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ORIGINAL PAPER

Lessons from state mandates of preventive cancer screenings

Wendy Yi Xu · Bryan Dowd · Jean Abraham

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Abstract We use the 1997–2008 Medical Expenditure Panel Survey (MEPS) and variation in the timing of state mandates for coverage of colorectal, cervical, and prostate cancer screenings to investigate the behavioral and financial effects of mandates on privately insured adults. We find that state mandates did not result in increased rates of cancer screening. However, coverage of preventive care, whether mandated or not, moves the cost of care from the consumer's out-of-pocket expense to the premium, resulting in a cross-subsidy of users of the service by non-users. While some cross-subsidies are intentional, others may be unintentional. We find that users of cancer screening have higher levels of income and education, while non-users tend to be racial minorities, lack a usual source of care, and live in communities with fewer physicians per capita. These results suggest that coverage of preventive care may transfer resources from more advantaged individuals to less advantaged individuals.

Keywords Health insurance regulations · Mandated benefits · Redistributive effects · Cancer prevention · Health care disparities

W. Y. Xu (✉)
Division of Health Services Management and Policy, College of Public Health, The Ohio State University, Columbus, OH, USA
e-mail: xu.1636@osu.edu

B. Dowd · J. Abraham
Division of Health Policy and Management, School of Public Health, University of Minnesota, Minneapolis, MN, USA

Introduction

Background

Every state in the United States has laws that require private health insurers to cover specific health care services. One rationale for mandating coverage of specific health services is fairness. For example, the government could mandate coverage of pre- and post-natal care if society believes that it is unfair for women to bear the full cost associated with pregnancy. That coverage mandate would result in increased premiums shared equally by men and women. A second rationale is an efficiency concern resulting from market failures, such as poor consumer information. Consumers might underestimate the value of a particular service, and thus purchase a sub-optimal level of health service. Or perhaps in the absence of insurance coverage, there is no other plausible private financing mechanism for a service for which the costs exceed a person's assets [1]. Externalities represent a third rationale. Studies have indicated consistently that preventive cancer screenings increase life expectancy and reduce mortality. Early detection of colorectal [2, 3] and cervical cancers [4] also have been shown to be cost-effective. Benefits from screening at recommended intervals accrue both to society, as well as to individuals. However, the costs of prevention are incurred immediately, while both the private and societal benefits may occur many decades later. Employers and health plans make sub-optimal investments even in cost-effective preventive care because the returns from investment might accrue to a different employer or health plan [5]. Historically, preventive cancer screenings were not well-covered by insurance, as screenings were neither "medically necessary" nor catastrophically expensive [6].

Mandating some level of coverage provides a way to address this externality problem.

A major reason why consumers do not seek medical care, including preventive services, is cost [7, 8]. Therefore a popular argument for mandated benefits is to make the service more affordable to consumers, e.g., to reduce the consumer's out-of-pocket cost. In the United States, the *Patient Protection and Affordable Care Act* (ACA) of 2010 introduced a seemingly large-scale change by mandating coverage of many preventive services with no cost-sharing [9, 10]. However, over the past two decades, many states already had enacted a substantial number of mandates requiring private insurers to cover preventive services (e.g., cancer screening tests). The majority of employer-sponsored insurance (ESI) plans have gradually adopted coverage for some low-cost screenings. Over 90 % of ESI plans had adopted coverage for screening mammograms and prostate-specific antigen (PSA) tests by the late 1990s. However, even ESI plans, which cover the majority of the insured, non-elderly US population, have not always covered cancer screenings [11]. To our knowledge, only 57 % of plans provide coverage for screening colonoscopy with coinsurance, based on a comprehensive survey conducted by National Cancer Institute in early 2000 [12].

Much research has focused on the cost-effectiveness of preventive care, including cancer screenings, documenting potential cost-savings in the long run [2–4]. However, important economic implications of preventive care mandates have been ignored. Coverage of any service connects with the premiums through two channels. Given the classic economic rationales above, the purpose of mandated benefits is to increase insurance coverage of a service, which will lead to more utilization assuming consumer demand is price-elastic. The increased utilization would result in increased premiums.

But coverage of a service also shifts the cost from individually borne, out-of-pocket costs to the premium, where the covered portion of the cost is shared by all enrollees [13–15]. Thus, whenever a service is covered by insurance, users are subsidized by non-users through premiums (cross-subsidies). When utilization is the result of exogenous risk factors that are distributed equally among the insured population, such subsidies reflect the underlying purpose of insurance. When underlying risk factors are not distributed equally in the population, the resulting cross-subsidies are among individuals of unequal risk. Some of these cross-subsidies may be intentional when only certain individuals may be eligible for a service, for example, coverage of maternity care and breast cancer screening for women.

In contrast, some cross-subsidies may be unintentional, because the factors affecting probabilities of consumption reflect disadvantages in certain individual's access to care, or because there may be no true stochastic "risk" of illness associated with consumption. The coverage of preventive care, such as coverage for cancer screenings, is one such example. Among people eligible for the service, utilization of screenings occurs at the discretion of the consumer. At the point of consumption, the out-of-pocket payment is shifted to the premium, and individuals who are less likely to consume preventive care subsidize those who are more likely. The mandated coverage of the care makes those cross-subsidies mandatory. Thus, it is not the coverage of screenings, per se, that makes it more affordable. If all individuals consumed the mandated preventive care, then the cost to each individual would be unchanged whether the services was covered or not (disregarding any price discounts available to the health plan, but not to the individual consumer). Instead, it is the cross-subsidies from individuals who are not eligible for the screening tests or choose not to consume it that makes it more "affordable". In our paper, we focus on studying the latter type of cross-subsidies (from eligible non-users to eligible users) that may be unintentional.

Changes in federal and state health policy toward mandating preventive care highlight the importance of understanding state mandates and their effects on cancer screenings. Therefore, it is important first to understand the behavioral effects of preventive cancer screening mandates and the factors that influence consumption of mandated screenings, and then to attempt to quantify the cross-subsidies.

Prior research

A number of studies have estimated the effects of specific types of state mandates on medical consumption, on insurance coverage, or on labor market outcomes. However, only a few studies have specifically investigated the implications of insurance benefit mandates for preventive cancer screenings. Bitler and Carpenter [16, 17] found that mandates substantially increased mammography utilization and Pap test utilization. Cokkinides et al. [18] found that mandates had moderately positive effects on utilization of endoscopy. However, results from other researchers [19] showed that the mandates increased use of endoscopy only among men aged 51–64 years, relative to individuals 65–75 years of age. One important methodological challenge of prior research is that these studies were all based on the Behavioral Risk Factor Surveillance System Survey (BRFSS), a data source that does not capture detailed information about a person's insurance type, only whether a person is insured or not. Another methodological challenge faced by previous research stems from the Employee Retirement Income Security Act (ERISA) of 1974, which exempts self-insured health plans, predominantly offered by large employers [20, 21], from having to comply with

state-level insurance mandates. Because data on self-insurance are missing from BRFSS, prior studies could not test the potentially diluting effects of the ERISA exemption.

The cross-subsidies associated with state-mandated coverage have not been addressed by any previous research. Moreover, these studies have not specifically examined the disparities in consumption among private insurance holders whose plans were mandated to provide cancer screening benefits.

Study contribution

Using the 1997–2008 Medical Expenditure Panel Survey (MEPS), a nationally representative survey of the US civilian population, our study entails two connected analyses aimed at studying the economic implications of screening mandates discussed above. We first investigate the effects of state mandates and disparities in consumption of preventive screenings for colorectal, cervical, and prostate cancers. One important feature of MEPS is that it collects information on specific types of insurance held by respondents, allowing more accurate estimates of the effects of mandates on privately insured individuals. Notably, the effectiveness of the mandates could vary by type of screening, since the tests differ in both level of complexity and the potential out-of-pocket costs to different population segments. We conducted extensive robustness tests, including tests that separate individuals who obtained insurance from employers that were likely to be self-insured firms.

In our second analysis, we modeled the cross-subsidies associated with the mandatory coverage of cancer screening benefits. Given that the users of a discretionary service such as as preventive cancer screenings aresubsidized by the non-users, it is reasonable to ask, "Who are the users and the non-users when mandates are implemented?"

It has been extensively documented that factors affecting utilization of preventive cancer screening include lack of access to a usual source of care [22], transportation problems [23, 24], skepticism regarding the efficacy of preventive care [24–26] or skeptical views of health care providers [27], limited knowledge and health literacy [28, 29] and lack of English proficiency [30–32]. Less educated individuals and those with fewer economic opportunities [22, 33], as well as those from minority groups, consume fewer preventive cancer screenings [34]. Finally, the local population and health care market characteristics may influence whether people received the recommended preventive care. A higher supply of physicians is associated with higher rates of cancer screenings [35–37], while living in isolated areas [38, 39] with inadequate physician supply [35–37] is associated with lower utilization. Because these additional barriers affect the probability of using preventive care, they also affect the cross-subsidies associated with coverage of preventive care. The cross-subsidies associated with access barriers may be unintentional. We estimate how these demographic and access barriers relate to compliance with these screenings when such benefits are covered, and we quantify the redistributive effects of mandated coverage between users and non-users.

Methodology

Data

Our primary data source is the MEPS for years 1997–2008. The MEPS uses an overlapping panel design of five rounds over 2 years. It includes information on the subjects' demographics, socioeconomic characteristics, as well as information on access to and utilization of medical care [40]. We augmented the MEPS with geographic-specific information on local physician supply from the Bureau of Health Profession's Area Resource File (ARF). Data on preventive benefit mandates were retrieved from the National Cancer Institute's State Cancer Legislative Database (SCLD) Program, the National Council of State Legislatures (NCSL), the Council for Affordable Health Insurance (CAHI), the Blue Cross Blue Shield Association (BCBS), and from each state government's public records. These benefit mandates were linked to MEPS respondents by their state of residence and year. However, no available national survey has collected detailed information on the price of preventive cancer screenings. Instead, we used the national average insurer-paid price listed on https://www.healthcarebluebook.com/—a public access website that synthesizes data from providers, payers and billing agencies to determine a reference price paid by insurance plans to physicians, for colon and prostate cancer screenings. Since https://www.healthcarebluebook.com/ does not report prices for cervical cancer screening, we relied on Medicare Part B reimbursement rates for this information.

Sample

Our study sample for each type of the cancer screening consists of privately insured adults under age 65, who also meet other age and gender-specific criteria indicated by the American Cancer Society (ACS) guidelines by 2008 (Table 1).[1] We excluded persons enrolled in Medicare (6.2 % of sample) or Medicaid (9.5 % of sample) during any month of the survey year, because mandated benefits typically apply only to private plans. Using the MEPS

[1] Prior to ACA, the ACS recommendations were the most widely adopted set of guidelines used for drafting state mandates [41].

Table 1 Sample characteristics (weighted means), years 1997–2008

	Colorectal cancer screening sample	Cervical cancer screening sample	Prostate cancer screening sample
Having had an endoscopy within past 5 years	0.38	…	…
Having had a Pap test within past year	…	0.68	
Having had a PSA within past year	…	…	0.50
Treatment group ($Policy_{jt} = 1$)	0.39	0.59	0.56
Female	0.51		
Age (years)	56.2 (4.2)	41.70 (12.3)	56.01 (4.17)
Obtained less than high school education	0.03	0.02	0.04
Obtained high school education	0.37	0.36	0.36
Obtained college education	0.60	0.62	0.60
Black	0.08	0.10	0.07
Asian	0.04	0.05	0.04
Other race	0.01	0.02	0.01
White	0.87	0.83	0.88
Being married	0.75	0.64	0.81
Living in urban areas	0.82	0.84	0.82
Income based on FPL: poor	0.02	0.03	0.02
Income based on FPL: near poor	0.01	0.01	0.01
Income based on FPL: low income	0.05	0.07	0.04
Income based on FPL: mid income	0.26	0.33	0.24
Income based on FPL: high income	0.66	0.56	0.68
English not proficient	0.02	0.02	0.02
Unemployed some time	0.22	0.25	0.17
Self-rated health status: excellent	0.23	0.29	0.24
Self-rated health status: very good	0.37	0.38	0.36
Self-rated health status: good	0.30	0.26	0.30
Self-rated health status: fair	0.08	0.06	0.08
Self-rated health status: poor	0.02	0.01	0.02
Having a usual place of care	0.89	0.86	0.87
Number of gastroenterologist/ 100,000 population	4.01 (3.34)	…	…
Number of Ob-gyn/100,000 population	…	13.67 (7.99)	…
Number of primary physician/ 100,000 population	…	…	31.32 (15.81)
N	27,605	50,664	13,314

PSA Prostate-specific antigen test, *FPL* federal poverty level

Medical Conditions file, we identified individuals with a prior diagnosis of cervical, prostate, or colon cancers and excluded them as well.

Model specification

By 2008, 27 of 50 states and Washington DC had adopted cervical cancer screening mandates and 28 states had screening mandates for colorectal cancer. Despite the controversies over early detection of prostate cancer [42], 33 states had mandated coverage for this screening too. States began to adopt cervical cancer screening mandates in late 1980s and relatively few states implemented the policy after 2000. In contrast, prostate cancer screening mandates were implemented widely in the mid-to-late 1990s and early 2000. States did not begin to adopt colorectal cancer screening mandates until after 2000. Figure 1 provides a map to illustrate this variation. Similar patterns of variation are observed for prostate and colorectal cancer screening mandates. We took advantage of variation in the timing of when state mandates were introduced to identify the effect of such policies on individuals' likelihood of screening. We used a differences-in-differences (DID) model with state and year fixed-effects (state and year dummy variables) to estimate the change in utilization of preventive screenings due to state-mandated benefits (Eq. 1). Therefore, the effect of the mandates can be separated from general secular trends in preventive care utilization, as well as from the between-states differences.

For each cancer screening, we specified a model corresponding to the probability that an individual received the recommended care and estimated the model via binary logistic regression.[2]

$$P(Y_{ijt} = 1|X_{ijt}) = F(\beta_0 + \alpha \text{Policy}_{jt} + \gamma X_{ijt} + \varphi \text{YearDummies} + \tau \text{State}_j + \mu_{ijt}) \quad (1)$$

The dependent variable $P(Y_{\text{ijt}} = 1|X_{\text{ijt}})$ represents the probability that individual i from state j reported a given screening procedure during year t. By 2008, the ACS guideline recommended annual Pap tests for cervical cancer for women 18 years of age and older and annual PSA tests for prostate cancer among men 50 years of age and older [43]. The guideline also recommended that people 50 years of age and older to have an annual fecal occult blood test (FOBT), paired with a sigmoidoscopy every 5 years or a colonoscopy every 10 years for early detection of colorectal cancer [43].[3] The MEPS survey question asks the respondent when the last colonoscopy or sigmoidoscopy (they are referred as endoscopy in our analysis) was done, at intervals of within 1, 2, 3, 5 years, or more than 5 years. In this study, individuals were considered compliant if they reported having endoscopy within past 5 years.

[2] We also estimated a linear probability model and the results were unchanged.

[3] ACS recommended more frequent screenings for patients at higher risk of developing cancers—those with family history or relevant disease history. We are unable to separate the average risk patients from high risk patients due to the limited survey questions.

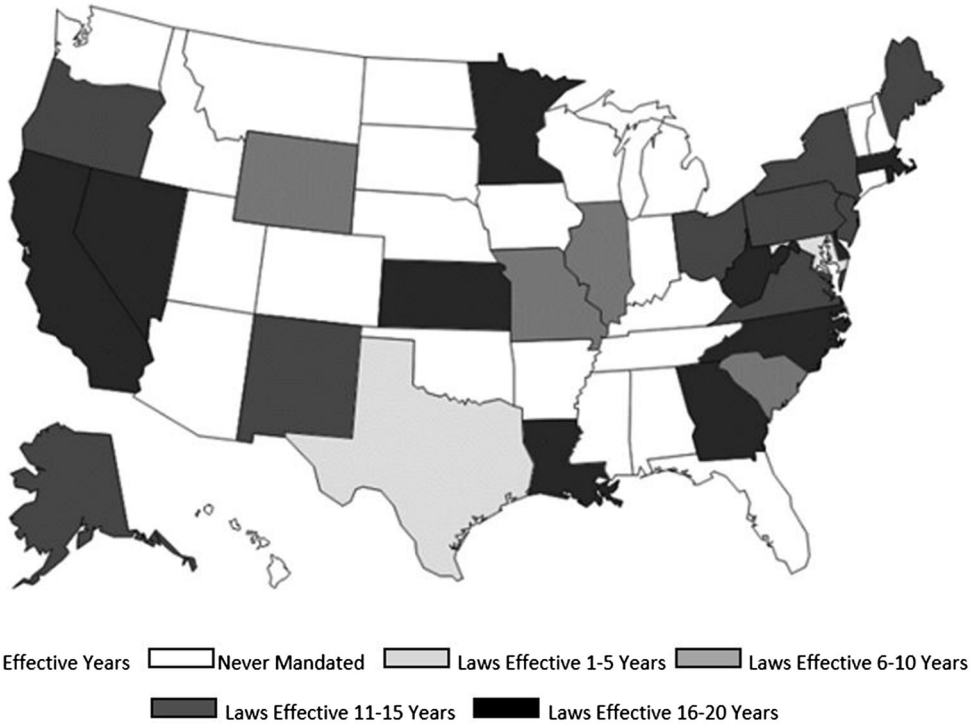

Fig. 1 Effective years of cervical cancer screening laws by 2008

Explanatory variables X_{ijt} represent the respondent's demographic attributes, socio-economic status and barriers to health care (Table 1). For instance, lack of English proficiency is represented by the respondent using a language other than English during the survey. Having a usual place of care means that the individual indicated that there was a particular doctor's office, hospital or other place that he or she usually went for health related issues. In addition, X_{ijt} includes variables that represent local physician availability. These include the rates of primary care physicians, gastroenterologists and OB-GYNs per 100,000 populations, respectively.

The Policy_{jt} variable is defined as being equal to 1 if the beneficiary was surveyed in a state and year in which the mandate was in effect. The mandates' effective dates were rounded to January 1 of the year following enactment, to allow the mandate to go into force for the following enrollment period.[4] The treatment effect of state mandates is captured by the average marginal effects (AME) of the Policy_{jt} variable [44].

We used MEPS person-level weights and clustered the standard errors at the individual respondent level to account for the fact that same person may be observed twice during the survey period and for the complex survey design. A variety of robustness tests were performed to verify the findings from the main analytic model.

[4] We also conducted robustness tests, lagging the "effective year" for 2 years after the enactment year. The results are similar.

Results

Characteristics of study sample

Table 1 summarizes the characteristics of the study sample of privately insured, non-elderly adults that meet the age and gender criteria for ACS recommended colorectal, cervical and prostate cancer screenings, respectively. Relative to the overall US non-elderly population, individuals within the sample had higher average educational attainment and income, and were more likely to be white and married [45].[5] The majority of respondents had a usual place of care, although approximately 15 % reported the place to be a hospital or emergency room. Individuals reporting cancer screenings also had higher educational attainment and income, were more likely to live in urban areas, and lived in counties with a higher physician to population ratio.

Effects of state-mandated benefits

Table 2 shows the marginal effects and standard errors of the explanatory variables on the probability of using each type of preventive cancer screening. Results from our first analysis indicated that there is no statistically significant

[5] The 2000 Census survey documented that the statistics (in percentage) of several demographic variables used in our analysis: 75.1 % white, 24.4 % obtained college education (among 25 years and older), 10.9 % adults had incomes below federal poverty level (FPL) (that is categorized as "Poor" in our analysis), 51.7 % married [44].

Table 2 Marginal effects of covariates on care receipts across all States in all years (percentage points change, robust standard errors)

Variable	Endoscopy with past 5 years	Pap test within past year	PSA test within past year
Mandate effect	−0.10 (1.45)	0.56 (1.72)	−0.20 (2.70)
Female	−2.57 (0.77)***	…	…
Age	1.68 (0.09)***	−0.23 (0.02)***	1.67 (0.13)***
Obtained less than high school education (ref = college education)	−14.32 (1.82)***	−8.33 (1.78)***	−19.88 (2.61)***
Obtained high school education	−5.94 (0.83)***	−7.50 (0.59)***	−8.93 (1.15)***
Black (ref = white)	−0.35 (1.22)	4.46 (0.83)***	3.71 (1.75)**
Asian	−11.04 (1.74)***	−12.00 (1.33)***	−14.35 (2.48)***
Other race	−1.79 (3.15)	−3.67 (2.01)*	−3.47 (4.63)
Being married	1.39 (0.93)	6.46 (0.63)***	5.11 (1.43)***
Living in urban areas	3.69 (1.10)***	3.19 (0.80)***	−1.16 (1.48)
Income based on FPL: poor (ref = high income)	−1.52 (2.07)	−0.84 (1.45)	−2.00 (3.19)
Income based on FPL: near poor	−8.03 (2.63)***	−3.07 (1.84)	−9.80 (4.33)**
Income based on FPL: low income	−7.38 (1.45)***	−3.99 (0.95)***	−4.59* (2.32)
Income based on FPL: mid income	−6.81 (0.82)***	−3.90 (0.58)***	−7.31 (1.21)***
English not proficient	−7.79 (2.23)***	1.70 (1.29)	−1.60 (3.16)
Unemployed some time	3.10***(0.95)	−3.47 (0.64)***	2.97 (1.46)**
Self-rated health status: very good (ref = excellent health)	1.33 (0.91)	−0.47 (0.62)	0. 47 (1.30)
Self-rated health status: good	1.50 (0.98)	−1.35 (0.69)*	−0.01 (1.38)
Self-rated health status: fair	4.11 (1.47)**	−2.95 (1.13)**	6.77 (2.03)***
Self-rated health status: poor	8.08 (2.61)***	−4.08 (2.07)*	3.23 (3.51)
Having a usual place of care	19.33 (1.00)***	11.77 (0.79)***	23.06 (1.47)***
Physician availability/100,000	0.56 (0.14)***	0.09 (0.04)**	−0.06 (0.04)*
N	27,605	50,664	13,314
Pseudo *R*-square	0.07	0.03	0.07

* Significance at 90 % confidence intervals, ** significance at 95 % confidence intervals, *** significance at 99 % confidence intervals

relationship between a person exposed to a mandate (living in mandated states, surveyed after mandate went into effect) and his or her probability of receiving endoscopy within 5 years, receiving an annual Pap test, or receiving an annual PSA following the enactment of state mandates. Relative to year 2000, years 2001–2008 saw very large increases in the utilization of colorectal cancer screening. Rates did not increase dramatically for the other types of screenings over the same time period. This finding is interesting, yet not surprising. During this time period, there was increased emphasis on public education for colorectal cancer screening at both the state- and federal-levels (e.g., CDC's Screen for Life: National Colorectal Cancer Action Campaign).

A number of non-financial explanatory variables were found to be associated significantly with the likelihood of obtaining a preventive cancer screening. For example, females were less likely to undergo an endoscopy (−2.57 percentage points), relative to males. We observed that as a person ages, he or she was more likely to receive an endoscopy test (1.68 percentage points) and PSA test (1.67 percentage points), but not a Pap test (−0.23 percentage points). Also, having a usual place of care was associated with an increase of about 20 percentage points in the probability of using an endoscopy and PSA, and a 12 percentage-point increase in the probability of getting a Pap test. Living in an urban area also was related positively to screening—urban residents were more likely to have an endoscopy or a Pap test (3.69 percentage points and 3.19 percentage points, respectively). Compared to those with a college education, people who had a high school education or less had significantly lower likelihood of using endoscopy, Pap test, or PSA test. In addition, being an Asian is strongly related to lower use of all cancer screening tests (more than −10 percentage points), and lacking English proficiency is associated with reduced use of endoscopy (−8 percentage points). The probability of endoscopy utilization also was significantly associated with income. The probability of endoscopy utilization was approximately seven to eight percentage points lower for lower income individuals compared to individuals in the highest income category.

Robustness checks

Besides these non-financial factors, there are other possible reasons for finding no effect of benefit mandates. One possibility is that not all private plans are subject to state mandates; therefore the effects of mandates could be diluted. State mandates typically apply to fully insured individual and group health plans. Self-insured plans are exempt from complying with state mandates. Self-insured plan status is related positively to employer size, with the majority of firms with 1,000 or more employees offering self-insured plans [46]. To assess this, we constructed difference-in-difference-in-differences (DDD) models, limiting the treatment group to individuals (when $\text{Policy}_{jt} = 1$) with coverage through small employers, defined as single-location business establishments with fewer than 200 employees (Table 3). The mandate effects remained statistically insignificant, suggesting that ERISA exemptions cannot explain the original null finding. Alternative definitions of small employer size (employees <100) were considered in separate robustness tests and produced similar results.

We also estimated several models to examine the possible heterogeneous effects of mandates across different demographic and socioeconomic groups, based on age, sex, race, and income. The model was re-estimated for each subgroup of interest. State mandates were not found to have a statistically significant effect on utilization of cancer screenings for most subgroups. However, the mandates exhibited a significant impact on increased endoscopy utilization and PSA test utilization among Asians (15 percentage points; 20 percentage points, respectively). The colorectal cancer screening mandates also increased the probability of consumption among individuals who lacked English efficiency by 17 percentage points ($N = 1169$), and increased the consumption among individuals who fell in the "Near Poor" income category by 17 percentage points ($N = 1031$). These findings imply that although, on

Table 3 Robustness tests of marginal effects of covariates on care receipts across all states in all years treatment group: individuals covered by small group (employees <200) insurance plans (percentage points change, robust standard errors)

Variable	Endoscopy with past 5 years	Pap test within past year	PSA test within past year
Mandate effect	−1.18 (1.55)	0.85 (0.88)	−2.36 (1.83)
Female	−1.65 (1.12)	…	…
Age	1.66 (0.13)***	−0.24 (0.04)***	1.82 (0.19)***
Obtained less than high school education (ref = college education)	−15.85 (3.52)***	−12.94 (2.90)***	−21.61 (3.72)***
Obtained high school education	−6.12 (1.19)***	−7.70 (0.88)***	−11.33 (1.73)***
Black (ref = white)	0.39 (1.85)	4.84 (1.35)***	8.71 (3.09)***
Asian	−11.84 (3.24)***	−11.41 (2.37)***	−14.26 (4.28)***
Other race	−1.82 (3.15)	−5.88 (3.13)*	−13.95 (6.41)**
Being married	0.96 (1.35)	5.44 (0.96)***	5.60 (2.26)**
Living in urban areas	3.14 (1.49)**	2.03 (1.07)*	2.70 (2.03)
Income based on FPL: poor (ref = high income)	1.34 (3.16)	−2.08 (2.26)	7.49 (5.04)
Income based on FPL: near poor	−10.71 (4.53)**	−2.46 (2.88)	−6.18 (6.96)
Income based on FPL: low income	−9.12 (2.36)***	−3.15 (1.47)**	−3.77 (3.65)
Income based on FPL: mid income	−6.88 (1.21)***	−4.63 (0.88)***	−6.88 (1.80)***
English not proficient	−13.74 (3.46)***	1.40 (2.18)	−0.16 (4.47)
Unemployed some time	2.92 (1.41)**	−2.66 (1.03)**	6.44 (2.34)***
Self-rated health status: very good (ref = excellent health)	0.94 (1.32)	−0.64 (0.97)	0.63 (2.03)
Self-rated health status: good	1.97 (1.41)	−0.53 (1.06)	0.13 (2.16)
Self-rated health status: fair	3.35 (2.17)	−2.13 (1.47)	9.51 (3.19)***
Self-rated health status: poor	9.21 (3.64)***	−7.15 (3.05)**	−4.06 (5.04)
Having a usual place of care	24.71 (1.92)***	11.82 (1.19)***	22.85 (2.21)***
Physician availability/100,000	0.73 (0.17)***	0.02 (0.06)***	−0.11 (0.08)
N	13,086	21,119	5,528
Pseudo *R*-square	0.07	0.03	0.07

* Significance at 90 % confidence intervals, ** significance at 95 % confidence intervals, *** significance at 99 % confidence intervals

average, the mandated benefits did not change the utilization of screenings, certain subgroups have responded to the mandates.

To examine the potential importance of recall bias, we estimated the probability of endoscopy use within the past year only. Mandates were not found to have an impact. Finally, to allow for different screening strategies to respond to state mandates differently, we performed robustness tests using alternative measures of screening. Specifically, we separately modeled receipt of an annual FOBT for colon cancer screening and we modeled receipt of a Pap test within every 2 years and every 3 years (versus annually). Again, our null finding remained robust.

Like all health care surveys, MEPS collects data on screening utilization retrospectively. It is possible that health plans responded to the mandates slowly, or beneficiaries and providers learned about the benefits gradually. To take these possibilities into account, we lagged the effective time since enactment by 2 years; the results of policy on utilization remained unchanged. In another test to address similar concerns, we re-estimated the logit model with a state and year-specific counter for the number of years the mandate has been in effect in each state. We found that the year counter was not significantly associated with the probability of screening consumption, suggesting the length of mandates were not a significant factor.

Analysis of cross-subsidies related to coverage

Our first analysis did not find an effect of mandated cancer screening on utilization for the population at large. Therefore, we assume that the mandates did not have an impact on premiums. Thus, our second analysis of cross-subsidies focuses on the redistributive effects of colon cancer screening coverage.[6] As noted above, utilization of preventive services remains at the discretion of the consumer, and is likely to be affected by a person's demographics, socio-economic factors, and access to providers in the market. However, coverage of preventive care (or any service) converts part of out-of-pocket costs to the premiums, borne by all individuals in the insurance pool. The subsidy of users by non-users raises two important policy questions: (1) what are the characteristics of users and non-users of preventive services; and (2) how large are the potential cross-subsidies from non-users to users? Our analysis models the cross-subsidies as a result of coverage of cancer screenings. We refer to this income transfer as the net subsidy. The net subsidy of interest in this analysis are among subjects all of whom are eligible for a service.

In order to estimate the effects of enrollee characteristics on utilization controlling for coverage, we used data from states in the years after their mandate legislation was passed. We first estimated another logistic regression to examine the characteristics of users and non-users of preventive cancer screenings when $\text{Policy}_{jt} = 1$. Table 4 presents the marginal effects and standard errors. The results are similar to our previous findings. The effects of some characteristics, such as higher education, non-Asian, and having a usual place of care, are consistently positive across all three types of screenings. Lack of English proficiency is associated with an 6 percentage-point reduction in the likelihood of receiving an endoscopy, while a larger supply of gastroenterologists increases the probability by nearly 2 percentage points ($0.82\ \% \times 3.34 = 1.60\ \%$). Being married is associated with increased consumption of Pap tests and PSA tests, respectively. Although mandates were found to increase endoscopy utilization among Asians in our earlier analysis, this group still was 13 percentage points less likely than the White group to consume the care with post-mandate coverage. These findings suggest that disparities in consumption persisted regardless of cancer screening coverage. In particular, individuals whose income fell into the Poor, Near Poor, or Middle Income levels were significantly less likely to use the care than their High Income peers. This positive effect of income on consumption of preventive care suggests that the coverage of screenings is regressive, transferring resources from insured individuals with lower incomes to those with higher incomes.

To simulate the amount of net subsidies, we suppose that all the subjects in our sample are in a single insurance pool. We compare enrollees' under two scenarios: (1) the health plan does not cover preventive services; and (2) the plan covers 80 % of the cost of preventive care. Thus, the enrollee's out-of-pocket cost drops from the full price of preventive care to 20 %[7] of the insurer's price. The expected increase in premiums from the coverage is the product of the level of consumption of preventive care in post-mandate years times the insurer's unit price times 80 %. The net subsidy is calculated by[8]:

[6] We reported the cross-subsidies results only for colorectal cancer screening coverage due to the relatively low cost of Pap test and the controversial PSA screening.

[7] The majority of state mandates required cost-sharing for mandated cancer screenings, similar to other outpatient services. We arbitrarily picked a common coinsurance rate of 20 %.

[8] If we instead assume all health plans had voluntarily covered the service prior to state mandates, we would estimate an equation of $\left\{\left[(0.8 \times \$_{\text{Price}}) \times \widehat{P}_{ijt}^{POST}\right] - [(0.8 \times \$_{\text{Price}}) \times \widehat{P}_{ijt}^{\text{PRE}}]\right\} - \$_{\text{Price}} \times \left(\overline{\widehat{P}_{jt}^{POST}} - \overline{\widehat{P}_{ijt}^{\text{Pre}}}\right) \times (1 - 0.20)$. On average, the sample still receives US $0 net subsidies. An individual is more likely to receive a positive net subsidy if the predicted probability of utilization in post-mandate increased more than the average increase of the sample.

Table 4 Marginal effects of covariates on probability of receiving care in mandated states in post mandates periods (percentage points change, robust standard errors)

Variable	Endoscopy within past 5 years	Pap test within past year	PSA test within past year
Female	−2.42 (1.23)*	…	…
Age	1.70 (0.14)***	−0.24 (0.03)***	1.55 (0.17)***
Obtained less than high school education (ref = college education)	−12.37 (2.86)***	−5.86 (2.25)**	−15.84 (3.48)***
Obtained high school education	−4.80 (1.34)***	−6.86 (0.77)***	−8.00 (1.56)***
Black (ref = white)	0.51 (1.78)	3.42 (1.06)***	4.55 (2.14)**
Asian	−12.65 (2.32)***	−11.999 (1.54)***	−14.46 (2.86)***
Other race	−0.69 (4.18)	−1.25 (2.65)	−0.69 (5.69)
Being married	2.06 (1.45)	6.90 (0.82)***	4.25 (1.89)**
Living in urban areas	2.49 (1.87)	3.10 (1.08)***	−2.92 (2.04)
Income based on FPL: poor (ref = high income)	−3.90 (3.15)	−0.75 (1.94)	−4.16 (4.20)
Income based on FPL: near poor	−7.97 (3.98)**	−2.43 (2.40)	−10.41 (5.43)*
Income based on FPL: low income	−9.33 (2.16)***	−3.87 (1.25)***	−7.72 (2.91)**
Income based on FPL: mid income	−8.26 (1.31)***	−3.85 (0.75)***	−8.34 (1.62)***
English not proficient	−6.34 (3.06)**	2.01 (1.58)	−0.96 (3.87)
Unemployed some time	3.01 (1.54)*	−3.42 (0.82)***	1.10 (2.01)
Self-rated health status: very good (ref = excellent health)	1.41 (1.45)	−0.17 (0.80)	−0.99 (1.72)
Self-rated health status: good	0.73 (1.55)	−1.72 (0.90)*	0.85 (1.82)
Self-rated health status: fair	5.10 (2.31)**	−3.83 (1.51)**	6.42 (2.68)**
Self-rated health status: poor	4.79 (4.23)	−2.94 (2.86)	5.36 (5.15)
Having a usual place of care	18.99 (1.59)***	11.84 (1.08)***	24.30 (1.97)***
Physician availability/100,000	0.48 (0.21)**	0.10 (0.05)*	0.04 (0.05)
N	11,212	29,548	7,661
Pseudo *R*-square	0.07	0.03	0.07

* Significance at 90 % confidence intervals, ** significance at 95 % confidence intervals, *** significance at 99 % confidence intervals

$$\begin{aligned}\text{Netsubsidy} &= \left\{\left[(0.8\times \$_{\text{Price}})\times \widehat{P}_{ijt}^{\text{POST}}\right]-\left[(0\times \$_{\text{Price}})\times \widehat{P}_{ijt}^{\text{PRE}}\right]\right\} \\ &\quad -\$_{\text{Price}}\times \overline{\widehat{P}_{jt}^{\text{POST}}}\times(1-0.20) \\ &= (0.8\times \$_{\text{Price}})\times\left(\widehat{P}_{ijt}^{\text{POST}}-\overline{\widehat{P}_{ijt}^{\text{POST}}}\right)\end{aligned} \tag{2}$$

The Net subsidy is the difference between the expected change in insurance contribution due to the coverage of screenings and the individual share of premiums (increased costs). The expected value (mean) of the net subsidy in Eq. (2) is zero. $\widehat{P}_{ijt}^{\text{POST}}$ and $\widehat{P}_{ijt}^{\text{PRE}}$ represents the predicted probability of using endoscopy for individual ijt before and after the mandatory benefit coverage was in place. The premium change is a function of $\overline{\widehat{P}_{jt}^{\text{POST}}}$, the average predicted probability of utilization in the post-mandate period. For $\$_{\text{Price}}$, we use the national average insurer-paid amount for a colonoscopy performed in an outpatient surgery center without biopsy. That amount consists of two parts: a physician fee (US $476) plus a facility fee (US $643), which sums to US $1,120 in total [47].

In our data, 38 % of consumers in the post-mandate ($\text{Policy}_{\text{jt}} = 1$) period received an endoscopy within the past 5 years when they were exposed to state mandates. If we think of our sample as a pool of insured individuals for this exercise, then mandated coverage of colonoscopies would increase premiums for everyone by US $1,120 × 0.38 × 0.80 = $340.48 (on an annualized basis, $68.10 from $340.48/5), according to Eq. 2. A PSA test ($23) [48] or a conventional pap smear ($39) [49] has to be done at the physician's office. It usually is a Level 2 visit for an established patient that costs $71 [50], the mandated coverage would increase premiums for the relevant individuals by $37.60 [($23 + $71) × 0.50 × 0.80], and by $60.72 [($39 + $71) × 0.69 × 0.80]. Even though payments for pap smears or PSA tests are modest compared to those of an endoscopy, the aggregated amount in the long term could be significant.

The average Net Subsidy in our sample is zero by construction of Eq. 2 (Table 5). Net subsidies vary across individuals with different socio-demographic characteristics. Negative subsidies result when the increase in premiums

Table 5 Net subsidies and minimum values of endoscopy needed to receive a positive benefit from coverage

Characteristic	Average probability of receiving a endoscopy ($Policy_{jt} = 1$)	Insurance contribution due to coverage ($)	Net subsidy [change in insurance contributions minus change in premium ($)[a]]
Sample average	0.38	340.48	0
High income	0.42	376.32	40.77
Mid income***	0.30	268.8	−64.27
Low income***	0.27	241.92	−91.32
Near poor**	0.30	268.8	−68.79
Poor	0.37	331.52	0
Female*	0.37	331.52	−6.25
Male	0.38	340.48	6.96
White	0.38	340.48	7.65
Black	0.38	340.48	10.78
Asian***	0.26	232.96	−104.31
Other race	0.36	322.56	−15.20
Obtained less than high school education***	0.20	179.2	−151.60
Obtained high school education***	0.34	304.64	−31.04
Obtained college education	0.41	367.36	36.48
English not proficient**	0.21	188.16	−144.21
English proficient	0.38	340.48	9.66
Unemployed some time*	0.42	376.32	38.75
Not unemployed	0.36	322.56	−10.98
Having a usual source of care***	0.40	358.4	23.00
Not having a usual source of care	0.19	170.24	−167.02
Living in urban areas	0.38	340.48	4.56
Not living in urban areas	0.34	304.64	−25.59
Excellent health	0.37	331.52	−1.47
Very good health	0.38	340.48	9.19
Good health	0.36	322.56	−15.60
Fair health**	0.39	349.44	15.57
Poor health***	0.41	367.36	31.54

If all health plans had voluntarily covered the service prior to state mandates, users are still subsidized by non-users when everyone shares the costs (premiums)

* Significant at 0.10, ** significant at 0.05, *** significant at 0.01

[a] The change in the individual' premium due to coverage is the price of endoscopy times the average probability of receiving an endoscopy post mandates and times the insurer's share of cost. In our data, the estimated increase in premiums (cost) is $340.48, and the same amount for all individuals

outweighs the reduction in out-of-pocket spending because the individual has very little probability of receiving an endoscopy. For example, relative to their college educated peers ($36.48), individuals with only high school education would receive a negative subsidy of −$31.04 due to the mandate, as would individuals with less than high school education compared to those with a college education (−$151.60). Given the US population in 2000 [45], there are potential $1.6 billion and 54 billion negative net subsidies to these groups of individuals respectively. Similarly, individuals whose income levels fall into near-poor, low-income or mid-income categories received negative net subsidies (−$68.79, −$91.32, −$64.27, respectively).

The value the enrollee assigns to preventive screenings must be taken into consideration because these tests ideally result in a reduction in expected losses due to illness (if they are cost-saving or cost-effective procedures). For each individual, the expected net *benefit* from coverage consists of both the net economic *subsidy* plus the individual's expected value of receiving the endoscopy.[9] For individuals who received a positive net subsidy due to the coverage, any value associated with receiving an

[9] The expected value of receiving an endoscopy is based upon probability of consumption, not the individual's value of the endoscopy.

endoscopy would result in an even larger positive net benefit. For individuals with a negative net subsidy, there is a minimum expected value that they would have to place on receiving an endoscopy in order for the overall net benefits of coverage to be positive. As shown in Table 5, when individuals faced additional barriers that reduce their demand of preventive screenings (probability), a higher expected value associated with the service is needed for a positive benefit because of the mandates. To at least fare neutrally with post-mandate coverage, the value of endoscopy has to be $151.60 more to an individual with less than a high school degree and $31.04 more to someone who obtained a high school education, relative to those with college education. Similarly, relative to individuals in high-income groups, those with middle-income need to place $64.27 more value on endoscopy, and those who were low-income or near poor (defined by reference to the federal poverty level (FPL)] need $91.32 and $68.79 more value, respectively, to get non-negative benefits.

Discussion

An important component of the ACA legislation is the mandated coverage for certain types of preventive care. Even self-insured health plans that formerly were exempt from state mandates, must now comply. The ACA mandate has raised new questions about the scope of preventive care. For example, the federal government ruled recently that if polyps are found during colonoscopies, the cost of removing the polyps must also be covered under the preventive care mandate [51], further increasing the effect of the mandate on premiums.

Taking advantage of state variation in the timing of preventive cancer screening mandates, this study investigates the behavioral and financial effects of such mandates on privately insured adults, and can inform the likely effects of similar federal mandates created by ACA. We do not find evidence that state-level benefit mandates resulted in increased rates of cancer screening. This contrasts with findings from other studies and may reflect differences in the data and study samples; for example, previous research using the BRFSS could not restrict attention to the privately insured, who represent the population affected directly by state mandate legislation.

We do find, however, that coverage of screenings, whether mandated or not, results in cross-subsidies. Individuals who are more likely to obtain the screenings enjoy a positive subsidy by non-users. Mandated coverage makes these transfers mandatory. When lower income non-users cross-subsidize higher income users, this transfer is regressive. Although many individuals received negative net subsidies due to the premium costs built into the coverage for preventive services, we found that those with less advantageous characteristics need to place a much higher value on endoscopies than the advantaged individuals in order to experience positive net benefits from coverage. Measured by the respondent's stated "willingness-to-pay (WTP)", some empirical studies have shown that the perceived value of preventive cancer screenings varied across demographic and socioeconomic groups. Frew et al. [52] found that higher income and education levels were associated with higher WTP for colon cancer tests and Wagner et al. [53] found that higher income is associated with more WTP for mammograms, and Chinese and Filipino women were willing to pay the least relative to non-Hispanic Whites. In contrast, we found that it is low income and less educated individuals, along with Asians, individuals who lack of usual source of care, or were not proficient in English who have to attach higher WTP to endoscopy in order for the net benefits of mandatory coverage to be positive for them. These less-advantaged beneficiaries would be less likely to receive a net benefit from the coverage.

Several limitations are worth noting. First, the outcome variable is measured retrospectively, as discussed earlier in the paper. We minimized the potential bias arising from this measurement by conducting robustness tests of recall bias, lagging an extra year for effect date, and by considering the length of mandates in effect. We found that the retrospective measurement was not likely to be a concern for our study. Second, the study design relies on repeated cross-sections of respondents rather than analyses on the same respondents observed within a state before and after the implementation of the mandate.[10] Third, detailed information on individuals' benefit designs, including cost-sharing requirements,[11] are not available in the MEPS. Thus, the effect of state mandates could be attenuated if some respondents had coverage prior to the laws. Fourth, the survey does not distinguish preventive screenings from surveillance or diagnostic screenings. Although we have excluded individuals with self-reported diagnosis or disease history that could be indicators of the procedure, the list from individual reports would not be complete as in any surveys. This may introduce measurement error into the dependent variables when screenings are done for these latter reasons. Finally, there are slight differences between how the MEPS questionnaire asks respondents about cancer screenings and ACS cancer screening guidelines.

[10] MEPS collects preventive care information only once during the 2-year survey period.

[11] The majority of state mandates did not remove deductibles or coinsurances, nor did they specify the amount of out-of-pocket costs from individuals. However, some generous private plans voluntarily provided coverage for cancer screenings prior to state mandates, or covered the services at first-dollar basis.

Although the DID model controls for state characteristics, a drawback of all natural experiment designs relying on state policy changes is the potential endogeneity of the policy change. State laws may reflect the preferences of the population and/or particular interest groups. These preferences are not observed in the data. In one robustness test, we matched states that implemented mandates with states without mandates by propensity scores (using county level population and health care market characteristics) to produce "comparable" control and treatment groups, using similar methods adopted by Ryan [54]. We re-estimated the model on the propensity score-matched samples and found null effects of the $Policy_{jt}$ variables. We also performed a robustness test to examine whether our treatment and control groups had equal time slopes in the pre-mandate period. The results indicated that the time slope of the dependent variable in the pre-intervention years was statistically indistinguishable between the two groups of observations.

Our study findings raised several important policy issues. While overall cancer screening utilization rates in the nation have increased over the past two decades and coverage has become more generous, disparities arising from differences in education, income levels and having a usual source of care remain even after the introduction of mandatory coverage. Many beneficiaries in fact received negative net subsidies due to the premium costs built into the coverage for preventive screenings. Disadvantaged individuals who are less likely to use services thus subsidize beneficiaries who have a higher likelihood of utilization. Instead of providing financial benefits, the coverage may impose negative net benefits on disadvantaged beneficiaries.

Although reducing the out-of-pocket cost of preventive care has become a widely embraced public policy, rather than implementing mandates that increase premiums, alternative approaches might be considered by the federal and state governments. For example, policymakers might consider strategies to increase access to regular sources of care, establish education programs for consumers who are skeptical about preventive care or who have poor health literacy, subsidize interpreter services for consumers who have difficulty with English, and promote health and wellness in rural areas. These policies also have distributional effects, but these effects are more likely to be progressive. In general, it is important that policymakers consider not only the first-order price effects of mandated coverage laws, but also the second-order distributional effects as well.

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