Medical Care And Health Among Low-Income Adults. Health Aff. 2017 May 17;10.1377/hlthaff.2017.0293.

63. Pickens G, Karaca Z, Cutler E, Dworsky M, Eibner C, Moore B, et al. Changes in Hospital Inpatient Utilization Following Health Care Reform. Health Serv Res. 2017 Jun 30;

64. Sommers BD, Blendon RJ, Orav EJ, Epstein AM. Changes in Utilization and Health Among Low-Income Adults After Medicaid Expansion or Expanded Private Insurance. JAMA Intern Med. 2016 Oct 1;176(10):1501–9.

65. Nikpay S, Buchmueller T, Levy HG. Affordable Care Act Medicaid Expansion Reduced Uninsured Hospital Stays In 2014. Health Aff. 2016 Jan 1;35(1):106–10.

66. Sommers BD, Blendon RJ, Orav EJ. Both The 'Private Option' And Traditional Medicaid Expansions Improved Access To Care For Low-Income Adults. Health Aff. 2016 Jan 1;35(1):96–105.

67. Benitez JA, Creel L, Jennings J. Kentucky's Medicaid Expansion Showing Early Promise On Coverage And Access To Care. Health Aff. 2016 Mar 1;35(3):528–34.

68. Holzmacher JL, Townsend K, Seavey C, Gannon S, Schroeder M, Gondek S, et al. Association of Expanded Medicaid Coverage With Hospital Length of Stay After Injury. JAMA Surg. 2017 Oct 1;152(10):960–6.

69. McMorrow S, Gates JA, Long SK, Kenney GM. Medicaid Expansion Increased Coverage, Improved Affordability, And Reduced Psychological Distress For Low-Income Parents. Health Aff (Millwood). 2017 May 1;36(5):808–18.

70. Sommers BD, Gunja MZ, Finegold K, Musco T. Changes in Self-reported Insurance Coverage, Access to Care, and Health Under the Affordable Care Act. JAMA. 2015 Jul 28;314(4):366–74.

71. Wherry LR, Miller S. Early Coverage, Access, Utilization, and Health Effects Associated With the Affordable Care Act Medicaid Expansions: A Quasi-experimental Study. Annals of Internal Medicine. 2016 Jun 21;164(12):795.

72. Anderson ME, Glasheen JJ, Anoff D, Pierce R, Lane M, Jones CD. Impact of state medicaid expansion status on length of stay and in-hospital mortality for general medicine patients at US academic medical centers. J Hosp Med. 2016 Dec;11(12):847–52.

73. Wehby GL, Lyu W. The Impact of the ACA Medicaid Expansions on Health Insurance Coverage through 2015 and Coverage Disparities by Age, Race/Ethnicity, and Gender. Health Serv Res. 2017 May 18;

74. Buchmueller TC, Levinson ZM, Levy HG, Wolfe BL. Effect of the Affordable Care Act on Racial and Ethnic Disparities in Health Insurance Coverage. Am J Public Health. 2016 Aug;106(8):1416–21.

75. Gonzales S, Sommers BD. Intra-Ethnic Coverage Disparities among Latinos and the Effects of Health Reform. Health Serv Res. 2017 Jun 28;

76. Heintzman J, Bailey SR, DeVoe J, Cowburn S, Kapka T, Duong T-V, et al. In Low-Income Latino Patients, Post-Affordable Care Act Insurance Disparities May Be Reduced Even More than Broader National Estimates: Evidence from Oregon. J Racial and Ethnic Health Disparities. 2017 Jun 1;4(3):329–36.

77. Chen J, Vargas-Bustamante A, Mortensen K, Ortega AN. Racial and Ethnic Disparities in Health Care Access and Utilization Under the Affordable Care Act. Med Care. 2016 Feb;54(2):140–6.

78. Benitez JA, Seiber EE. US Health Care Reform and Rural America: Results From the ACA's Medicaid Expansions. J Rural Health. 2018 Mar;34(2):213–22.

79. Shartzer A, Long SK, Anderson N. Access To Care And Affordability Have Improved Following Affordable Care Act Implementation; Problems Remain. Health Aff. 2015 Dec 16;10.1377/hlthaff.2015.0755.

80. Choi SK, Adams SA, Eberth JM, Brandt HM, Friedman DB, Tucker-Seeley RD, et al. Medicaid Coverage Expansion and Implications for Cancer Disparities. Am J Public Health. 2015 Oct 8;105(S5):S706–12.

81. Sabik LM, Tarazi WW, Bradley CJ. State Medicaid Expansion Decisions and Disparities in Women's Cancer Screening. American Journal of Preventive Medicine. 2015 Jan 1;48(1):98–103.

82. Cole MB, Galárraga O, Wilson IB, Wright B, Trivedi AN. At Federally Funded Health Centers, Medicaid Expansion Was Associated With Improved Quality Of Care. Health Aff. 2017 Jan 1;36(1):40–8.

83. Simon K, Soni A, Cawley J. The Impact of Health Insurance on Preventive Care and Health Behaviors: Evidence from the 2014 ACA Medicaid Expansions [Internet]. National Bureau of Economic Research; 2016 May. Report No.: 22265. Available from: http://www.nber.org/papers/w22265

84. Cawley J, Soni A, Simon K. Third Year of Survey Data Shows Continuing Benefits of Medicaid Expansions for Low-Income Childless Adults in the U.S. J Gen Intern Med. 2018 Sep;33(9):1495–7.

85. Goodwin SM, Anderson GF. Effect of cost-sharing reductions on preventive service use among Medicare fee-for-service beneficiaries. Medicare Medicaid Res Rev. 2012;2(1).

86. Cooper GS, Kou TD, Schluchter MD, Dor A, Koroukian SM. Changes in Receipt of Cancer Screening in Medicare Beneficiaries Following the Affordable Care Act. J Natl Cancer Inst. 2016 May;108(5).

87. Cooper GS, Kou TD, Dor A, Koroukian SM, Schluchter MD. Cancer preventive services, socioeconomic status, and the Affordable Care Act. Cancer. 2017 May 1;123(9):1585–9.

88. Mehta SJ, Polsky D, Zhu J, Lewis JD, Kolstad JT, Loewenstein G, et al. ACA-mandated elimination of cost sharing for preventive screening has had limited early impact. Am J Manag Care. 2015 Jul;21(7):511–7.

89. Han X, Yabroff KR, Guy GP, Zheng Z, Jemal A. Has recommended preventive service use increased after elimination of cost-sharing as part of the Affordable Care Act in the United States? Preventive medicine. 2015;78:85–91.

90. Fedewa SA, Goodman M, Flanders WD, Han X, Smith RA, M Ward E, et al. Elimination of cost-sharing and receipt of screening for colorectal and breast cancer. Cancer. 2015 Sep 15;121(18):3272–80.

91. Jena AB, Huang J, Fireman B, Fung V, Gazelle S, Landrum MB, et al. Screening Mammography for Free: Impact of Eliminating Cost Sharing on Cancer Screening Rates. Health Serv Res. 2017 Feb;52(1):191–206.

92. Jensen GA, Salloum RG, Hu J, Ferdows NB, Tarraf W. A slow start: Use of preventive services among seniors following the Affordable Care Act's enhancement of Medicare benefits in the U.S. Prev Med. 2015 Jul;76:37–42.

93. Nelson HD, Weerasinghe R, Wang L, Grunkemeier G. Mammography Screening in a Large Health System Following the U.S. Preventive Services Task Force Recommendations and the Affordable Care Act. PLoS ONE. 2015;10(6):e0131903.

94. Hong Y-R, Jo A, Mainous AG. Up-to-Date on Preventive Care Services Under Affordable Care Act: A Trend Analysis From MEPS 2007-2014. Med Care. 2017 Aug;55(8):771–80.

95. Agirdas C, Holding JG. Effects of the ACA on Preventive Care Disparities. Appl Health Econ Health Policy. 2018 Aug 24;

96. Medical Expenditure Panel Survey, Agency for Healthcare Research and Quality [Internet]. 2018 [cited 2018 Feb 19]. Available from: https://meps.ahrq.gov/mepsweb/

97. Ai C, Norton EC. Interaction terms in logit and probit models. Economics Letters. 2003 Jul 1;80(1):123–9.

98. Puhani PA. The treatment effect, the cross difference, and the interaction term in nonlinear "difference-in-differences" models. Economics Letters. 2012 Apr 1;115(1):85–7.

99. Using Statistical Software Packages to Produce Estimates from MEPS Data Files [Internet]. [cited 2018 Sep 23]. Available from: https://meps.ahrq.gov/survey_comp/hc_samplecodes_se.shtml

100. Accounting for Clustering in the Analysis of MEPS Data: Frequently Asked Questions (FAQ). :2.

101. American Cancer Society. Cancer Facts & Figures 2018 [Internet]. 2018 [cited 2018 Feb 18]. Available from: https://www.cancer.org/content/dam/cancer-org/research/cancer-facts-and-statistics/annual-cancer-facts-and-figures/2018/cancer-facts-and-figures-2018.pdf

102. Centers for Disease Control and Prevention CDC. United States Cancer Statistics [Internet]. [cited 2018 Nov 10]. Available from: https://gis.cdc.gov/grasp/USCS/DataViz.html

103. National Center for Health Statistics. Health, United States, 2016: With Chartbook on Long-term Trends in Health. Hyattsville, MD. [Internet]. 2017 [cited 2017 Jul 20]. Available from: https://www.cdc.gov/nchs/data/hus/hus16.pdf#070

104. Patient Protection and Affordable Care Act [Internet]. 2010 p. 393. Available from: http://housedocs.house.gov/energycommerce/ppacacon.pdf

105. Garfield R, Licata R, Feb 06 KYP, 2014. The Uninsured at the Starting Line: Findings from the 2013 Kaiser Survey of Low-Income Americans and the ACA [Internet]. The Henry J. Kaiser Family Foundation. 2014 [cited 2018 Nov 19]. Available from: https://www.kff.org/uninsured/report/the-uninsured-at-the-starting-line-findings-from-the-2013-kaiser-survey-of-low-income-americans-and-the-aca/

106. Smith J, Medala C. Health Insurance Coverage in the United States: 2014. Current Population Reports [Internet]. 2015 [cited 2017 Jul 19]. Available from: https://www.census.gov/content/dam/Census/library/publications/2015/demo/p60-253.pdf

107. Rowland D. Profiles in coverage: Medicaid, CHIP, and the uninsured. Presented at "On the Road to 2014: Medicaid and CHIP Eligibility and the Uninsured" [Internet]. 2011 [cited 2017 Jul 19]. Available from: https://www.medicaid.gov/State-Resource-Center/downloads/0907_CB_1215_1_Profiles_in_Coverage_508.pdf

108. Simon K, Soni A, Cawley J. The Impact of Health Insurance on Preventive Care and Health Behaviors: Evidence from the 2014 ACA Medicaid Expansions [Internet]. National Bureau of Economic Research; 2016 May. Available from: http://www.nber.org/papers/w22265

109. Cawley J, Soni A, Simon K. Third Year of Survey Data Shows Continuing Benefits of Medicaid Expansions for Low-Income Childless Adults in the U.S. J Gen Intern Med. 2018 Sep;33(9):1495–7.

110. Cole MB, Galárraga O, Wilson IB, Wright B, Trivedi AN. At Federally Funded Health Centers, Medicaid Expansion Was Associated With Improved Quality Of Care. Health Aff. 2017 Jan 1;36(1):40–8.

111. Miller S, Wherry LR. Health and Access to Care during the First 2 Years of the ACA Medicaid Expansions. N Engl J Med. 2017 09;376(10):947–56.

112. MEPS-HC response rates by panel [Internet]. Agency for Healthcare Research and Quality; 2017. Available from: https://meps.ahrq.gov/mepsweb/survey_comp/hc_response_rate.jsp

113. Simon K, Soni A, Cawley J. The Impact of Health Insurance on Preventive Care and Health Behaviors: Evidence from the First Two Years of the ACA Medicaid Expansions. J Policy Anal Manage. 2017;36(2):390–417.

114. Miller S, Wherry LR. Health and Access to Care during the First 2 Years of the ACA Medicaid Expansions. N Engl J Med. 2017 09;376(10):947–56.

115. State Cancer ProfilesHistorical Trends [Internet]. [cited 2018 Nov 18]. Available from: https://statecancerprofiles.cancer.gov/historicaltrend/index.php

116. Choi SK, Adams SA, Eberth JM, Brandt HM, Friedman DB, Tucker-Seeley RD, et al. Medicaid Coverage Expansion and Implications for Cancer Disparities. Am J Public Health. 2015 Oct 8;105(S5):S706–12.

117. Zhao G, Okoro CA, Li J, Town M. Health Insurance Status and Clinical Cancer Screenings Among U.S. Adults. Am J Prev Med. 2018 Jan;54(1):e11–9.

118. In 2011 nearly one-third of physicians said they would not accept new Medicaid patients, but rising fees may help. - PubMed - NCBI [Internet]. [cited 2018 Nov 19]. Available from: https://www-ncbi-nlm-nih-gov.pallas2.tcl.sc.edu/pubmed/22869644

119. Petry KU, Wörmann B, Schneider A. Benefits and Risks of Cervical Cancer Screening. ORT. 2014;37(Suppl. 3):48–57.

120. Hassani L, Dehdari T, Hajizadeh E, Shojaeizadeh D, Abedini M, Nedjat S. Barriers to Pap Smear Test for the Second Time in Women Referring to Health Care Centers in the South of Tehran: A Qualitative Approach. Int J Community Based Nurs Midwifery. 2017 Oct;5(4):376–85.

121. Løberg M, Lousdal ML, Bretthauer M, Kalager M. Benefits and harms of mammography screening. Breast Cancer Res [Internet]. 2015 [cited 2018 Nov 11];17(1). Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4415291/

122. Heywang-Köbrunner SH, Hacker A, Sedlacek S. Advantages and Disadvantages of Mammography Screening. Breast Care (Basel). 2011 Jun;6(3):199–207.

123. Miglioretti DL, Lange J, van den Broek JJ, Lee CI, van Ravesteyn NT, Ritley D, et al. Radiation-Induced Breast Cancer Incidence and Mortality from Digital Mammography Screening: A Modeling Study. Ann Intern Med. 2016 Feb 16;164(4):205–14.

124. USPSTF A and B Recommendations. U.S. Preventive Services Task Force [Internet]. 2017 Apr. Available from: https://www.uspreventiveservicestaskforce.org/Page/Name/uspstf-a-and-b-recommendations/

125. CDC - Cancer - NBCCEDP Screening Program Summaries - National Aggregate [Internet]. 2018 [cited 2018 Nov 19]. Available from: https://www.cdc.gov/cancer/nbccedp/data/summaries/national_aggregate.htm

126. Moss SM, Cuckle H, Evans A, Johns L, Waller M, Bobrow L, et al. Effect of mammographic screening from age 40 years on breast cancer mortality at 10 years' follow-up: a randomised controlled trial. Lancet. 2006 Dec 9;368(9552):2053–60.

127. Little benefit of cervical-cancer screening after age 55 with HPV-negative test [Internet]. Journal Of Clinical Pathways. [cited 2018 Nov 10]. Available from: https://www.journalofclinicalpathways.com/news/little-benefit-cervical-cancer-screening-after-age-55-hpv-negative-test

128. Viens LJ. Human Papillomavirus–Associated Cancers — United States, 2008–2012. MMWR Morb Mortal Wkly Rep [Internet]. 2016 [cited 2018 Nov 10];65. Available from: https://www.cdc.gov/mmwr/volumes/65/wr/mm6526a1.htm

129. Cancer Facts & Figures 2017 [Internet]. [cited 2017 Jul 30]. Available from: https://www.cancer.org/research/cancer-facts-statistics/all-cancer-facts-figures/cancer-facts-figures-2017.html

130. What Are the Key Statistics About Cervical Cancer? [Internet]. [cited 2017 Jun 16]. Available from: https://www.cancer.org/cancer/cervical-cancer/about/key-statistics.html

131. Aron-Dine A, Einav L, Finkelstein A. The RAND Health Insurance Experiment, three decades later. J Econ Perspect. 2013;27(1):197–222.

132. Patient Protection and Affordable Care Act [Internet]. 42 U.S.C. § 18001 et seq 2010 p. 393. Available from: http://housedocs.house.gov/energycommerce/ppacacon.pdf

133. DeSantis C, Siegel R, Jemal A. Cancer Facts & Figures for African Americans 2016-2018. :40.

134. Han X, Yabroff KR, Guy GP, Zheng Z, Jemal A. Has recommended preventive service use increased after elimination of cost-sharing as part of the Affordable Care Act in the United States? Preventive medicine. 2015;78:85–91.

135. CDC - Cancer - NBCCEDP Screening Program Summaries [Internet]. 2018 [cited 2018 Nov 11]. Available from: https://www.cdc.gov/cancer/nbccedp/data/summaries/index.htm

136. McKenna RM, Langellier BA, Alcalá HE, Roby DH, Grande DT, Ortega AN. The Affordable Care Act Attenuates Financial Strain According to Poverty Level. Inquiry. 2018 Dec;55:46958018790164.

137. Simon K, Soni A, Cawley J. The Impact of Health Insurance on Preventive Care and Health Behaviors: Evidence from the First Two Years of the ACA Medicaid Expansions. J Policy Anal Manage. 2017;36(2):390–417.

138. Goodwin SM, Anderson GF. Effect of cost-sharing reductions on preventive service use among Medicare fee-for-service beneficiaries. Medicare Medicaid Res Rev. 2012;2(1).

139. Cooper GS, Kou TD, Schluchter MD, Dor A, Koroukian SM. Changes in Receipt of Cancer Screening in Medicare Beneficiaries Following the Affordable Care Act. J Natl Cancer Inst. 2016 May;108(5).

140. Cooper GS, Kou TD, Dor A, Koroukian SM, Schluchter MD. Cancer preventive services, socioeconomic status, and the Affordable Care Act. Cancer. 2017 May 1;123(9):1585–9.

141. Mehta SJ, Polsky D, Zhu J, Lewis JD, Kolstad JT, Loewenstein G, et al. ACA-mandated elimination of cost sharing for preventive screening has had limited early impact. Am J Manag Care. 2015 Jul;21(7):511–7.

142. Fedewa SA, Goodman M, Flanders WD, Han X, Smith RA, M Ward E, et al. Elimination of cost-sharing and receipt of screening for colorectal and breast cancer. Cancer. 2015 Sep 15;121(18):3272–80.

143. Jena AB, Huang J, Fireman B, Fung V, Gazelle S, Landrum MB, et al. Screening Mammography for Free: Impact of Eliminating Cost Sharing on Cancer Screening Rates. Health Serv Res. 2017 Feb;52(1):191–206.

144. Nelson HD, Weerasinghe R, Wang L, Grunkemeier G. Mammography Screening in a Large Health System Following the U.S. Preventive Services Task Force Recommendations and the Affordable Care Act. PLoS ONE. 2015;10(6):e0131903.

145. Hong Y-R, Jo A, Mainous AG. Up-to-Date on Preventive Care Services Under Affordable Care Act: A Trend Analysis From MEPS 2007-2014. Med Care. 2017 Aug;55(8):771–80.

APPENDIX A

MEDICAID EXPANSION STATUS

State Medicaid expansion status as of September 2018 (Source: Kaiser foundation website)

Medicaid Expansion Status	States	Start date
Adapted	Arizona, Arkansas, California, Colorado, Connecticut, Hawaii, Illinois, Iowa, Kentucky, Maryland, Minnesota, Nevada, New Jersey, New Mexico, North Dakota, Ohio, Oregon, Rhode Island, Washington, West Virginia	Jan 2014
	Michigan	Apr 2014
	New Hampshire	Aug 2014
	Pennsylvania	Jan 2015
	Indiana	Feb 2015
	Alaska	Sep 2015
	Montana	Jan 2016
	Louisiana	Jul 2016
	Virginia	Jan 2019
	Maine	TBD
Did not adapt	Alabama, Florida, Georgia, Kansas, Mississippi, Missouri, North Carolina, Oklahoma, South Carolina, South Dakota, Tennessee, Texas, Wisconsin, Wyoming	NA
Considering	Idaho, Nebraska, Utah	To be determined

States that expanded Medicaid to childless adults before 2014 (Source: Kaiser foundation website)

Medicaid Expansion Status	States	Start date	Income eligible level
Adapted before 2014	District of Columbia	Jul 2010	215%
	Vermont	Jan 2011	160%
	New York	Apr 2009	100%
	Delaware	2009	100%
	Massachusetts	Apr 2009	133%

APPENDIX B

PARALLEL TREND TEST RESULTS

Mammogram

mamogr53	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
year	-.0297063	.013681	-2.17	0.030	-.0565226	-.0028899
year_group	.0039422	.0188091	0.21	0.834	-.0329256	.04081
expand_group	-8.093744	37.79246	-0.21	0.830	-82.17103	65.98354
_cons	61.95831	27.48885	2.25	0.024	8.077201	115.8394

Pap tests

papsmr53	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
year	-.0025966	.0081149	-0.32	0.749	-.0185021	.0133089
year_group	-.0163429	.0111188	-1.47	0.142	-.0381361	.0054502
expand_group	32.70334	22.34045	1.46	0.143	-11.0846	76.49128
_cons	6.826774	16.305	0.42	0.675	-25.13151	38.78506