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Published in:
Journal of Comparative Effectiveness Research

DOI:
10.2217/cer-2022-0112

Publication date:
2022

Research Article

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Journal of **Comparative Effectiveness Research**

Costs and outcomes of mobile cardiac outpatient telemetry monitoring post-transcatheter aortic valve replacement

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Aim: To estimate the costs and outcomes of transcatheter aortic valve replacement (TAVR) recipients based on the use of mobile cardiac outpatient telemetry (MCOT) monitoring. **Materials & methods:** A retrospective database study was conducted to estimate costs, contribution margins (CMs), pacemaker insertions and other outcomes for patients undergoing TAVR procedures with MCOT monitoring post-procedure versus non-MCOT monitoring. **Results:** A total of 4164 patients were identified (283 MCOT monitoring and 3881 non-MCOT monitoring). The rate of pacemaker insertion following hospital discharge was higher in the MCOT cohort (6.6 MCOT vs 2.1% non-MCOT; p = 0.007). MCOT use was associated with lower costs and improved CMs of the index TAVR admission (costs: US$40,569 MCOT vs $43,289 non-MCOT; p = 0.003; CMs: US$7087 MCOT vs $5177 non-MCOT; p = 0.047) with no difference through the subsequent 60-day period following discharge. **Conclusion:** MCOT for ambulatory cardiac monitoring post-TAVR discharge is associated with higher rates of pacemaker insertion, at no overall greater costs.

First draft submitted: 15 June 2022; Accepted for publication: 15 July 2022; Published online: 28 July 2022

Keywords: ambulatory monitoring • health economics • MCOT • medicare • outcomes research • TAVR

Transcatheter aortic valve replacement (TAVR) is a percutaneous procedure for the treatment of severe, symptomatic aortic stenosis [1,2]. While data on the prevalence of aortic stenosis is sparse, a 2013 study estimated that 91,000 patients were eligible for TAVR in North American and European countries, with a prevalence of severe aortic stenosis of 3.4% in elderly populations [3]. TAVR provides several key patient benefits over surgical aortic valve replacement, most notably a reduced length of hospital stay and an increased likelihood of home discharge [4]. While TAVR was initially limited to high-surgical-risk patients, such as those with advanced age and multiple pre-existing conditions, TAVR is becoming increasingly utilized, with US procedure volumes rising from 6481 in 2012 to 73,411 in 2019 [5–7]. TAVR growth is driven in part by the broadening of patient eligibility; as of 2019, the US FDA had expanded TAVR indications to include patients of low surgical risk [7–9]. With TAVR numbers continuing to climb, there is a need for increased attention to improving health outcomes and managing costs associated with the procedure and downstream health events.

In-hospital cardiac telemetry monitoring is critical for detecting both new-onset conduction disturbances and their progression following TAVR, thereby allowing for safe patient discharge [10]. Cardiac rhythm abnormalities such as high-degree atrioventricular (AV) block necessitate the surgical implantation of a permanent pacemaker, and post-TAVR monitoring generally focuses on identifying the progression of AV block [7,11,12]. During hospitalization, inpatient continuous telemetry monitoring and routine ECG serve as the primary monitoring methods for detecting

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arrythmias; however, the risk of developing AV block and possible death as a result, extends beyond discharge [7,10,13]. Ambulatory cardiac monitoring after discharge provides an opportunity for physicians to continue to monitor beyond the confines of the hospital setting [10,14].

Despite decreasing risks of some adverse events over the past decade, the rate of pacemaker implantation post-TAVR continues to be the most frequent procedural complication, with recent reported rates between 8.6 and 10.8% [7,11,15,16]. Minimalist TAVR approaches focus on shortening length of stay; thus, the risk of conduction disturbances beyond discharge necessitates improved ambulatory monitoring practices [10,14]. Ambulatory cardiac monitoring services, such as mobile cardiac outpatient telemetry (MCOT), continuously analyze the cardiac rhythm and immediately transmit critical findings, allowing for nearly real-time detection of clinically significant arrythmias that may occur after patient discharge [17,18]. The detection of arrythmias, including those occurring without symptoms, supports earlier intervention by notifying physicians of post-discharge abnormalities. Indeed, prior research has confirmed that MCOT devices are associated with faster intervention compared with other ambulatory monitoring options [19]. Prescribing MCOT to patients post-TAVR may provide an opportunity for improved health outcomes or cost savings by monitoring for arrhythmic disturbances and, if they are detected, allowing for timely intervention via pacemaker and the avoidance of costly and dangerous emergency care.

The goal of this claims analysis was to evaluate the incidence of pacemaker implant post-discharge, length of stay, hospital costs and Medicare payments associated with the use of mobile cardiac telemetry, such as MCOT (BioTelemetry, Inc., a Philips company, PA, USA), for heart monitoring after TAVR compared with no MCOT monitoring after TAVR in Medicare patients. A retrospective observational study design was employed using the Medicare 5% analytical claims files. The study examines outcomes and costs through 60 days post-TAVR for all patients and separately for patients with an AV block or conduction delay diagnosis.

Materials & methods

Data source & patient identification

The Standard Analytic Files (Medicare Claims) Limited Data Set 5% sample was the data source for the study. In total, 4 years of data (2017–2020) were used in the analysis and included the inpatient, outpatient, carrier and master beneficiary files. Patients with an inpatient admission for a TAVR procedure between 1 January 2017 and 31 October 2020 were included in the analysis. The index admission for TAVR procedures was identified by Current Procedural Terminology (CPT) codes in the Medicare carrier files, matched with the Medicare inpatient files and confirmed by the presence of TAVR International Classification of Diseases 10th Revision Procedure Coding System (ICD-10-PCS) codes in the inpatient files. Only admissions paid for by DRG 266 (endovascular cardiac valve replacement with major complications or comorbidities) or 267 (endovascular cardiac valve replacement without major complications or comorbidities) were included. Patients were required to have continuous enrollment in Medicare for the 2 years prior to the TAVR admission and 60 days post-discharge or until death; patients who died during or within 60 days of the procedure were excluded from the outcomes analysis.

Patients were excluded for having a pacemaker installed during the index procedure or within 2 years prior to the TAVR procedure or if they had either pacemaker or defibrillator monitoring codes billed within the 2 years prior to the TAVR; these patients would not be candidates for MCOT post-TAVR, since they already had a pacing device implanted. Patients were also excluded for having missing data to conduct the analysis, for transfer to or from a different facility where the patient had an inpatient stay or for an MCOT claim after a pacemaker within 60 days post-TAVR procedure (Figure 1). A detailed list of the CPT and ICD-10 codes used appears in the Supplementary File.

Patients who received MCOT monitoring were identified by CPT codes within 30 days of the TAVR procedure. In the USA, MCOT is a commonly available remote patient diagnostic and monitoring technology. The MCOT service continuously monitors a patient's rhythm for up to 30 days and relays any detected abnormalities to a service center staffed with certified technicians for adjudication. If an abnormality merits urgent or emergent notification, clinical care providers are notified, so that they can take appropriate action. The MCOT's combination of continuous sensing and nearly real-time notification provides an option for immediate intervention, something not offered with looping or non-transmitting ECG recorders.

Analysis

The analysis compared the pacemaker placement rate, hospital costs, Medicare payments, contribution margins (CMs) and length of stay for patients with the use of MCOT monitoring and for patients with non-MCOT

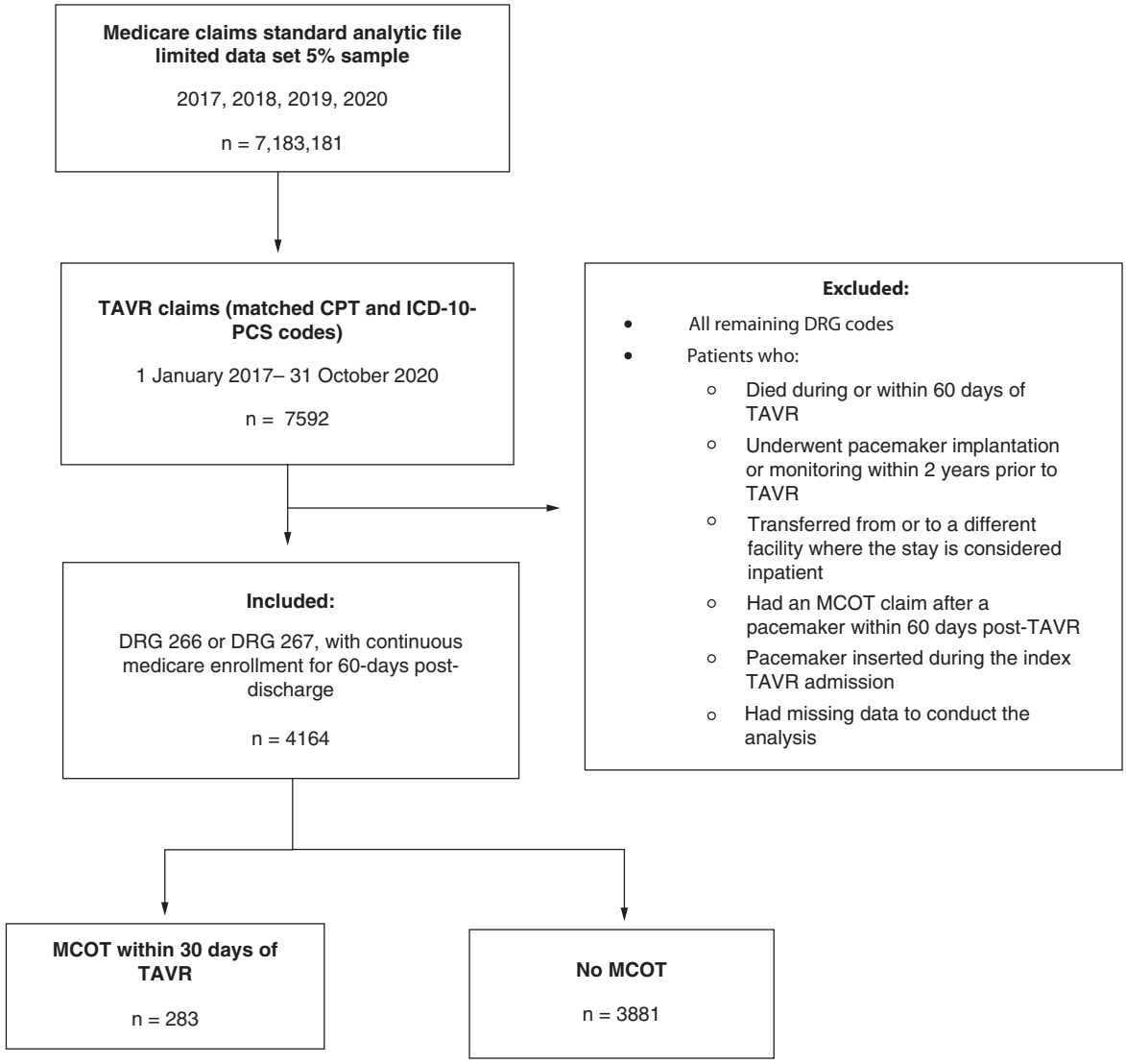

Figure 1. Sample flowchart.
CPT: Current procedural terminology: ICD: International Classification of Diseases; MCOT: Mobile cardiac outpatient telemetry; PCS: Procedure coding system; TAVR: Transcatheter aortic valve replacement.
DRG: Diagnosis-related group.

post-TAVR. Hospital costs, Medicare payments and CMs were measured at index and through 60 days post-TAVR procedure. Length of stay was measured only for the index admission. The pacemaker placement rate was measured only for the post-discharge period through 60 days and was identified using CPT codes. The intention was to estimate the percentage of patients with pacemaker insertions in the MCOT versus non-MCOT groups, as post-TAVR ambulatory monitoring can lead to pacemaker implantation. Subgroup analyses were conducted for patients with an AV block or a conduction delay diagnosis. Elixhauser comorbid conditions and the presence of AV block or conduction delay diagnosis during the TAVR admission were used in addition to age, sex, race and discharge year to adjust the study population to ensure a balanced cohort for comparison [20]. The Elixhauser comorbid conditions are a set of 30 conditions, including the presence of cardiac arrythmia, that can impact clinical and resource use outcomes.

Costs and payments were measured only for the inpatient and hospital outpatient settings. Hospital-specific cost-to-charge ratios, obtained from Medicare cost reports, were used to calculate costs to the provider (hospital inpatient or outpatient settings) for each corresponding data year except 2020, when 2019 cost-to-charge ratios were used due to missing 2020 data [21]. For consistency, any claims from providers without a specific cost-to-charge

ratio for the conversion were dropped from the analysis. All costs and payments were converted to constant 2020 dollars using the Medical Consumer Price Index, as reported by the US Bureau of Labor Statistics.

Statistical methods

For summary statistics, two sample t-tests were conducted for continuous variables. Chi-squared tests were used for categorical variables unless the assumptions were not met, in which case the Fisher's exact test was used. A propensity score analysis was conducted for all outcomes to adjust for patient characteristics and patient severity. Propensity scores were estimated using a logistic regression with age, sex, race, discharge year, AV block diagnosis and the Elixhauser comorbid conditions as covariates. The propensity scores were used to balance the covariates across the two groups and covariate balance was considered to be achieved when the mean standardized differences were <10%, as shown in Figure 2. The method of inverse probability of treatment weighting was used, which weights the groups using the inverse of the propensity score to achieve covariate balance. The inverse probability of treatment weighting was chosen due to achieving a balanced cohort while keeping most of the original sample. A $p < 0.05$ was considered to be statistically significant. All analyses were conducted using STATA v.17 (StataCorp LP, College Station, TX, USA) statistical software.

Results

Of the 7,183,181 claims available in the 2017–2020 carrier files, there were 7592 TAVR inpatient claims. After applying the inclusion and exclusion criteria, the final sizes of the two cohorts were 283 claims in the MCOT group and 3881 in the non-MCOT group (Figure 1). There were no significant differences in demographic or hospital admission characteristics, including age, sex, race, diagnosis-related group code, admission type or discharge destination (Table 1). There was a significant difference in discharge year, with more MCOT claims occurring in 2020 (37.1%) compared with previous years.

An analysis of comorbidities revealed that there were no significant differences in the overall Elixhauser comorbidities. However, two individual comorbidities had differences between the two groups: cardiac arrhythmias (37.5 MCOT vs 23.5% non-MCOT; $p < 0.001$) and solid tumor without metastasis (0.7 MCOT vs 2.8% non-MCOT; $p = 0.033$). Patients were propensity score weighted based on all Elixhauser comorbidities, including these two comorbidities, to help ensure balanced cohorts for analysis. Additionally, a separate analysis was performed on patients with heart block or conduction delay diagnosis because patients with MCOT were found to have significantly higher rates of diagnosed heart block or conduction delay upon hospital discharge (63.3 MCOT vs 30.1% non-MCOT; $p < 0.001$). In total, 1346 patients had a diagnosis of heart block or conduction delay at time of discharge; 179 received MCOT and 1167 did not. Thus, all reported results are based on adjusted findings unless otherwise specified.

Overall costs & outcomes

Use of MCOT was associated with a statistically significant increased rate of pacemaker insertion within 60 days following hospital discharge for TAVR compared with the non-MCOT group (6.6 MCOT vs 2.1% non-MCOT; $p = 0.007$; Table 2). There was no difference in length of stay between the two groups. Index TAVR hospital admission costs were lower in the MCOT group (US$40,569 MCOT vs $43,289 non-MCOT; $p = 0.003$), while there were no significant differences in Medicare payments between the two cohorts (US$47,656 MCOT vs $48,466 non-MCOT; $p = 0.333$). No difference in costs, payments or CMs were seen during the subsequent 60-day period following discharge. The use of MCOT post-TAVR was associated with an improved hospital CM of the index TAVR admission (US$7087 MCOT vs $5177 non-MCOT; $p = 0.047$). An analysis of the revenue center costs suggests that the cost savings related to the index TAVR admission can be attributed to surgical supply costs, which were found to be lower in the MCOT group compared with the non-MCOT group (Supplementary Table 2).

An unadjusted analysis of pacemaker outcomes found higher rates of pacemaker placement and lower rates of mortality in the MCOT cohort (Table 3). Although patients who died were excluded from the adjusted analyses due to the small MCOT sample size, the authors did nonetheless identify that no deaths occurred in the MCOT group, while death occurred in the non-MCOT group in 0.39% of the patients. Additionally, a review of the place-of-service codes for pacemaker placement was performed to better understand the differences between the two cohorts. For MCOT, the authors observed higher rates of pacemaker insertion in the outpatient setting (40.0 MCOT vs 26.0% non-MCOT; unadjusted $p = 0.217$) and identified the referral for pacemaker implantation stemmed from

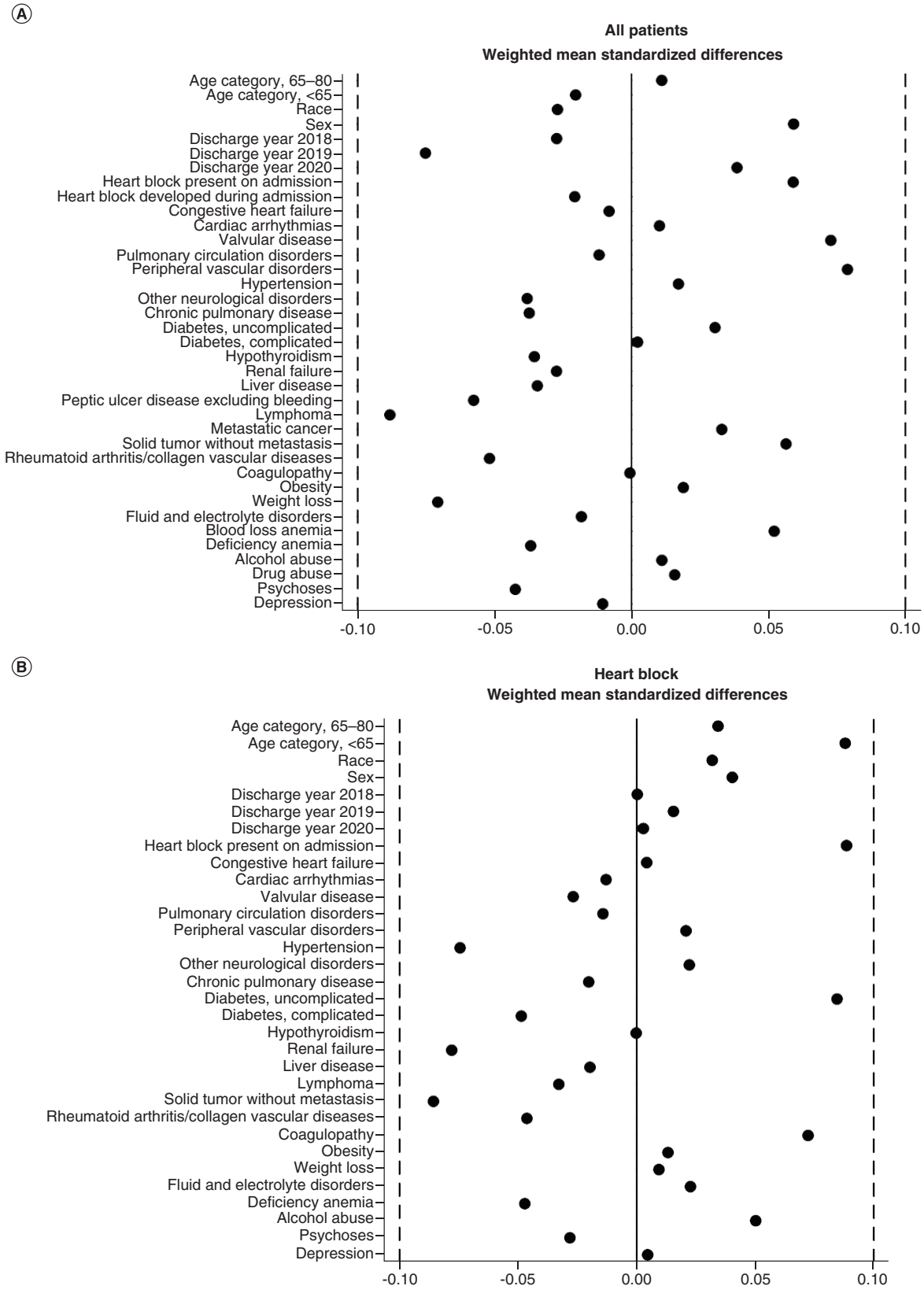

Figure 2. Weighted mean standardized differences to assess covariate balance. (A) All patients. **(B)** Patients with heart block.

Table 1. Patient demographics and comorbidity data.

	MCOT	Non-MCOT	p-value
n	283	3881	
Patient demographics			
Age, mean (SD) years	79.3 (7.0)	79.5 (7.4)	0.599
Sex, % (n)			0.979
Female	47.0% (133)	47.1% (1827)	
Male	53.0% (150)	52.9% (2054)	
Race/ethnicity, % (n)			0.295
White	96.1% (272)	95.0% (3688)	
Black	2.8% (8)	2.5% (96)	
Other	1.1% (3)	2.5% (97)	
Hospitalization characteristics			
Diagnosis-related group, % (n)			0.263
266 – TAVR with MCCs	27.9% (79)	31.1% (1207)	
267 – TAVR without MCCs	72.1% (204)	68.9% (2674)	
Admission type, % (n)			0.820
Elective	89.1% (252)	89.7% (3481)	
Emergent/urgent/trauma	11.0% (31)	10.0% (389)	
Unknown	0% (0)	0.3% (11)	
Discharge destination, % (n)			0.071
Home/self-care	80.6% (228)	77.4% (3,004)	
Home health agency home care	17.3% (49)	16.9% (657)	
Skilled nursing, intermediate care, or long-term care	2.1% (6)	5.5% (212)	
Other	0% (0)	0.21% (8)	
Discharge year, % (n)			**<.001**
2017	14.1% (40)	21.3% (826)	
2018	22.3% (63)	24.0% (933)	
2019	26.5% (75)	30.1% (1190)	
2020	37.1% (105)	24.0% (932)	
Comorbidity data			
Heart block, % (n)	63.3% (179)	30.1% (1167)	**<.001**
Present on admission, % (n)	49.7% (89)	41.2% (481)	**0.032**
Developed during hospitalization, % (n)	50.3% (90)	58.8% (686)	
Elixhauser comorbidities count, mean (SD)	4.2 (1.9)	4.1 (1.9)	0.400
Comorbidities, % (n)			
Congestive heart failure	70.0% (198)	67.5% (2619)	0.389
Cardiac arrhythmias	37.5% (106)	23.5% (912)	**<.001**
Valvular disease	12.0% (34)	12.4% (482)	0.842
Pulmonary circulation disorders	12.7% (36)	13.5% (523)	0.719
Peripheral vascular disorders	16.3% (46)	20.2% (784)	0.109
Hypertension	92.2% (261)	89.2% (3,461)	0.108
Paralysis	0% (0)	0.1% (2)	1.000
Other neurological disorders	7.8% (22)	8.3% (321)	0.769
Chronic pulmonary disease	21.6% (61)	26.0% (1008)	0.100
Diabetes, uncomplicated	12.7% (36)	15.7% (609)	0.182
Diabetes, complicated	19.1% (54)	18.8% (731)	0.919
Hypothyroidism	24.0% (68)	19.8% (769)	0.088
Renal failure	29.0% (82)	25.9% (1004)	0.251
Liver disease	4.6% (13)	3.1% (122)	0.184

Bold text indicates significant p-value of <0.05.
MCC: Major complications and comorbidities; MCOT: Mobile continuous outpatient telemetry; SD: Standard deviation; TAVR: Transcatheter aortic valve replacement.

Table 1. Patient demographics and comorbidity data (cont.).

	MCOT	Non-MCOT	p-value
Peptic ulcer disease excluding bleeding	0.71% (2)	0.57% (22)	0.676
AIDS/HIV	0% (0)	0.1% (3)	1.000
Lymphoma	1.1% (3)	1.9% (74)	0.488
Metastatic cancer	0.4% (1)	0.4% (16)	1.000
Solid tumor without metastasis	0.7% (2)	2.8% (110)	**0.033**
Rheumatoid arthritis/collagen vascular diseases	5.7% (16)	5.2% (201)	0.729
Coagulopathy	4.6% (13)	5.7% (222)	0.428
Obesity	21.2% (60)	20.3% (788)	0.717
Weight loss	1.1% (3)	1.5% (57)	0.797
Fluid and electrolyte disorders	3.2% (9)	4.7% (182)	0.241
Blood loss anemia	0.4% (1)	0.5% (21)	1.000
Deficiency anemia	13.1% (37)	14.5% (564)	0.500
Alcohol abuse	1.4% (4)	1.1% (42)	0.551
Drug abuse	0.7% (2)	0.1% (5)	0.077
Psychoses	0.4% (1)	0.7% (27)	1.000
Depression	7.4% (21)	7.5% (292)	0.949

Bold text indicates significant p-value of <0.05.
MCC: Major complications and comorbidities; MCOT: Mobile continuous outpatient telemetry; SD: Standard deviation; TAVR: Transcatheter aortic valve replacement.

Table 2. Propensity score-adjusted outcomes for patients with mobile cardiac outpatient telemetry monitoring versus non-mobile cardiac outpatient telemetry monitoring post-transcatheter aortic valve replacement procedure.

	MCOT	Non-MCOT	Difference (95% CI)	p-value
All patients				
Raw n	275	3746		
Inverse probability weight n	2003	2019		
Pacemaker implant post-TAVR discharge				
Pacemaker implants postdischarge through 60 days, % (n)	6.6%	2.1%	4.5% (1.2–7.8%)	**0.007**
Length of stay				
Length of stay of TAVR admission	2.60	2.48	0.12 (-0.339–0.585)	0.602
Costs				
Average costs for TAVR admission (US$)	40,569	43,289	-2720 (-4511– -931)	**0.003**
Average costs including TAVR procedure through 60 days post (US$)	47,159	46,903	256 (-3459–3972)	0.892
Medicare payments				
Average payments for TAVR admission (US$)	47,656	48,466	-810 (-2450–830)	0.333
Average payments including TAVR procedure through 60 days post (US$)	52,831	50,812	2020 (-2075–6114)	0.334
CM: difference in payments and costs				
Average CM for TAVR admission (US$)	7087	5177	1911 (25–3797)	**0.047**
Average CM including TAVR procedure through 60 days post (US$)	5672	3909	1763 (-441–3967)	0.117

Bold text indicates significant p-value of <0.05.
CI: Confidence interval; CM: Contribution margin; MCOT: Mobile cardiac outpatient telemetry; TAVR: Transcatheter aortic valve replacement.

physician referral more commonly (100 MCOT vs 83.5% non-MCOT; unadjusted p = 0.191; Table 3), while pacemaker referral directly from another healthcare facility was only identified in non-MCOT patients (0 MCOT vs 17.5% non-MCOT; Table 3).

Heart block: costs & outcomes

Including only patients with a recorded diagnosis of heart block or conduction delay, the use of MCOT was still associated with a statistically significant increase in the rate of pacemaker insertion compared with the non-MCOT group (10.2 MCOT vs 3.4% non-MCOT; p = 0.009). Likewise, the cost of the index TAVR admission was lower in

Table 3. Pacemaker outcomes.

	MCOT	Non-MCOT	p-value
Pacemaker rates			
n	283	3896	**<.001**
Pacemaker inserted within 60 days post-TAVR discharge, % (n)	7.1% (20)	1.98% (77)	
Patients without a pacemaker inserted within 60 days post-TAVR discharge, % (n)	92.9% (263)	97.6% (3804)	
Death within 60 days post-TAVR discharge, % (n)	0% (0)	0.39% (15)	
Pacemaker place of service post-discharge			
n	20	77	0.217
Inpatient, % (n)	60.0% (12)	74.0% (57)	
Outpatient, % (n)	40.0% (8)	26.0% (20)	
Source of admission for inpatient pacemaker placement post-discharge from TAVR			
n	12	57	0.191
Physician referral (non-healthcare facility or outpatient clinic)	100% (12)	83.5% (47)	
Transfer from hospital (different facility) or another healthcare facility	0.0% (0)	17.5% (10)	

Bold text indicates significant p-value of <0.05.
MCOT: Mobile cardiac outpatient telemetry; TAVR: Transcatheter aortic valve replacement.

Table 4. Propensity score-adjusted outcomes for heart block patients with mobile cardiac outpatient telemetry monitoring versus non-mobile cardiac outpatient telemetry monitoring post-transcatheter aortic valve replacement procedure.

	MCOT	Non-MCOT	Difference (95% CI)	p-value
Raw n	174	1145		
Inverse probability weight (n)	656	663		
Pacemaker implant post-TAVR discharge				
Pacemaker implants post-discharge through 60 days, % (n)	10.2%	3.4%	6.8% (1.7–11.8%)	**0.009**
Length of stay				
Length of stay of TAVR admission	2.79	2.73	0.06 (-0.65–0.765)	0.874
Costs				
Average costs for TAVR admission (US$)	41,066	44,353	-3286 (-5597– -75)	**0.005**
Average costs including TAVR procedure through 60 days post (US$)	47,663	48,323	-660 (-4357–3037)	0.726
Medicare payments				
Average payments for TAVR admission (US$)	48,579	49,710	-1131 (-2862–601)	0.201
Average payments including TAVR procedure through 60 days post (US$)	52,659	52,428	231 (-2107–2570)	0.846
CM: difference in payments and costs				
Average CM for TAVR admission (US$)	7512	5357	2155 (-218–4529)	0.075
Average CM including TAVR procedure through 60 days post (US$)	4996	4105	892 (-2032–3816)	0.550

Bold text indicates significant p-value of <0.05.
CM: Contribution margin; MCOT: Mobile cardiac outpatient telemetry; TAVR: Transcatheter aortic valve replacement.

the MCOT group (US$41,066 MCOT vs $44,353 non-MCOT; p = 0.005), while Medicare payments and CMs of both the index admission and 60-day post-TAVR period remained similar (Table 4). There was no difference in length of stay between the two cohorts.

Discussion

The development of post-procedural heart block continues to be the most common complication of TAVR, yet unmet needs remain for monitoring the onset of heart block and identifying the resulting need for a permanent pacemaker [7,11,15,16]. Many recent studies have discussed the utility of ambulatory cardiac monitoring as a means of improving care for such patients [13,15,22]. This is the first known study evaluating the impact of ambulatory cardiac monitoring on the incidence of pacemaker placements and short-term costs associated with ambulatory monitoring practices in the post-TAVR Medicare population.

In this study, the use of MCOT was associated with a higher rate of pacemaker insertion within 60 days of the index procedure compared with patients who did not receive ambulatory monitoring. The results suggest that the use of MCOT is more likely to reveal the need for a pacemaker by detecting cardiac arrythmias, leading to appropriate and timely intervention. While patients who do not undergo MCOT monitoring may possess a similar risk for developing heart block, they are not afforded the opportunity for detection offered by the MCOT device. In the subgroup analysis of patients who carried a heart block or conduction delay diagnosis, who are known to be at higher risk for pacemaker implantation, patients with MCOT monitoring were three-times more likely to receive a pacemaker in the 60-day period post-TAVR. These results underscore MCOT's ability to identify the need for a pacemaker by allowing physicians to closely monitor and intervene at the onset or progression of arrythmia. Additionally, while patients who died in the 60 days post-procedure were excluded from the outcomes analysis, the authors did uncover no deaths among patients who received MCOT, while observing a 0.39% rate of death in patients who did not receive MCOT.

The higher placement rates of pacemakers in the outpatient setting and as a result of a scheduled physician referral in the MCOT group may indicate that the monitoring device allows physicians to react more quickly to a change in patient condition, thus reducing the risk of decompensation and a resulting urgent event. Previous literature, including expert panels, preferentially recommends ambulatory cardiac monitors with telemetric alert systems because of their ability to facilitate earlier intervention [10]. As the use of TAVR continues to rise, there will remain a portion of patients who experience delayed cardiac arrythmias after discharge and are at risk for complications and/or death if not detected in a timely manner [13,22]. The findings of the present study indicate that MCOT is a valuable tool that may support early detection measures and prevent patients from experiencing adverse events stemming from undetected and/or unaddressed cardiac arrythmias.

The use of MCOT can improve patient care by enabling more proactive monitoring and intervention, all while maintaining a cost-savings or cost-neutral environment. In this study, the use of MCOT was associated with significantly lower hospital costs for the index TAVR admission and improved hospital CMs in the MCOT group compared with the non-MCOT group. This difference was attributed mainly to lower central supply costs due to the valve implant. While this was an unexpected observation, it might indicate that hospital systems where MCOT was prescribed are better at negotiating valve-related supplies as well as understanding the potential clinical and financial value of MCOT. Medicare payments were similar between the two cohorts for both index hospitalization and throughout the duration of the 60 days post-discharge. Even with the increased rate of pacemaker insertion in the MCOT group, there was no observed impact on costs in the 60-day period post-TAVR, suggesting that MCOT provides an opportunity to improve patient care without afflicting greater cost on the hospital or payer.

The study findings are limited by the lack of a randomized study design. Further research is needed to determine whether there is a causal relationship between the use of MCOT and the rate, timing and urgency of pacemaker placement. Costs were measured only for the inpatient and hospital outpatient settings and do not account for treatment in other places of service. Furthermore, while differences observed in the incidence of pacemaker placement in the MCOT group may reflect more appropriate use based on actual need as assessed by monitoring, they may also be due to differences in the degree or type of block present between MCOT versus non-MCOT patients. Additionally, the use of MCOT for post-TAVR monitoring is relatively novel and this analysis was limited, in some instances, by the low number of TAVR cases and even lower number with MCOT. As TAVR volumes grow and more data become available, further research is warranted to assess whether the trends observed in these data rise to the level of significance.

The results of this study support the belief that real-time cardiac monitoring of patients post-TAVR may confidently provide physicians data pertaining to arrhythmia status and that this information may promote proactive non-emergent intervention, when needed. Furthermore, the findings demonstrate that these clinical benefits can be achieved without increasing hospital or payer costs. These results have implications for clinicians, hospitals, and policymakers as they continue to look for opportunities to balance the delivery of high-quality care and the management of costs for the growing population of TAVR patients.

Conclusion

The use of MCOT after TAVR is associated with a higher incidence of pacemaker insertions, at no greater cost. These findings support MCOT's ability to improve patient care by detecting cardiac arrythmias, thereby prompting appropriate intervention and mitigating emergent events. Adding MCOT into the postprocedural management

paradigm may provide a cost-neutral solution to the unmet needs in monitoring for delayed cardiac arrythmias in the TAVR population.

Future perspective

As healthcare costs continue to rise, emphasis will continue to be placed on how to improve patient outcomes while reducing costs. For TAVR patients, the use of MCOT post-discharge will be a valuable tool to support the early detection of cardiac abnormalities and prevent patients from experiencing adverse events. Future research will study MCOT in treatment algorithms and will compare the costs and benefits to patients.

Summary points

- In the transcatheter aortic valve replacement (TAVR) population, ambulatory cardiac monitoring services, such as mobile cardiac outpatient telemetry (MCOT), used post-discharge support earlier intervention by notifying physicians of post-discharge abnormalities.
- The use of MCOT was associated with a higher rate of pacemaker insertion within 60 days of the index TAVR procedure compared with patients who did not receive ambulatory monitoring.
- In the subgroup of patients with a heart block or conduction delay diagnosis, patients with MCOT monitoring were three-times more likely to receive a pacemaker in the 60-day period post-TAVR.
- The use of MCOT was associated with significantly lower hospital costs for the index TAVR admission and improved hospital contribution margins in the MCOT group compared with the non-MCOT group.
- Medicare payments were similar between the two cohorts for both index hospitalization and throughout the duration of the 60 days post-discharge.
- Even with the increased rate of pacemaker insertion in the MCOT group, there was no observed impact on costs in the 60-day period post-TAVR, suggesting that MCOT provides an opportunity to improve patient care without afflicting greater cost on the hospital or payer.

Supplementary data

To view the supplementary data that accompany this paper please visit the journal website at: www.futuremedicine.com/doi/suppl/10.2217/cer-2022-0112

Author contributions

All authors made a significant contribution to the work reported, whether in the conception, study design, execution, acquisition of data, analysis and interpretation or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Financial & competing interests disclosure

BA Mohr, G Medic, M Wadhwa, J Lavelle and V Norlock are employees of Philips. M Wadhwa is the chief medical officer for Biotelemetry (a Philips company), a producer of MCOT. JD Buchenberger is an employee of Veranex. Veranex received funding from Philips to write the manuscript. The authors have no other relevant affiliations or financial involvement with any organization or entity with a financial interest in or financial conflict with the subject matter or materials discussed in the manuscript apart from those disclosed.

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