

# Co-payment Policies and Breast and Cervical Cancer Screening in Medicaid

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**M**orbidity and mortality from breast and cervical cancer can be reduced through screening.<sup>1,2</sup> Breast cancer is the second leading cause of cancer death among US women.<sup>3</sup> Although the prevalence of cervical cancer is low in the United States, it could be practically eliminated through screening and treatment for precancerous lesions.<sup>4</sup> However, cancer-related disparities persist among women of low socioeconomic status, for whom out-of-pocket costs are often a barrier to seeking screening and treatment for cancer.<sup>5-7</sup>

Although cost sharing in Medicaid is typically low, most states require co-payments from adult enrollees<sup>8,9</sup> and, in some states, cost sharing is on the rise.<sup>10</sup> Beginning in 2013, the Affordable Care Act (ACA) incentivized states to eliminate cost sharing for preventive care, offering a 1% increase in the federal match rate for states that cover recommended preventive services without cost sharing.<sup>11,12</sup> In contrast, to curb healthcare utilization, CMS encouraged states to increase cost sharing for certain services for nondisabled adults in Medicaid.<sup>13</sup> While the policy debate over the role of cost sharing in the Medicaid program continues, evidence regarding the impact of cost sharing on utilization of different types of services is needed to inform policy and programmatic decisions.<sup>14</sup>

Preventive care such as cancer screening is potentially of high value and has benefits for population health.<sup>15</sup> For example, since its implementation, routine screening has led to a substantial decrease in deaths from cervical cancer.<sup>16</sup> However, cost sharing may discourage the use of these services, particularly among low-income women who have few resources and do not habitually seek cancer screening, often leading to late-stage diagnosis and poor prognosis.<sup>17-19</sup>

Several studies have examined the role of cost sharing in healthcare utilization. The seminal RAND Health Insurance Experiment, which randomized families to insurance plans with various levels of cost sharing, found that those with greater out-of-pocket costs had significantly lower healthcare utilization.<sup>20</sup> Findings of recent studies suggest negative effects of co-payments on healthcare utilization for Medicaid and other low-income populations across multiple types of care, but few studies have focused on

## ABSTRACT

**OBJECTIVES:** This study investigated the relationship between state Medicaid co-payment policies and cancer screening for Medicaid-enrolled women.

**STUDY DESIGN:** Cross-sectional analysis of administrative claims and enrollment data.

**METHODS:** Our data included Medicaid Analytic eXtract (MAX) outpatient claims files across 43 states in 2003, 2008, and 2010, the years for which both MAX data and state cost-sharing data were available. Data on enrollee demographics and screening services from enrollment and claims files were merged with state-year data on co-payment policies and county-level controls from the Area Health Resources File. Participants were nonelderly, nondisabled, nonpregnant women in the recommended age range for each screening service (50-64 years for mammograms; 21-64 years for Pap tests) enrolled in fee-for-service Medicaid. The main independent variable is whether an enrollee faced cost sharing for preventive services. We examined 3 categories of cost sharing: co-payments for all visits, including for preventive services; co-payments for outpatient visits but waived for preventive services; and no co-payments. The main outcome measure was receipt of mammogram or Pap test within a 12-month period.

**RESULTS:** Medicaid enrollees with co-payments for preventive services were less likely to receive both screening mammograms and Pap tests than enrollees in states not requiring cost sharing for preventive services.

**CONCLUSIONS:** Co-payments for preventive services discourage breast and cervical cancer screening among Medicaid enrollees. The effect is larger for breast cancer screening, which is costlier and requires an additional visit. Considering this evidence, cost sharing for preventive services may lead to adverse health consequences and greater long-term costs.

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## TAKEAWAY POINTS

Co-payments for preventive services can discourage breast and cervical cancer screening among Medicaid enrollees. Such cost sharing may lead to adverse health consequences and greater costs.

- ▶ Analysis of outpatient claims files across 43 states from 2003, 2008, and 2010 indicated that Medicaid enrollees facing co-payments for preventive services were less likely to receive both screening mammograms and Pap tests than those without co-payments.
- ▶ Ongoing changes to Medicaid policy across multiple states that emphasize cost sharing and consumer-directed healthcare principles should carefully consider the impact of out-of-pocket cost on receipt of preventive care and other high-value services.

preventive services.<sup>21-23</sup> Within the Medicare population, even co-payments as low as \$10 are associated with significantly lower rates of mammography in managed care plans.<sup>24</sup> Although these studies suggest that co-payments reduce utilization, evidence is needed on the effect of co-payments on receipt of preventive care for Medicaid enrollees, who are vulnerable due to their low income, risk factors (eg, smoking, obesity, comorbid conditions), and lack of access to care. One recent study examined the association of multiple Medicaid policies (not focusing primarily on cost sharing) with receipt of cancer screenings using a single year of data and found that enrollees in states requiring a co-payment for physician services were less likely to receive certain screening services, including mammograms and Pap tests.<sup>18</sup> The current study uses multiple years of data and detailed information on cost-sharing policies to evaluate how state-level Medicaid cost-sharing policies influence breast and cervical cancer screening among nonelderly, nondisabled adult enrollees.

## METHODS

### Data and Study Sample

We used 3 data sets to examine the association between state Medicaid cost-sharing policies and breast and cervical cancer screening. Information on state Medicaid cost-sharing policies came from Kaiser Family Foundation surveys of states on Medicaid policy benefits.<sup>8,9,25-28</sup> Data on Medicaid enrollees and their use of screening services came from the Medicaid Analytic eExtract (MAX) files. The MAX personal summary file provides enrollees' eligibility pathway, demographics, and type of Medicaid enrollment (managed care or fee-for-service [FFS]). Utilization data for breast and cervical cancer screening came from the MAX other therapy claims file. We used data for years 2003, 2008, and 2010, during which both MAX data and state cost-sharing data were available. We supplemented these data sets with county-level variables from the Area Health Resources File, linked to the MAX data using county-level Federal Information Processing System codes to control for area-level sociodemographic characteristics (as a proxy for individual-level socioeconomic variables not in the claims files) and for local healthcare provider supply.

The study sample consists of nonelderly, nondisabled, nonpregnant

women in the recommended age range for each screening service (50-64 years for mammograms and 21-64 years for Pap tests) who were enrolled in Medicaid. We excluded men; women younger than 21 or older than 64 years; women who had claims for pregnancy or labor and delivery within the calendar year; and individuals with dual eligibility or who were enrolled under the disabled eligibility category, had missing enrollment length, or appeared in the MAX data in more than 1 state within a calendar year. We restricted the sample to enrollees

in FFS Medicaid for 2 reasons: First, managed care data may not be reliable for all states and years,<sup>29,30</sup> and second, cost-sharing requirements may differ for managed care plans compared with FFS plans. We excluded Maine and Kansas because MAX data for those states were unavailable for the study years. Given that MAX data are based on standardization of state reports that vary in completeness, particularly for states with many enrollees in managed care who may, for example, be in FFS Medicaid only upon initial enrollment in the program, we focused on states with robust FFS claims during our study period. To gauge data completeness by state, we examined the count of FFS claims available in the MAX data per state and per year. We excluded Hawaii, Maryland, Arizona, New Mexico, and Tennessee because the FFS claim count for each study year (ie, 2003, 2008, and 2010) was 1.5 SD below the average number of FFS claims that year for each of these states. We chose the 1.5 SD threshold to exclude the extreme outliers based on examination of the distribution of claims by state. We also excluded Rhode Island because the number of eligible women was less than 100 in each year for both samples. Thus, the final sample included data from 42 states and the District of Columbia (DC).

### Study Measures

Claims were used to measure the primary outcomes: receipt of mammography or Pap test within the given calendar year, based on procedure and diagnosis codes (**eAppendix Table 1** [eAppendix available at [ajmc.com](http://ajmc.com)]). Explanatory variables of interest indicate whether the state required co-payments for different types of outpatient visits. Specifically, states fall into 1 of 3 categories in any year: those requiring co-payments for all visits, including preventive services; those requiring co-payments for outpatient visits, but with co-payments waived for preventive services; or those without co-payments, regardless of visit type. We constructed co-payment policy variables that compare states with co-payments for preventive services with states without co-payments for preventive services and then compared enrollees' utilization of breast and cervical cancer screening in each of the 3 co-payment policy groups.

We controlled for potential confounders that may differ across states or years and may be associated with receipt of screening, including individual and area-level variables identified in models of healthcare access and shown in previous literature to be associated

with preventive services and healthcare access.<sup>18,31-34</sup> Individual-level controls include age, race/ethnicity, basis of Medicaid eligibility (ie, 1115 waiver adult, medically needy, parent, poverty, or other eligibility pathway), number of months in Medicaid that year, and whether the woman was enrolled in a primary care case management (PCCM) program, because those in PCCM may experience more coordinated primary care, which could increase use of preventive services.<sup>35</sup> County-level sociodemographic variables include percentage of population 25 years or older with less than a high school diploma, percentage of population that is white non-Hispanic, percentage of population living in an urban area, percentage of population that is unemployed, and median household income. We also controlled for the availability of healthcare providers in the county of residence, measured per 1000 population in the county: primary care physicians (including obstetricians/gynecologists [OB/GYNs]), specialists, hospital beds, federally qualified health centers (FQHCs), and rural health centers (RHCs).

**Analysis**

We estimated 2 sets of multivariable logistic regression models adjusting for all covariates, as well as state fixed effects, to control for time-invariant state characteristics, and year fixed effects, to control for trends in screening over time. In the first model, we compared enrollees for whom co-payments apply to preventive services with those without co-payments for preventive services (regardless of co-payments for other types of visits). In the second model, we compared enrollees across the 3 co-payment groups described previously. We estimated all models for a sample of women enrolled in Medicaid for the entire calendar year and for the overall sample with at least 1 month of Medicaid enrollment. Using the estimated coefficients, we derived predicted probabilities of receiving screening. Because most states increased enrollment in managed care over time, we also estimated models including an indicator for the percentage of enrollees in managed care. Analyses were conducted using SAS software version 9.4 (SAS Institute; Cary, North Carolina).

**RESULTS**

**Table 1** describes co-payment policies for our sample states. Twelve states had no co-payments in any of the years studied. Of the 26 states that required co-payments, 2 (Minnesota, Nebraska) waived preventive co-payments over the entire study period. Cost-sharing policies changed over the study period for 5 states. Delaware, Kentucky, Michigan, and South Carolina had no co-payments required for any services in 2003 but in 2008 and 2010 required co-payments

**TABLE 1.** Co-payment Policies for General and Preventive Visits by State<sup>a</sup> in 2003, 2008, and 2010

Co-payment Policy	Number	List of States <sup>a</sup>
No co-payments	12	Arkansas, Idaho, Indiana, Louisiana, Massachusetts, Nevada, New Hampshire, Ohio, Texas, Vermont, Washington, West Virginia
Co-payments apply to preventive services	24	Alabama, Alaska, California, Colorado, Connecticut, District of Columbia, Florida, Georgia, Illinois, Iowa, Mississippi, Montana, New Jersey, New York, North Carolina, North Dakota, Oklahoma, Oregon, Pennsylvania, South Dakota, Utah, Virginia, Wisconsin, Wyoming
Co-payments waived for preventive services	2	Minnesota, Nebraska
Co-payment policies changed over the study period <sup>b</sup>	5	Delaware, Kentucky, Michigan, Missouri, South Carolina

<sup>a</sup>The District of Columbia is included in the list of states.

<sup>b</sup>Delaware, Kentucky, Michigan, and South Carolina had no co-payments in 2003 but changed requirements in 2008 and 2010, implementing co-payments for all services (including preventive care). In 2003, Missouri required co-payments for most services but waived them for preventive visits, but Missouri policy changed to require co-payments for all services (including preventive care) in 2008 and 2010.

for all visits, including those for preventive services. Additionally, co-payments for preventive visits were waived in Missouri in 2003, but these waivers were discontinued in 2008 and 2010.

**Table 2** reports results for mammogram receipt; 19% of women enrolled for 12 months and 11% enrolled for any number of months during the calendar year had a Medicaid claim for screening mammography. The low observed screening rates are similar to those observed in other research using MAX data to examine cancer screening.<sup>18</sup> In panel A, we report results from models of mammography receipt among women aged 50 to 64 years comparing screening rates among women with co-payments for preventive services visits with rates among women without a co-payment for preventive services (either because the co-payment is waived for preventive care or because the state does not require a co-payment for any visit). Women with co-payments for preventive services are less likely to receive a screening mammogram than those without a co-payment for preventive care (adjusted odds ratio [aOR], 0.81; 95% CI, 0.71-0.94 for 12-month enrollment sample). Results are similar when the sample includes women with any number of months of enrollment during the year.

Panel B reports results from models comparing all 3 co-payment policies. Women for whom co-payments applied to preventive visits had a lower likelihood of receiving a mammogram than women without co-payments for any visits (aOR, 0.84; 95% CI, 0.72-0.97). In the 12-month enrollment sample, receipt of a mammogram among women with co-payments for preventive services did not differ significantly from that among women with co-payments for other outpatient visits but for whom co-payments were waived for preventive services (aOR, 0.70; 95% CI, 0.48-1.01); the corresponding estimate for the sample with any length of enrollment suggests that women with co-payments for preventive services were less likely to receive a mammogram than women without co-payments for most visits but no co-payment for preventive services (aOR, 0.71; 95% CI,

**POLICY**

**TABLE 2.** ORs From Logistic Regressions of Receipt of Mammogram on Cost-Sharing Policies (ages 50–64 years)<sup>a</sup>

	12-Month Enrollment		Any Enrollment	
n	190,155		549,541	
Received screening mammogram, %	18.5		10.6	
	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
<b>Model A</b>				
Co-payments apply to preventive services vs no co-payment for preventive visits (waived or no co-payments)	1.01 (0.98-1.03)	0.81 (0.71-0.94)	0.83 (0.82-0.85)	0.83 (0.74-0.92)
<b>Model B</b>				
Co-payments apply to preventive services vs no co-payments	1.01 (0.99-1.04)	0.84 (0.72-0.97)	0.83 (0.81-0.84)	0.85 (0.76-0.95)
Co-payments waived for preventive services vs no co-payments	1.26 (1.10-1.45)	1.20 (0.80-1.79)	0.77 (0.70-0.85)	1.19 (0.89-1.61)
Co-payments apply to preventive services vs co-payments waived for preventive services	0.80 (0.70-0.92)	0.70 (0.48-1.01)	1.08 (0.98-1.18)	0.71 (0.54-0.94)

OR indicates odds ratio.

<sup>a</sup>Models based on Medicaid Analytic eXtract data from 42 states and the District of Columbia. The 12-month enrollment sample includes women enrolled in Medicaid for the entire calendar year; the any-enrollment sample includes women with at least 1 month of Medicaid enrollment in a given calendar year. All models control for covariates noted in text.

**TABLE 3.** ORs From Logistic Regressions of Receipt of Pap Test on Cost-Sharing Policies (ages 21–64 years)<sup>a</sup>

	12-Month Enrollment		Any Enrollment	
n	4,647,977		14,259,137	
Received Pap test, %	30.4		21.9	
	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
<b>Model A</b>				
Co-payments apply to preventive services vs no co-payment for preventive visits (waived or no co-payments)	1.15 (1.14-1.16)	0.96 (0.94-0.98)	1.30 (1.29-1.31)	0.99 (0.97-1.00)
<b>Model B</b>				
Co-payments apply to preventive services vs no co-payments	1.18 (1.17-1.19)	1.05 (1.03-1.07)	1.31 (1.30-1.32)	1.05 (1.04-1.07)
Co-payments waived for preventive services vs no co-payments	1.36 (1.33-1.38)	1.49 (1.43-1.55)	1.21 (1.20-1.23)	1.38 (1.34-1.42)
Co-payments apply to preventive services vs co-payments waived for preventive services	0.87 (0.85-0.88)	0.70 (0.68-0.73)	1.09 (1.07-1.10)	0.76 (0.74-0.79)

OR indicates odds ratio.

<sup>a</sup>Models based on Medicaid Analytic eXtract data from 42 states and the District of Columbia. The 12-month enrollment sample includes women enrolled in Medicaid for the entire calendar year; the any-enrollment sample includes women with at least 1 month of Medicaid enrollment in a given calendar year. All models control for covariates noted in text.

0.54-0.94). Among the sample with 12 months of continuous Medicaid enrollment, the group with co-payments for most visits but not preventive services had the highest predicted probability (24%) of receiving a screening mammogram, whereas those who had co-payments for all visits had the lowest predicted probability (18%) of receiving a mammogram (eAppendix Figure).

Table 3 presents model estimates for cervical cancer screening; 30% of women enrolled for a full 12 months and 22% enrolled for any number of months during the calendar year had a Medicaid claim for a Pap test. Women with co-payments for preventive services were slightly less likely to receive a Pap test during the year (aOR, 0.96; 95% CI, 0.94-0.98 for 12-month enrollment sample) (panel A). Panel B compares women under the 3 co-payment policies. Women with co-payments for preventive services were slightly more likely to receive cervical cancer screening compared with women who had no co-payments for any type of visit (aOR, 1.05; 95% CI, 1.03-1.07). In contrast, women with co-payments for preventive services were less likely to receive a Pap test than women with co-payments for most visits but not preventive visits (aOR, 0.70; 95% CI, 0.68-0.73). Based on these results, we estimate that among the sample with 12 months of continuous Medicaid enrollment, those with co-payments waived for preventive visits had the highest predicted probability (29%) of receiving a Pap test, whereas those without co-payments for any visits and with co-payments for preventive services had similar rates of Pap tests (eAppendix Figure).

Summary statistics, full regression results, and sensitivity analyses are presented in the eAppendix. eAppendix Table 2 reports descriptive statistics for the full sample and stratified by whether state Medicaid policy requires co-payments for any visits. Characteristics of the mammogram- and Pap test-eligible samples were similar, except that most Pap test-eligible cases were younger than 40 years (82%). Full regression results for the mammography sample are presented in eAppendix Tables 3 and 4. Conditional on all other covariates, women enrolled in earlier years were more likely to receive screening than those enrolled in 2010. Across all models, receipt of mammography is positively associated with FQHC, RHC, and specialist density in the enrollee's county but

negatively associated with PCP density in the county. Receipt of Pap tests is also positively associated with FQHC and RHC density in the enrollee's county and negatively associated with PCP density in the county conditional on other controls. In contrast with mammography, specialist density is not consistently associated with cervical cancer screening across models.

We also tested whether our results changed when including an indicator for the percentage of enrollees in comprehensive managed care in each state year using a range of thresholds to define this variable. Results remained virtually the same ([eAppendix Tables 5 and 6](#)).

## DISCUSSION

This paper considers how state co-payment policies affect breast and cervical cancer screening among low-income nondisabled women enrolled in FFS Medicaid. For both mammograms and Pap tests, women were less likely to receive screening when their state required co-payments for these services. We also compared women across states and years with different co-payment structures to understand whether there was a difference in screening among those required to pay co-payments that apply to all visits, those required to pay co-payments for most outpatient visits but for whom co-payments are waived for preventive services, and those without co-payments. For both types of screening, the group that had co-payments for some visits but had them waived for preventive care had the highest rates of screening. Counterintuitively, women with co-payments for preventive services are somewhat more likely to receive Pap tests compared with those who face no co-payments for any services. This difference in findings between Pap tests and mammograms may arise from differences in these screening procedures' complexity and time costs; this warrants further investigation in future research.

Our results are strongest for mammography, with a bigger difference in screening rates observed for mammograms compared with Pap tests between those with co-payments for preventive services versus those without co-payments for preventive care. Mammograms are likely to require a separate visit that may entail an additional co-payment, whereas a Pap test could be completed during a visit to an OB/GYN or other primary care physician. Therefore, co-payment policies appear to restrict services that require separate visits and additional costs for the patient.

Our findings suggest that Medicaid policies should consider the impact of co-payments on utilization of potentially high-value services such as screening. Although concerns have been raised regarding overscreening in older and higher-income populations,<sup>36,37</sup> screening rates among the nonelderly Medicaid population are far below population-wide target levels.<sup>38</sup> Thus, the influence of Medicaid policies, including cost-sharing requirements, on utilization of high-value services needs careful consideration before implementation. These policies could result in future higher utilization and costs.

## Limitations

Notably, annual screening rates in Medicaid claims data are lower than survey estimates for the general population, low-income population, or Medicaid-enrolled women. This might reflect a combination of low screening rates among Medicaid enrollees, inability to measure screenings not paid for by Medicaid, and overestimates of screening in survey data. Our study does not capture screenings completed outside the Medicaid program. We estimate all models for 2 samples: those continuously enrolled for all 12 months of a calendar year and those with at least 1 month of enrollment within the year. The first is a consistently enrolled Medicaid sample, whereas the second includes those who may have dropped out of Medicaid for a period of time and thus may have had a screening test outside of Medicaid reimbursement, but may also be more representative of a population known to churn in and out of Medicaid enrollment. Further, this study examines changes in annual screening for breast and cervical cancer over time in the context of changes in cost-sharing requirements; we do not capture whether the women in the sample receive guideline-recommended screening, and although our study uses multiple years of data, we capture just 3 nonadjacent calendar years, limiting the observation period. Therefore, we cannot assess longitudinal screening behavior outside these time frames. Other study limitations include the fact that we cannot control for all state-year differences in policy and health systems factors that may influence whether women receive recommended screenings. Further, the number of states that require co-payments for most services but waive them for preventive care is small. Finally, the data used are from the pre-ACA period, and the characteristics of nonelderly adult enrollees may have changed under Medicaid expansions.

## CONCLUSIONS

Our results offer insight for policy, practice, and future research. First, state Medicaid programs that do not require co-payments for preventive services have higher rates of screening among nonelderly, nondisabled women. Second, rates of annual screening among women enrolled in Medicaid are low. Third, we find suggestive evidence that the full range of cost-sharing policies (including for other types of services) may affect utilization of preventive care in the Medicaid population. The use of longitudinal data could improve our understanding of cost-sharing policies and allow us to assess how these policies facilitate or create barriers to preventive services in low-income insured populations over time. ■

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**eAppendix Table 1.** Billing Codes Used to Identify Screening Claims

Code type	Code	Description
Screening Mammography		
CPT	77057	Mammogram, Screening
CPT	76092	Mammogram, Screening
HCPCs	G0202	Screening mammography, producing direct digital image, bilateral, all views
ICD9-Procedure	8736	Xerography Of Breast
ICD9-Procedure	8737	Other Mammography
ICD9-Diagnosis	V7611	Screening mammogram for high-risk patient
ICD9-Diagnosis	V7612	Other screening mammogram
UB-92 Revenue	0403	Other Imaging Services: Screening mammography
Pap Test		
CPT	88141	Cytopath, c/v, interpret
CPT	88142	Cytopath, c/v, thin layer
CPT	88143	Cytopath c/v thin layer redo
CPT	88144	Cytopath, c/v auto, in fluid
CPT	88145	Cytopath c/v auto fluid redo
CPT	88147	Cytopath, c/v, automated
CPT	88148	Cytopath, c/v, auto rescreen
CPT	88150	Cytopath, c/v, manual
CPT	88151	Cytopath, c/v, interpret
CPT	88152	Cytopath, c/v, auto redo
CPT	88153	Cytopath, c/v, redo
CPT	88154	Cytopath, c/v, select
CPT	88155	Cytopath, c/v, index add-on
CPT	88164	Cytopath tbs, c/v, manual
CPT	88165	Cytopath tbs, c/v, redo
CPT	88166	Cytopath tbs, c/v, auto redo
CPT	88167	Cytopath tbs, c/v, select
CPT	88174	Cytopath, c/v auto, in fluid
CPT	88175	Cytopath c/v auto fluid redo

HCPCS	G0123	Screening cytopathology, cervical or vaginal (any reporting system), collected in preservative fluid, automated thin layer preparation, screening by cytotechnologist under physician supervision
HCPCS	G0124	Screening cytopathology, cervical or vaginal (any reporting system), collected in preservative fluid, automated thin layer preparation, requiring interpretation by physician
HCPCS	G0141	Screening cytopathology smears, cervical or vaginal, performed by automated system, with manual rescreening, requiring interpretation by physician
HCPCS	G0143	Screening cytopathology, cervical or vaginal (any reporting system), collected in preservative fluid, automated thin layer preparation, with manual screening and rescreening by cytotechnologist under physician supervision
HCPCS	G0144	Screening cytopathology, cervical or vaginal (any reporting system), collected in preservative fluid, automated thin layer preparation, with screening by automated system, under physician supervision
HCPCS	G0145	Screening cytopathology, cervical or vaginal (any reporting system), collected in preservative fluid, automated thin layer preparation, with screening by automated system and manual rescreening under physician supervision
HCPCS	G0147	System under physician supervision screening cytopathology smears, cervical or vaginal, performed by automated
HCPCS	G0148	Screening cytopathology smears, cervical or vaginal, performed by automated system with manual rescreening
HCPCS	P3000	Technician under physician supervision screening papanicolaou smear, cervical or vaginal, up to three smears
HCPCS	P3001	Screening papanicolaou smear, cervical or vaginal, up to three smears, requiring interpretation by physician
HCPCS	Q0091	Screening papanicolaou smear; obtaining, preparing and conveyance of cervical or vaginal smear to laboratory
ICD9-Procedure	9146	Microscopic Examination Of Specimen From Female Genital Tract; Cell Block And Papanicolaou Smear
ICD9-Diagnosis	V762	Special screening for malignant neoplasms, cervix



**eAppendix Table 2.** Descriptive Statistics for Mammography and Pap Test Samples (Any Enrollment Length), Pooled and by State Co-Payment Policy

	Mammography Sample (50-64)			Pap Test Sample (21-64)		
	Full Sample	Copoly for Office Visits		Full Sample	Copoly for Office Visits	
		No	Yes		No	Yes
Total Enrollees	549541	154338	395203	14259137	2575300	11683837
<b>CO-PAYMENT POLICY</b>						
Co-payment required for preventive visits (%)	71.00	-	98.73	80.60	-	98.37
Co-payment waived for preventive visits (%)	29.00	-	1.27	19.40	-	1.63
<b>SCREENING RATE</b>						
Mammography Screening Rate (%)	10.59	11.94	10.06	-	-	-
Pap Test Screening Rate (%)	-	-	-	21.85	18.39	22.65
<b>YEAR</b>						
Year: 2003	22.58	19.07	23.95	30.28	37.27	28.74
Year: 2008	33.79	38.72	31.86	32.99	29.83	33.69
Year: 2010	43.63	42.21	44.19	36.73	32.90	37.58
<b>AGE GROUP</b>						
Age: 21-25	-	-	-	24.11	24.39	24.05
Age: 25-30	-	-	-	24.83	24.66	24.86
Age: 30-35	-	-	-	18.72	17.92	18.89
Age: 35-40	-	-	-	14.06	13.23	14.24
Age: 40-45	-	-	-	9.26	8.81	9.35
Age: 45-50	-	-	-	5.17	4.98	5.21
Age: 50-55	62.41	49.09	67.61	2.41	2.95	2.29
Age: 55-60	25.42	30.89	23.28	0.98	1.85	0.79
Age: 60-64	12.17	20.02	9.10	0.47	1.20	0.31
<b>RACE / ETHNICITY</b>						
Non-Hispanic White	32.64	29.59	33.83	33.38	39.25	32.08

Non-Hispanic Black	14.60	7.01	17.57	15.22	14.93	15.29
Hispanic or Latino	27.51	11.28	33.85	38.28	18.04	42.74
Non-Hispanic Other Race	7.02	3.78	8.29	4.61	2.24	5.14
Race/Ethnicity Unknown	18.22	48.34	6.46	8.51	25.53	4.75
<b>MSIS ELIGIBILITY</b>						
1115 Waiver Adult	46.97	74.13	36.36	42.88	42.34	43.00
Adult, MN	13.06	8.39	14.88	7.43	7.66	7.38
Adult, Parents/1931	16.91	9.30	19.88	18.73	20.30	18.39
Adult, Poverty	4.55	0.18	6.25	13.61	8.98	14.63
Other Adult	18.52	8.00	22.63	17.35	20.73	16.61
<b>ENROLLMENT</b>						
Enrollment in PCCM (%)	21.78	31.90	17.82	16.59	25.31	14.67
Enrollment Months	7.60 (4.13)	8.16 (3.94)	7.38 (4.18)	7.84 (3.98)	7.57 (4.14)	7.90 (3.94)
<b>COUNTY-LEVEL CONTROLS</b>						
Median Household Income	52.44 (12.84)	54.97 (14.24)	51.44 (12.10)	49.9 (12.40)	46.05 (12.64)	50.74 (12.19)
PCPs <sup>a, b</sup> per 1000 capita	1.13 (0.67)	1.20 (0.62)	1.10 (0.69)	0.93 (0.47)	0.93 (0.52)	0.93 (0.46)
Specialists <sup>a</sup> per 1000 capita,	2.00 (1.89)	2.11 (1.80)	1.95 (1.93)	1.44 (1.20)	1.45 (1.36)	1.43 (1.16)
Federally Qualified Health Center per 1000 capita	0.02 (0.03)	0.02 (0.03)	0.01 (0.03)	0.01 (0.03)	0.02 (0.03)	0.01 (0.03)
Rural Health Clinics per 1000 capita	0.01 (0.04)	0.01 (0.03)	0.01 (0.05)	0.01 (0.04)	0.02 (0.04)	0.01 (0.04)
Hospital Beds per 1000 capita	2.76 (1.67)	2.47 (1.58)	2.87 (1.69)	2.58 (1.59)	2.78 (1.83)	2.53 (1.53)
Percent Unemployed, 16+	8.03 (3.09)	6.85 (2.10)	8.49 (3.29)	8.21 (3.22)	6.92 (2.34)	8.50 (3.31)
Percent 25+ w/ < High School Diploma	15.36 (6.49)	13.05 (6.78)	16.27 (6.14)	17.37 (6.59)	16.38 (7.60)	17.58 (6.33)
Percent White Non- Hispanic/Latino	62.52 (22.80)	75.88 (19.20)	57.27 (21.94)	56.81 (22.50)	68.16 (22.66)	54.32 (21.68)

Percent Urban	83.34 (24.39)	80.52 (24.88)	84.45 (24.10)	82.79 (24.17)	74.26 (25.97)	84.67 (23.34)
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<sup>a</sup> Includes providers with MD degree

<sup>b</sup> PCP count includes OB/Gyn

**eAppendix Table 3.** Full Regression Results for Mammography Sample

Parameter	Co-payments for both general and preventive visits		Co-payments for only preventive visits	
	12-Month Enrollment	Any Enrollment	12-Month Enrollment	Any Enrollment
N	190155	549541	190155	549541
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Co-payments for preventive visits	0.7 (0.48,1.01)	0.71 (0.54,0.94)	0.81 (0.71,0.94)	0.83 (0.74,0.92)
Co-payments waived for preventive visits	1.2 (0.80,1.79)	1.19 (0.89,1.61)	-	-
Reference group	No Copay for any visits	No Copay for any visits	No Copay for Preventive visits	No Copay for Preventive visits
Year: 2003	1.34 (1.28,1.41)	1.24 (1.20,1.29)	1.34 (1.28,1.41)	1.25 (1.20,1.29)
Year: 2008	1.06 (1.02,1.11)	0.97 (0.95,1.00)	1.06 (1.02,1.11)	0.97 (0.95,1.00)
Year: 2010	REF	REF	REF	REF
Age Group: 50-55	0.93 (0.90,0.97)	0.95 (0.92,0.98)	0.93 (0.90,0.97)	0.95 (0.92,0.98)
Age Group: 55-60	1 (0.95,1.04)	1.02 (0.98,1.05)	1 (0.95,1.04)	1.02 (0.98,1.05)
Age Group: 60-64	REF	REF	REF	REF
Non H/L Black	0.99 (0.95,1.03)	0.96 (0.93,0.99)	0.99 (0.95,1.03)	0.96 (0.93,0.99)
Non H/L Other	1.2 (1.13,1.28)	1.2 (1.15,1.26)	1.2 (1.13,1.28)	1.2 (1.15,1.26)
Hispanic/Latino	1.35 (1.29,1.41)	1.28 (1.24,1.32)	1.35 (1.29,1.41)	1.28 (1.24,1.32)
Missing/Unknown Race	0.99 (0.95,1.03)	1.01 (0.98,1.05)	0.99 (0.95,1.03)	1.01 (0.98,1.05)
Non H/L White	REF	REF	REF	REF
Adult, parents / 1931	1.52	1.49	1.52	1.49

	(1.45,1.60)	(1.44,1.55)	(1.45,1.60)	(1.44,1.55)
Adult, poverty	0.18 (0.15,0.22)	0.18 (0.16,0.20)	0.18 (0.15,0.22)	0.18 (0.16,0.20)
Adult, MN	1.62 (1.52,1.72)	2.48 (2.38,2.58)	1.62 (1.52,1.72)	2.48 (2.38,2.58)
Other adult	0.84 (0.79,0.89)	1.04 (1.00,1.08)	0.84 (0.79,0.89)	1.04 (1.00,1.08)
1115 waiver adult	REF	REF	REF	REF
Enrollment Months	-	1.19 (1.19,1.20)	-	1.19 (1.19,1.20)
Enrollment in PCCM	7.25 (6.93,7.59)	6.46 (6.26,6.67)	7.26 (6.94,7.59)	6.47 (6.26,6.68)
Median Household Income	1 (0.99,1.01)	1 (1.00,1.00)	1 (0.99,1.01)	1 (1.00,1.00)
PCPs per 1000 pop	0.83 (0.77,0.89)	0.87 (0.82,0.92)	0.83 (0.77,0.89)	0.87 (0.82,0.92)
Specialists per 1000 pop	1.13 (1.10,1.16)	1.09 (1.07,1.12)	1.13 (1.10,1.16)	1.09 (1.07,1.12)
FQHCs per 1000 pop	1.94 (1.30,2.90)	1.46 (1.08,1.97)	1.94 (1.30,2.90)	1.46 (1.08,1.97)
Hospital Beds per 1000 pop	1 (0.99,1.01)	1 (0.99,1.01)	1 (0.99,1.01)	1 (0.99,1.01)
RHCs per 1000 pop	1.43 (1.06,1.94)	1.38 (1.10,1.75)	1.43 (1.06,1.93)	1.38 (1.10,1.74)
Percent Unemployed	521.87 (260.18,1046.79)	497.01 (293.69,841.1)	523.92 (261.23,1050.79)	497.42 (293.94,841.74)
Percent 25+ w/<HS Diploma	1.09 (0.69,1.72)	0.89 (0.64,1.25)	1.09 (0.69,1.72)	0.89 (0.64,1.25)
Percent White Non-Hispanic	1.01 (1.01,1.01)	1.01 (1.01,1.01)	1.01 (1.01,1.01)	1.01 (1.01,1.01)
Percent Urban Population	1 (0.99,1.01)	1 (0.99,1.01)	1 (0.99,1.01)	1 (0.99,1.01)

Abbreviations: OR, odds ratio; CI, confidence interval. 95% confidence intervals in parentheses. All models also include state fixed effects. Models based on MAX data from 43 states. (ME MAX data is not available from CMS for these years; KS MAX data is not available from CMS for 2010; HI, MD, NM, AZ and TN were excluded because FFS claim count indicating insufficient data; RI was excluded since the total FFS enrollees in 2003 and 2008 samples were less than 100.)

**eAppendix Table 4.** Full Regression Results for Pap Test Sample

Parameter	Co-payments for both general and preventive visits		Co-payments for only preventive visits	
	12-Month Enrollment	Any Enrollment	12-Month Enrollment	Any Enrollment
N	4647977	14259137	4647977	14259137
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Co-payments for preventive visits	0.7 (0.68,0.73)	0.76 (0.74,0.78)	0.96 (0.94,0.98)	0.99 (0.97,1.00)
Co-payments waived for preventive visits	1.49 (1.43,1.55)	1.38 (1.34,1.42)	-	-
Reference group	No Copay for any visits	No Copay for any visits	No Copay for Preventive visits	No Copay for Preventive visits
Year: 2003	1.19 (1.18,1.20)	1.1 (1.09,1.11)	1.19 (1.18,1.20)	1.1 (1.09,1.11)
Year: 2008	1.07 (1.06,1.08)	1.05 (1.04,1.05)	1.07 (1.06,1.08)	1.05 (1.04,1.05)
Year: 2010	REF	REF	REF	REF
Age: 21-25	3.87 (3.70,4.04)	2.98 (2.88,3.08)	3.86 (3.70,4.03)	2.98 (2.88,3.08)
Age: 25-30	3.69 (3.54,3.86)	2.98 (2.88,3.08)	3.69 (3.53,3.85)	2.98 (2.88,3.08)
Age: 30-35	3.26 (3.12,3.41)	2.85 (2.75,2.94)	3.26 (3.12,3.40)	2.85 (2.75,2.94)
Age: 35-40	2.96 (2.83,3.09)	2.76 (2.67,2.85)	2.96 (2.83,3.09)	2.76 (2.67,2.85)
Age: 40-45	2.9 (2.78,3.03)	2.81 (2.72,2.91)	2.9 (2.77,3.03)	2.81 (2.72,2.90)
Age: 45-50	2.85 (2.72,2.97)	2.86 (2.76,2.95)	2.84 (2.72,2.97)	2.85 (2.76,2.95)
Age: 50-55	2.21 (2.11,2.31)	2.26 (2.19,2.34)	2.21 (2.11,2.31)	2.26 (2.19,2.34)

Age: 55-60	1.42 (1.35,1.49)	1.37 (1.32,1.42)	1.42 (1.35,1.49)	1.37 (1.32,1.42)
Age: 60-64	REF	REF	REF	REF
Non H/L Black	1.1 (1.09,1.11)	1.08 (1.08,1.09)	1.1 (1.09,1.11)	1.08 (1.07,1.09)
Non H/L Other	1.02 (1.01,1.03)	1.04 (1.03,1.05)	1.02 (1.01,1.03)	1.04 (1.03,1.05)
Hispanic/Latino	1.18 (1.17,1.19)	1.26 (1.26,1.27)	1.18 (1.17,1.19)	1.26 (1.26,1.27)
Missing/Unknown Race	1.01 (1.00,1.02)	1.08 (1.07,1.08)	1.02 (1.01,1.03)	1.08 (1.07,1.08)
Non H/L White	REF	REF	REF	REF
Adult, parents / 1931	0.49 (0.49,0.49)	0.52 (0.52,0.53)	0.49 (0.49,0.49)	0.53 (0.52,0.53)
Adult, poverty	1.07 (1.06,1.08)	1.14 (1.14,1.15)	1.07 (1.06,1.08)	1.14 (1.14,1.15)
Adult, MN	0.37 (0.37,0.38)	0.59 (0.58,0.59)	0.37 (0.37,0.38)	0.59 (0.58,0.59)
Other adult	0.18 (0.18,0.18)	0.22 (0.22,0.22)	0.18 (0.18,0.18)	0.22 (0.22,0.22)
1115 waiver adult	REF	REF	REF	REF
Enrollment Months	-	1.18 (1.18,1.18)	-	1.18 (1.18,1.18)
Enrollment in PCCM	3.35 (3.32,3.38)	3.13 (3.11,3.14)	3.35 (3.32,3.38)	3.12 (3.11,3.14)
Median Household Income	1 (1.00,1.00)	1 (1.00,1.00)	1 (1.00,1.00)	1 (1.00,1.00)
PCPs per 1000 pop	0.91 (0.90,0.92)	0.9 (0.89,0.91)	0.91 (0.89,0.92)	0.9 (0.89,0.91)
Specialists per 1000 pop	1 (0.99,1.01)	1.02 (1.02,1.02)	1.01 (1.00,1.01)	1.02 (1.02,1.02)
FQHCs per 1000 pop	1.29 (1.20,1.39)	0.82 (0.78,0.87)	1.28 (1.19,1.38)	0.82 (0.78,0.87)



Hospital Beds per 1000 pop	1.01 (1.01,1.01)	1 (1.00,1.01)	1.01 (1.01,1.01)	1 (1.00,1.01)
RHCs per 1000 pop	1.29 (1.22,1.36)	1.29 (1.24,1.34)	1.27 (1.21,1.34)	1.28 (1.23,1.33)
Percent Unemployed	0.2 (0.18,0.23)	0.07 (0.07,0.08)	0.2 (0.18,0.23)	0.07 (0.07,0.08)
Percent 25+ w/<HS Diploma	1.36 (1.26,1.45)	2.11 (2.02,2.21)	1.36 (1.27,1.46)	2.12 (2.03,2.22)
Percent White Non-Hispanic	1 (1.00,1.00)	1 (1.00,1.00)	1 (1.00,1.00)	1 (1.00,1.00)
Percent Urban Population	1 (1.00,1.00)	1 (1.00,1.00)	1 (1.00,1.00)	1 (1.00,1.00)

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Abbreviations: OR, odds ratio; CI, confidence interval. 95% confidence intervals in parentheses. All models also include state fixed effects. Models based on MAX data from 43 states. (ME MAX data is not available from CMS for study years; KS MAX data is not available from CMS for 2010; HI, MD, NM, AZ and TN were excluded because FFS claim count indicated insufficient data; RI was excluded since total FFS enrollees in 2003 and 2008 samples were less than 100.)

**eAppendix Table 5.** Sensitivity of Results to Inclusion of Managed Care Proportion Control for Mammography Sample (Age 50-64)

	NO FLAG		0% MC CUTOFF		5% MC CUTOFF		10% MC CUTOFF	
Cost-Sharing for both General Visit and Preventive Visit								
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
N	190155	549541	190155	549541	190155	549541	190155	549541
Co-payments for preventive visits	0.70 (0.48,1.01)	0.71 (0.54,0.94)	0.71 (0.48,1.03)	0.73 (0.55,0.96)	0.71 (0.48,1.03)	0.72 (0.55,0.95)	0.67 (0.46,0.97)	0.68 (0.52,0.9)
Co-payments waived For preventive visits	1.20 (0.8,1.79)	1.19 (0.89,1.61)	1.20 (0.8,1.79)	1.19 (0.88,1.61)	1.20 (0.8,1.79)	1.19 (0.89,1.61)	0.89 (0.59,1.34)	0.93 (0.69,1.26)
No Copay for any visits	REF	REF	REF	REF	REF	REF	REF	REF
Percent MC flag	-	-	0.87 (0.79,0.96)	0.84 (0.78,0.9)	0.63 (0.54,0.73)	0.63 (0.56,0.7)	1.65 (1.5,1.82)	1.64 (1.53,1.76)
Cost-Sharing for Preventive Visit								
N	190155	549541	190155	549541	190155	549541	190155	549541
Co-payments for preventive visits	0.81 (0.71,0.94)	0.83 (0.74,0.92)	0.83 (0.72,0.95)	0.84 (0.76,0.94)	0.82 (0.72,0.95)	0.84 (0.75,0.93)	0.60 (0.52,0.7)	0.64 (0.57,0.72)
No Copayment for preventive visits	REF	REF	REF	REF	REF	REF	REF	REF
Percent MC Flag	-	-	0.87 (0.79,0.96)	0.84 (0.78,0.9)	0.63 (0.54,0.73)	0.63 (0.56,0.7)	1.64 (1.49,1.81)	1.64 (1.53,1.76)
ENROLLMENT	12 MONTHS	ANY	12 MONTHS	ANY	12 MONTHS	ANY	12 MONTHS	ANY

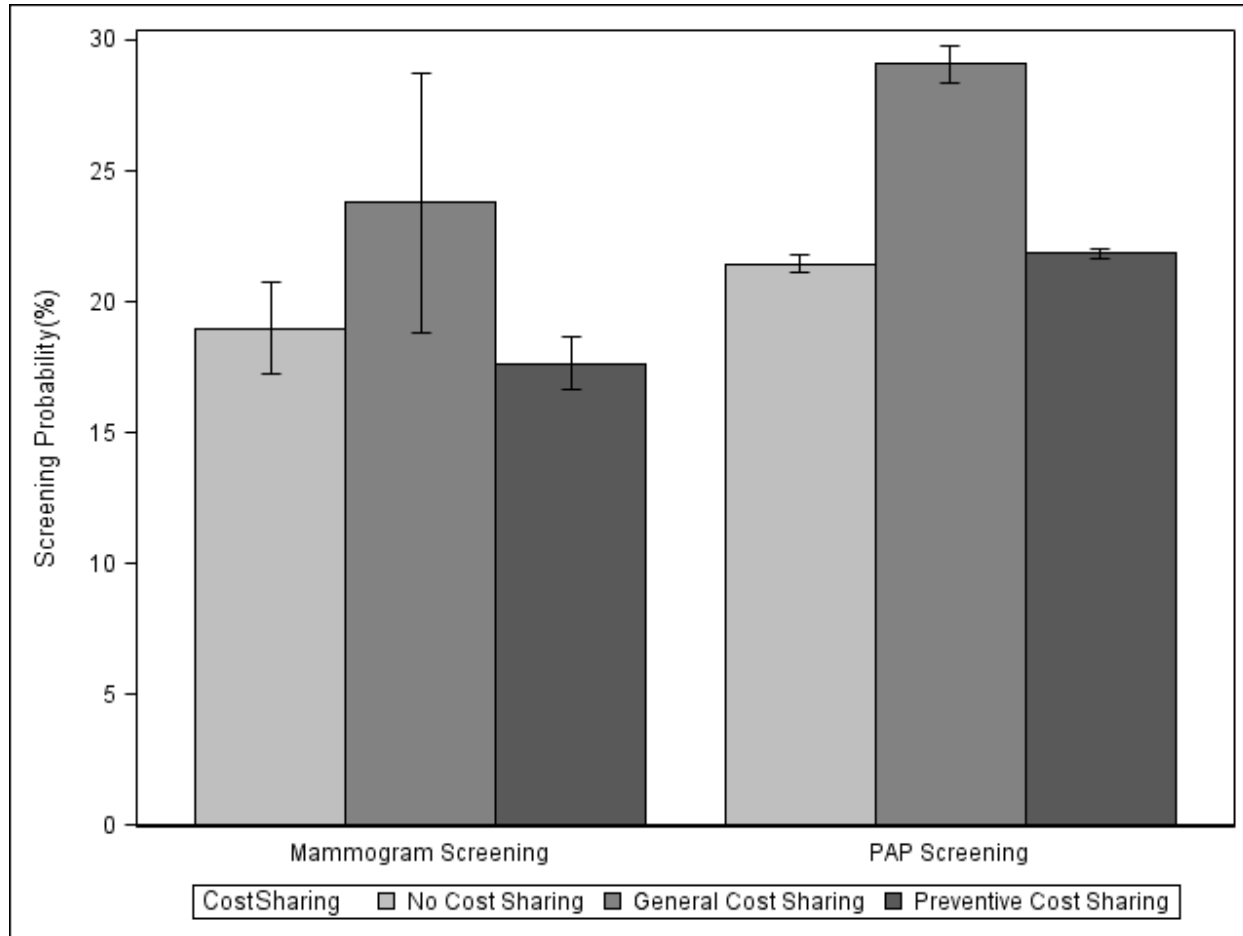
Abbreviations: OR, odds ratio; CI, confidence interval; MC: managed care. 95% confidence intervals in parentheses. PCCM control was included in all models. Models based on MAX data from 43 states. (ME MAX data is not available from CMS for study years; KS MAX data is not available from CMS for 2010; HI, MD, NM, AZ and TN were excluded because FFS claim count indicated insufficient data; RI was excluded since total FFS enrollees in 2003 and 2008 samples were less than 100.) “Percent MC flag” is a binary variable representing whether the percentage of enrollees in comprehensive managed care in each state year is greater than the specific cutoff.

**eAppendix Table 6.** Sensitivity of Results to Inclusion of Managed Care Proportion Control for Pap Test Sample (Age 21-64)

	NO FLAG		0% MC CUTOFF		5% MC CUTOFF		10% MC CUTOFF	
Cost-Sharing for both General Visit and Preventive Visit								
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
N	4647977	14259137	4647977	14259137	4647977	14259137	4647977	14259137
Co-payments for preventive visits	0.70 (0.68,0.73)	0.76 (0.74,0.78)	0.69 (0.66,0.71)	0.76 (0.74,0.78)	0.71 (0.68,0.73)	0.77 (0.75,0.79)	0.66 (0.64,0.69)	0.74 (0.72,0.76)
Co-payments waived For preventive visits	1.49 (1.43,1.55)	1.38 (1.34,1.42)	1.49 (1.43,1.56)	1.38 (1.34,1.42)	1.49 (1.43,1.55)	1.38 (1.34,1.42)	1.11 (1.06,1.15)	1.14 (1.11,1.18)
No Copay for any visits	REF	REF	REF	REF	REF	REF	REF	REF
Percent MC flag	-	-	1.26 (1.24,1.28)	1.12 (1.11,1.14)	0.91 (0.88,0.94)	0.88 (0.86,0.9)	1.55 (1.52,1.57)	1.35 (1.33,1.36)
Cost-Sharing for Preventive Visit								
N	4647977	14259137	4647977	14259137	4647977	14259137	4647977	14259137
Co-payments for preventive visits	0.96 (0.94,0.98)	0.99 (0.97,1)	0.94 (0.92,0.95)	0.98 (0.96,0.99)	0.96 (0.94,0.98)	0.99 (0.98,1)	0.71 (0.7,0.73)	0.82 (0.81,0.83)
No Copayment for preventive visits	REF	REF	REF	REF	REF	REF	REF	REF
Percent MC flag	-	-	1.26 (1.24,1.28)	1.12 (1.11,1.14)	0.91 (0.88,0.94)	0.88 (0.86,0.9)	1.56 (1.54,1.58)	1.36 (1.35,1.37)
ENROLLMENT	12 MONTHS	ANY	12 MONTHS	ANY	12 MONTHS	ANY	12 MONTHS	ANY

Abbreviations: OR, odds ratio; CI, confidence interval; MC: managed care. 95% confidence intervals in parentheses. PCCM control was included in all models. Models based on MAX data from 43 states. (ME MAX data is not available from CMS for study years; KS MAX data is not available from CMS for 2010; HI, MD, NM, AZ and TN were excluded because FFS claim count indicated insufficient data; RI was excluded since total FFS enrollees in 2003 and 2008 samples were less than 100.) “Percent MC flag” is a binary variable representing whether the percentage of enrollees in comprehensive managed care in each state year is greater than the specific cutoff.

**eAppendix Figure.** Predicted Probabilities of Receiving Mammogram Screenings (sample: ages 50-64) and Cervical Cancer Screenings (sample: ages 21-64) for Full-Year Enrollees



Notes: “Preventive cost sharing” indicates those that require co-payments for all visits, including those for preventive services; “General cost sharing” indicates those that require co-payments for outpatient visits, but the co-payments are waived for preventive services; and “No cost sharing” indicates those without co-payments, regardless of visit type.