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Influence of the Maryland All-Payer Model on Primary Total Knee Arthroplasties

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Background: In 2014, Maryland received a waiver for the Global Budget Revenue (GBR) program. We evaluated GBR's impact on patient and hospital trends for total knee arthroplasty (TKA) in Maryland compared with the U.S. Specifically, we examined (1) patient characteristics, (2) inpatient course, and (3) costs and charges associated with TKAs from 2014 through 2016.

Methods: A comparative analysis of TKA-treated patients in the Maryland State Inpatient Database (n = 36,985) versus those in the National Inpatient Sample (n = 2,117,191) was performed. Patient characteristics included race, Charlson Comorbidity Index (CCI), morbid obesity, patient income status, and primary payer. Inpatient course included length of hospital stay (LOS), discharge disposition, and complications.

Results: In the Maryland TKA cohort, the proportion of minorities increased from 2014 to 2016 while the proportion of whites decreased (p = 0.001). The proportion of patients with a CCI of ≥3 decreased (p = 0.014), that of low-income patients increased (p < 0.001), and that of patients covered by Medicare or Medicaid increased (p < 0.001). In the U.S. TKA cohort, the proportion of blacks increased (p < 0.001), that of patients with a CCI score of ≥3 decreased (p < 0.001), and the proportions of low-income patients (p < 0.001) and those covered by Medicare or Medicaid increased (p < 0.001). In both Maryland and the U.S., the LOS (p < 0.001) and complication rate (p < 0.001) decreased while home-routine discharges increased (p < 0.001). Costs and charges decreased in Maryland (p < 0.001 for both) whereas charges in the U.S. increased (p < 0.001) and costs decreased (p < 0.001).

Conclusions: While the U.S. health reform and GBR achieved similar patient and hospital-specific outcomes and broader inclusion of minority patients, Maryland experienced decreased hospital charges while hospital charges increased in the U.S.

Level of Evidence: Economic <u>Level IV</u>. See Instructions for Authors for a complete description of levels of evidence.

T otal joint arthroplasties are frequently performed procedures among Medicare beneficiaries and constitute the largest proportion of annual Medicare expenditures[1]. In 2010, the enactment of the Affordable Care Act (ACA) changed the health-care paradigm from a fee-for-service system to a patient-centered model[2]. Mitigating unnecessary health expenses and high-volume surgical procedures such as total knee arthroplasty (TKA) became a target of the ACA's cost-containment strategies[1,3]. Under the ACA, the Centers for Medicare & Med-

icaid Services (CMS) introduced the Comprehensive Care for Joint Replacement (CJR) and Bundled Payments for Care Improvement (BPCI) initiative, which are alternative payment models to improve care delivery and control Medicare spending[4]. The CJR and BPCI emphasized coordinated care following total joint arthroplasties and demonstrated cost reduction; however, the long-term consequences and sustainability remain unknown.

Maryland acquired a waiver in 2014 to implement the ACA through a unique payment model called Global Budget

TABLE I Maryland Patient Demographics					
	No. (%)*				
Demographics	2014	2015	2016	Total†	P Value
No. of patients	11,994	12,148	12,843	36,985	
Age (yr)	65.58 (9.76)	65.63 (9.71)	66.14 (9.56)	65.78 (9.70)	<0.001
Sex					0.821
Male	4,330 (36.1%)	4,389 (36.1%)	4,676 (36.4%)	13,395	
Female	7,663 (63.9%)	7,757 (63.9%)	8,153 (63.6%)	23,573	
Race					0.001
White	7,707 (75.2%)	8,963 (74.3%)	9,407 (73.5%)	26,077	
Black	1,951 (19.0%)	2,406 (19.9%)	2,597 (20.3%)	6,954	
Hispanic	204 (2.0%)	238 (2.0%)	291 (2.3%)	733	
Asian	185 (1.8%)	221 (1.8%)	264 (2.1%)	670	
Native American	13 (0.1%)	33 (0.3%)	46 (0.4%)	92	
Other	189 (1.8%)	208 (1.7%)	188 (1.5%)	585	
CCI					0.014
0	38 (0.3%)	38 (0.3%)	40 (0.3%)	116	
1	398 (3.3%)	394 (3.2%)	409 (3.2%)	1,201	
2	1,825 (15.2%)	1,974 (16.2%)	2,193 (17.1%)	5,992	
≥3	9,733 (81.1%)	9,742 (80.2%)	10,201 (79.4%)	29,676	
Median household income quartile‡					<0.001
1 ($1-$39,999/$1-$41,999/$1-$42,999)	1,013 (8.5%)	1,100 (9.1%)	1,115 (8.7%)	3,228	
2 ($40,000-$50,999/$42,000-$51,999/ $43,000-$53,999)	1,293 (10.9%)	1,110 (9.2%)	1,277 (10.0%)	3,680	
3 ($51,000-$65,999/$52,000-$67,999/ $54,000-$70,999)	2,758 (23.2%)	2,717 (22.5%)	3,320 (26.0%)	8,795	
4 (≥$66,000/≥$68,000/≥$71,000)	6,834 (57.4%)	7,143 (59.2%)	7,048 (55.2%)	21,025	
Primary payer					<0.001
Medicare	6,218 (51.8%)	6,345 (52.2%)	6,984 (54.4%)	19,547	
Medicaid	567 (4.7%)	635 (5.2%)	628 (4.9%)	1,830	
Private	4,835 (40.3%)	4,813 (39.6%)	4,766 (37.1%)	14,414	
Self-pay	16 (0.1%)	12 (0.1%)	9 (0.1%)	37	
No charge	5 (0.0%)	1 (0.0%)	3 (0.0%)	9	
Other	353 (2.9%)	341 (2.8%)	450 (3.5%)	1,144	
Morbidly obesity				0	0.012
No (BMI <40 kg/m^2)	10,570 (88.1%)	10,681 (87.9%)	11,169 (87.0%)	32,420	
Yes (BMI ≥40 kg/m^2)	1,424 (11.9%)	1,467 (12.1%)	1,674 (13.0%)	4,565	

*Except for age, which is given as the mean with the standard deviation in parentheses. †Except for age, which is the mean for the 3-year period. ‡2014/2015/2016.

Revenue (GBR). Under this program, individualized annual capitated budgets are set for each hospital on the basis of historic volume, patient demographics, and case mix[5]. Hospitals still receive payments from private and public payers; however, rate setting is enforced, creating a common rate for hospital-based inpatient, outpatient, and emergency services, eliminating cost shifting between payers for hospital-based services[5]. By constraining hospital revenue, GBR incentivizes hospitals to reduce unnecessary utilization due to readmissions and complications, thereby reducing cost and improving quality. However, there are concerns about decreased access to care, as hospitals may avoid high-risk patients.

Maryland and the CMS both agreed on specific benchmarks for Maryland to attain between January 2014 and January 2019, including limiting annual hospital revenue growth to 3.58%, saving $330 million for Medicare, achieving a 30% reduction in preventable hospital-acquired complications, and reducing 30-day readmissions to match the national average[6]. CMS viewed this program as a potential model for

TABLE II Maryland TKA Outcomes					
	No. (%)*				
Demographics	2014	2015	2016	Total†	P Value
LOS *(days)*	2.65 (1.34)	2.47 (1.29)	2.31 (2.18)	2.47 (1.67)	<0.001
Discharge disposition					<0.001
Home-routine	4,465 (37.4%)	4,724 (38.9%)	5,198 (40.5%)	14,387	
Short-term hospital	32 (0.3%)	32 (0.3%)	23 (0.2%)	87	
Other facility	3,227 (27.0%)	3,061 (25.2%)	3,000 (23.4%)	9,288	
Home health care	4,212 (35.3%)	4,306 (35.5%)	4,617 (35.9%)	13,135	
Left against medical advice	1 (0.0%)	5 (0.0%)	3 (0.0%)	9	
Deceased	4 (0.0%)	5 (0.0%)	2 (0.0%)	11	
Charges ($)	23,377.46 (8,512.52)	22,713.15 (7,995.19)	21,990.87 (8,671.51)	22,677.77 (8,421.75)	<0.001
Costs ($)	17,956.22 (6,818.48)	17,786.01 (6,323.11)	17,389.21 (6,990.41)	17,703.39 (6,725.52)	<0.001
Complications					<0.001
Not present	9,576 (79.8%)	10,249 (84.4%)	11,032 (85.9%)	30,857	
Present	2,418 (20.2%)	1,899 (15.6%)	1,811 (14.1%)	6,128	
Readmissions					<0.001
Not readmitted	11,758 (98.0%)	11,814 (97.3%)	12,620 (98.3%)	36,192	
Readmitted	236 (2.0%)	334 (2.7%)	223 (1.7%)	793	

*Except for LOS, charges, and costs, which are given as the mean with the standard deviation in parentheses. †Except for LOS, charges, and costs, which are the means for the 3-year period.

other states to adopt and will likely base its decision on initial results[7].

In Maryland, the Health Services Cost Review Commission (HSCRC) is the state regulatory body charged with design, implementation, and oversight of the GBR model. Several benchmarks were achieved by the end of 2017, including an average hospital per capita cost growth of 2.03%, 916 million Medicare dollars saved, and readmission rates that were 0.19% lower than national readmission rates[8].

The ACA is shifting health care away from volume-based models to ones that reward value and care quality[9,10]. Given that GBR is Maryland's method of implementing the ACA, we aimed to evaluate GBR's impact on patient and hospital trends for primary TKA in Maryland compared with the U.S. as a whole. Specifically, this study examined and compared changes regarding (1) patient characteristics, (2) inpatient course, and (3) costs and charges for inpatient hospital stays for patients who underwent primary TKA between January 1, 2014, and December 31, 2016. We hypothesized that GBR reduced TKA costs more than the U.S. had in the same time frame.

Materials and Methods
Database
This study utilized the Maryland State Inpatient Database (SID) and the National Inpatient Sample (NIS) to analyze trends. These are large public data sets provided by the Agency for Healthcare Research and Quality (AHRQ) and available from the Healthcare Cost and Utilization Project (HCUP)[11].

Patient Selection
We queried the Maryland SID and the NIS between January 1, 2014, and December 31, 2016, for all primary TKA procedures by utilizing the International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) and ICD-10-CM procedure codes for primary TKA. We then excluded all revision TKAs and primary and revision total hip arthroplasties by using their ICD-9 and 10 codes. A total of 2,154,176 patients were identified.

Variables
Patient characteristics included race, health status, morbid obesity (body mass index [BMI] ≥40 kg/m^2), income status, and primary payer. Race was categorized according to the HCUP website as white, black, Asian, Hispanic, Native American, or other[11]. Health status was determined using the age-adjusted Charlson Comorbidity Index (CCI)[12], which was calculated using diagnosis codes within each database. Income status was estimated using the median household income by ZIP Code. Income levels are updated yearly and ranked into quartiles. Quartile 1 is considered the poorest and quartile 4 is considered the wealthiest. National and state-level insurance payers were categorized as Medicare, Medicaid, private, self-pay, no charge, and other.

Inpatient course included length of hospital stay (LOS), discharge dispositions, and inpatient complications. LOS was recorded from the date of admission to the date of discharge. Dispositions after discharge were classified as 6 destinations:

TABLE III U.S. Patient Demographics					
	No. (%)*				
Demographics	2014	2015	2016	Total†	P Value
No. of patients	680,241	702,999	733,951	2,117,191	
Age (yr)	65.89 (9.79)	66.08 (9.70)	66.39 (9.57)	66.13 (9.68)	<0.001
Sex					0.015
Male	259,440 (38.1%)	267,680 (38.1%)	280,990 (38.3%)	808,110	
Female	420,780 (61.9%)	435,209 (61.9%)	452,490 (61.7%)	1,308,479	
Race					<0.001
White	520,960 (82.0%)	534,164 (81.6%)	570,135 (82.0%)	1,625,259	
Black	49,300 (7.8%)	54,855 (8.4%)	55,935 (8.0%)	160,090	
Hispanic	37,490 (5.9%)	37,935 (5.8%)	41,275 (5.9%)	116,700	
Asian	8,965 (1.4%)	10,465 (1.6%)	10,605 (1.5%)	30,035	
Native American	2,490 (0.4%)	2,820 (0.4%)	2,840 (0.4%)	8,150	
Other	15,875 (2.5%)	14,110 (2.2%)	14,175 (2.0%)	44,160	
CCI					<0.001
0	2,385 (0.4%)	2,410 (0.3%)	2,850 (0.4%)	7,645	
1	23,165 (3.4%)	23,145 (3.3%)	24,400 (3.3%)	70,710	
2	106,390 (15.6%)	111,215 (15.8%)	119,495 (16.3%)	337,100	
≥3	548,300 (80.6%)	566,229 (80.5%)	587,206 (80.0%)	1,701,735	
Median household income quartile†					<0.001
1 ($1-$39,999/$1-$41,999/$1-$42,999)	144,385 (21.6%)	157,300 (22.7%)	162,790 (22.5%)	464,475	
2 ($40,000-$50,999/$42,000-$51,999/$43,000-$53,999)	190,055 (28.4%)	173,915 (25.1%)	188,460 (26.1%)	552,430	
3 ($51,000-$65,999/$52,000-$67,999/$54,000-$70,999)	175,185 (26.2%)	191,795 (27.7%)	195,715 (27.1%)	562,695	
4 (≥$66,000/≥$68,000/≥$71,000)	159,590 (23.8%)	168,980 (24.4%)	175,740 (24.3%)	504,310	
Primary payer					<0.001
Medicare	370,870 (54.6%)	388,549 (55.3%)	415,575 (56.7%)	1,174,994	
Medicaid	26,385 (3.9%)	30,150 (4.3%)	31,700 (4.3%)	88,235	
Private	257,575 (37.9%)	258,610 (36.8%)	260,395 (35.5%)	776,580	
Self-pay	2,860 (0.4%)	3,345 (0.5%)	3,465 (0.5%)	9,670	
No charge	340 (0.1%)	260 (0.0%)	340 (0.0%)	940	
Other	21,155 (3.1%)	21,470 (3.1%)	21,725 (3.0%)	64,350	
Morbid obesity					<0.001
No (BMI <40 kg/m^2)	621,186 (91.3%)	638,499 (90.8%)	662,531 (90.3%)	1,922,216	
Yes (BMI ≥40 kg/m^2)	59,055 (8.7%)	64,500 (9.2%)	71,420 (9.7%)	194,975	

*Except for age, which is given as the mean with the standard deviation in parentheses. †Except for age, which is the mean for the 3-year period. ‡2014/2015/2016.

home-routine, short-term hospital, other facility, home health care, left against medical advice, and deceased. Complications included both procedure-related and medical-related inpatient complications.

Hospital costs were estimated utilizing the "Cost-to-Charge Ratio" supplemental file provided by HCUP. Hospital charges were recorded as the total amount that the hospital billed the insurance payer for the inpatient stay. The Consumer Price Index was utilized to adjust all dollar amounts to January 2018.

Data Analysis

A side-by-side qualitative analysis was utilized to compare patient characteristics and outcomes between Maryland and the U.S. This design was chosen to avoid confounding factors due to Maryland data being included in the U.S. data. Analysis of variance (ANOVA) and chi-square analyses were performed to evaluate patient and hospital characteristics during the study. A p value of 0.05 was set as the threshold for significance. All analyses were performed using SPSS version-25 software.

TABLE IV U.S. TKA Outcomes

Demographics	No. (%)*				P Value
	2014	2015	2016	Total†	
LOS (days)	2.84 (1.53)	2.68 (1.62)	2.48 (1.69)	2.66 (1.62)	<0.001
Discharge disposition					<0.001
Home-routine	199,485 (29.3%)	227,099 (32.3%)	256,551 (35.0%)	683,135	
Short-term hospital	3,165 (0.5%)	2,705 (0.4%)	1,945 (0.3%)	7,815	
Other facility	195,730 (28.8%)	179,630 (25.6%)	157,850 (21.5%)	533,210	
Home health care	281,310 (41.4%)	292,170 (41.6%)	316,140 (43.1%)	889,620	
Left against medical advice	140 (0.0%)	855 (0.1%)	520 (0.1%)	1,515	
Deceased	290 (0.0%)	320 (0.0%)	170 (0.0%)	780	
Destination unknown	20 (0.0%)	0 (0.0%)	0 (0.0%)	20	
Charges ($)	59,820.16 (34,182.29)	61,724.26 (36,770.48)	62,073.87 (35,290.19)	61,235.48 (35,456.09)	<0.001
Costs ($)	16,845.17 (7,745.08)	16,948.06 (8,267.88)	16,644.04 (7,472.19)	16,809.49 (7,832.08)	<0.001
Complications					<0.001
Not present	522,600 (76.8%)	559,154 (79.5%)	598,161 (81.5%)	1,679,915	
Present	157,640 (23.2%)	143,845 (20.5%)	135,790 (18.5%)	437,275	

*Except for LOS, charges, and costs, which are given as the mean with the standard deviation in parentheses. †Except for LOS, charges, and costs, which are means for the 3-year period.

Results

Maryland

Patient Characteristics

In Maryland, 36,985 patients underwent a TKA from 2014 through 2016 (Table I). The mean patient age increased (65.6 years in 2014 versus 66.1 years in in 2016, p < 0.001) while the proportion of females remained consistent (63.9% versus 63.6%, p = 0.821).

There were decreases in the proportions of white (−1.7%) and "other" (−0.3%) patients from 2014 to 2016 and increases in the proportions of non-white groups (Native Americans, +0.3%; blacks, +1.3%; Hispanics, +0.3%; and Asians, +0.3%) (p = 0.001 for all). The proportion of patients with a CCI score of ≥3 decreased (−1.7%) while the proportion of those with a CCI score of 2 increased (+1.9%) (p = 0.014 for both). The Maryland data showed an increase in the proportion of patients in income quartile 1 (+0.2%) and a decrease in those in quartile 4 (−2.2%) (p < 0.001 for both). Usage of Medicare increased (+2.6%) from 2014 to 2016, as did Medicaid (+0.2%), while use of private insurance decreased (−3.2%) (p < 0.001 for all). There was an increase in morbid obesity (+1.1%, p = 0.012).

Inpatient Course

The mean LOS decreased from 2.65 to 2.31 days from 2014 to 2016 (p < 0.001) (Table II). Discharges to home-routine increased (37.4% versus 40.5%) while discharges to other facilities decreased (27.0% versus 23.4%, p < 0.001 for both). The complication rate decreased (−6.1%, p < 0.001).

Hospital Costs and Charges

Between 2014 and 2016, charges decreased (−5.9%, p < 0.001) and costs decreased (−3.2%, p < 0.001).

U.S.

Patient Characteristics

In the U.S., 2,117,191 patients underwent TKA from 2014 through 2016 (Table III). The mean patient age increased (65.9 years in 2014 versus 66.4 years in 2016, p < 0.001), and the proportion of females decreased (61.9% versus 61.7%, p = 0.015).

From 2014 to 2016, the proportions of white (0.0%), Hispanic (0.0%), and Native American (0.0%) patients stayed constant, while those of black (+0.2%) and Asian (+0.1%) patients increased (p < 0.001 for all). The proportion of patients with a CCI score of ≥3 decreased (−0.6%) while that of patients with a CCI score of 2 increased (+0.7%) (p < 0.001 for both). There were increases in the proportions of patients in income quartile 4 (+0.5%) and quartile 1 (+0.9%) (p < 0.001 for both), and a decrease in the proportion of those in quartile 2 (−2.3%, p < 0.001). Medicare (+2.1%) and Medicaid (+0.4%) usage increased, and use of private insurance decreased (−2.4%) (p < 0.001 for all). Morbid obesity increased (+1.0%, p < 0.001).

Inpatient Course

The mean LOS decreased from 2.84 to 2.48 days from 2014 to 2016 (p < 0.001) (Table IV). Home-routine (29.3% versus 35.0%) and home health care (41.4% versus 43.1%) discharges increased, while short-term hospital (0.5% versus 0.3%) and other facility (28.8% versus 21.5%) discharges decreased (p < 0.001 for all). The complication rate decreased (−4.7%, p < 0.001).

Hospital Costs and Charges

From 2014 to 2016, charges increased (+3.8%, p < 0.001) while costs decreased (−1.2%, p < 0.001).

Maryland Versus United States

Patient Characteristics

The proportions of black and Asian patients increased in both TKA cohorts, while the proportions of Native Americans and Hispanics increased in the Maryland TKA cohort (Native Americans, +0.3%; Hispanics, +0.3%) but not in the U.S. TKA cohort (Native Americans, +0.0%; Hispanics, +0.0%). The proportion of CCI scores of ≥3 decreased in both (Maryland: −1.7% versus U.S.: −0.6%) while the proportion of CCI scores of 2 increased in both (Maryland: +1.9% versus U.S.: +0.7%). The proportion of patients in income quartile 1 increased in both groups (Maryland: +0.2% versus U.S.: +0.9%). Use of Medicare (Maryland: +2.6% versus U.S.: +2.1%) and Medicaid (Maryland: +0.2% versus U.S.: +0.4%) increased in both.

Inpatient Course

Both cohorts had a decrease in the mean LOS (Maryland: −0.34 day versus U.S.: −0.36 day) and complications (Maryland: −6.1% versus U.S.: −4.7%) as well as an increase in home-routine discharges (Maryland: +3.1% versus U.S.: +5.7%).

Hospital Costs and Charges

Charges declined in Maryland (−5.9%) but rose in the U.S. (+3.8%). Costs decreased in both cohorts (Maryland: −3.2% versus U.S.: −1.2%).

Discussion

In January 2014, CMS implemented GBR as an experimental all-payer model in the state of Maryland with a goal to maximize care quality while reducing spending[13]. Program initiation coincided with the national health reform and, specifically, when major health coverage provisions were taking effect[9,14]. Maryland's GBR program and the ACA have similar aims including improving quality of care, increasing access to care, and encouraging utilization of primary care services to manage chronic illness and prevent unnecessary hospital usage[13]. In this study, we examined GBR's impact on primary-TKA patient and hospital trends as well as costs and charges in Maryland compared with those in the U.S. from 2014 to 2016. During the study, patients undergoing TKA in 2016 were healthier than those treated in 2014 in both cohorts, despite increases in morbid obesity. Furthermore, more patients had Medicare and Medicaid in 2016, the mean LOS was shorter, there were fewer complications, and hospital costs were lower. Major differences included greater increases in TKA utilization by minority patients in Maryland. Additionally, hospital TKA charges decreased in Maryland while they increased nationwide. Many trends seen in both cohorts were similar, possibly because of the overarching ACA effects on Maryland. However, the differences between Maryland and the U.S. may highlight some GBR effects on TKA utilization.

This study had limitations. There was some inherent interdependence between the databases utilized for analysis (NIS and Maryland SID) because Maryland's state data contributed to the NIS data set, although the contribution was relatively small. To avoid potential analysis issues, side-by-side qualitative analysis was utilized to evaluate both data sets. Additionally, both databases rely on administrative ICD-9-CM and ICD-10-CM coding for primary TKA and may be prone to transcription errors. However, these errors are likely minimal. Another limitation is the lack of recorded readmissions within the NIS database, which prevented us from reporting national readmission rates. Nevertheless, the aim of this study was to evaluate hospital performance, which fulfills the purpose behind HCUP's database and its aim to inform health policy makers and stakeholders.

The age of patients undergoing TKA increased in both Maryland and the U.S during the course of this study. While this finding could reflect the aging population, these results are not clinically relevant. Furthermore, there was a modest decrease in the proportion of females receiving TKA in the U.S. While statistically significant, we do not believe that this is clinically relevant.

During the study, shifts in racial demographics occurred in Maryland. The combined proportions of minority patients (all non-white races) receiving primary TKA increased, while the proportion of white patients decreased. Conversely, in the U.S. TKA population, the proportion of patients identifying as black or Asian increased and all other groups demonstrated no change. While we are not aware of any study examining GBR's effect on TKA utilization among minority patients, Gwam et al. found an increase in primary TKA utilization among black, Hispanic, and Asian patients from 2009 to 2015[15]. The additional year of data in our study demonstrated no significant difference among Hispanic and Native American patients from 2009 to 2016.

Regarding the health status of patients undergoing TKA, the proportion of patients with a CCI score of ≥3 decreased during the study in both cohorts. Both the ACA and GBR models aim to improve population health by increasing utilization of primary care and health screening services to proactively identify and treat chronic disease to avoid readmission penalties, which may have contributed to reductions in the percentages of severely medically compromised patients[16]. However, there is concern that GBR may restrict access to care for populations that have been more expensive to treat, such as those with a higher CCI score[17]. This may have contributed to the observed reduction in CCI scores for patients undergoing TKA in Maryland. Continuous monitoring is required to ensure that GBR does not leave behind those with the greatest need.

Despite nationally declining CCI scores among TKA recipients, the proportion of morbidly obese patients undergoing the procedure increased in both cohorts during the study period. National trends suggest that BMI is increasing among the American population, and more morbidly obese patients may require TKA[18]. While heavier patients generally have more comorbidities, BMI is only one component of the CCI score and may not substantially contribute to the composite score

for TKA recipients, which may explain why CCI scores are decreasing.

The percentage of patients insured by Medicaid increased from 2014 to 2016 in both TKA cohorts. Similarly, Gwam et al. found increased Medicaid utilization in their study of national TKA trends from 2009 to 2015[15]. Since the ACA implemented insurance expansion provisions, the number of patients with health insurance who were previously uninsured increased, probably as a result of increased Medicaid eligibility in participating states[19]. Maryland became a Medicaid-expansion state on January 1, 2014, the same date that the GBR program started[20], which may explain increases in Medicaid usage and percentages of non-white patients receiving TKA in Maryland. Moreover, our findings demonstrate increased TKA utilization in the lowest income quartile. While the GBR model aims to decrease preventable utilization of emergency and hospital services[21], the greatest effect of population health improvement projects is likely attributed to enhanced access to preventive care and not elective procedures such as TKA.

Our analysis demonstrated a decrease in LOS in both the U.S. and Maryland and a reduction in Maryland readmissions. LOS is an important metric for efficiency of care delivery and is the driving force behind rapid recovery protocols[22-24]. The LOS after surgical procedures has been decreasing since 2008[3], a trend that has continued according to the present study. Additionally, complications are employed as a benchmark to determine care quality and reimbursement rates[3,25]. In October 2014, the ACA introduced the Hospital-Acquired Condition Reduction Program (HACRP) to hold hospitals accountable for hospital-acquired complications and to penalize those performing in the lowest 25th percentile[7]. Therefore, reductions in complications in both cohorts may be attributable to ACA-guided CMS initiatives. We previously reported a reduction in complications following TKA in the post-GBR period (23.1% versus 12.5%, p = 0.117)[10]. Although the finding was not statistically significant, a reduction in complications is favorable and clinically relevant.

The number of home-routine discharges increased in both cohorts. We previously found that the percentage of patients who were discharged to home following primary TKA in Maryland increased from 2012 to 2015 (66.9% versus 73.6%, p = 0.058)[26]. It is plausible that improved care following the ACA and the introduction of the BPCI initiative, whereby patient-centered care is carried through by care coordination, discharge planning, and medication reconciliation, led to an increase in discharges to home[27].

Hospital charges increased nationally but decreased in Maryland. Charges under GBR are capped, which may explain why they were lower and decreased more than they did in the U.S. To ensure that inpatient hospital costs are covered for the uninsured and public programs, hospitals outside of Maryland increase charges in anticipation of negotiating better reimbursements with private insurance companies[28]. Unfortunately, this tactic comes at the detriment of uninsured patients and smaller insurance companies, who must pay more because they cannot compete with the monopoly power of larger hospital networks[28]. This cost shifting does not occur in Maryland. All insurance companies, public payers, and the uninsured are charged the same amount, ensuring the economic burden of TKA is shared equitably.

Hospital costs decreased in both cohorts. Reduced costs and hospital savings could be achieved with comprehensive coordinated care[29]. In both the U.S. and Maryland, this coordination partially contributed to cost savings via decreased admissions to inpatient facilities, decreased inpatient LOS, and fewer readmissions[5]. However, hospitals under GBR are financially incentivized to go further, leading to increased home visits to patients, improved discharge planning, investments in continuity of care, and improved treatment adherence programs to avoid unnecessary hospital utilization[30].

Conclusions

The enactment of the ACA marked the beginning of a transition from a volume-based model of health care to a care-based model with the aims of reducing costs, improving population health and access, and optimizing quality of care[5,25]. GBR, an all-payer model, is Maryland's unique mechanism for enacting the ACA[5]. TKA is a common procedure in the U.S. that has been a major target for cost-reduction initiatives[1]. Therefore, our study evaluated trends in both Maryland and the U.S. between 2014 and 2016. Despite similar outcomes, hospital charges decreased in Maryland while they increased in the U.S. We believe that these findings will be useful for objectively critiquing the effects of GBR on high-demand procedures such as TKA. ■

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