Ninety-Day Readmissions of Bundled Valve Patients: Implications for Healthcare Policy

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Medicare's Bundle Payment for Care Improvement (BPCI) Model 2 groups reimbursement for valve surgery into 90-day episodes of care, which include operative costs, inpatient stay, physician fees, postacute care, and readmissions up to 90 days postprocedure. We analyzed our BPCI patients' 90-day outcomes to understand the late financial risks and implications of the bundle payment system for valve patients. All BPCI valve patients from October 2013 (start of risk-sharing phase) to December 2015 were included. Readmissions were categorized as early (≤30 days) or late (31–90 days). Data were collected from institutional databases as well as Medicare claims. Analysis included 376 BPCI valve patients: 202 open and 174 transcatheter aortic valves (TAVR). TAVR patients were older (83.6 vs 73.8 years; $P = 0.001$) and had higher Society of Thoracic Surgery predicted risk (7.1% vs 2.8%; $P = 0.001$). Overall, 18.6% of patients (70/376) had one-or-more 90-day readmission, and total claim was on average 51% greater for these patients. Overall readmissions were more common among TAVR patients (22.4% (39/174) vs 15.3% (31/202), $P = 0.052$) as was late readmission. TAVR patients had significantly higher late readmission claims, and early readmission was predictive of late readmission for TAVR patients only ($P = 0.04$). Bundled claims for a 90-day episode of care are significantly increased in patients with readmissions. TAVR patients represent a high-risk group for late readmission, possibly a reflection of their chronic disease processes. Being able to identify patients at highest risk for 90-day readmission and the associated claims will be valuable as we enter into risk-bearing episodes of care agreements with Medicare.

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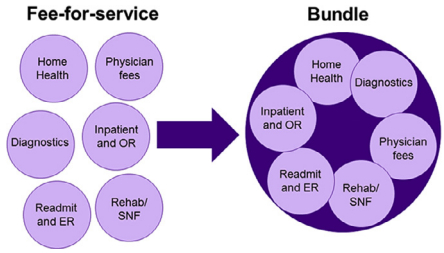
Keywords: Bundled payments, Healthcare policy, Readmissions



Transition from fee-for-service to bundled payment model.

Central Message

Financial risk bearing for extended episodes of care is associated with significant late (post-30 day) postdischarge claims dollars in valve patients.

Perspective Statement

Bundle payment models assign financial responsibility for extended episodes of care to the cardiac surgeon. After optimizing postdischarge management to reduce readmissions, significant late financial risk exists. Targeting high-risk patients to optimized late management may help. Late readmissions may represent chronic disease state; these patients may not be appropriate for prolonged risk sharing.

Abbreviations: ACA, Affordable Care Act; BPCI, Bundled Payments for Care Improvement; CHF, congestive heart failure; CNP, cardiac nurse practitioner; CMMI, Center for Medicare and Medicaid Innovation; CMS, Centers for Medicare and Medicaid Services; CSSL, cardiac surgical service line; DRG, Diagnosis Related Group; EOC, episode of care; FFS, fee-for-service; HRRP, Hospital Readmissions Reduction Program; SAVR, surgical aortic valve replacement; STS, Society of Thoracic Surgery; TAVR, transcatheter aortic valve replacement; TVT, transcatheter valve therapy

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INTRODUCTION

Unplanned hospital readmission has long been recognized as a significant driver of healthcare spending, making readmission reduction an important target of healthcare reform.[1] Historically, readmission rates for Medicare beneficiaries in the fee-for-service (FFS) program have been reported as high as 20% within 30 days and 34% at 90 days.[2,3] Thirty-day readmissions accounted for approximately $24 billion of Medicare spending in 2011 alone.[4] In an effort to consolidate care and move away from the traditional "FFS" payment model, the Center for Medicare and Medicaid Innovation (CMMI) was created under the Affordable Care Act in 2010 to investigate and test new payment and service delivery models.

Model 2 of Bundled Payments for Care Improvement (BPCI) initiative was developed by the CMMI to allow providers to

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take financial risk for all Medicare billable services during a 90-day episode of care (EOC), starting with an index hospital admission for medical or surgical Diagnosis Related Group (DRG) and continuing for 90 days postdischarge regardless of index admission length of stay. It is a retrospective payment arrangement where actual Medicare expenditures are reconciled against a baseline target price for the EOC.[5] If a provider was able to reduce 90-day Medicare costs below a provider-specific baseline, the provider could share in the savings with Medicare. Financial risk creates incentives for the providers to control costs during the entire 90-day period including postacute care, readmissions, and emergency room use.[6,7]

Our institution entered the financial risk-bearing phase of BPCI Model 2 for 90-day EOC payments for valve procedures and instituted a postdischarge management process to help reduce costs; we previously reported information regarding our postdischarge management through 30 days.[8] After completing the prolonged reconciliation of the master claim file, we now report our BPCI patients' 90-day financial outcomes.

The purposes of this report were to describe observations regarding readmission rates during the 90-day EOC for FFS Medicare patients undergoing valve replacement and to identify post discharge Medicare payments, when they occurred, and with which patient subpopulations they were associated.

METHODS

Local institutional review board approval for retrospective de-identified data analysis was obtained with waiver of the requirement for written informed consent.

BPCI Details

Our institution decided to participate in BPCI Model 2 for valve surgery with a 90-day EOC. The preparation period started in January 2013 with the financial risk-bearing phase starting in October 2013. Patient inclusion criteria include traditional Medicare as the primary payer with eligibility for Part A and enrollment in Part B, and index admission at our institution. Exclusion criteria include end-stage renal disease, enrollment in any managed care plan (Medicare Advantage, Health Care Prepayment Plans, cost-based health maintenance organizations), and coverage under United Mine Workers. Additionally, if a patient dies or has a major noncardiac event (such as emergent orthopedic procedure), the patient is excluded from the bundle payment program.

Institutional Response in Preparation of BPCI

As previously described, our cardiac surgical service line team developed a comprehensive management and discharge planning approach.[8] Briefly, it includes presurgical risk stratification based on a variety of heart failure, frailty and cognitive measures, early predischarge planning, and family education with coordination of home-care services or acute and/or subacute facilities. Standardized postdischarge management led by cardiac nurse practitioners included 48 hours phone contact, regimented office visits (postdischarge days 7 and 21) and visit with a cardiologist on day 14. This tight management was employed through 30 days postdischarge with a separate care coordination team maintaining contact through the remaining 90 days of the EOC.

Patients and Outcomes

All BPCI valve patients from October 1, 2013 to December 31, 2015 were included in analysis. Patients were grouped according to DRG codes: DRGs 216−221 for open valves and DRGs 266−267 for Cary (TAVR). We analyzed Centers for Medicare and Medicaid Services (CMS) claim data linked to our prospectively collected adult cardiac surgery discharge database, as well as Transcatheter Valve Therapy and Society of Thoracic Surgery (STS) registries. Readmissions were identified based on CMS claims for unplanned in-patient hospitalizations, and categorized as early (≤30 days) or late (31−90 days) from index admission discharge. These claims were inclusive of all hospitals where readmissions of index patients occurred, including outside institutions. Administrative claims data did not include detailed reasons for the readmission. About half of all readmissions occurred at non-NYU hospitals.

Statistics

Statistical analyses were performed using SPSS 23 (IBM Corp; Armonk, NY). Readmission rates were calculated per index discharge. Continuous variables are reported as mean ± standard deviation (SD) with non-normally distributed data reported as median and interquartile range (IQR), unless otherwise stated. Categorical variables are reported as a rate of occurrence. Groups were compared by χ^2 methods while nonparametric testing was employed (Mann-Whitney) for analysis of non-normally distributed data. A P value less than or equal to 0.05 was considered statistically significant. The Andersen-Gill methodology for recurrent time-to-events was used to test for variables impacting readmissions.[9] The weighted readmission claims payments were explored with the Nelson methodology[10] for mean cumulative function. Both analyses were performed using SAS 9.4 (SAS Institute Inc, Cary, NC).

RESULTS

From October 2013 to December 2015, 1404 valve procedures were performed at our institution; 326 TAVR and 1078 open surgical cases. Of these, 376 patients were Medicare FFS participants in BPCI, 202 were open surgical valves, and 174 were TAVR (Table 1). As expected, TAVR patients were older (83.6 ± 6.0 years vs 73.8 ± 8.0 years; $P = 0.001$) and had higher STS predicted risk (median 6.6% vs 2.0%; $P = 0.001$), with a higher incidence of several comorbidities as outlined in Table 2. With respect to demographics, open surgical valve patients were more likely to be Caucasian (89.6% (181/202) vs 62.1% (108/219), $P < 0.001$) and TAVR patients were more likely to have Medicaid as a secondary insurance carrier (12.6% (22/219) vs 4.0%

Table 1. Surgical Valve Procedures Performed in 376 BPCI Valve Patients

OPEN DRGs (216–221)	*N* = 202
Aortic	77 (38.1%)
Mitral	50 (24.8%)
Tricuspid	1 (0.5%)
Multi valve	18 (8.9%)
CABG/Valve	29 (14.4%)
Other	27 (13.4%)
TAVR DRGs (266–267)	*N* = 174
TAVR	174 (100%)

DRG, Diagnosis Related Group; CABG, coronary artery bypass graft; TAVR, transcatheter aortic valve replacement.

(8/202); $P = 0.004$). Index procedure median length of stay was 6 days (IQR 4–8 days) for open surgical patients and 2 days (IQR 1–3) for TAVR patients, $P < 0.001$.

Overall, 18.6% of patients (70/376) had 1 or more readmission within 90 days for a total of 104 readmissions; 14 patients had 2 readmissions and 7 patients had more than 2 readmissions. Half of all readmissions occurred during the first 30 days (52/104). Readmission was more prevalent among TAVR patients (22.4% (39/174) vs 15.3% (31/202), $P = 0.052$). While there was no difference in early readmissions between groups (12.1% TAVR, 9.9% open; $P = 0.501$), late readmission occurred more frequently in TAVR patients (14.9% TAVR vs 6.4% open; $P = 0.007$).

Univariate analysis revealed that older age and higher STS risk score were associated with late readmissions, as were congestive heart failure (CHF) and non-Caucasian race (Table 3). Open valve patients who had an early readmission were at no higher risk of subsequent late readmission (2/20; 10.0%); early readmission of TAVR patients was associated with late readmission ([8/21; 38.1%], $P = 0.002$).

Multivariable analysis of recurrent time-to-readmission revealed that STS risk score was the sole significant predictor ($\chi^2 = 5.96$; $P = 0.015$) of readmissions. The weighted readmission claims payments stratified by open valves and TAVR are presented in Figure 1. DRG category was not significant ($P = 0.104$; log-rank test).

The average CMS DRG payment for early readmission at all facilities was the same for open surgical and TAVR patients, $14,437 (IQR 6319) and $13,853 (IQR 7846) respectively. While there was a minor difference in early readmission rate between the two groups, the total early readmission claims for each cohort were effectively the same: $288,741 for open and $290,924 for TAVR. Each episode of late readmission had an average CMS claim of $14,179, with $10,740 for open DRGs and $15,899 for TAVR DRGs at all facilities. Overall, late readmission claims consumed $553,018, with $139,628 for open DRGs and $413,389 for TAVR DRGs (Table 4). Patients with at least 1 readmission had a significantly higher total episode claim than those without readmissions, 51.1% higher ($P < 0.001$). This trend was more pronounced among the TAVR group (64.8% higher) than for open valves (42.9%).

DISCUSSION

With the future of the BPCI program in question, it is important to understand the implication of these bundled payment models and their applicability to various procedural and medical diagnoses. Since entering the financial risk-bearing phase of Model 2 for valve procedures in October 2013, we have just now accrued enough data to evaluate the financial impact and institutional risk. Among our 376 BPCI valve patients, we found 10.9% of patients were readmitted within 30 days and 18.6% of patients had at least 1 readmission by 90 days. Accounting for all 90-day readmissions for index discharges, the total readmission rate was 27.7% (104/376).

Table 2. Preprocedural Patient Demographics in 376 BPCI Valve Patients

	All BPCI Valves *n* = 376	Open Surgical *n* = 202	TAVR *n* = 174	*P* Value
Age (mean ± SD)	78.3 ± 8.7	73.8 ± 8.0	83.6 ± 6.0	
Age (median – IQR)	78 – 12.3	74 – 10.0	84 – 9.00	<0.001
Male	218	120 (59.4%)	98 (56.3%)	0.62
EF (mean ± SD)	58.6 ± 12.5	59.7 ± 11.4	57.2 ± 13.7	
EF (median – IQR)	60.0 – 10.0	60.0 – 10.0	60.0 – 15.0	0.056
Congestive heart failure	150 (39.9%)	75 (37.1%)	75 (43.1%)	0.141
Non-Caucasian	87 (23.1%)	21 (10.3%)	66 (37.9%	<0.001
Diabetes	89 (23.7%)	35 (17.3%)	54 (31.0%)	0.003
Chronic obstructive pulmonary disease	53 (14.1%)	19 (9.4%)	34 (19.5%)	0.008
Baseline creatinine ≥ 2.0	16 (4.3%)	5 (2.5%)	11 (6.3%)	0.065
History atrial fibrillation	113 (30.1%)	69 (34.2%)	44 (25.3%)	0.061
Prior sternotomy	85 (22.6%)	28 (13.9%)	57 (32.8%)	<0.001
STS risk (mean ± SD)	4.95 ± 3.68	2.79 ± 2.67	7.08 ± 3.3	
STS risk (median – IQR)	3.98 – 5.04	2.0 – 2.10	6.5 – 3.50	<0.001
Medicaid secondary insurance	30 (8.0%)	8 (4.0%)	22 (12.6%)	0.004
Length of stay, d (median – IQR)	4 – 4	6 – 4	2 – 2	<0.001

EF, ejection fraction; STS, Society of Thoracic Surgeons; TAVR, transcatheter aortic valve replacement; IQR, Inter Quartile Range.

Table 3. Univariate Factors Associated With Late Readmission (30–90 days; $n = 52$)

	Late Readmit With Risk Factor	Late Readmit Without Risk Factor	Odds Ratio (95% CI) χ^2	*P* Value
Age, y (mean ± SD)	N/A	N/A	NA	0.044*
Male	24 (11.0%)	15 (9.5%)	1.18 (0.60–2.33)	0.641
Non-Caucasian	15 (17.2%)	24 (8.3%)	2.30 (1.15–4.61)	0.017
STS risk score, %	N/A	N/A	NA	0.006*
TAVR	26 (14.9%)	13 (6.4%)	2.55 (1.27–5.14)	0.007
Congestive heart failure	22 (14.7%)	17 (7.5%)	2.11 (1.08–4.13)	0.021
Diabetes	12 (13.5%)	27 (9.4%)	1.50 (0.73–3.10)	0.271
Chronic obstructive pulmonary disease	6 (11.3%)	33 (10.2%)	1.12 (0.45–2.82)	0.807
Baseline creatinine ≥2.0	3 (18.8%)	36 (10.0%)	2.08 (0.57–7.63)	0.481
Atrial fibrillation	15 (13.3)	24 (9.1%)	1.52 (0.77–3.03)	0.226
Prior sternotomy	9 (10.6%)	30 (10.3%)	1.03 (0.47–2.26)	0.941
Medicaid secondary insurance	5 (16.7%)	34 (9.8%)	1.84 (0.66–5.11)	0.239

CI, confidence interval; STS, Society of Thoracic Surgeons; TAVR, transcatheter aortic valve replacement.
*Mann-Whitney test.

In September 2016, CMMI released an evaluation report of the data accrued from the second year of the BPCI program (fiscal Q4 2013–Q3 2014). During that period, there were 30 hospitals participating in Model 2 for Cardiovascular Surgery and 2859 EOCs were initiated (32% of these were for valve MS-DRGs), 87% of which were 90-day episodes. For all cardiovascular DRGs, CMS reports an unplanned readmission rate of 15.4% within 30 days and 24.2% within 90 days—similar to

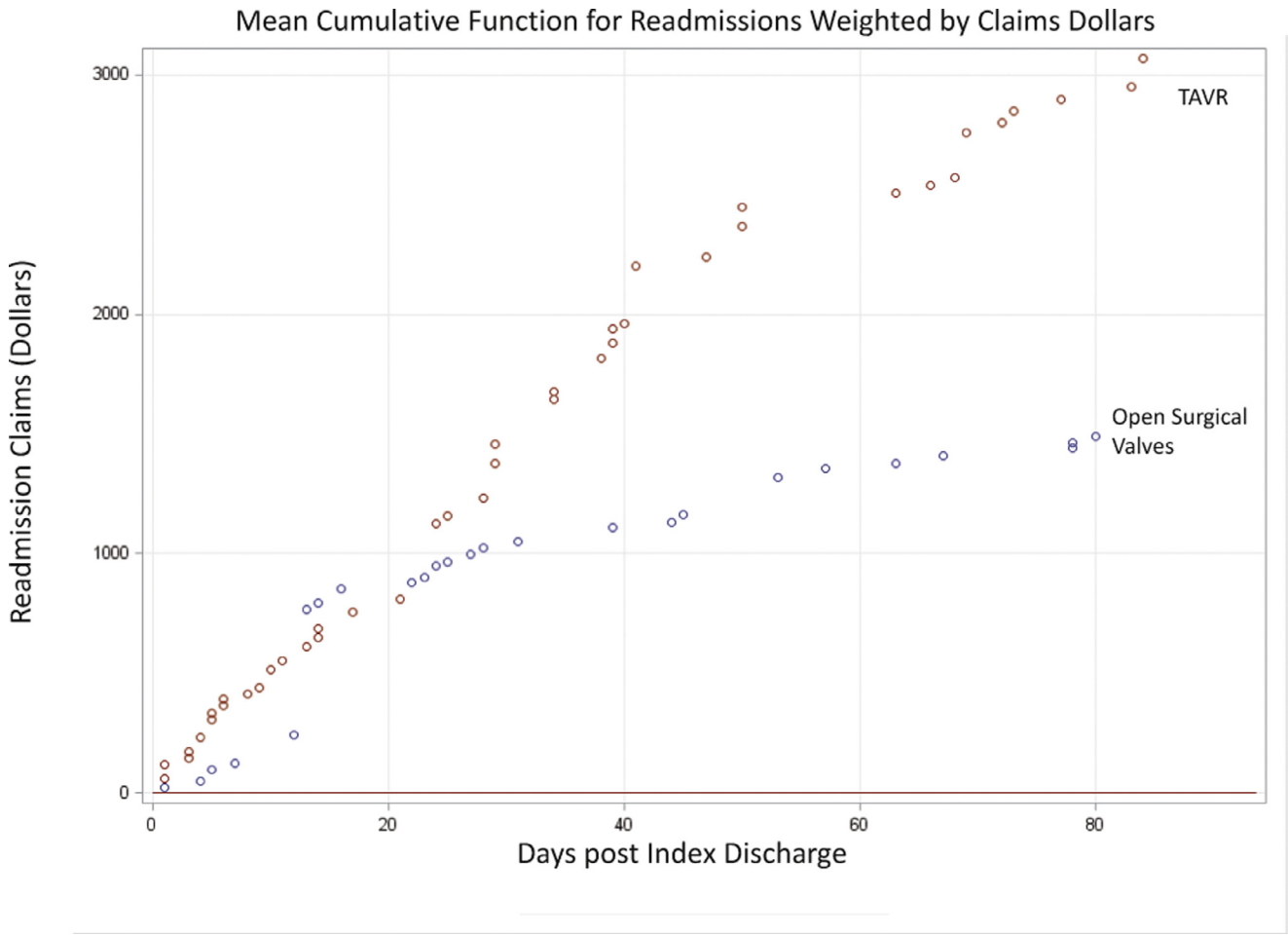


Figure 1. Mean cumulative function for readmissions weighted by readmission claims. Color version of figure is available online.

Table 4. Early and Late Readmissions and CMS Claims Dollars for BPCI Patients

	All Bundle Valves ($n = 376$)	Open Valves ($n = 202$)	TAVR ($n = 174$)	*P* Value
Patients with any readmission	70 (18.6%)	31 (15.3%)	39 (22.4%)	0.052
Patients with early readmission	41 (10.9%)	20 (9.9%)	21 (12.1%)	0.501
Patients with late readmission	39 (10.4%)	13 (6.4%)	26 (14.9%)	0.007
>1 early readmits	8 (2.1%)	3 (1.5%)	5 (2.9%)	0.283
>1 late readmits	10 (2.7%)	5 (2.5%)	5 (2.9%)	0.529
Early readmit claims dollars*	$14,138	$14,437	$13,853	0.770
Median [IQR]	$7767 [7402]	$6416 [6319]	$9633 [7846]	
Mean [sum]	[$579,665]	[$288,741]	[$290,924]	
Late readmit claims dollars*	$14,179	$10,740	$15,899	0.011
Median [IQR]	$9290 [12,431]	$6524 [10,279]	$9600 [14,296]	
Mean[sum]	[$553,018]	[139,628]	[$413,389]	

TAVR, transcatheter aortic valve replacement; IQR, Inter Quartile Range.
*Claims dollars represent payments to all hospitals where readmission occurred (approximately 50% to outside institutions).

the rates seen in our series.[11] To understand the financial impact of BPCI, CMS created a matched comparison group of all Medicare beneficiaries and tabulated their spending under the BPCI rules. Both the BPCI and matched comparison groups were compared to their baseline from Q4 2011 to Q3 2012 to find an intervention effect. They found no difference in readmission rates or episode spending between BPCI and the comparison groups.[11]

There are a paucity of data in the cardiothoracic surgery literature on 90-day outcomes as until the BPCI initiative, the 30-day postoperative period used as a standard quality metric. Indeed, several recent series have been published on 30-day readmission after cardiac surgery and TAVR, with readmission rates ranging from 12% to 25%.[12–14] Iribarne et al. used 65-day follow-up data from the Cardiothoracic Surgery Trials Network of over 5000 open surgical patients, and found an overall rate of readmission of 18.7% with 80% of patients readmitted in the first 30 days.[15]

In our series, with follow-up carried through 90 days postdischarge, only half of the readmissions in the 90-day EOC occurred in the first 30 days. Looking specifically at late readmission, we identified TAVR, age, STS risk score, non-Caucasian race, and history of CHF as risk factors. CHF and age have both been consistently reported as risk factors for 30-day readmission across several different patient populations.[12–16] Readmission has also been linked to socioeconomic differences including low-income, educational level, and race.[16,17] Non-Caucasian race is possibly a surrogate for socioeconomic status in our data set, but unfortunately our data lacks the granularity to elucidate this further.

With TAVR patients representing an older population with greater comorbidities, it is not surprising that late readmission is higher in this group. In our series, approximately 15% of TAVR patients had late readmissions vs 6% for open surgical patients. Over $500,000 in CMS claims were incurred for late readmissions, with 75% spent on TAVR patients.

Readmissions only account for approximately 5% of our total 90-day episode claims. Interestingly, however, those patients with a readmission had on average 50% higher 90-day episode claims. This reflects greater episode spending for these readmitted patients, which is not accounted for by the cost of the readmission itself. Readmission, therefore, can act as an identifier of higher risk, higher cost patients. For example, in our TAVR population, early readmission was predictive of late readmission. If strategies can be employed to identify these patients on their first readmission, resources can target preventing subsequent readmission and potentially reduce spending for these high-risk patients.

LIMITATIONS

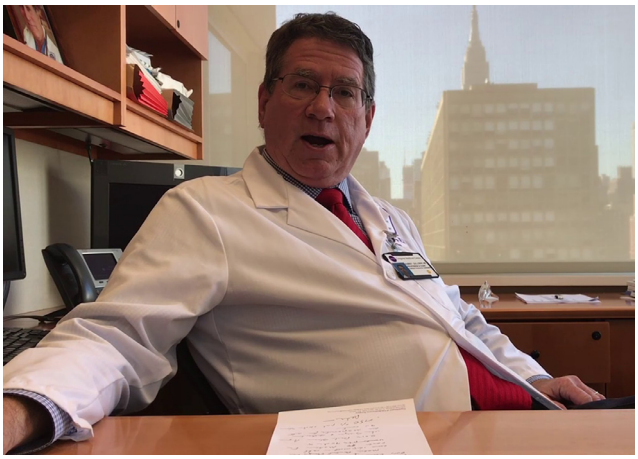
There were several limitations to this study. This is a single-center analysis with a relatively small sample size. We relied on CMS claims data for all readmissions, assuring full capture of readmissions to our institutions or any external facility. While we had the benefit of our electronic medical record for patients seen at our institution, outside hospital claims data are unavailable. Due to cofounders such as mortality exclusion and lack of detailed clinical information other than CMS payments beyond 30 days, we do not believe that complex modeling analyses would be useful and in fact could be misleading due to participation censuring in the Bundle program. As noted previously, death is not a competing risk in the bundle program—it is a post hoc eliminator to which we are blinded by CMS and unable to obtain.

CONCLUSION

There is significant spending due to readmissions in valve surgery patients in the BPCI initiative, particularly in TAVR patients, where early readmission predicts late readmission. Additionally, readmitted valve patients have over 50% greater episode claims than those without readmission. Late readmissions in high-risk patients may represent chronic disease management and identifying these high-risk and/or high-cost patients may allow for targeting of resources for optimized late outpatient management as we enter into an era of prolonged risk bearing.

SUPPLEMENTARY MATERIAL

The following is the supplementary data to this article:



Video 1. Dr Galloway discusses the impact of readmissions in the 90-day risk-sharing bundle pilot with CMS.

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