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Rural-urban disparities in colonoscopies after the elimination of patient cost-sharing by the Affordable Care Act

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ABSTRACT

Introduction: Improving the prevention and early detection of colorectal cancer is a priority for reducing rural-urban disparities in colorectal cancer mortality. By eliminating out-of-pocket (OOP) costs for preventive colonoscopies, the Affordable Care Act (ACA) could have reduced rural-urban disparities in screening.

Methods: We used the Maine Health Data Organization All-Payer Claims Database including all commercially-insured and Medicare beneficiaries aged 50–75 between 2009 and 2012. Rural-urban commuting areas were used to classify rural/urban residence. ICD-9 and CPT codes identified colonoscopies. We summed all OOP payments per patient-day. An interrupted time series model estimated the impact of the ACA on trends in rural-urban disparities in colonoscopy rates and OOP costs.

Results: Before the ACA, colonoscopy rates were 16% lower in rural than urban areas (5.1% vs. 6.1% of enrollees annually) and median OOP costs were nearly double ($195 vs. $98). The ACA reduced median OOP payments by $94 ($p = .001$) initially and $4 monthly ($p = .038$) in rural areas, and $63 ($p < .001$) in urban areas. The rural-urban gap in OOP payments dropped by $4 monthly ($p = .007$). The ACA also reduced rural-urban disparities in colonoscopy rates (disparity decrease of 0.005 (6%) monthly, $p < .001$). The rural-urban gap in colonoscopy rates declined 40% relative to the pre-ACA period by December 2012.

Conclusions: The ACA was associated with significant reductions in rural-urban disparities in colonoscopies in Maine, suggesting that OOP costs are an important barrier for rural residents. Further research is needed to determine whether increased uptake, particularly in rural areas, translated into better patient outcomes for colorectal cancer.

1. Introduction

Colorectal cancer (CRC) is the second-leading cause of cancer-related deaths in the US, accounting for approximately 50,000 deaths annually (American Cancer Society, 2019). CRC incidence is similar in urban and rural areas, but mortality rates are 15% higher for rural residents (Coughlin et al., 2006; Hines and Markossian, 2012). Rural-urban disparities in CRC mortality are likely driven in part by large disparities in screening rates (Cole et al., 2012; Rabeneck et al., 2010). Colonoscopies can prevent CRC and detect the disease at an earlier stage, when treatment can reduce risk of death (Zauber et al., 2012). However, rural residents are 17% less likely to be up to date on CRC screenings (Cole et al., 2012; Rabeneck et al., 2010).

One objective of the Patient Protection and Affordable Care Act (ACA) was to reduce geographic health disparities (Patient Protection and Affordable Care Act, 2010). The ACA's elimination of out-of-pocket (OOP) patient costs for privately insured and Medicare enrollees for preventive colonoscopies is one way it could have achieved this goal. Existing evidence on the impact of the ACA's no cost-sharing provision on CRC screening rates is mixed, with some evidence of increases in CRC screening for members of high deductible health plans and people of low socioeconomic status (Wharam et al., 2016; Richman et al., 2016; Fedewa et al., 2015; Hamman and Kapinos, 2015), and modest increases in CRC screenings for the Medicare population, but not the privately insured (Mehta et al., 2015; Cooper et al., 2015; Cooper et al., 2017). The Medicaid expansion is also associated with increases in the number of eligible adults screened for colorectal cancer (Hendryx and Luo, 2018). To-date, no studies have estimated the impact of the ACA on rural-urban disparities in CRC screenings, even though rural residents are more likely to report costs as a barrier to CRC screening

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(Hughes et al., 2015), have lower income on average (Bishaw and Posey, 2016), and are more likely to be underinsured (Ziller et al., 2006).

A priori, removal of OOP costs could have disproportionately benefited rural populations if rural residents were more price-sensitive. On the other hand, rural populations could have benefited less from the ACA because of the substantially lower density of gastroenterologists and surgeons in rural areas (Hughes et al., 2015; Aboagye et al., 2014), which could limit access to colonoscopies. This study assessed whether the ACA was associated with changes in rural-urban disparities in OOP costs and colonoscopy rates in the state of Maine, the most rural state in the US (U.S. Census Bureau, 2011-2015).

2. Methods

2.1. Data and study population

This study used Medicare (including fee-for-service and managed care) and commercial payer claims from the 2009–2012 Maine Health Data Organization All Payer Claims Database (MHDO APCD). We included enrollees aged 50–75, the recommended age group for CRC screening (American Cancer Society, 2011). We examined colonoscopies because they are the most common CRC screening method (De Moor et al., 2018) and are expensive (Hoover et al., 2017). The ACA cost-sharing elimination policy pertained to colonoscopies coded as preventive, which we identified using common procedural terminology (CPT) and International Classification of Disease (ICD) codes. These codes were based on the billing guidelines of the largest insurers in Maine (Appendix Tables S1.1 and S1.2). We classified enrollees' zip codes as rural or urban based on Rural-Urban Commuting Areas (RUCAs) codes of 10.0 and higher. We chose RUCAs because they capture social and economic integration as well as physical connectivity (i.e. roads), important factors for access to health services (United States Department of Agriculture Economic Research Service, 2016; Hart et al., 2005; Morrill et al., 1999).

We examined two outcomes of the ACA: OOP costs and colonoscopy rates. OOP costs were calculated as the sum of deductible, co-payment, and co-insurance for all claims on the day the colonoscopy occurred. We calculated the median cost by month. Colonoscopy rates were calculated as the share of enrollees aged 50–75 who received a colonoscopy each month, multiplied by 100 to represent percentages. Each monthly measure was constructed for rural residents and urban residents separately, and as the difference of rural minus urban measures.

2.2. Analysis

We first showed urban and rural monthly trends visually. Consistent with other studies on the ACA's elimination of cost-sharing for preventive services (Cooper et al., 2015; Mehta et al., 2015), we considered January 2011 to be the first month of the post-period because many insurers, including Medicare, update plan features each January. However, we would expect a phased decline in OOP costs because updates to plan features are implemented throughout the year. We plotted the outcomes by month and fitted a trend line based on linear predictions for the pre-period (January 2009 to December 2010) and post-period (January 2011 to December 2012). We extended the pre-policy linear trend into the post-period to visualize the projected OOP and colonoscopy rates if the pre-trend had continued. A vertical dashed line in January 2011 represented the first month of the post-period.

We conducted two regression analyses for each outcome. First, we implemented an interrupted time series (ITS) regression model for colonoscopy rates and OOP costs for urban and rural areas separately. Second, we implemented a "differenced ITS", similar to Mehta et al. (2015), which applied an ITS model to the difference in OOP costs and colonoscopy rates between rural and urban areas. Each regression model included: i) a trend variable equal to zero in December 2010 and representing the number of months before (negative) and after (positive) this month, ii) a binary "post" variable equal to one after December 2010, and iii) an interaction between the trend and post variables. All models adjusted for seasonality using quarter-of-year dummies, to control for seasonal variation related to social and economic conditions, such as holidays, tourism, and other factors, such as deductibles and insurance enrollment periods, that could play a role in the uptake of health services (Bernal et al., 2017). We also adjusted for clustering over time using Newey-West standard errors with a lag of four, selected based on the lag size recommended in statistical literature (Newey and West, 1987; Green, 2012).

The appendix assessed the robustness of the results to a range of regression specifications (S2) and changes in member enrollment (S3). We included controls (average age of beneficiaries and the share of beneficiaries that are female), a lag of the dependent variable, and omit the "implementation period" between September 2010 and June 2011, using the concept of an impact model articulated by Bernal et al. (2018), and similar to the approach implemented in Haffajee et al. (2017). We also conduct regressions by week, controlling with an indicator for month, covariates and omitting the implementation period. Finally, because the ACA began providing subsidies for insurance to small businesses and people retiring between the ages of 55–65 during this time, we also assess changes in enrollment as a possible alternative driver of changes in colonoscopy rates.

3. Results

The MHDO APCD included 73,344 commercially insured and Medicare enrollees in rural areas and 284,675 in urban areas. 84,038 colonoscopy claims were included in our analysis (15,004 among rural residents and 69,034 among urban residents). A larger share of the study population was enrolled in Medicare in rural areas than urban areas (49% vs. 42%, $p < .001$) (Table 1). Median OOP costs for a colonoscopy for rural residents was nearly double that of urban residents ($195 vs. $98, $p < .001$). The rural-urban gap in colonoscopies in the pre-period was 5.1% vs. 6.1% per year (0.39% vs. 0.47% per month, $p < .001$).

Trends in OOP costs for colonoscopies prior to the ACA were roughly parallel for rural and urban areas (Fig. 1a). After the introduction of the ACA, OOP costs in rural areas dropped by $94 (48%, $p = .001$) and continued to decrease by $4 (2%) per month ($p = .038$, Table 2, Column 1). In urban areas, median OOP costs also dropped after the introduction of the ACA by $63 (64%, $p < .001$) (Table 2, Column 2). By the last six months of 2012, median OOP costs declined to just $5 in rural areas and $0 in urban areas. The rural-urban gap in OOP costs declined after the ACA by $4 (4%) per month ($p = .007$) (Table 2, Column 3).

Before the ACA, the gap in colonoscopy rates between rural and urban areas was increasing (Fig. 2) (0.004, $p < .001$; Table 2, Column 6). After the introduction of the ACA, the colonoscopy rate increased significantly in rural areas at 0.007 percentage points (2%) per month ($p < .001$) (Table 2, Column 4). In urban areas, colonoscopy rates increased 0.002 (0.4%) ($p = .027$) after the ACA (Table 2, Column 5). The gap in colonoscopy rates declined by 0.005 percentage points (6%) per month ($p < .001$) after the introduction of the ACA (Table 2, Column 6). The rural-urban gap in colonoscopy rates in the last six months of 2012 was nearly 40% lower than the gap in the last six months of 2010.

3.1. Robustness checks

Robustness tests confirm that rural residents on the whole responded more substantially to the ACA in terms of uptake of screening colonoscopies. Our results are robust to a wide range of regression specifications (Tables S2.3–S2.8 in the appendix). In all regression specifications, rural colonoscopy rates increased significantly and the

Table 1
Descriptive statistics of rural and urban insurance enrollees, aged 50–75, January 2009 to December 2010.

	Rural	Urban	p-Value [H_0 difference = 0)
Female share of members	51%	52%	< .001
Average age	62	61	< .001
Share of members enrolled in Medicare	49%	42%	< .001
Monthly share of members receiving a colonoscopy	0.39%	0.47%	< .001
Annual share of members receiving a colonoscopy	5.1%	6.1%	–
Median patient-day OOP	$195	$98	< .001
Medicare enrollee median patient-day OOP	$118	$41	< .001
Privately insured median patient-day OOP	$314	$245	< .001
Median patient-day OOP as a share of patient-day provider reimbursement	22.6%	9.7%	.001
Median claim-line OOP as a share of claim-line provider reimbursement	11.1%	0%	< .001
Median patient-day provider reimbursement	$960	$932	.001
Median claim-line provider reimbursement	$407	$433	.951

Notes: The annual share of members receiving a colonoscopy was calculated for August 1, 2009 to August 31, 2010. p-Values based on unequal variance (Welch) *t*-test of difference in monthly values. OOP: out-of-pocket payments. Patient-day OOP costs calculated as the sum of co-insurance, co-pays and deductibles of all claims on the day of the colonoscopy.

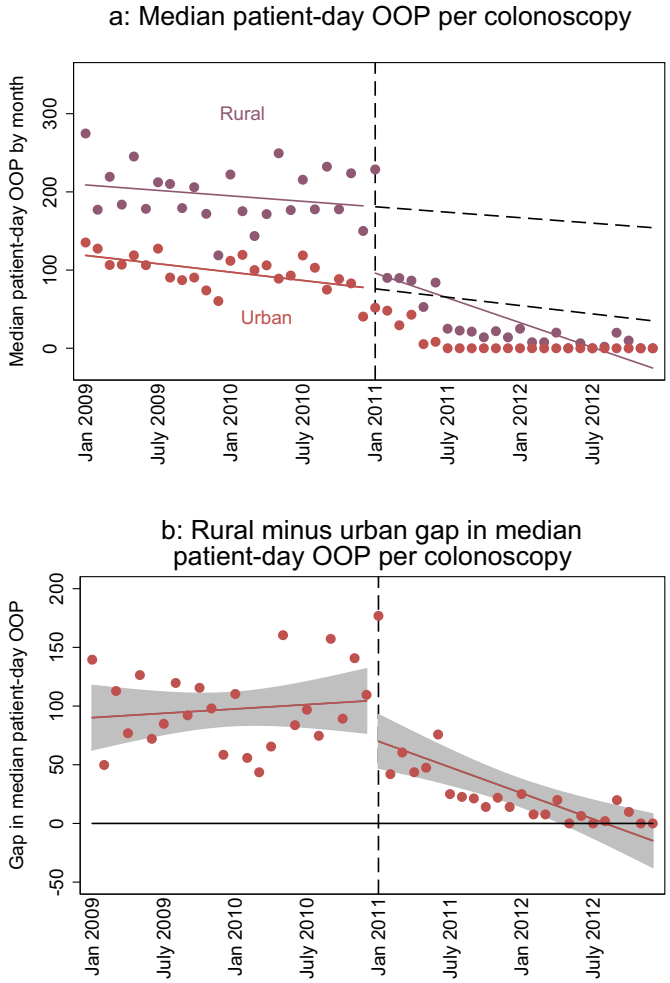

Fig. 1. Median monthly patient-day OOP patient costs for a colonoscopy, 2009–2012, by urban/rural residence.
Notes: Patient-day OOP costs represent the sum of claim-line co-payment, co-insurance and deductible payments made by the payment for any procedure received on the same day as the colonoscopy among private insurance and Medicare enrollees aged 50–75 receiving a preventive colonoscopy. Solid lines represent a linear regression of the patient-day OOP costs (a) and the differenced patient-day OOP costs (b) on the month trend. The gray area in (b) represents the 95% confidence interval of the linear regression. The horizontal dashed lines in (a) represent the extension of the pre-period trend into the post-period. OOP: out-of-pocket.

rural-urban gap in OOP and colonoscopy rates decreased significantly. Major differences pertain to the urban-only regressions for OOP costs and colonoscopy rates, which estimate statistically significant coefficients only for a small subset of the post and post X month covariates, suggesting a weaker association between the ACA and changes in colonoscopy rates among urban residents. Controlling for age and share female also resulted in non-significant results for rural OOP and the rural-urban gap in OOP, but this is the only specification for which this is observed and underscores the possible role of age-sex shifts in enrollment.

Although we cannot rule out an association with changes in insurance enrollment, our results suggest they are unlikely to be a prominent driver. We depict trends over time in enrollment counts (Fig. S3.3 in the appendix), showing that no major changes in insurance enrollment occurred during the study period. Regression results suggest a small increase in enrollment at the beginning of 2011 but the differences are larger (as a percent of existing enrollees) in urban areas than rural areas. Furthermore, the increases in rural areas are not large enough to explain the sustained 6% monthly increases in colonoscopy rates: enrollment increased just 1.6% initially and 0.07% monthly.

4. Conclusions

This study demonstrated that the ACA was associated with a substantial reduction in rural-urban disparities in OOP costs for colonoscopies and colonoscopy rates in Maine. Prior to the ACA, median OOP patient costs were nearly $100 higher for rural versus urban enrollees. After the ACA, the gap in OOP patient costs closed, with a difference of just $5 remaining by the end of December 2012, a 95% decline. The reduction in costs was associated with a 2% increase in the colonoscopy rate monthly. Rural-urban disparities in colonoscopy rates declined nearly 40% by the end of 2012.

Results from this study suggest that health insurance policies that include the elimination of patient costs for screening can have a substantial impact on the use of preventive services in rural areas. OOP costs for colonoscopies were found to be higher in rural areas in Maine where, based on data from the US Department of Agriculture, income-per-capita is 16% lower and poverty rates are 38% higher than in urban areas of the state (United States Department of Agriculture Economic Research Service (USDA-ERS), 2016). Higher costs for preventive colonoscopies are related to the low levels of financial risk protection furnished by insurance in rural areas: compared to the insured in urban areas, insured rural residents nationwide are 40% more likely to be underinsured, defined as paying > 10% of income OOP for patient care (Ziller et al., 2006). Rural employers and employees typically have plans that offer less generous coverage, including higher OOP costs as compared to urban areas (Lenardson et al., 2009).

Table 2
Interrupted time series regression results: Impact of the ACA on OOP payments and screening colonoscopies in rural vs. urban areas.

	(1) Rural median patient-day OOP ($)	(2) Urban median patient-day OOP ($)	(3) Difference (rural minus urban) in median patient-day OOP ($)	(4) Rural colonoscopy rate (%)	(5) Urban colonoscopy rate (%)	(6) Difference (rural minus urban) in colonoscopy rate (%)
Month trend	−0.62	−1.23**	0.61	−0.002	0.003***	−0.004***
	(−2.40 to 1.16)	(−2.15 to −0.32)	(−1.03 to 2.25)	(−0.004 to 0.001)	(0.002 to 0.004)	(−0.006 to −0.003)
Post indicator	−93.83**	−63.29***	−30.54	0.023	−0.013	0.0361**
	(−149.1 to −38.57)	(−88.93 to −37.66)	(−70.35 to 9.27)	(−0.013 to 0.059)	(−0.034 to 0.008)	(0.013 to 0.059)
Post indicator interacted with month trend	−4.11*	0.184	−4.30**	0.007***	0.002*	0.005***
	(−7.99 to −0.23)	(−1.12 to 1.49)	(−7.33 to −1.26)	(0.004 to 0.010)	(0.0002 to 0.004)	(0.003 to 0.007)
Season indicators	X	X	X	X	X	X
Number of data points	48	48	48	48	48	48

Notes: †p < .1, *p < .05, **p < .01. Confidence intervals in parentheses. Post is an indicator for all months from January 2011 to December 2012. OOP: out-of-pocket payments calculated as the sum of all co-insurance, co-pays and deductibles incurred on the day of the colonoscopy. Colonoscopy rates calculated as the percent of private insurance and Medicare enrollees aged 50–75 receiving a screening colonoscopy: sum of colonoscopies divided by the sum of enrollees times 100. Differences are all calculated in terms of rural minus urban. OOP: out-of-pocket payments.

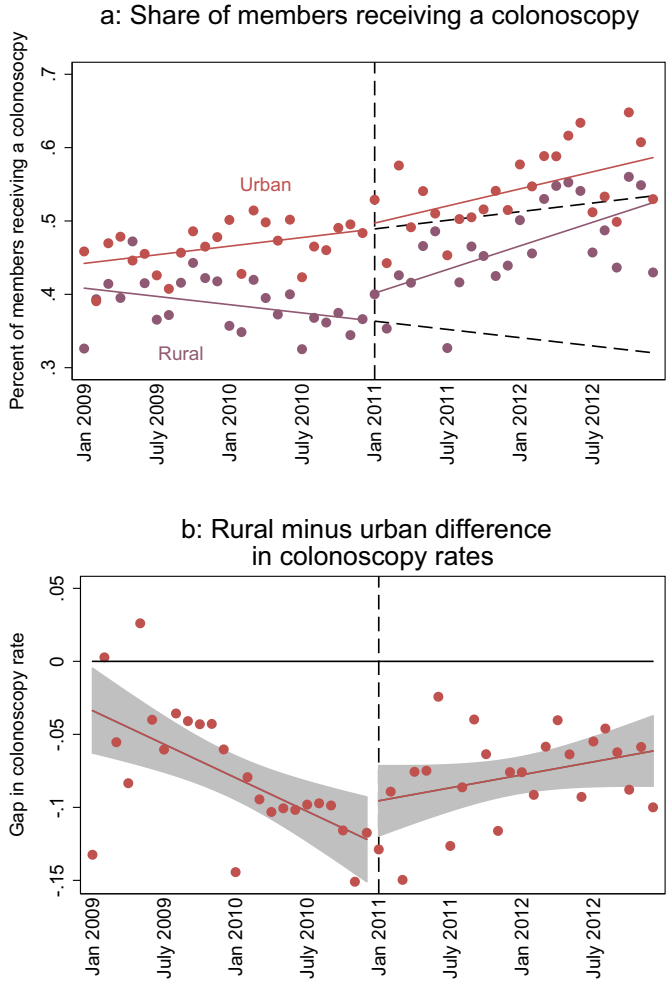

Fig. 2. Monthly colonoscopy rates, 2009–2012, by urban/rural residence.
Notes: Colonoscopy rates calculated as percent of private insurance and Medicare enrollees aged 50–75 receiving a screening colonoscopy: sum of colonoscopies divided by the sum of enrollees times 100. Solid lines represent a linear regression of the colonoscopy rate (a) and the differenced colonoscopy rate (b) on the month trend. The gray area in (b) represents the 95% confidence interval of the linear regression. The horizontal dashed lines in (a) represent the extension of the pre-period trend into the post-period.

The ACA did not tackle other known barriers to CRC screenings, which may explain the rural-urban gap that remained by December 2012. None of the provisions of the ACA that came into effect between September 2010 and January 2011 directly targeted the supply of colonoscopy providers or primary care providers, a critical issue in rural areas (Rosenblatt et al., 2010; Rosenblatt and Hart, 2000). Public awareness and acceptability also limits colonoscopy screening.

The substantial association between the ACA and CRC screening for rural residents is striking given the mixed impact of the ACA overall on rural communities found in previous literature. Existing evidence suggests that the ACA improved access to insurance in rural areas through Medicaid expansion in some states (Barker et al., 2017), and through the dependent care provision (Look et al., 2017), but this has not been shown to have translated into better access to health care or reduced OOP health care costs for rural residents. Post-Medicaid expansion reductions in costs were higher in urban areas, and upticks in a regular source of medical care and doctor visits were detectable only among urban residents (Benitez and Seiber, 2018). Rural-urban disparities in unmet need for mental health or substance abuse treatment for young adults persisted in 2014 (Chavez et al., 2018).

The main limitation of this study was the focus on a single state, which limits the generalizability to other settings. We were also unable to assess the share of beneficiaries that were up to date on CRC screening, which is pertinent for CRC health outcomes. Relatedly, we did not assess home-based methods of screening, such as fecal-occult blood tests, because of concerns of double-counting and because costs for these procedures are very low, but future research on uptake of these approaches is critical to understanding screening rates. We did not include the uninsured population in our study and thus cannot rule out the role of increased insurance coverage. Given the ten-year window for colorectal cancer screening, we are also unable to rule out the possibility that the changes observed after the ACA reflect pent-up demand, i.e. that patients in rural areas put off initial or follow-up screening until costs were eliminated. Finally, we cannot rule out the role of the ACA in increasing the inclusion of preventive colonoscopies in insurance benefits packages, and better protection of the financial risks of health care more generally, in changing the propensity of the insured population to take-up screening colonoscopies.

Rural-urban disparities in CRC screenings persisted for at least ten years nationwide before the ACA took effect (Cole et al., 2012). This makes the closing of the rural-urban gap after the ACA in Maine a potential achievement of the law and a result that can be used to assess how to tackle other rural-urban disparities in screening nationwide. Even so, further research is needed to determine whether increased uptake, particularly in rural areas, translated into cancer prevention and better patient outcomes.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ypmed.2019.105877.

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