A Budget Impact Model to Estimate the Cost Dynamics of Treating High-Risk Heart Failure Patients with Advanced Percutaneous Cardiac Assist Devices: The Payer Perspective

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Summary

Treatment of heart disease is a major driver of health care spending in the United States. Temporary and timely use of hemodynamic support devices can be particularly beneficial to two high-risk patient populations: cardiogenic shock patients and those requiring hemodynamic support as an adjunct to high-risk coronary revascularization. The rate of adoption of advanced percutaneous cardiac assist devices (pVADs) for providing such support is steadily increasing. The objective of this study is to propose a budget impact model, from the third-party payer perspective, to estimate the separate and combined economic costs to health plans of covering this emerging trend in medical treatment. Clinical and financial inputs used to generate our results were obtained from a nationally recognized source of commercial claims data.

Key Points

• The prevalence rates of cardiogenic shock and high-risk percutaneous interventions are relatively low within the study population.
• While medical costs to treat these patient subgroups is relatively high during the acute hospitalization period, post-discharge resource consumption does not suggest a pattern of chronic utilization.
• Budgetary modeling of the combined impact of covering treatment costs for both clinical indications suggests a scenario in which health plans may experience meaningful savings, depending upon the assumed rates of migration from traditional circulatory support strategies to advanced pVAD therapy.

Introduction

More than one in three American adults have at least one type of cardiovascular disease and it is the leading cause of death in the U.S. for both men and women. Recent estimates of the total burden of cardiovascular disease equate to $312.6 billion in annual combined direct and indirect costs. Heart failure is one of the main causes necessitating acute hemodynamic support, and acute heart failure is the leading reason for medical readmissions in the Medicare population and is likely a major readmission driver for private commercial health plans. These heart failure patients typically have unstable hemodynamic profiles, with left ventricular function and/or an ejection fraction frequently less than 30 percent, which has clinical and economic implications to payers and providers alike.

Temporary and timely use of percutaneous cardiac assist devices (pVADs) to provide hemodynamic support can be particularly beneficial to two high-risk patient populations: cardiogenic shock (CS) patients and those who require hemodynamic support as an adjunct to high-risk percutaneous coronary intervention (HR-PCI) procedures. For CS patients, pVADs urgently provide effective and systemic circulatory support, prevent additional cardiac damage and hypoperfusion-induced organ damage, thereby allowing acute cardiac recovery while the damaged heart is off-loaded and effectively perfused. Treatments have included surgical hemodynamic support from extracorporeal membrane oxygenation (ECMO) or extracorporeal left ventricular assist devices (LVADs), in combination with IABP as appropriate. However, despite advances in medicine,
the mortality rate for CS remains over 50 percent, and the effectiveness of these traditional therapies continues to be challenged. The annual incidence of CS stands at 40,000 to 50,000 cases per year, most often occurring with ST-elevation myocardial infarction (STEMI). It is estimated that 12,000 post-STEMI cardiogenic shock patients are in need of acute hemodynamic support.

For other high-risk patients, pVADs are intended to ensure that percutaneous revascularization procedures and other interventions can be performed successfully; it can be an option for select patients who are turned down for complex, invasive surgical and cardiac procedures because of their clinical and coronary anatomy risk. Approximately 7 to 10 percent of the 600,000 PCI procedures performed annually are at high risk for hemodynamic collapse and may benefit from pVAD support. Further, it is estimated that there are approximately 8,000 commercially insured patients nationwide that would be considered to be HR-PCI (and therefore pVAD) candidates.

The traditional treatment for HR-PCI patients has been the IABP, despite published data questioning its value. In the recently published PROTECT II randomized clinical trial involving HR-PCI patients, pVAD therapy (using Impella 2.5, Abiomed, Inc., Danvers, MA) resulted in a 22 percent reduction (p = 0.023) in major adverse events compared to the IABP; this reduction increased to 56 percent (p = 0.002) post hospital discharge. Alternatively, these patients would face high-risk coronary artery bypass grafting (CABG) procedures with increased risk of morbidity and mortality.

The shortcomings of the traditional therapies have led practitioners and their patients to express a desire for alternative therapeutic options. Advanced technologies, such as pVADs, are filling the gap created by unmet clinical and practitioner needs in the provision of circulatory support for treatment of CS and HR-PCI patients. Furthermore, while the economic impact of adopting this new technology has been explored from the provider perspective, the need for a payer impact assessment is now appropriate. The objective of this study was to develop a budget impact model, from the payer perspective, to estimate the annual direct medical costs of treatment for these two important patient populations and to estimate
the combined incremental budgetary impact of introducing the innovative pVAD treatment option.

Methods

Study Population and Data Sources

Data for this study were obtained from a recognized database compiled by OptumInsight, Inc. (Eden Prairie, MN) comprising claims generated by a national commercial health plan consisting of approximately 25 million members. Included in the database were all members affiliated with fully-insured entities as well as self-insured clients reliant on administrative services only. A demographic profile of the plan membership appears in Exhibit 1a. Overall, the database comprised approximately 25 million members nearly evenly divided between males and females. The majority of members were under 50 years of age and over two million were 65 years of age or older and thus likely to exhibit the utilization and cost characteristics of the Medicare population. In addition, Exhibits 1b and 1c detail the demographics of the specific high-risk patients under review in this model. Specifically, for HR-PCI, 49 percent of patients were 65 years of age or older, with another 44 percent between the ages of 50 to 64. With regard to CS patients, only 21 percent were 65 years of age or older, while 44 percent were between the ages of 50 to 64. Moreover, the cohort populations were heavily weighted toward males (71 percent to 82 percent across all cohorts under review).

The time frame for the claims data used in the model was 2009, 2010, and the first half of 2011. Any patient that experienced CS or had a PCI in 2009 or 2010 was excluded from the 2010 or 2011 data set, respectively, to avoid double counting of cases. This accounted for approximately 5 percent of the potential cases. It is also worth noting that advanced pVADs have been cleared for use by the FDA only recently, and were not widely employed in clinical practice prior to 2009. Accordingly, the 30-month time interval selected for this study was...
chosen to maximize the sample size available for entry into the budget impact model (BIM).

The logic applied to identify cases for each BIM was derived from specific International Classification Disease 9th Version (ICD-9) diagnosis and procedure codes. Claims classified as CS cases included patients diagnosed with CS who received surgical cardiac support from ECMO or extracorporeal LVADs (with or without IABP support) or those receiving non-surgical cardiac support from a pVAD. Claims classified as HR-PCI cases included patients receiving a percutaneous coronary intervention supported by either IABP or pVAD; a complete description of the coding schemes used to create these patient classifications is presented in Exhibit 2.

**Model Development**

A dynamic BIM was developed to show the effect of pVAD adoption on commercial claim costs for both high-risk (CS and HR-PCI) populations. The cost of an individual claim was defined as the payer’s maximum allowed amount in accordance with the payer’s provider network contracts. These allowed amounts subsume both the provider and patient components of financial responsibility and therefore removed member benefit differences as a confounding variable in the analysis. Specifically, the model for CS cases estimates the per member per month (PMPM) cost and, the overall cost of CS coverage, as well as the impact of increasing the percentage of the membership that receives pVAD therapy vs. current surgical alternatives for hemodynamic support, including ECMO or extracorporeal LVAD in combination with IABP as appropriate. The model for HR-PCI cases estimates the PMPM cost and the overall cost of HR-PCI coverage, as well as the impact of increasing the percentage of the membership that receives pVAD therapy vs. hemodynamic support via the IABP. For both models, pVAD therapy includes both major types of percutaneous cardiac assist devices, Abiomed’s Impella 2.5 and the TandemHeart system (CardiacAssist, Inc., Pittsburgh, PA) as defined by ICD-9 procedure code 37.68, with market share data from both companies indicating that Impella 2.5 comprises at least 80 percent of this category of devices.

Both models included three relevant time intervals for these high-risk populations: the index hospital stay (up to 30 days), 31 to 90 days post-index hospital stay, and 91 to 365 days post-index hospital stay. Claims activity was limited and the existence of meaningful differences were not observed in the 90-day time intervals comprising the final nine months of the tracking period. Consequently, we collapsed these data into a single time span for posed of estimating budget impact. In addition, the claim costs for each time period were collected for inpatient, outpatient, emergency room, physician, and pharmacy services. These three time intervals and five service components were aggregated for both cohorts (pVAD and surgical hemodynamic support alternatives) to derive an overall mean allowed costs for CS subpopulation of patients. Similarly, for the HR-PCI model, the same three time intervals and five service components were aggregated for both the pVAD and IABP cohorts to derive an overall HR-PCI coverage cost for the membership. In both models, these total costs were then converted into a PMPM for each cohort. Differences were first analyzed assuming no change in utilization for the interventions under review. Finally, the impact on PMPM and overall costs were analyzed with various utilization changes, specifically focusing on the expansion of pVAD therapy as a replacement for the identified surgical alternatives in the CS model and for IABP in the HR-PCI model. The percentage of pVAD therapy adoption in this sensitivity analysis was permitted to vary from 10 percent to 60 percent in both models.

**Statistical Analysis**

Our ability to conduct formal statistical analyses of differences between study cohorts was limited by lack of availability of claim-level data beyond the index admission period (defined as the first 30 days including the index event). Statistical testing of mean differences in allowed costs for the various service components and length of stay that was observed during the index admission period was performed by SPSS Version 20 (IBM SPSS Statistics, USA). Differential comparisons for non-normally distributed variables were calculated by Mann-Whitney U-test; categorical variables were compared by Fisher’s exact test.

**Results**

**Prevalence Rates**

For the 30-month study period spanning from 2009 to the first half of 2011, the overall prevalence of CS requiring surgery and/or hemodynamic support was observed to be 0.0619 per 1,000 members. pVAD therapy prevalence in the CS population was 0.00225 index admissions per thousand members, while the prevalence of surgical hemodynamic support alternatives was 0.00282 index admissions per thousand members.

For the two and a half year period from 2009 through the first half of 2011, the overall prevalence of HR-PCI was observed to be 0.0312 per 1,000 members. pVAD therapy prevalence in this cohort...
was 0.00306 index admissions per thousand members, while the prevalence of IABP was 0.0282 index admissions per thousand members.

Budget Impact
In the CS budget impact analysis, comparisons of mean allowable costs were made between the pVAD and the surgical hemodynamic support cohort. Exhibit 3 shows the mean allowable costs per CS claim by treatment cohort and service component for each time period.

The major difference in cost, both in percentage and absolute dollars, between the surgical cohort and the pVAD cohort was observed in the index hospital stay through 30 days. For the surgical alternative, the total mean cost was $457,731 compared with $287,731 for the pVAD cohort, a difference of $154,435, primarily driven by the major difference in costs associated with the inpatient service component. Statistical analysis, using the non-parametric Mann-Whitney test, indicates this difference is significant (p = 0.006). The mean length of stay (LOS) for the index hospitalization was 30.9 days for the surgical cases versus 20.4 for the pVAD cases (p = 0.053). While not quite achieving statistical significance at the p < 0.05 level (likely attributable to the small sample sizes involved), this differential in LOS certainly has operational implications and is worth noting.

The 31- to 90-day time interval revealed a similar cost trend between the two cohorts, with the total mean cost per case for the surgical alternative cohort at $22,650 compared to $20,682 for the pVAD total mean cost. Further review of the cost categories shows a mixed trend with physician and pharmacy services being higher for the surgical cohort, but lower for inpatient and outpatient services compared to the corresponding cost categories for the pVAD cohort. However, the magnitude of these post-index expenditures is relatively small for both cohorts.

In the 91- to 365-day time interval, the total mean costs per case for surgical cohort and pVAD cohort were $52,904 and $32,627, respectively. The primary drivers of this cost differential are the inpatient and outpatient service components, which were higher in the surgical cohort. However, as with the 31- to 90-day time interval, the magnitude of these post-index costs is negligible compared to the index costs previously reported.

Aggregating all costs across the 12-month tracking period for each qualifying case, the costs of surgical cases were considerably greater than those incurred by the use of pVADs ($533,285 vs. $341,040, respectively), driven largely by the index admission costs reported above. Both cohorts incurred approximately 85 percent of their total annual cost within the first 30 days. This demonstrates that while these patients are high-intensity resource utilizers during the acute phase of their condition, they do not display “chronic” utilization and cost patterns on a post-index basis. On a PMPM basis, the payer cost for surgical cases was $0.07 PMPM versus $0.03 PMPM for pVADs.

In the HR-PCI budget impact analyses, comparisons were made between the pVAD and IABP device cohorts. Exhibit 4 shows the mean allowed costs per HR-PCI claim by treatment cohort and service component for each time period.

As was the case for the CS budget impact analysis, the major difference in allowed cost, both in per-
Exhibit 4: Mean Allowed Costs Per HR-PCI Case by Treatment Cohort, Service Component and Time Period

<table>
<thead>
<tr>
<th>Service Component</th>
<th>Mean Cost Per Case (Index Stay up to 30 days)</th>
<th>Mean Cost Per Case (31 - 90 days)</th>
<th>Mean Cost Per Case (91 - 365 days)</th>
<th>Mean Cost Per Case (12 month Tracking Period)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IABP</td>
<td>pVAD</td>
<td>Δ</td>
<td>IABP</td>
</tr>
<tr>
<td>Inpatient</td>
<td>$73,308</td>
<td>$85,700</td>
<td>$(12,392)</td>
<td>$3,420</td>
</tr>
<tr>
<td>Outpatient</td>
<td>1,383</td>
<td>856</td>
<td>527</td>
<td>3,567</td>
</tr>
<tr>
<td>Physician</td>
<td>7,832</td>
<td>6,760</td>
<td>872</td>
<td>1,898</td>
</tr>
<tr>
<td>Emergency Room</td>
<td>2,135</td>
<td>714</td>
<td>1,421</td>
<td>233</td>
</tr>
<tr>
<td>Pharmacy</td>
<td>440</td>
<td>389</td>
<td>51</td>
<td>653</td>
</tr>
<tr>
<td>Total Allowed Cost Per Claim</td>
<td>$85,048</td>
<td>$94,670</td>
<td>$(9,622)</td>
<td>$10,172</td>
</tr>
</tbody>
</table>

Notes: *Detail at the claim-level detail was available only for the Index Admission (1 to 30 days) time period. The Emergency Room cost differential between IABP and pVAD treatments was statistically significant (p < .000). All other service component differences associated with the index admission period were not statistically significant. Although not reported in this exhibit, inpatient LOS for the IABP cohort was 2.1 days longer than for the pVAD cohort (11.9 days vs. 9.8 days, respectively), p = 0.001.*

Exhibit 5a: Sensitivity Analysis of the Impact on PMPM and Total Health Plan Cost Resulting from Incremental Migration from Surgical to pVAD Therapy in Treating CS Patients

<table>
<thead>
<tr>
<th>Percent Migration</th>
<th>PMPM</th>
<th>Total Allowed Dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>10%</td>
<td>($0.0024)</td>
<td>($1,345,717)</td>
</tr>
<tr>
<td>20%</td>
<td>($0.0049)</td>
<td>($2,691,434)</td>
</tr>
<tr>
<td>30%</td>
<td>($0.0073)</td>
<td>($4,037,152)</td>
</tr>
<tr>
<td>40%</td>
<td>($0.0097)</td>
<td>($5,382,869)</td>
</tr>
<tr>
<td>50%</td>
<td>($0.0122)</td>
<td>($6,728,586)</td>
</tr>
<tr>
<td>60%</td>
<td>($0.0146)</td>
<td>($8,074,303)</td>
</tr>
</tbody>
</table>

centage and absolute dollars, between IABP cohort and the pVAD cohort was observed in the index hospital stay through 30 days. For IABP, the total mean cost was $85,048 compared with $94,670 for the pVAD cohort. This was an 11 percent increase overall, primarily driven by the major difference in inpatient costs. Statistical analysis of the cost data for the index stay, using the non-parametric Mann-Whitney test, indicates the difference in inpatient cost between the two cohorts of $12,392 was not statistically significant (p = 0.218). However, the 2.1 day differential in mean index admission LOS between IABP cases (11.9 days) and pVAD (9.8 days) was found to be a statistically significant (p = 0.001).

The 31- to 90-day time interval showed a similar cost trend between the two cohorts, with the total mean cost for IABP cohort at $10,172 compared to $11,722 for the pVAD cohort. Further review of the cost categories shows a mixed trend with outpatient and ER, costs being higher for the IABP cohort, but lower for inpatient and physician as compared to those cost categories for the pVAD cohort. However, the magnitude of these post-index costs is equally not impressive for either cohort.

In the 91- to 365-day time interval, the total mean cost per case for IABP cohort and pVAD cohort were $17,762 and $15,210, respectively. The primary drivers of this overall difference are the outpatient, ER, and pharmacy cost categories being higher in the IABP cohort. However, as with the 31- to 90-day time interval the magnitude of these post-index costs is negligible compared to the index costs previously reported.

Aggregating all costs across the 12-month tracking period, the mean allowed costs of pVAD were somewhat more than those of IABP ($121,602 vs. $112,982, respectively), driven largely by cost of the pVAD during the index admission. Both cohorts incurred approximately 75 percent of their total annual costs during the first 30-day interval. This again demonstrates that these patients, while high-intensity resource utilizers during the acute phase of
their condition, do not display “chronic” utilization and cost patterns on a post-index stay basis. On a PMPM basis, the current costs for IABP were $0.14 PMPM versus $0.02 PMPM for pVADs; however, this simply reflects a utilization disparity driven by a mature adoption level for IABP and a slowly emerging adoption level for pVADs.

**Sensitivity Analysis**

The BIM for CS cases computes the impact on PMPM as well as the total cost to the health plan if pVAD therapy had been administered to the surgical cohort on a sensitivity scale ranging from 10 percent to 60 percent. If 10 percent of the surgical cohort switched to pVAD therapy, the impact on the health plan costs would be negative $0.0024 PMPM, resulting in approximately $1.3 million in potential cost savings for a health plan of similar size to that associated with this study’s database. Moreover, if 60 percent of the surgical cohort switched to pVAD therapy, the impact on PMPM would be a negative $0.0146 PMPM, resulting in a potential savings in excess of $8 million for a similarly-sized health plan. Exhibit 5a illustrates the impact on PMPM, as well as overall cost to the health plan, for the entire range sensitivity scenarios.

Sensitivity analysis of the BIM for HR-PCI cases was also conducted to examine the impact on PMPM as well as the total cost to the health plan if pVAD therapy had been administered to patients in the IABP cohort on a sliding scale ranging from 10 percent to 60 percent. If 10 percent of the cohort switched to pVAD therapy, the impact on health plan costs would be a positive $0.0011 PMPM, resulting in approximately $603,000 in greater cost to the health plan under review. Moreover, if 60 percent of the IABP cohort switched to pVAD therapy, the impact on PMPM would be a positive $0.0065 and over $3.6 million in additional cost to the health plan. Exhibit 5b illustrates the impact on PMPM, as well as overall cost to the health plan, for the entire range of sensitivity scenarios.

**Overall Budget Impact**

Given these independent results, the combined impact across both conditions yields net savings ranging from approximately $2.2 million to $3.7 million based on assumed pVAD migrations ranging from

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**Exhibit 6: Integrated Sensitivity Analysis for All High-Risk Patients (a)**

<table>
<thead>
<tr>
<th>HR-PCI PMPM</th>
<th>CS PMPM</th>
<th>PMPM Combined</th>
<th>Total Allowed Amount (HR-PCI)</th>
<th>Total Allowed Amount (CS)</th>
<th>Total Allowed Amount Combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.00%</td>
<td>$0.0011</td>
<td>($0.0024)</td>
<td>$0.0013</td>
<td>$603,415</td>
<td>($1,345,717) ($742,302)</td>
</tr>
<tr>
<td>20.00%</td>
<td>$0.0022</td>
<td>($0.0049)</td>
<td>($0.0027)</td>
<td>$1,206,830</td>
<td>($2,691,434) ($1,484,604)</td>
</tr>
<tr>
<td>30.00%</td>
<td>$0.0033</td>
<td>($0.0073)</td>
<td>($0.0040)</td>
<td>$1,810,245</td>
<td>($4,037,152) ($2,226,907)</td>
</tr>
<tr>
<td>40.00%</td>
<td>$0.0044</td>
<td>($0.0097)</td>
<td>($0.0054)</td>
<td>$2,413,660</td>
<td>($5,382,869) ($2,969,209)</td>
</tr>
<tr>
<td>50.00%</td>
<td>$0.0055</td>
<td>($0.0122)</td>
<td>($0.0067)</td>
<td>$3,017,075</td>
<td>($6,728,586) ($3,711,511)</td>
</tr>
<tr>
<td>60.00%</td>
<td>$0.0065</td>
<td>($0.0146)</td>
<td>($0.0081)</td>
<td>$3,620,490</td>
<td>($8,074,303) ($4,453,813)</td>
</tr>
</tbody>
</table>

(a) Represents changes in payer allowed amounts associated with a transition to pVAD from targeted standards of care.

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30 percent to 50 percent for both indications (refer to Exhibit 6). These migration levels are considered reasonable and achievable, particularly given some key pVAD marketplace dynamics including:

- Clinical data demonstrating improved clinical outcomes for CS and HR-PCI patients\(^{16,17,18}\)
- Inclusion in national clinical guidelines for cardiogenic shock as endorsed by professional societies
- Minimally invasive deployment which facilitates expedited introduction in emergent and urgent cases
- New Category I CPT codes effective January, 2013
- Steady insurance coverage expansion for pVAD use

Discussion
The Affordable Care Act and its enabling of fully-integrated “accountable care organizations” (ACOs) will accelerate fundamental transformation in the delivery of acute and chronic care, from the organization of the health care delivery system, the measurement of care outcomes, and importantly payment incentives to providers. The latter change will likely come in the form of shared savings models that will attempt to align the incentives of third-party payers and all provider types to work collaboratively toward positive patient-centered outcomes that also yield cost-mitigating benefits. Such economic benefits may include reduced adverse events, readmissions and resource consumption through new clinical protocols supported by new and improved technologies.

As these incentives permeate the market through both the Centers for Medicare and Medicaid Services and private payer initiatives, new and innovative ways to deliver care to acutely ill patient populations will be important. To this end, high-risk heart failure patients that experience CS or require a high-risk PCI have historically been treated with technologies and protocols that were expensive and/or produced poor outcomes.\(^{5-15}\) Updated clinical literature indicates the pVADs can improve clinical outcomes; this budget impact model seems to indicate that pVADs can do so at a minimal cost to the system. Furthermore, this technology offers a subset of high-risk patients a treatment option where one was not previously available.\(^{16,17}\)

Importantly, this model tracked patients for a full year subsequent to the qualifying event to evaluate key cost items that the health care system often does not contemplate in severe cases. In doing so, it became clear that while these patients experience relatively infrequent but very resource-intensive in-
dex events (usually associated with high inpatient costs), they are not incurring significant costs in the post-index period. Thus, this new technology, while it represents an incremental cost to providers and payers in non-surgical cases, is producing favorable clinical outcomes at a relatively low PMPM cost to payers. The finding is primarily based on the low incidence of these high-risk cardiac patients, the high-cost of current surgical interventions for CS patients and the reduced variability of resource consumption in HR-PCI patients (extreme cost outliers were more prevalent in the IABP arm). Notably, traditional Medicare patients appear to track along a similar cost dynamic, in that HR-PCI cases cost more but CS cases cost significantly less, with a net impact that is less than $0.05 PMPM.

Few studies are without limitations. While this study offers economic stakeholders a viable framework for evaluating new technologies like pVADs, several model challenges should be considered when evaluating this analysis and/or designing subsequent models. First, the retrospective nature of the study presented challenges with regard to the matching of “high-risk” patients across the cohorts, particularly in the HR-PCI model where “high-risk” assignment was limited to claims coding and not actual patient assessments. In addition, with regard to the CS model, patients that did not undergo a surgical intervention or receive pVAD therapy were not analyzed given that pVADs role in this population is undetermined. If this population (including those who receive IABP therapy without surgery) is determined to benefit from pVAD therapy, future models will need to contemplate the impact of these patients on payer costs as well.

Moreover, the migration sensitivity analysis applied estimated case conversion rates to retrospective volumes given the difficulty in projecting targeted case volumes moving forward. With regard to the commercial claim set utilized, while the membership base was large and national in scope, the resulting model estimates may not be completely generalizable to smaller, regional plans. To this end, the authors encourage plans to use the structure of this model in conjunction with their own data to generate plan-specific results.

Conclusion
In this era of health care reform, in which all stakeholders are ultimately preparing for population health management, models like this one will be useful in identifying the most effective and efficient ways to manage patients, particularly high-risk patients with the potential to generate significant costs if not managed properly. Moreover, this model
seems to indicate that technologies such as pVADs should be given careful consideration despite their initial incremental cost in non-surgical cases, as the incidence rates for target cases are relatively low and post-index resource consumption is unimpressive from a cost standpoint. This study demonstrates that pVAD technology has a minimal PMPM impact across very challenging heart failure patient populations and throughout a technology adoption curve. 

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References