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RESEARCH ARTICLE

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The effects of global budget payments on hospital utilization in rural Maryland

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Abstract

Objective: To assess the effect of Maryland's 2010 Total Patient Revenue (TPR) global budget reform in eight rural hospitals on population-level hospital rates of utilization three years after implementation.

Data Sources/Study Setting: Data on all inpatient discharges and outpatient department visits from the Health Services Cost Review Commission, population data from Claritas Demographic Reports, and county-level data from the Area Health Resource File.

Study Design: We use a difference-in-differences approach to compare changes in utilization rates over time in the reform areas comprising 125 Zip Code Tabulation Areas (ZCTAs) and in two control hospital areas (66 ZCTAs and 327 ZCTAs, respectively). We examine several inpatient and outpatient measures and distinguish between relatively discretionary and nondiscretionary utilization.

Data Collection: Admissions data are hospital-reported discharge abstracts of all encounters in Maryland during 2008-2013. Population data are derived from the US Census.

Principal Findings: We find no statistically significant changes in admissions, either overall or discretionary. We find a statistically significant 8.9 percent (95%CI = [1.8, 16.0]) reduction in outpatient visits, with a statistically significant reduction of 14.8 percent (95%CI = [5.3, 24.3]) visits not to the Emergency Department.

Conclusions: We find that the TPR reform decreased outpatient utilization but did not affect inpatient utilization.

KEYWORDS
hospitals, payment systems, state health policies

1 | INTRODUCTION

Provider payment reform has become a prominent strategy for health policy makers seeking to reduce spending and achieve higher health care value over the past several decades. Global budgets are promising as a payment method that caps health care expenditures, although countries like Germany, France, Canada, and Taiwan have implemented very different models.[1] In the United States, global budgets have been implemented for Maryland hospitals as one of several initiatives and demonstration programs that seek to shift provider incentives from focusing on service volume to rewarding higher quality and reductions in wasteful care. These alternative payment models include the formation of risk-taking Accountable Care Organizations (ACOs), bundled payments, primary care transformation initiatives, and pay-for-performance (P4P) programs.[2] As the shift to value-based payment is set to accelerate both within Medicare[3] and among commercial payers and Medicaid programs,[4-6] it is critical to

compare the different payment reforms in terms of their impact on utilization and quality.

Maryland implemented global budgets for rural hospitals in 2010 under its Total Patient Revenue (TPR) program and then subsequently implemented global budgets statewide in 2014 under its Global Budget Revenue (GBR) program. These reforms leveraged the state's preexisting unique all-payer hospital rate-setting system and the federal government's State Innovation Models (SIM) Initiative.[7] Previous studies have shown little early impact on inpatient readmission rates in TPR's rural hospitals[8] and on either potentially preventable complications or inpatient utilization after GBR's statewide expansion.[9-12] (See Appendix S1 for more details.)

In this paper, we evaluate the impact of the 2010 TPR reform on hospital utilization at the population level. Using data on all inpatient and outpatient discharge abstracts from Maryland hospitals from 2008 to 2013, we estimate the effects of the 2010 reform on several measures of inpatient and outpatient hospital service use. We use a difference-in-differences approach to control for trends in utilization over time in other areas served by hospitals not participating in the TPR program. The data on all patient encounters for regulated hospital services in Maryland hospitals allow us to comprehensively assess population-level changes in utilization at ZIP Code Tabulation Area (ZCTA) level. The four years of data following the reform also makes it possible to study the longer-term effects of the program, a limitation of most previous studies.

2 | POLICY DESCRIPTION

2.1 | Payment system before the TPR program

Maryland is the only state that still operates an all-payer rate-setting system for hospitals, with origins in the early 1970s, as a way to control rapid hospital cost inflation. The Health Services Cost Review Commission (HSCRC) was established in 1971 as an independent regulatory body with authority to publicly disclose hospital operating performance data and to set hospital payment rates for commercial payers and, since 1977, for public payers.

Maryland's pre-TPR hospital payment system combined elements of fee-for-service and case-based reimbursement. The state's HSCRC initially used detailed self-reported cost data from hospitals to determine hospital-specific payment rates for each service unit. Allowed charges were calculated by aggregating services provided per admission, after applying a markup, and adjusted to reflect the patient demographic mix and local labor market conditions for each hospital. The system only regulated payments to hospitals and did not apply to independent physicians. Over time, Maryland adopted case-based revenue constraints, both in inpatient and outpatient settings. (See Appendix S2 for more details.)

2.2 | The TPR program

The HSCRC introduced global budget payments for Maryland hospitals in two stages. In the first stage, eight rural hospitals adopted global budgets in 2010 as part of a three-year-long pilot program. (Characteristics of all Maryland hospitals, broken down by TPR eligibility and participation, are presented in Table A1). In the second stage, Maryland renegotiated its Medicare waiver with CMS in 2014, expanding global budgets to every hospital in the state. The new GBR system refined the approach to account for competing urban hospitals, but it maintained its core methodology.

The TPR program established a revenue target for each hospital, covering the care for the entire population in the hospital's service area. The program's stated objective was to provide hospitals with a financial incentive to manage their resources efficiently and slow down rising health care costs. The underlying goal was to increase the value of care hospitals provided to their communities.[13,15]

Hospital budgets were calculated prospectively for the fiscal year 2011 based on the previous year's utilization in each hospital's catchment area. This area included ZIP codes in which at least 75 percent of the patient volume is treated by the hospital, forming the primary service area (PSA), and ZIP codes in which between 25 and 75 percent of the patient volume is treated by the hospital, forming the secondary service area (SSA). Utilization was restricted to regulated services, consisting of inpatient and outpatient services provided at the hospital campus but excluding certain services provided at hospital-affiliated outpatient clinics or services to non-Maryland residents.

In practice, the TPR program functioned as a "shadow capitation" payment system, as hospitals continued to charge payers based on the DRG rates set by HSCRC but then adjusted their prices monthly within a ±5 percent corridor (or, if approved with justification by the HSCRC, within a ±10 percent corridor) to have total spending equal the initial budget. Each hospital was also eligible to receive an agreed-upon transitional revenue as a lump sum for specific hospital investments in the first two years of the program's operation. These revenues were intended to aid the hospitals in changing their service delivery process toward improved care coordination, chronic disease management, and resource utilization.[14] Although comprehensive data on hospitals' compliance with the budget caps were not published by the HSCRC, the studies commissioned by CMS found that most hospitals consistently reached their targets; only sporadically the revenues of one or two hospitals exceeded or did not meet the budget caps set by the HSCRC, while penalties were very rare.[11,12]

In subsequent years, the budgets were adjusted based on projected changes in patient volume, payer mix, and variation in service prices from the state-approved rates. Any overage or shortfall from the budget was applied as a penalty or addition, respectively, to the subsequent year's budget, but there was no dynamic recalculation of the budgets. Importantly, the budgets only applied to hospital revenue but not to the fees charged by the practicing physicians; most physicians in Maryland are not directly hired by hospitals but instead practice independently and may have admitting privileges in certain hospitals.

The TPR program also had the HSCRC monitor several quality indicators, including patient satisfaction and clinical quality indicators

including rates of preventable admissions and readmissions, hospital risk-adjusted mortality, and hospital-acquired conditions with the intent to counteract any potential incentives for hospitals to decrease service quality under the revenue constraint. Specifically, hospitals were eligible to receive additional "scaling revenue" if they performed well on the Hospital Consumer Assessment of Health Plans and Systems (HCAHPS)[14] and clinical process of care results as measured by the state's already ongoing Quality-Based Reimbursement Program, which added a pay-for-performance dimension to the global budget program.[13]

3 | STUDY OBJECTIVES

Our main objective is to assess the various changes in overall population-level rates of inpatient and outpatient hospital utilization associated with the TPR program. The economic incentives linked to the implementation of a global budget should result in hospital efforts to decrease utilization rates. That said, the features of the program, including the "shadow capitation" approach to payment, the exclusion of physician fees, and the preexistence of various revenue constraints for Maryland hospitals, may have led to a relatively attenuated effect.

Our second objective is to determine whether the program had differential impacts on various types of services. Specifically, one should expect TPR's incentives to cause hospitals to direct their efforts toward reducing utilization of discretionary services more compared to utilization of nondiscretionary services. In particular, we expect no effect for more essential acute inpatient services admitted from the Emergency Department (ED) (eg, hip fractures). Likewise, we expect that reductions in outpatient utilization due to TPR will be greater for non-ED visits compared to ED visits.

4 | DATA AND METHODS

4.1 | Overview of empirical approach

The main difficulty in estimating the causal effect of the TPR policy change is that estimates may be confounded by concurrent changes in utilization over time due to unobserved factors. Changes in the population at risk may affect the evolution of utilization rates in the two groups, and unobserved policy changes may also affect utilization rates over time by changing the incentives of hospitals or other providers. We therefore rely on a pre-post difference-in-differences design and, in doing so, examine two different control groups. Specifically, we compare changes in utilization per capita after reform implementation in geographic areas served by hospitals that implemented the TPR reform to changes in utilization after reform implementation in two increasingly more expansive areas served by nonparticipating hospitals, as described further below.

4.2 | Data

We assemble data from multiple sources to construct a panel of ZCTAs for 2008 through 2013, comprising 2 years in the preintervention period and 4 years in the postintervention periods. The year of the intervention, 2010, is categorized as postintervention even though the TPR program was in effect starting in July that year, because the contracts were finalized in December 2009. Therefore, hospital managers knew their facilities would face total revenue constraints in 2010. We combine data on inpatient and outpatient encounters in Maryland hospitals from the Hospital Discharge Abstract Database, with ZCTA from the Claritas Demographic Reports and county characteristics at the population level from the Area Health Resource File (AHRF; See Appendix S3 for more details.)

4.3 | TPR vs control samples

We assign ZCTAs to hospital service areas based on HSCRC methodology. As described above, the ZCTAs assigned by the HSCRC to the PSAs and SSAs of the TPR hospitals were also specified in the contracts that each hospital signed with the HSCRC; there are 135 treatment ZCTAs. We replicate the HSCRC methodology to identify the ZCTAs comprising the service areas of the control hospitals in 2010. The analyses we present include both PSAs and SSAs as part of a hospital's catchment area, but alternative analyses (not shown here) in which we exclude SSAs give qualitatively similar results, since SSAs are generally small and/or account for a relatively small share of admissions for a hospital.

Our preferred control group is comprised of only rural ZCTAs in the state, but we exclude the ZCTAs covered by the two hospitals under guaranteed revenue before the TPR program started; this control group has 66 ZCTAs. We also examine another relatively larger "extended controls" sample which includes the 126 ZCTAs which are not part of the large urban and suburban areas surrounding Baltimore and Washington, DC (but still excludes the ZCTAs served by the two hospitals under guaranteed revenue). Specifically, we exclude ZCTAs located in Core-Based Statistical Areas (CBSAs) 12580 (Baltimore-Columbia-Towson, MD) and 47900 (Washington-Arlington-Alexandria, DC-VA-WV); a CBSA is defined as the counties anchored in an urban center that are socioeconomically tied to that center by commuting. This "extended rural control" approach essentially compares TPR areas to all nonurban and non-suburban Maryland ZCTAs.

The HSCRC also assigns to the service areas of participating hospitals' several ZCTAs that are part of the neighboring states Pennsylvania and West Virginia. To ensure that the results are not confounded by other demographic, regulatory, and economic differences in these states, our main analysis excludes these out-of-state ZCTAs.

Figure 1 illustrates how the Maryland ZCTAs across these different analytical groups are distributed geographically. The TPR reform ZCTAs are shown in blue. The main set of control ZCTAs comprising

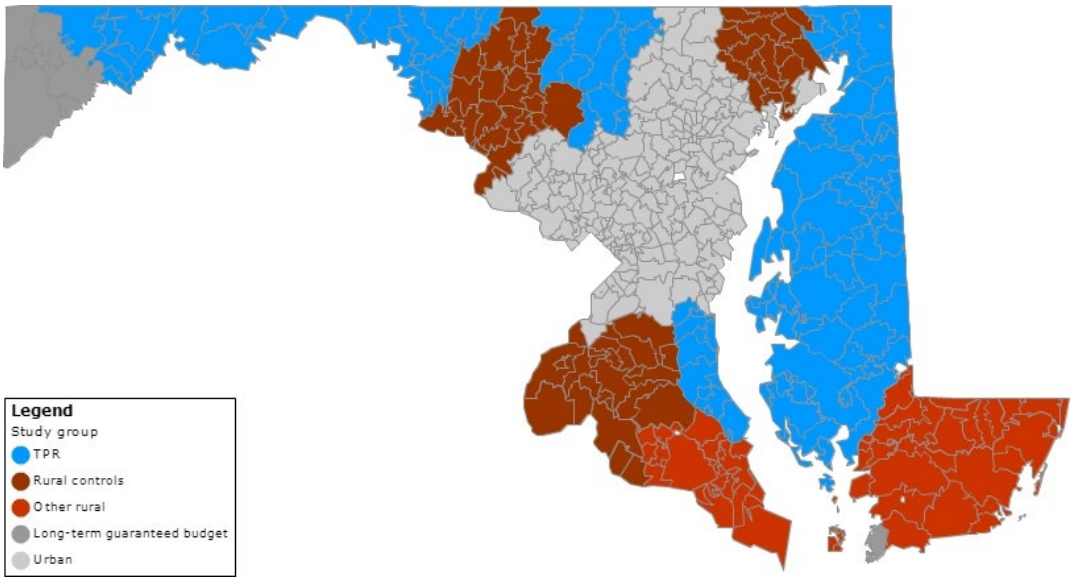

FIGURE 1 Maryland ZCTAs by assignment to treatment and control groups [Color figure can be viewed at wileyonlinelibrary.com]
Notes: Rural controls include ZCTAs assigned by the HSCRC to the service areas of hospitals that were eligible to participate in TPR but declined. Other nonurban include ZCTAs assigned to nonparticipating hospitals outside of the CBSAs 12580 (Baltimore-Columbia-Towson, MD) and 47900 (Washington-Arlington-Alexandria, DC-VA-WV).
Abbreviations: CBSAs, Core-Based Statistical Areas; HSCRC, Health Services Cost Review Commission; TPR, Total Patient Revenue; ZCTAs, Zip Code Tabulation Areas.
Source: Authors' analyses of the US Census Bureau ZCTA geographic delineations linked to hospital service areas according to HSCRC methodology.

the "rural controls" is shown in dark red. The relatively smaller suburban ZCTAs added to the "extended control" group are shown in light red. (The "extended control" group therefore includes both the dark and light red ZCTAs on the map.) Baltimore and DC's urban and suburban areas are shown in light gray, and the ZCTAs assigned to the two small rural hospitals in Maryland's long-standing "guaranteed budget" program and are shown in dark gray.

Table A2 presents summary statistics for the ZCTA- and county-level characteristics in the TPR reform and two control areas, both before and after the 2010 reform implementation. Although not all of the treatment and control groups' observable characteristics are comparable at baseline, our empirical difference-in-differences models (described in more detail below) include ZCTA-level fixed effects to control for time-invariant baseline differences in unobservable characteristics.

4.4 | Inpatient and outpatient utilization measures

Our main study outcomes are population-based measures of hospital utilization in both the inpatient and outpatient settings. Our first analyses focus on various inpatient utilization measures, and our second analyses focus on various outpatient utilization measures. Within each group of inpatient and outpatient utilization, we make several efforts to distinguish between types of utilization potentially more responsive vs less responsive to the financial incentives of TPR to reduce utilization. (Table A3 lists the outcome variables.)

For inpatient utilization, we first examine ZCTA-level models for total inpatient days and total inpatient admissions. We then distinguish between admissions not from the ED vs admissions from the ED, hypothesizing that the former are more amenable to reduction through hospital efforts. We also distinguish between deferrable vs nondeferrable admissions, where nondeferrable admissions are those with a principal diagnosis of those identified by Card et al[16] as having the same rate in the weekdays as during the weekend and thus presumably less amenable to hospital efforts to reduce utilization. Using the DRG classification, we distinguish between admissions classified under a medical DRG vs those classified under a surgical DRG. We also distinguish between nonpreventable vs potentially preventable admissions. Potentially preventable inpatient utilization measures include admissions due to Ambulatory Care Sensitive Conditions (ACSCs) as defined by AHRQ's Prevention Quality Indicators (PQIs), a validated and widely used indicator for indirectly assessing access to and quality of outpatient care.[17,18] (Table A4 lists these conditions.) Finally, we examine the rates of all-cause 30-day readmissions per 1000 residents and the 30-day readmission rate (ie, the percent of initial admissions leading to a subsequent readmission).

For outpatient utilization, we first examine ZCTA-level models for total outpatient encounters. We then distinguish between all visits not to an ED vs all ED visits. We identify ED visits as outpatient encounters with a Current Procedural Terminology (CPT) Management and Evaluation codes of 99281-99285. We also categorize ED utilization into three groups, potentially more or less amenable to hospital financial incentives. We use the ICD-9-CM codes described by Billings et al[19] which assigns a probability of falling into one of a mutually exclusive set of categories. (See Appendix S4 for details.)

4.5 | Regression analyses

We conduct all our regression analyses at the ZCTA-year level. Because the data on population rates can be skewed for most utilization measures (and thus inappropriate for OLS), our preferred specification is a Poisson model. Specifically, we estimate difference-in-differences Poisson regression models with the utilization count in the ZCTA-year N_{it} as the outcome measure and the population estimate n_{it} as the population at risk:

$$Y_{it} \sim Poisson\left(\lambda_{it}, \omega\right)$$
$$\lambda_{it} = n_{it} \times \exp\left\{\gamma T_{it} + \beta X_{it} + \delta_i + \theta_t\right\}$$

For each set of analyses, the indicator T_{it} denotes whether the reform is in effect and γ is our coefficient of interest. The main identifying assumption of this model is the conditional exogeneity of the program implementation. To make this assumption more convincing, we account for time-invariant unobserved heterogeneity by including ZCTA-level fixed effects, δ_i. We also control for sample-wide

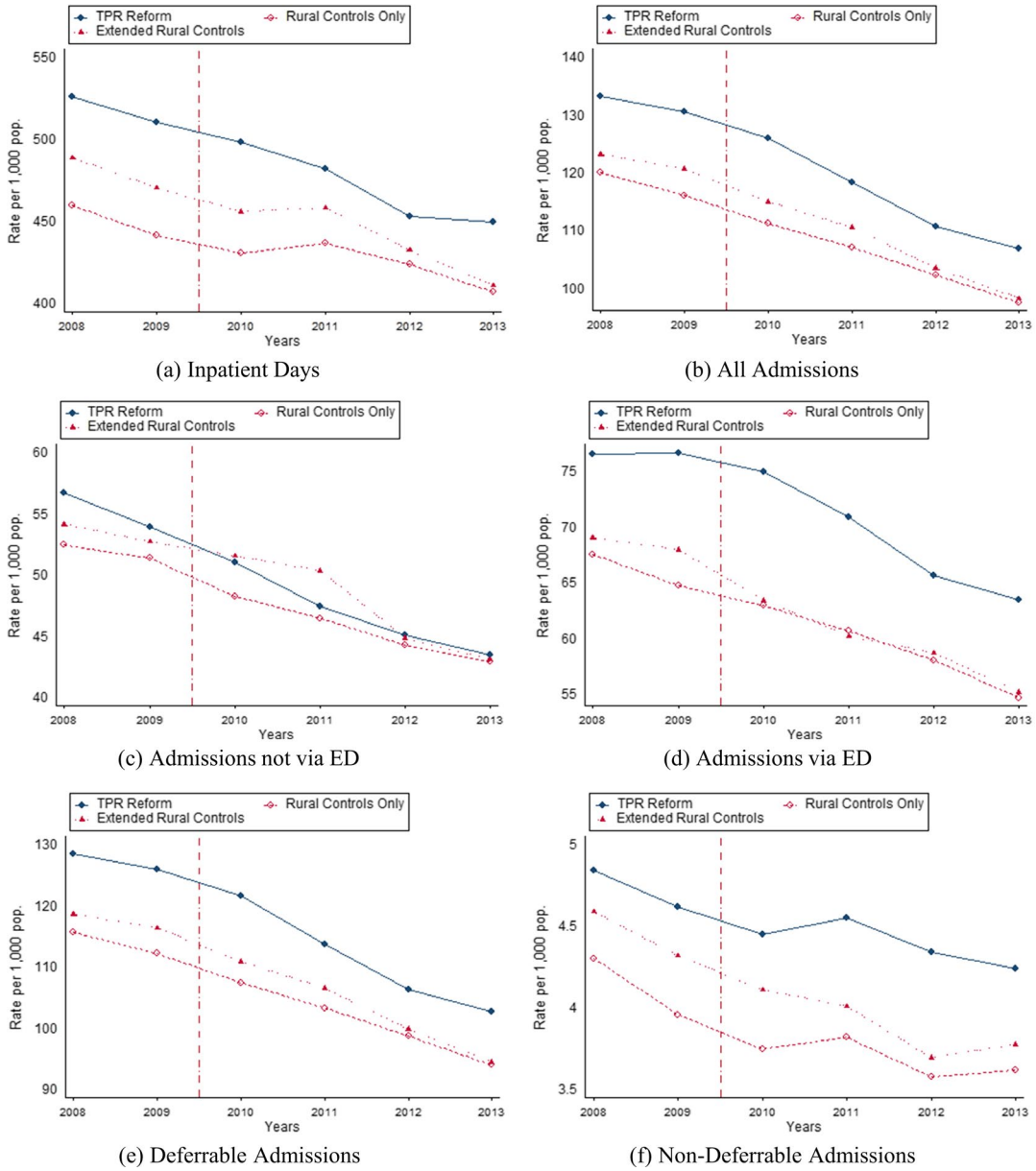

FIGURE 2 Unadjusted trends in inpatient outcomes in TPR and control areas, 2008-2013 [Color figure can be viewed at wileyonlinelibrary.com]

Notes: Authors' calculation based on inpatient discharge abstract data from the Maryland HSCRC linked to population estimates by ZCTA from the Claritas Demographic Reports. ZCTAs are assigned according to the hospital service area designations from the HSCRC. See text for definitions of the definitions of the control groups.

Abbreviations: ED, Emergency Department; HSCRC, Health Services Cost Review Commission; TPR, Total Patient Revenue; ZCTAs, Zip Code Tabulation Areas.

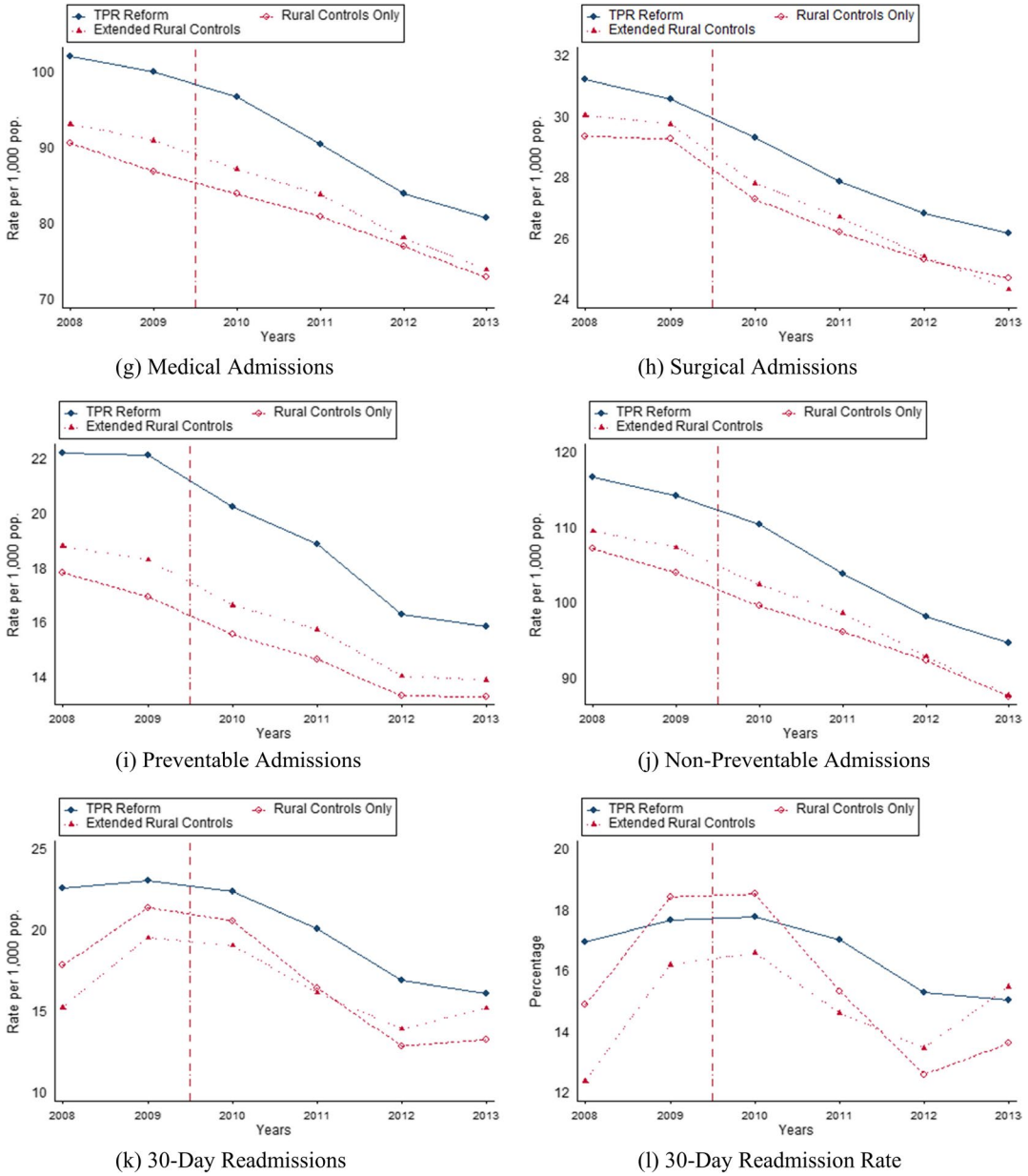

FIGURE 2 Continued

secular trends using year fixed effects θ_t. We control for the time-varying potential confounders at the ZCTA and county levels X_{it}. In all our models, we obtain robust standard error estimates which account for clustering at the ZCTA level. We also test several of the assumptions made in our preferred models in sensitivity analyses, as detailed in Appendix S4.

5 | RESULTS

5.1 | Changes in inpatient utilization

Figure 2 shows the unadjusted trends in the inpatient outcome variables for the TPR group vs the two different control groups of hospitals. This figure reveals that baseline inpatient utilization rates in the TPR hospital service areas were generally higher compared to those in the control areas. Moreover, the utilization rates are mostly following descending trends which generally appear to be parallel between the intervention and control groups before the 2010 intervention, with the exception of the 30-day readmission rates.

Table 1 presents the incidence rate differences from the Poisson regression models comparing the differential changes in inpatient service utilization between the TPR group and the two control groups, with our main focus on the results from the models using the rural-only areas as the control group, as we consider this group to be most similar to the intervention group (Estimates from linear models for inpatient utilization per capita are shown in Table A5 and are also generally similar to those presented here).

Overall, we find no statistically significant changes in inpatient utilization from the implementation of TPR. While we find a

TABLE 1 Estimated TPR effects on inpatient outcomes

	Rural controls		Extended controls	
	(1)	(2)	(3)	(4)
	Estimate	Outcome mean	Estimate	Outcome mean
Inpatient days	−5.24* (2.70)	461.7	−2.46 (2.32)	468.0
All admissions	−1.25 (3.06)	115.4	0.72 (2.49)	115.9
Admissions not from ED	−4.70 (2.81)	48.7	−6.86** (2.58)	49.5
Admissions via ED	1.20 (4.13)	66.7	6.73* (3.81)	66.4
Deferrable admissions	−1.53 (3.11)	111.2	0.38 (2.53)	111.7
Nondeferrable admissions	6.30 (4.03)	4.19	9.63*** (3.39)	4.27
Medical DRGs	−1.50 (3.38)	87.5	0.52 (2.78)	88.0
Surgical DRGs	−0.60 (2.48)	27.9	1.21 (2.09)	27.9
Nonpreventable admissions	−0.99 (2.99)	102.3	0.87 (2.39)	102.7
Preventable admissions	−2.67 (4.43)	17.3	0.055 (4.05)	17.5
30-d readmissions	6.50 (8.53)	18.7	−5.72 (6.43)	18.2
30-d readmission rate (%)	7.26 (8.22)	16.2	−7.96 (6.34)	0.16

Notes: Standard errors in parentheses. Models control for ZCTA and year fixed effects, and time-varying controls at the ZCTA and county level. Models report percent incidence rate differences. ZCTAs are assigned according to the hospital service area designations from the HSCRC. See text for definitions of the definitions of the control groups. The sample sizes for the regression models are N = 1206 ZCTA/y for the models using rural controls and N = 1566 ZCTA/y for the models using the extended controls. Models with preventable admissions as dependent variables use the adult population in each ZCTA as exposure.

Abbreviations: CBSAs, Core-Based Statistical Areas; HSCRC, Health Services Cost Review Commission; TPR, Total Patient Revenue; ZCTA, Zip Code Tabulation Area.

*$P < 0.1$, **$P < 0.05$, ***$P < 0.01$.

marginally significant decrease in inpatient days of 5.24 percent using the rural control groups, it is instead a statistically insignificant reduction of 2.46 percent when using the extended group of controls. We also observe statistically insignificant effects from the TPR reform on overall admissions compared to either control groups.

The results for discretionary inpatient utilization measures tell a similar story. While the point estimate for any discretionary admission is generally smaller than the point estimate for the less discretionary admissions (as expected), there is no consistent support that TPR indeed led to reductions in discretionary admissions. For example, there is a statistically insignificant reduction of 4.70 percent in admissions not from the ED vs a small and statistically insignificant differential increase in admissions via the ED of 1.20 percent when using the rural control groups. We also find a statistically significant reduction of 6.86 percent in admissions not originating from the ED vs a marginally significant increase in admissions via the ED of 6.73 percent when using the extended rural control groups. Similarly, TPR's effect on deferrable admissions is a statistically insignificant 1.53 percent decrease, while TPR's effect on nondeferrable admissions is a statistically insignificant 6.30 percent increase using the rural control groups. We find no statistically significant differential changes in either medical vs surgical admissions or preventable vs nonpreventable admissions.

5.2 | Changes in outpatient utilization

Figure 3 displays the unadjusted trends in the outpatient outcomes across the TPR hospital service areas and two control groups. Similar to inpatient admissions, baseline levels in outpatient visit rates are higher in the TPR hospitals compared to those in the control groups (for both visits to the ED and visits to other outpatient departments) and the trends for the TPR hospitals and control group hospitals generally appear to be parallel prior to 2010, although in contrast to inpatient admissions, outpatient visits were initially trending upward over time. Notably, Figure 3B suggests that the rate of non-ED visits decreased in the TPR areas after 2010, while it continued to increase slowly in both of the control groups. In contrast, ED visit rates

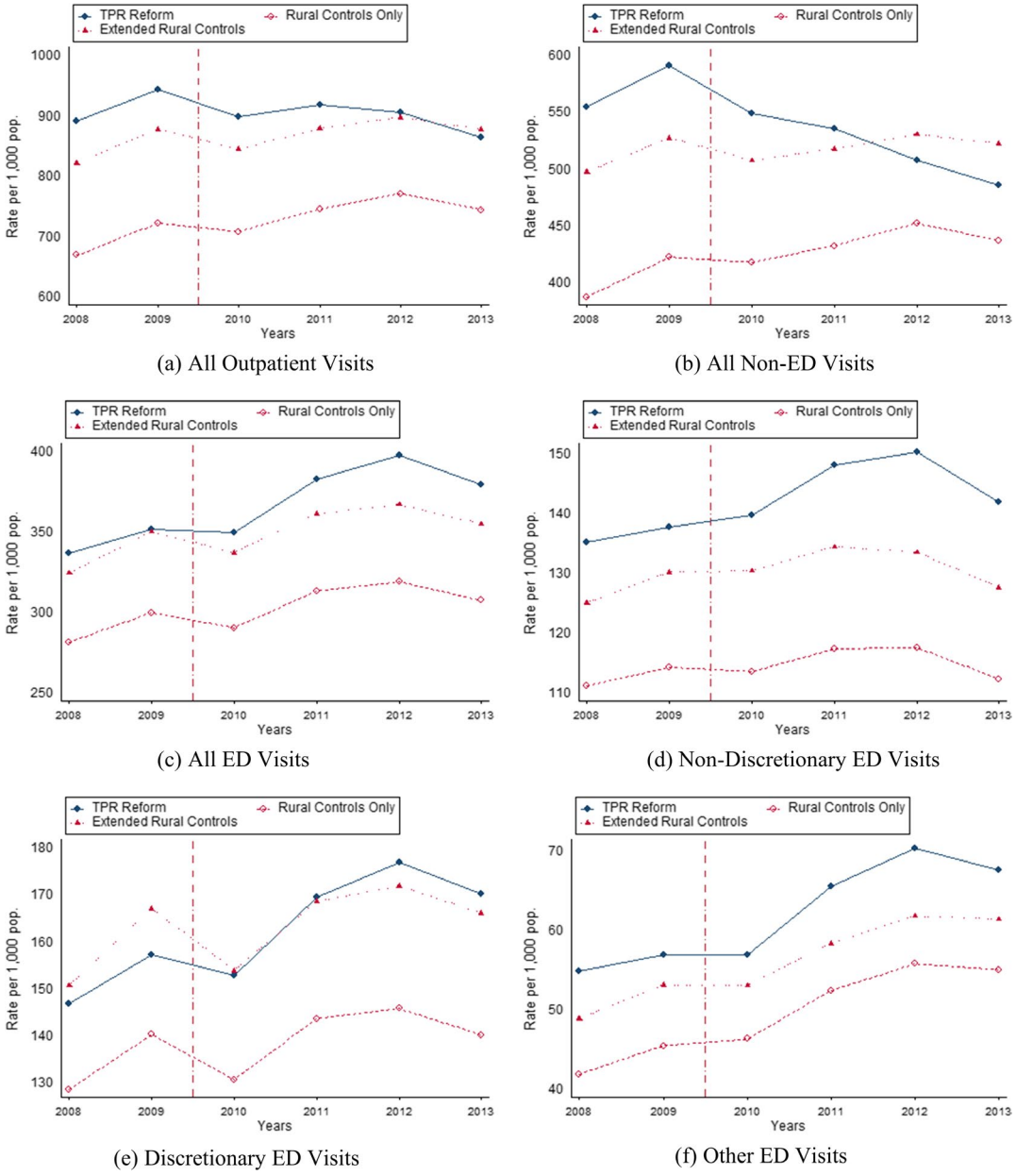

FIGURE 3 Unadjusted trends in outpatient outcomes in TPR and control areas, 2008-2013 [Color figure can be viewed at wileyonlinelibrary.com]

Notes: ZCTAs are assigned according to the hospital service area designations from the HSCRC. See text for definitions of the definitions of the control groups.

Abbreviations: HSCRC, Health Services Cost Review Commission; TPR, Total Patient Revenue; ZCTA, Zip Code Tabulation Area.

Source: Authors' calculation based on outpatient encounter abstract data from the Maryland HSCRC linked to population estimates by ZCTA from the Claritas Demographic Reports.

continued to increase in the post-TPR period across both the TPR and control areas.

Table 2 presents the incidence rate differences from the Poisson regression models assessing changes in outpatient utilization for TPR hospitals compared to the control groups (Estimates from linear models for outpatient utilization per capita are shown in Table A6 and are also generally similar to those presented here). Confirming the trends in Figure 3, the regression results indicate a statistically significant reduction in all outpatient visits of 8.86 percent when using the rural controls yet a statistically insignificant reduction of 5.49 percent when using the extended rural controls. This reduction in all outpatient visits appears to be driven by relatively large reductions in visits not to the ED, as the effect on ED visits is statistically insignificant. In particular, TPR's implementation led to a statistically significant 14.80 percent reduction in non-ED visits when compared to the rural controls and a statistically

TABLE 2 Estimated TPR effects on outpatient outcomes

	Rural controls		Extended controls	
	(1)	(2)	(3)	(4)
	Estimate	Outcome mean	Estimate	Outcome mean
All outpatient visits	−8.86** (3.63)	821.5	−5.49 (3.60)	883.6
All non-ED visits	−14.8*** (4.85)	484.9	−11.2** (4.71)	526.3
All ED visits	−0.13 (2.02)	336.6	2.55 (1.95)	357.3
Discretionary ED visits	1.22 (2.65)	151.1	3.84 (2.44)	162.8
Nondiscretionary ED visits	−0.11 (1.88)	129.2	1.02 (1.81)	135.6
Other ED visits	−4.04 (2.61)	56.2	2.21 (2.89)	58.9

Notes: Standard errors in parentheses. Models control for ZCTA and year fixed effects, and time-varying controls at the ZCTA and county level. Models report percent incidence rate differences. ZCTAs are assigned according to the hospital service area designations from the HSCRC. See text for definitions of the definitions of the control groups. The sample sizes for the regression models are N = 1206 ZCTA/y for the models using rural controls and N = 1566 ZCTA/y for the models using the extended controls. All models use the total ZCTA population in each ZCTA as exposure variable.

Abbreviations: HSCRC, Health Services Cost Review Commission; TPR, Total Patient Revenue; ZCTA, Zip Code Tabulation Area.

*$P < 0.1$, **$P < 0.05$, ***$P < 0.01$.

significant 11.2 percent reduction in non-ED visits when compared to the extended rural controls.

Overall, we find no statistically significant changes in ED visits rates for the TPR hospitals compared to the control groups. The breakdown by ED visit categories shows neither discretionary nor nondiscretionary ED visit rates experienced statistically significant changes. These findings are consistent in the TPR comparison to the larger group of Maryland controls.

6 | DISCUSSION

Our analyses estimate the effects of Maryland's global budget program for rural hospitals from its 2010 implementation through 2013 using a period of two earlier years as a baseline. While we generally find no statistically significant effects of TPR on inpatient utilization, we find that TPR had substantial reductions in outpatient utilization, which are robust across alternative model specifications. (Appendix S4 includes a description of these sensitivity analyses and Tables A7-A10 presents their results.) Overall, we find a decrease of roughly 9 percent in outpatient encounters, and this reduction is driven almost entirely by a 15 percent decrease in non-ED visits, including outpatient clinic visits and outpatient surgeries. Our insignificant inpatient results are inconsistent with the results from a similar global budget experiment implemented in Rochester, NY, between 1980 and 1984, which saw relative reductions of 5-7 admissions per 1000 residents.[20,21] (The insignificant 1.25 percent decline in total admissions we observe translates to about 1.4 admissions per 1000 residents.) The larger effect we observed for outpatient care than for inpatient care is consistent with the observation that the global budget altered financial incentives more for outpatient departments' prior use of EAPG than for inpatient settings' prior use of DRGs. Overall, our estimates indicate little to no effect on ED use.

Despite no statistically significant inpatient reductions, our pattern of results is somewhat consistent with an expectation of more discretionary impatient admissions being reduced more than less discretionary admissions. Admissions not from the ED had a statistically insignificant decrease of 4.70 percent, while admissions from the ED had a statistically insignificant increase of 1.2 percent. We find no statistically significant differential changes when we analyze admissions based on whether they are deferrable or nondeferrable, preventable or nonpreventable, medical or surgical; and we find no differential changes in 30-day readmissions.

6.1 | Limitations

Our study has notable limitations. First, we only use data on Maryland residents admitted to Maryland hospitals, which implies that the patterns of seeking hospital care at out-of-state hospitals have remained constant or at least evolved similarly over the course of the study for the individuals living in the treatment and control areas.

Second, because we must aggregate our data to the population level, our study may be underpowered to detect policy-relevant effects. Using ZCTAs as a unit of analysis may increase the possibility for geographic mismatch, as some residents use Postal Office boxes to receive their mail at work or in commercial locations. Also, population counts serving as the offset for our Poisson models are measured with error and may introduce bias toward a null effect.

Other limitations relate to measure validity, particularly those for the measures of preventable utilization. For inpatient care, although

AHRQ's Preventable Quality Indicators have been validated rigorously and have a strong track record of being used by researchers, they reflect the product of expert consensus based on available evidence and may exclude many other types of conditions for which the evidence is lacking. All-cause readmissions have been shown to have considerable limitations as quality metrics, including a strong pattern of regression to the mean.[22]

Our outpatient care measures have similar limitations. As assessing whether a specific ED visit was preventable is generally not possible without a detailed chart review, the Billings algorithm assigns each visit a probability of being in one of the categories of interest. Despite evidence suggesting that the Billings categories differentiate ED visits based on the need for hospitalization and mortality risk in commercially insured patients,[23] the algorithm was formulated using claims data from New York City in the 1990s.[19] It is possible that patterns of emergency care are different in Maryland hospitals two decades later.

Other important limitations relate to the choice of control groups and to confounding due to unobserved time-varying factors, such as other concurrent policy changes. Changes in the demand for hospital care or other programs affecting either health status or utilization may have differentially affected the treatment and control groups. Changes induced by ACOs and other initiatives, such as the Admission-Readmission Revenue (ARR) program's bundled payment initiative grouping each admission with the readmissions following it within a 30-day period, could be problematic. However, other studies of the statewide global budgets expansion[11,12] show that Maryland's unique policy and regulatory environments would undermine any alternative comparisons between Maryland populations and out-of-state groups. In that respect, our comparison group of relatively similar hospitals within Maryland is perhaps the most adequate set of control hospitals available.

6.2 | Policy implications and future research

Even in the absence of complete evidence on the impact of global budgets, our findings suggest that the impact of this payment policy on inpatient utilization has been rather limited. One explanation for this may be that the incentives of the program are not strong enough to promote profound health care delivery transformation. First, the budgets set by the HSCRC allow for the continuation and even moderate growth of historical utilization trends. Second, the structure of the program, whereby hospitals continue to charge payers and adjust their charges within a certain corridor, incentivizes reaching the full revenue target or falling within a very narrow margin of it.

Third, since the program excludes payments to physicians, there is an inherent conflict between the incentives of hospitals and those of their associated physicians, as noted by various hospital stakeholders in Maryland.[12] Although the number of physicians employed by hospitals has grown over time (both in Maryland and across the United States), the proportion of physicians employed by hospitals is still quite low.[24,25] As physicians ultimately make decisions on treatments provided, the limited scope of Maryland's global budget program on physician incentives is likely to prevent a stronger response in physician practice patterns. The proposed next phase of the GBR program seeks to better align physician incentives to regional outcomes, including outcomes related to population health.[26]

That said, our results differ from those of Roberts et al[27] in that we do find a significant decrease in outpatient visits. Their analyses use only Medicare fee-for-service data, while our analyses include all payers' data. While our result is robust to multiple alternative specifications in our sample, it is possible that it is an artifact of our inability to fully differentiate the various types of outpatient visits or our aggregation of data at the ZCTA level. However, our results for reductions in outpatient care are consistent with the more recent findings from the GBR evaluations in a CMS-commissioned report[28] with results after 3 years of implementation, suggesting that the reforms have their intended effects of limiting outpatient utilization.

Future research will undoubtedly continue to study the long-term impact of the statewide GBR program introduced in 2014. An important limitation, though, is that out-of-state control groups are susceptible to bias given Maryland's unique rate-setting system and because the program implementation coincides with the ACA's health insurance expansion. That said, it will be important to examine the impact of global budgets on nonhospital service utilization for Maryland's outpatient population, as physician services and prescription drugs are often substitutes to inpatient care.

Although the TPR program seems to have reduced outpatient utilization, the mechanism by which this occurred is not clear. One potential explanation is that increasing attention to continuity of care and hospitalization prevention among hospitals led to improvements in care which were, in turn, reflected in decreased outpatient visits. Even a small decrease in hospitalizations may be associated with fewer follow-up visits to the outpatient department. Another plausible explanation for the observed reduction in outpatient visits may be related to the proactive shift of services to other locations (which is generally not feasible for inpatient care). The HSCRC dataset includes only regulated services provided on the main hospital campus. However, many Maryland hospitals also own specific locations outside their main campus, particularly outpatient clinics, which provide services not included in the hospital global budgets. Hospitals could have potentially shifted services to these clinics (although we are unaware of evidence that this occurred). Future research should examine this care shifting as a potential unintended consequence of the global budget program.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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