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The Association Between the 2014 Medicaid Expansion and Screening Colonoscopy and Sigmoidoscopy Receipt for Adults Aged 50-75 Years

Madison E. Gilbert

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ABSTRACT

THE ASSOCIATION BETWEEN THE 2014 MEDICAID EXPANSION AND SCREENING COLONOSCOPY AND SIGMOIDOSCOPY RECEIPT FOR ADULTS AGED 50-75 YEARS

By

MADISON ELIZABETH GILBERT

April 30, 2018

INSTRUCTION: In 2014, more than 50,000 Americans died of colorectal cancer (CDC). Adults between the ages of 50 and 75 are recommended to have colorectal cancer screenings. The Patient Protection and Affordable Care Act (ACA) was signed into law in 2010. The ACA included provisions to encourage preventive services as well as opportunities for affordable health insurance coverage for low and middle-income populations, including Medicaid expansion. Due to the 2012 Supreme Court decision, Medicaid expansion, implemented in 2014, became optional for states.

AIMS: This study investigates whether state decisions regarding Medicaid expansion are associated with the rates of adults ages 50-75 receiving a colorectal cancer screening, comparing the rates in 2008 (pre-ACA) to 2016 (post ACA and Medicaid expansion).

METHODS: This study utilized the Behavioral Risk Factor Surveillance System (BRFSS) data from 2008 and 2016 to explore colorectal cancer screening rates pre- and post-ACA across a selection of expansion and non-expansion states. Multilevel models were applied to account for correlated data resulting from within-state clustering.

RESULTS: The dataset was comprised of American adults aged 50-75 years. In total, 38 states were analyzed; 18 non-expansion states and 20 expansion states. After controlling for demographics and accounting for within-state clustering, differences in screening rates between Medicaid expansion and non-expansion states were not statistically significant (OR=1.12; 95% CI: [0.99, 1.25], p=0.0875). Participants in the 2008 survey were, however, less likely to have received a screening colonoscopy or sigmoidoscopy than participants in the 2016 survey (OR 0.65, 95%CI [0.63, 0.68], p=<0.0001) after controlling for demographics and accounting for within-state clustering.

DISCUSSION: Despite a significant increase in rates for screening sigmoidoscopy and colonoscopy after ACA implementation, the failure to find a significant relationship with Medicaid expansion status may warrant further investigation.

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COLONOSCOPY AND SIGMOIDOSCOPY RECEIPT FOR ADULTS AGED 50-75 YEARS

by

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APPROVAL PAGE

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Author's Statement Page

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1. Introduction

1.1 Background

The Patient Protection and Affordable Care Act (ACA) was signed into law on March 23, 2010. The ACA expanded access to affordable health insurance through expansion of Medicaid and by providing subsidies for low and middle-income Americans. While Medicaid expansion was intended to be implemented in all states, the Supreme Court decision in 2012 made this optional, allowing states to choose rather than being compelled to adopt the Medicaid expansion (KFF). The ACA also included provisions to encourage the use of clinical preventive services, including colorectal cancer screening, by eliminating cost sharing for many preventive health services (healthcare.gov). As of January 2018, 33 states and Washington, D.C., expanded Medicaid expansion while 18 states had not (KFF).

Colorectal cancer is the most common fatal cancer among adults in the United States (CDC). In 2014, more than fifty thousand Americans died of colorectal cancer (CDC). The United States Preventive Service Task Force has issued screening guidelines for adults between the ages of 50 and 75 to promote early detection of colorectal cancer, when it is easier to treat and cure. There are two common types of colorectal cancer screening, colonoscopy and a combination of flexible sigmoidoscopy and fecal occult blood testing (FOBT). During a colonoscopy procedure, a scope is inserted into the rectum and colon to look for irritation, inflammation, polyps (which may be pre-cancerous), cancer, and other health issues. It is also possible to remove polyps or obtain biopsies during the procedure (NIDDK). Screening colonoscopies are recommended every ten years. A flexible sigmoidoscopy procedure is similar to a colonoscopy, but the score only visualizes the lower third of the colon (NIDDIK). The fecal blood occult test is a non-invasive test. A stool sample is collected and tested to look for blood in

the stool. The FOBT is recommended yearly, along with a flexible sigmoidoscopy every three to five years (USPSTF).

The ACA provisions for coverage of clinical preventive services required that most health insurance, public and private, cover the cost of age-appropriate preventive services without cost-sharing by the patient. This was implemented for private insurance plans on September 23, 2010 and Medicare on January 1, 2011 (Richman). It is also applied to the newly expanded Medicaid population. Medicaid expansion, along with the health insurance subsidies for individual health insurance plans for low and middle-income Americans, went into effect on January 1, 2014.

1.2 <u>Research Objectives</u>

This study investigates whether the colorectal cancer screening rates for adults aged 50-75 significantly changed from 2008 (pre-ACA) to 2016 (post ACA and Medicaid expansion) and whether there were significant differences between Medicaid expansion states and non-expansion states.

2. Literature Review

Studies on the effects of the elimination of cost-sharing on utilization of health services date back to the RAND Health Insurance Experiment from the 1970s. This experiment had 5,200 participants grouped into six categories: a coinsurance rate of 25% for most services by 50% for dental and outpatient mental health services, a coinsurance rate of 95% for outpatient care and 0% for inpatient care, coinsurance rate of 95% for all health services, coinsurance rate of 50% for all health services, coinsurance rate of 25% for all health services, and a coinsurance rate of 0% for all health services (effectively free healthcare). Participants were on the plans for

between three and five years. The results show medical care and health service utilization is sensitive to price, as interpreted from the higher utilization of services by the 0% coinsurance group when compared to other groups (Aron-Dine, Einav & Finkelstein, 2013).

Han, et al. conducted a study investigating the changes in rates of preventive service use after the ACA eliminated cost-sharing in the United States (2015). The elimination of cost-sharing for preventive services went into effect in 2010; Han, et al. analyze data from 2009 and 2011/2012 Medical Expenditure Panel Survey (MEPS). The study observed increases in private health insurance participants receiving flu vaccines, blood pressure checks, and cholesterol checks, but "few changes were observed for cancer screening" (Han, et al., 2015). Additionally, the researchers "observed little change in the uninsured population" (Han, et al., 2015).

Studies on colonoscopy rates tend to focus on the enactment of the ACA and the effects on Medicare beneficiaries. Richman, et al., sought to "evaluate use of colorectal cancer screening in a national population-based sample before and after implementation of the Affordable Care Act" (2015). Utilizing the Medical Expenditure Panel Survey (MEPS) from 2009 and 2012, the researchers looked at adults between 50 and 64 years old with private insurance and adults between 65 and 75 years old with Medicare. The results show there were no changes in the rates of sigmoidoscopy and FOBT rates from 2009 to 2012. However, there was an increase in the utilization of colonoscopy screenings for those without supplemental insurance and those in poverty when comparing 2009 and 2012. Cooper, et al., found little to no increases in preventive colonoscopy screening when comparing 2009-2010 (prior to ACA) and 2011-2012 (post ACA) among Medicare beneficiaries aged 70 or older (2015). Hamman, et al. discovered a 4% increase in receipt of screening colonoscopies in men enrolled in Medicare (2015). The researchers also write, "our research indicates cost may be an important barrier to colorectal cancer screening, at

least among men" (Hamman, et al., 2015). The disparity of colonoscopy rates between men and women are not explained.

Schneider, et al. investigated the differences in colorectal cancer preventive screenings among those in Medicare-managed health insurance plans and traditional health insurance plans (2008). This study took place prior to the implementation of the ACA. Utilizing data from 2000, the researchers found the Medicare managed beneficiaries with supplemental insurance had a higher rate of colorectal cancer screening compared to Medicare managed care beneficiaries without supplemental insurance and those in traditional health insurance plans. Additionally, Medicare beneficiaries were found to have a higher rate of FOBT than any other type of colorectal cancer screening. Cooper, et al. found no change in receipt of screening colonoscopies in Medicare beneficiaries after the implementation of the ACA (2017). However, when researchers looked at screening colonoscopy receipt by education level and income, a small effect was detected (Cooper, et al., 2017).

Fedewa, et al. (2015) and Khatami (2012) studied the effects of eliminating cost sharing on the rates of colorectal cancer screenings. Fedewa, et al. found that eliminating cost sharing increased the colorectal cancer screening rate only for those with a low socioeconomic status; it had no effect for those with a higher socioeconomic status or those who had private insurance. The study only analyzed adults between ages 50 and 75 with private health insurance or Medicare; there was no analysis of those with Medicaid. Khatami (2012) looked at the University of Texas employee, retiree, and dependent health plan recipients. This insurance plan removed cost sharing for screening colonoscopies in 2009, before the ACA began. The study found a modest increase in colonoscopy utilization, approximately a 1.5% increase.

A study by Wright, et al. demonstrated that gaining Medicaid coverage resulted in higher levels of cancer screening (2015). The state of Oregon had a Medicaid lottery prior to the implementation of the ACA; a state lottery randomly selected impoverished, nondisabled individuals from a reservation list to gain Medicaid coverage. Wright, et al. used this as an opportunity for a randomized trial to determine the effects gaining Medicaid coverage had on receipt of preventive cancer screenings, including breast, colorectal, cervical, and prostate cancer screenings. Acquiring Medicaid coverage led to a 10% higher receipt of colonoscopies compared to the control group (Wright, et al., 2015). Redmond Knight, et al., found the major barriers to receiving colorectal cancer screenings include education level, income level, race/ethnicity, and insurance coverage (2015). Additionally, those with high deductible insurance plans did not see a significant decrease in receipt of colorectal cancer screenings after the institution of the ACA (Wharam, et al., 2016). This suggests that the additional people covered through the Medicaid expansion in those states that participated should result in higher rates of screening colonoscopy/sigmoidoscopy as compared to states that did not expand Medicaid.

A study by Halpern (2007) showed increases in Medicaid reimbursement for appointments and for cancer screenings, including colonoscopy, mammography, and cervical cancer screening. This study was published prior to the Medicaid expansion. No studies analyzed the effects of the Medicaid expansion on the colorectal screening rates.

3. Methods

<u>3.1 Sample</u>

This study utilizes the 2008 and 2016 Behavioral Risk Factor Surveillance System (BRFSS) data to explore changes in rates of colorectal screening before and after the

implementation of the ACA and Medicaid expansion between a selection of states that did and did not expand Medicaid. The BRFSS survey is the largest continuously conducted health survey system in the world. It is a cross-sectional telephone survey. Participants are chosen through random digit dialing and a complex probability sample is used to obtain a U.S.-based representative sample. The survey includes participants from all 50 states, Washington, D.C., Puerto Rico, the U.S. Virgin Islands, Guam, American Samoa, and Palau. Prior to 2011, BRFSS utilized the post stratification method to weight the sample to known proportions of age, race/ethnicity, sex, and region. From 2011 to the present, the BRFSS has utilized the iterative proportional fitting (raking) method, which allows for more variables to be considered in the weighting process; additional variables include education, marital status, home ownership status, and type of telephone ownership. This study did not consider sampling weights in the analysis due to limitations of multilevel modeling procedures in the SAS Software System, Version 9.4.

3.2 Statistical Analysis

The data were analyzed with the SAS Software System, Version 9.4. Categorical variables were analyzed using the PROC FREQ procedure. The frequencies and percentages were calculated for each characteristic by year and by receipt of screening colonoscopy/sigmoidoscopy. Frequency distributions stratified by Medicaid expansion status were calculated by year for each state and screening colonoscopy/sigmoidoscopy receipt. Multilevel modeling was used to account for the state level clustering. For these multilevel data, the first level is time (years 2008 and 2016) and the second level is state. A logistic regression model with random effects was defined with use of the logit link function and binomial distribution function. The PROC GENMOD procedure in SAS was used to fit bivariate and multivariable marginal models. Marginal modelling is a type of multilevel modelling; marginal

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models are population-averaged models that account for correlated data in producing correct standard errors to enable statistical inferences about fixed effects. The level of significance in this work was pre-defined as 0.05.

The outcome variable was defined as yes or no if a participant did or did not have a screening colonoscopy or sigmoidoscopy. In the BRFSS survey, the screening colonoscopy/sigmoidoscopy item reads: "Sigmoidoscopy and colonoscopy are exams in which a tube is inserted in the rectum to view the colon for signs of cancer or other health problems. Have you ever had either of these exams?"; possible answers were yes, no, don't know/not sure, and refused. Missing responses were coded the same as those outside of the age range for a screening colonoscopy. Only participants that responded with "yes" or "no", are included in the analyses, since the "missing" category includes both those responses that are truly missing and those who are outside the age range of 50-75years old; there was no way to discern any meaningful information about those who were deemed 'missing' because of the grouping of the data. Missing data are assumed to be missing completely at random in all analyses.

Thirty-eight states were included in the analysis: 20 that expanded Medicaid on January 1, 2014; 18 that had not expanded Medicaid as of November 2017. Washington, D.C., and states that expanded Medicaid after January 1, 2014, were excluded. Additionally, the state of Wisconsin was excluded since the state government did not expand Medicaid but did significantly lighten their Medicaid requirements.

Based on the literature, several predictor variables were considered: education level, state of residence, self-reported general health, how often the participant exercised in the previous 30 days, sex, marital status, self-reported employment status, race/ethnicity, and self-reported income level. The education survey item originally contained six levels, however the data was

aggregated, resulting in four levels: "less than high school," "high school graduate," "some college/technical school," and "college 4 years or more." General health contains five levels ranging from "excellent" to "poor." Exercise is a yes/no item. Employment status contains eight levels: "employed for wages," "self-employed," "out of work for more than one year," "out of work for less than one year," "homemaker," "student," "retired," and "unable to work." The income survey item was aggregated from eight levels to four levels: "<$25,000," "$25,000 to $49,999," "≥$50,000," and "Refused/ Don't Know/Not Sure." The refused and don't know/not sure levels were retained because there are tens of thousands of observations in these levels. The race item has five categories: "White (non-Hispanic)," "Black (non-Hispanic)," "Multiracial," "Other (non-Hispanic)," and "Hispanic."

Participants with responses of 'refused' and 'don't know/not sure' (except for income) and those with missing data for any of the covariates presented estimation challenges and were excluded from the analysis.

4. Results

Descriptive statistics were used to summarize the covariates as shown in Table 1. Overall, 69.6% of participants indicated they had received a screening colonoscopy/sigmoidoscopy. There were 417,947 total participants analyzed. Of the total participants, 61% were females. Whites make up 84.5% of the sample. Of the participants that answered the education level survey item, 91% had a high school or higher education. Of those participants that indicated they had received a screening colonoscopy/sigmoidoscopy, 32.2% self-reported their health was "very good" and 31.3% self-reported their health was "good". Approximately 83% of participants are employed for wages, self-employed, or retired, with the majority being retired (44.2%). More than 15% of respondents refused to answer the income

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survey item; 36.8% claim to have an income of $50,000 or more. For every covariate in both 2008 and 2016, more participants said they'd received a screening sigmoidoscopy or colonoscopy.

Table 2 displays summary statistics for the twenty states with the Medicaid expansion. New York (18,016 received colonoscopy/sigmoidoscopy; 6,397 did not) and Washington state (15,969 received colonoscopy/sigmoidoscopy; 6,630 did not) had the highest number of participants. All states had a higher number of participants that had received a screening colonoscopy or sigmoidoscopy than participants who had not received either test, for each year and overall. Table 3 displays the summary statistics for the eighteen non-expansion states. Florida (20, 987 received colonoscopy/sigmoidoscopy; 8,515 did not) and Nebraska (11,746 received colonoscopy/sigmoidoscopy; 7, 487 did not) had the highest number of participants. Like the states with expanded Medicaid, all states in Table 3 had a higher number of participants that had received a screening colonoscopy or sigmoidoscopy than participants who had not received either test. There were 196,840 participants from the non-expansion states; there were 221,107 participants from the expansion states.

The results of the bivariate (unadjusted) marginal models are displayed in Table 4. Sex (OR=1.02; 95% CI [1.0, 1.05], p=0.0907) and Medicaid expansion status (OR=1.13; 95% CI[0.98, 1.30], p=0.1184) were not significantly associated with screening rates. All other independent variables analyzed were statistically significant (p <0.05). Accounting for within-state correlation, hispanics were 0.52 (95% CI [0.46, 0.58]) times as likely as Whites to have received a screening colonoscopy or sigmoidoscopy. Participants who did not graduate from high school were 0.54 (95% CI [0.51, 0.57] times as likely as those who went to a technical college or had some college to have received a screening colonoscopy or sigmoidoscopy.

Retirees were 1.92 (95% CI [1.82, 2.04]) times as likely as those unable to work to have received a screening colonoscopy or sigmoidoscopy.

Table 5 shows the multivariable (adjusted) marginal model results. Medicaid expansion status is the only covariate that is not significant when controlling for other variables (OR=1.12; 95% CI [0.99, 1.25], p=0.0875). Sex was not statistically significant in the bivariate model, but it was statistically significant (OR=1.13, 95% CI [1.10, 1.49], p=<0.0001) when controlling for race, education, general health, employment, income, marital status, exercise, year, and expansion status. Those who self-reported being in "Excellent" general health were 0.83 (95% CI: [0.81, 0.85]) times as likely to have received a screening colonoscopy or sigmoidoscopy as those in "Very Good" self-reported general health when controlling for the other covariates. Participants in the 2008 survey were less likely to have received a screening colonoscopy or sigmoidoscopy than participants in the 2016 survey (OR 0.65, 95%CI [0.63, 0.68], p=<0.0001) after controlling for demographics and accounting for within-state clustering.

5. Discussion

5.1 Discussion of Research Question

Medicaid expansion status was not significantly associated with screening status. This suggests that Medicaid expansion, two years into its implementation, may not have had adequate time in effect to have a significant impact on receipt of sigmoidoscopy or colonoscopy. Possible reasons for not detecting an effect may be: 1. The Medicaid expansion is relatively recent; once a few years have passed an effect may be detectable. 2. It is possible the coverage provision of the ACA drowned out the effect of the Medicaid expansion; not many people in the 50-75 age group were new enrolled in Medicaid compared to Medicare and private insurance. 3. There was no

significant effect. Future studies will preferably isolate the Medicaid enrollees to compare pre- and post- Medicaid expansion. Participants of the 2008 survey were less likely to have received a sigmoidoscopy or colonoscopy than the participants of the 2016 survey (OR 0.65, 95%CI [0.63, 0.68]).

5.2 Study Strengths and Limitations

A strength of this study was the clustering of the data at the state level. Clustering allows for a more accurate result when the data are nested, as in this study where participants are nested within states. Participants from the same state are likely to be more similar to each other than to those from other states. Another strength is the large sample size; the study included a sample of 417,947 participants.

A limitation of this work is an unweighted statistical analysis; sampling weights were not used in the analysis. The BRFSS includes sample weights to ensure the survey is representative of the United States and its territories. The multilevel modeling procedures in the SAS Software System only allow for unweighted analysis. This means the sample may be potentially biased, although it is not possible to directly ascertain the extent of the bias. In addition, the BRFSS includes collection of self-reported data, leading to the possibility of bias (e.g., response bias, social desirability bias, etc.) Another limitation is the assumption that the missing data are missing completely at random (MCAR). This assumption was necessary for estimation of the marginal model. However, it may not hold; the data is coded as missing for those outside of the age range of 50-75 years. This suggests there may be a pattern to the missing data. Further work is needed to explore the possible effects of the Medicaid expansion on the receipt of sigmoidoscopies and colonoscopies.

5.3 Conclusion

Medicaid expansion is a recent development in the American healthcare landscape. This study found a positive effect of the ACA implementation, mainly that participants in 2016 were more likely to have received a screening colonoscopy or sigmoidoscopy than those in 2008. This study failed to detect effects of the Medicaid expansion on the receipt of screening colonoscopy or sigmoidoscopy by adults aged 50-75 despite an overall increase in screening rates in both expansion and non-expansion states post-ACA implementation. It may be that Medicaid expansion did not have an effect; it is also possible there is a difference in states with Medicaid expansion, but there was inadequate statistical power to detect it. Future studies that allow a larger window of time since implementation may shed light on effects from the expansion.

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Table 1. Descriptive statistics for all study measures by colonoscopy/sigmoidoscopy receipt[*]

	2008		2016		Total	
	Yes (121,624)	No (67,879)	Yes (169,467)	No (58,977)	Yes (291,091)	No (126,856)
Sex n(%)						
Male	45083 (37.1)	25122 (37.0)	68957 (40.7)	25236 (42.8)	114040 (39.2)	50358 (39.7)
Female	76541 (62.9)	42757 (63.0)	100510 (59.3)	33741 (57.2)	177051 (60.8)	76498 (60.3)
Missing=54						
Race n(%)						
Black (Non-Hispanic)	7031 (5.8)	4687 (6.9)	11318 (6.7)	4548 (7.7)	18349 (6.3)	9235 (7.9)
Hispanic	3875 (3.2)	3684 (5.4)	5950 (3.5)	4034 (6.8)	9825 (5.4)	7718 (6.1)
Multiracial	1692 (1.4)	1244 (1.8)	2649 (1.6)	1159 (2.0)	4341 (1.5)	2403 (1.9)
Other (Non-Hispanic)	3227 (2.7)	2577 (3.8)	4526 (2.7)	2592 (4.4)	7753 (2.7)	5169 (4.1)
White (Non-Hispanic)	105799 (87.0)	55687 (82.0)	145027 (85.6)	46644 (79.1)	250823 (86.2)	102331 (80.1)
Missing = 10261						
Education n(%)						
Less Than High School	10315 (8.5)	8926 (13.2)	9775 (5.8)	6984 (11.8)	20090 (6.9)	15910 (12.5)
High School Graduate	35966 (29.6)	23185 (34.2)	45447 (26.8)	19859 (33.7)	81413 (28.0)	43044 (33.9)
Technical school or Some College	32407 (26.7)	17757 (26.2)	46714 (27.6)	15948 (27.0)	79121 (27.2)	33705 (26.6)
College Graduate	42936 (35.3)	18011 (26.5)	67531 (39.9)	16186 (27.4)	110467 (38.0)	34197 (27.0)
Missing = 2466						
General Health n(%)						
Excellent	18332 (15.1)	11001 (16.2)	25450 (15.0)	9080 (15.4)	43782 (15.0)	20081 (15.8)
Very Good	37511 (30.8)	20074 (29.6)	56090 (33.1)	17057 (28.9)	93601 (32.2)	37131 (29.3)
Good	38276 (31.5)	21017 (31.0)	52876 (31.2)	18914 (32.1)	91152 (31.3)	39931 (31.5)
Fair	18659 (15.3)	10688 (15.8)	24515 (14.5)	9659 (16.4)	43174 (14.8)	20347 (16.0)
Poor	8846 (7.3)	5099 (7.5)	10536 (6.2)	4267 (7.2)	19382 (6.7)	9366 (7.4)
Missing = 2452						

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Employment n(%)

Employed	35746 (29.4)	25,342 (37.3)	46154 (27.2)	20253 (34.3)	81900 (28.1)	45595 (35.9)
Homemaker	7786 (6.4)	4,746 (7.0)	7347 (4.3)	3273 (5.6)	15133 (5.2)	8019 (6.3)
Out of Work More Than 1 Year	1510 (1.2)	1,366 (2.0)	2289 (1.4)	1608 (2.7)	3799 (1.3)	2974 (2.3)
Out of Work Less Than 1 Year	1348 (1.1)	1363 (2.0)	1679 (1.0)	1030 (1.8)	3027 (1.0)	2393 (1.9)
Retired	57512 (47.3)	22270 (32.8)	85682 (50.6)	19800 (33.6)	143194 (49.2)	42070 (33.2)
Self-Employed	9345 (7.7)	7042 (10.4)	13050 (7.7)	6472 (11.0)	22395 (7.7)	13514 (10.7)
Student	179 (0.2)	127 (0.2)	194 (0.1)	143 (0.2)	373 (0.1)	270 (0.2)
Unable to Work	8198 (6.7)	5623 (8.3)	13072 (7.7)	6398 (10.9)	21270 (7.3)	12021 (9.5)

Missing = 4487

Income n(%)

<$25,000	28798 (23.7)	21548 (31.7)	33277 (19.6)	18043 (30.6)	62075 (21.3)	39591 (31.2)
$25,000-$49,999	30917 (25.4)	17086 (25.2)	37534 (22.2)	13338 (22.6)	68451 (23.5)	30424 (24.0)
>$50,000	45064 (37.1)	20091 (29.6)	72512 (42.8)	18192 (30.9)	117576 (40.4)	38283 (30.2)
Don't Know/ Not Sure/ Refused	16845 (13.9)	9154 (13.5)	26144 (15.4)	9404 (16.0)	42989 (14.8)	18558 (14.6)

Missing = 3587

Marital Status n(%)

Divorced	17797 (14.6)	12392 (18.3)	25488 (15.0)	11461 (19.4)	43285 (14.9)	23853 (18.8)
Married	68903 (56.7)	34203 (50.4)	97368 (57.5)	28137 (47.7)	166271 (57.1)	62340 (49.1)
Never Married	6217 (5.1)	5394 (8.0)	10384 (6.1)	5986 (10.2)	16601 (5.7)	11380 (9.0)
Separated	1628 (1.3)	1449 (2.1)	2439 (1.4)	1528 (2.6)	4067 (1.4)	2977 (2.4)
Member of Unmarried Couple	1043 (0.9)	775 (1.1)	2229 (1.3)	1111 (1.9)	3272 (1.1)	1886 (1.5)
Widowed	26036 (21.4)	13666 (20.1)	31559 (18.6)	10754 (18.2)	57595 (19.8)	24420 (19.3)

Missing = 3982

Exercise n(%)

Yes	88311 (72.6)	45709 (67.3)	125108 (73.8)	39471 (66.9)	213419 (73.3)	85180 (67.2)
No	33313 (27.4)	22170 (32.7)	44359 (26.2)	19506 (33.1)	77672 (26.7)	41676 (32.9)

Missing = 994

*Percentages may not add to 100% due to rounding

Table 2. Summary statistics for 20 Medicaid expansion states by year and colonoscopy/sigmoidoscopy receipt[*]

	2008		2016		Total	
	Yes (65,682)	No (34,243)	Yes (90,936)	No (30,246)	Yes (156,618)	No (64,489)
State						
California	4096 (6.2)	2186 (6.4)	3426 (3.8)	1519 (5.0)	7522 (4.8)	3705 (5.8)
Colorado	4113 (6.3)	2280 (6.7)	6206 (6.8)	2229 (7.4)	10319 (6.6)	4509 (7.0)
Connecticut	2536 (3.9)	1044 (3.1)	5821 (6.4)	1364 (4.5)	8357 (5.3)	2408 (3.7)
Delaware	1786 (2.7)	625 (1.8)	1834 (2.0)	541 (1.8)	3620 (2.3)	1166 (1.8)
Hawaii	2232 (3.4)	1513 (4.4)	3409 (3.8)	1423 (4.7)	5641 (3.6)	2936 (4.6)
Illinois	1864 (2.8)	1137 (3.3)	1974 (2.2)	746 (2.5)	3838 (2.5)	1883 (2.9)
Maryland	3943 (6.0)	1480 (4.3)	8839 (9.7)	2523 (8.3)	12782 (8.2)	4003 (6.2)
Massachusetts	7799 (11.9)	3439 (10.0)	3652 (4.0)	901 (3.0)	11451 (7.3)	4340 (6.7)
Minnesota	1884 (2.9)	722 (2.1)	7481 (8.2)	2006 (6.6)	9365 (6.0)	2728 (4.2)
Nevada	1577 (2.4)	1126 (3.3)	1746 (1.9)	761 (2.5)	3323 (2.1)	1887 (2.9)
New Jersey	4001 (6.1)	2541 (7.4)	3165 (3.5)	1304 (4.3)	7166 (4.6)	3845 (6.0)
New Mexico	2010 (3.1)	1670 (4.9)	2403 (2.6)	1268 (4.2)	4413 (2.8)	2938 (4.6)
New York	3160 (4.8)	1507 (4.4)	14856 (16.3)	5890 (16.2)	18016 (11.5)	6397 (9.9)
North Dakota	1815 (2.8)	1236 (3.6)	2618 (2.9)	1015 (3.4)	4433 (2.8)	2251 (3.5)
Ohio	5110 (7.8)	2988 (8.7)	5695 (6.3)	2272 (7.5)	10805 (6.9)	5260 (8.2)
Oregon	2083 (3.2)	962 (2.8)	2169 (2.4)	641 (2.1)	4252 (2.7)	1603 (2.5)
Rhode Island	1989 (3.0)	833 (2.4)	2681 (3.0)	682 (2.3)	4670 (3.0)	1515 (2.4)
Vermont	2825 (4.3)	1228 (3.6)	3287 (3.6)	863 (2.9)	6112 (3.9)	2091 (3.2)
Washington	9440 (14.4)	4558 (13.3)	6529 (7.2)	2072 (6.9)	15969 (10.2)	6630 (10.3)
West Virginia	1419 (2.2)	1168 (3.4)	3145 (3.5)	1226 (4.1)	4564 (2.9)	2394 (3.7)

*Percentages may not add to 100% due to rounding

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Table 3. Summary statistics for 18 Medicaid non-expansion states by year and colonoscopy/sigmoidoscopy receipt[*]

State	2008		2016		Total	
	Yes (55,942)	No (33,636)	Yes (78,531)	No (28,731)	Yes (134,473)	No (62,367)
Alabama	2381 (4.3)	1524 (4.5)	2981 (3.8)	1101 (3.8)	5362 (4.0)	2625 (4.2)
Florida	4509 (8.1)	2339 (7.0)	16478 (21.0)	6176 (21.5)	20987 (15.6)	8515 (13.7)
Georgia	2179 (3.9)	1126 (3.4)	2248 (2.9)	938 (3.3)	4427 (3.3)	2064 (3.3)
Idaho	1664 (3.0)	1258 (3.4)	2331 (3.0)	950 (3.3)	3995 (3.0)	2208 (3.5)
Kansas	3341 (6.0)	1997 (5.9)	5359 (6.8)	1824 (6.4)	8700 (6.5)	3821 (6.1)
Maine	3091 (5.5)	1196 (3.6)	5386 (6.9)	1335 (4.7)	8477 (6.3)	2531 (4.1)
Mississippi	2858 (5.1)	2080 (6.2)	2117 (2.7)	977 (3.4)	4975 (3.7)	3057 (4.9)
Missouri	1920 (3.4)	1216 (3.6)	3359 (4.3)	1326 (4.6)	5279 (3.9)	2542 (4.1)
Nebraska	5458 (9.8)	4568 (13.6)	6288 (8.0)	2919 (10.2)	11746 (8.7)	7487 (12.0)
North Carolina	6474 (11.6)	3073 (9.1)	2693 (3.4)	865 (3.0)	9167 (6.8)	3938 (6.3)
Oklahoma	2757 (4.9)	1996 (5.9)	2984 (3.8)	1408 (4.9)	5741 (4.3)	3404 (5.5)
South Carolina	4079 (7.3)	2098 (6.2)	5473 (7.0)	1616 (5.6)	9552 (7.1)	3714 (6.0)
South Dakota	2714 (4.9)	1699 (5.1)	2724 (3.5)	991 (3.5)	5438 (4.0)	2690 (4.3)
Tennessee	1910 (3.4)	1234 (3.7)	2688 (3.4)	931 (3.2)	4598 (3.4)	2165 (3.5)
Texas	3880 (6.9)	2374 (7.1)	4931 (6.3)	1979 (6.9)	8811 (6.6)	4353 (7.0)
Utah	1740 (3.1)	828 (2.5)	4296 (5.5)	1243 (4.3)	6036 (4.5)	2071 (3.3)
Virginia	2212 (4.0)	979 (2.9)	4011 (5.1)	1214 (4.2)	6223 (4.6)	2193 (3.5)
Wyoming	2775 (5.0)	2051 (6.1)	2184 (2.8)	938 (3.3)	4959 (3.7)	2989 (4.8)

*Percentages may not add to 100% due to rounding

Table 4. Bivariate models of Colonoscopy/Sigmoidoscopy and Covariates

| | Unadjusted | | | |
| | | 95% CI | | |
Covariate	Odds Ratio	Lower Limit	Upper Limit	p-value
Sex				0.0907
Male	1.02	1.00	1.05	
Female	reference			
Race				0.0002
Black (Non-Hispanic)	0.81	0.71	0.92	
Hispanic	0.52	0.46	0.58	
Multiracial	0.74	0.65	0.83	
Other (Non-Hispanic)	0.61	0.52	0.72	
White (Non-Hispanic)	reference			
Education				<0.0001
Less Than High School	0.54	0.51	0.57	
High School Graduate	0.81	0.79	0.82	
Some College or Tech School	reference			
College Graduate	1.38	1.34	1.41	
General Health				<0.0001
Excellent	0.86	0.84	0.89	
Very Good	reference			
Good	0.91	0.88	0.93	
Fair	0.84	0.81	0.88	
Poor	0.82	0.78	0.87	
Employment				0.0002
Employed	1.02	0.95	1.08	
Homemaker	1.07	1.02	1.12	
Out of Work More Than 1 Year	0.72	0.67	0.78	
Out of Work Less Than 1 Year	0.71	0.65	0.79	
Retired	1.92	1.82	2.04	
Self-Employed	0.94	0.88	1.00	
Student	0.78	0.69	0.88	
Unable to Work	Reference			
Income				<0.0001
<$25,000	0.68	0.65	0.71	
$25,000-$49,999	0.97	0.94	1.01	
>$50,000	1.33	1.27	1.39	
Don't Know/ Not Sure/ Refused	reference			
Marital Status				<0.0001
Divorced	0.77	0.73	0.81	
Married	1.13	1.09	1.17	
Never Married	0.74	0.67	0.81	
Separated	0.62	0.57	0.67	
Member of Unmarried Couple	0.58	0.54	0.62	
Widowed	reference			
Exercise				<0.0001
Yes	1.34	1.31	1.38	
No	reference			
Year				<0.0001
2008	0.62	0.59	0.65	
2016	reference			
Medicaid Expansion Status				0.1184
Yes	1.13	0.98	1.30	
No	reference			

Table 5. Multivariable model of Colonoscopy/Sigmoidoscopy and Covariates

Covariate	Adjusted Odds Ratio	95% CI Lower Limit	95% CI Upper Limit	p-value
Sex				<0.0001
Male	1.13	1.10	1.49	
Female	reference			
Race				0.0011
Black (Non-Hispanic)	1.03	0.94	1.14	
Hispanic	0.70	0.63	0.78	
Multiracial	0.79	0.68	0.92	
Other (Non-Hispanic)	0.63	0.58	0.69	
White (Non-Hispanic)	Reference			
Education				<0.0001
Less Than High School	0.63	0.60	0.66	
High School Graduate	0.83	0.82	0.85	
Some College or Tech School	Reference			
College Graduate	1.30	1.27	1.33	
General Health				<0.0001
Excellent	0.83	0.81	0.85	
Very Good	reference			
Good	1.04	1.02	1.06	
Fair	1.13	1.10	1.15	
Poor	1.22	1.18	1.27	
Employment				<0.0001
Employed	0.63	0.60	0.66	
Homemaker	0.80	0.77	0.84	
Out of Work More Than 1 Year	0.63	0.59	0.67	
Out of Work Less Than 1 Year	0.58	0.54	0.63	
Retired	1.41	1.35	1.47	
Self-Employed	0.58	0.56	0.61	
Student	0.57	0.50	0.65	
Unable to Work	reference			
Income				<0.0001
<$25,000	0.79	0.77	0.82	
$25,000-$49,999	1.06	1.03	1.09	
>$50,000	1.42	1.38	1.47	
Don't Know/ Not Sure/ Refused	reference			
Marital Status				<0.0001
Divorced	0.89	0.86	0.92	
Married	1.11	1.09	1.14	
Never Married	0.78	0.72	0.84	
Separated	0.68	0.64	0.72	
Member of Unmarried Couple	0.78	0.75	0.82	
Widowed	reference			
Exercise				<0.0001
Yes	0.84	0.83	0.86	
No	reference			
Year				<0.0001
2008	0.65	0.63	0.68	
2016	reference			
Medicaid Expansion Status				0.0875
Yes	1.12	0.99	1.25	
No	reference			