BlueCross BlueShield of Alabama

Name of Policy:
Transcatheter Pulmonary Valve Implantation

Policy #: 486
Category: Surgery

Latest Review Date: May 2018
Policy Grade: B

Background/Definitions:

As a general rule, benefits are payable under Blue Cross and Blue Shield of Alabama health plans only in cases of medical necessity and only if services or supplies are not investigational, provided the customer group contracts have such coverage.

The following Association Technology Evaluation Criteria must be met for a service/supply to be considered for coverage:

1. *The technology must have final approval from the appropriate government regulatory bodies;*
2. *The scientific evidence must permit conclusions concerning the effect of the technology on health outcomes;*
3. *The technology must improve the net health outcome;*
4. *The technology must be as beneficial as any established alternatives;*
5. *The improvement must be attainable outside the investigational setting.*

Medical Necessity means that health care services (e.g., procedures, treatments, supplies, devices, equipment, facilities or drugs) that a physician, exercising prudent clinical judgment, would provide to a patient for the purpose of preventing, evaluating, diagnosing or treating an illness, injury or disease or its symptoms, and that are:

1. *In accordance with generally accepted standards of medical practice; and*
2. *Clinically appropriate in terms of type, frequency, extent, site and duration and considered effective for the patient's illness, injury or disease; and*
3. *Not primarily for the convenience of the patient, physician or other health care provider; and*
4. *Not more costly than an alternative service or sequence of services at least as likely to produce equivalent therapeutic or diagnostic results as to the diagnosis or treatment of that patient's illness, injury or disease.*

Description of Procedure or Service:

Transcatheter pulmonary valve implantation (TVPI) has been proposed as a less invasive alternative to open surgical pulmonary valve replacement or reconstruction for right ventricular outflow tract (RVOT) obstruction. Percutaneous pulmonary valve replacement may be indicated for congenital pulmonary stenosis. Pulmonary stenosis or regurgitation in a patient with congenital heart disease (CHD), who has previously undergone RVOT surgery, are additional indications. Patients with prior CHD repair are at risk of needing repeated reconstruction procedures.

Congenital Heart Disease

Congenital heart disease, including tetralogy of Fallot, pulmonary atresia, and transposition of the great arteries, is generally treated by surgical repair at an early age. This involves reconstruction of the right ventricular outflow tract (RVOT) and pulmonary valve by means of a surgical homograft or a bovine-derived valved conduit. These repairs are prone to development of pulmonary stenosis or regurgitation over long periods of follow-up.

Because individuals with surgically corrected congenital heart disease repair are living longer into adulthood, the problem of RVOT dysfunction following initial repair has become more common. Calcification of the RVOT conduit can lead to pulmonary stenosis, while aneurysmal dilatation can result in pulmonary regurgitation. RVOT dysfunction can lead to decreased exercise tolerance, potentially fatal arrhythmias, and/or irreversible right ventricular dysfunction.

Treatment

Interventions for RVOT dysfunction often require repeat open heart surgery, resulting to numerous open heart procedures in patients who live into adulthood. Treatment options for pulmonary stenosis, open surgery with valve replacement, balloon dilatation, or percutaneous stenting. Interventions for pulmonary regurgitation are primarily surgical, either reconstruction of the RVOT conduit or replacement of the pulmonary valve through open surgery. The optimal timing of these interventions is not well understood.

Transcatheter pulmonary valve replacement offers a potentially less invasive treatment option for patients with prior surgery for congenital heart disease and RVOT dysfunction. It is possible that the use of less invasive valve replacement techniques can spare patients from multiple repeat open heart procedures over long periods of follow-up.

Policy:

Effective for dates of service on and after May 22, 2018:

Native Valve:

Transcatheter pulmonary valve implantation, when using an FDA-approved device according to its specific indications, meets Blue Cross and Blue Shield of Alabama's medical criteria for coverage for **patients with congenital heart disease and current right ventricular outflow tract obstruction or regurgitation including the following indications:**

- A dysfunctional , non-compliant right ventricular outflow tract (RVOT) conduit with a clinical indication for intervention , and:
  - Pulmonary regurgitation ≥ moderate; or
  - A mean RVOT gradient ≥35mmHg

Valve-in-Valve:

Transcatheter pulmonary valve implantation, when using an FDA-approved device according to its specific indications (i.e. Melody), meets Blue Cross and Blue Shield of Alabama's medical criteria for coverage for **patients with congenital heart disease and current right ventricular outflow tract obstruction or regurgitation including the following indications:**

- A surgical bioprosthetic pulmonary valve that has:
  - ≥ moderate regurgitation; OR
  - A mean RVOT gradient ≥ 35mmHG

Transcatheter pulmonary valve implantation does not meet Blue Cross and Blue Shield of Alabama's medical criteria for coverage and is considered **investigational** for all other indications.

Effective for dates of service prior to May 22, 2018:

Transcatheter pulmonary valve implantation, when performed according to **FDA-approved indications**, **meets** Blue Cross and Blue Shield of Alabama's medical criteria for coverage **for patients with prior repair of congenital heart disease and right ventricular outflow tract (RVOT) dysfunction, who are not good candidates for open repair** due to one or more of the following conditions:

- High-risk for surgery due to concomitant medical comorbidities; OR
- Poor surgical candidate due to multiple prior thoracotomies for open heart surgery.

Transcatheter pulmonary valve implantation does not meet Blue Cross and Blue Shield of Alabama's medical criteria for coverage and is considered **investigational** for all other indications.

Blue Cross and Blue Shield of Alabama does not approve or deny procedures, services, testing, or equipment for our members. Our decisions concern coverage only. The decision of whether or not to have a certain test, treatment or procedure is one made between the physician and his/her patient. Blue Cross and Blue Shield of Alabama administers benefits based on the member's contract and corporate medical policies. Physicians should always exercise their best medical

judgment in providing the care they feel is most appropriate for their patients. Needed care should not be delayed or refused because of a coverage determination.

Key Points:

The most recent update with literature review is through May 15, 2017.

Evidence reviews assess the clinical evidence to determine whether the use of a technology improves the net health outcome. Broadly defined, health outcomes are length of life, quality of life, and ability to function-including benefits and harms. Every clinical condition has specific outcomes that are important to patients and to managing the course of that condition. Validated outcome measures are necessary to ascertain whether a condition improves or worsens; and whether the magnitude of that change is clinically significant. The net health outcome is a balance of benefits and harms.

To assess whether the evidence is sufficient to draw conclusions about the net health outcome of a technology, 2 domains are examined: the relevance and the quality and credibility. To be relevant, studies must represent one or more intended clinical use of the technology in the intended population and compare an effective and appropriate alternative at a comparable intensity. For some conditions, the alternative will be supportive care or surveillance. The quality and credibility of the evidence depend on study design and conduct, minimizing bias and confounding that can generate incorrect findings. The randomized controlled trial is preferred to assess efficacy; however, in some circumstances, nonrandomized studies may be adequate. Randomized controlled trials are rarely large enough or long enough to capture less common adverse events and long-term effects. Other types of studies can be used for these purposes and to assess generalizability to broader clinical populations and settings of clinical practice.

Studies Using FDA-Approved Valves

The only device that currently has U.S. Food and Drug Administration (FDA) approval for transcatheter pulmonary valve implantation is the Melody™ valve (Medtronic, Inc., Minneapolis, MN). Approved indications include right ventricular outflow tract (RVOT) dysfunction, defined as pulmonic regurgitation (moderate or greater) or pulmonic stenosis (mean gradient of 35 mm Hg or higher). In addition, a circumferential RVOT conduit should exist that is equal to or greater than 16 mm in diameter when originally implanted.

Melody Transcatheter Pulmonary Valve

The multicenter U.S. Melody TPV trial was a multicenter, prospective uncontrolled trial designed to assess the safety, procedural success, and short-term effectiveness of the Melody Transcatheter Pulmonary Valve (TPV). The Summary of Safety and Probable Benefit (SSPB) to support the approval of a humanitarian device exemption to market the Melody Transcatheter Pulmonary Valve (TPV) was based on clinical data from 99 subjects enrolled in this trial who were catheterized for potential implantation with the TPV from January 31, 2007, through December 12, 2008, with expected follow-up and adverse event data on these subjects current through March 27, 2009. Approved indications included right ventricular outflow tract (RVOT) dysfunction, defined as pulmonic regurgitation (moderate or greater) or pulmonic stenosis (mean

gradient, ≥35 mm Hg). In addition, a circumferential RVOT conduit should exist that is 16 mm or greater in diameter when originally implanted.

The investigators planned to follow 150 patients over a 5-year period. Eligibility criteria included a dysfunctional RVOT conduit or a dysfunctional bioprosthetic pulmonary valve, plus evidence of heart failure. For patients with New York Heart Association (NYHA) class I heart failure, a Doppler mean gradient of 40 mm Hg or greater or severe pulmonary regurgitation was required; for patients with NYHA class II to IV heart failure, a mean gradient of 35 mm Hg or greater or moderate pulmonary regurgitation was required. These inclusion criteria generally were indications for pulmonary valve replacement. The primary outcomes were defined as procedural success, adverse events from the procedure, and effectiveness, as measured by the proportion of patients with acceptable valve function at 6 months.

Results from this trial have been published in several reports. Short and medium term outcomes for 136 patients who underwent attempted TPVI were reported by McElhinney et al in 2010. A total of 124/136 patients (91.2%) had successful implantation. In 12 patients, implantation was not possible due to anatomic or other intraprocedural findings that precluded implantation. One death occurred as a result of the procedure (0.7%), and serious adverse events occurred in 8/136 patients (6%). Adverse events included coronary artery dissection, conduit rupture/tear, wide complex tachycardia, respiratory failure, femoral vein thrombosis, and perforation of the pulmonary artery.

A total of 94 patients had successful implantation and reached the 6-month follow-up time point at the time of publication. Acceptable valve function, defined as mild pulmonary regurgitation or less on echocardiography, was present in greater than 90% of patients. Right ventricular pressure and right ventricular outflow tract gradient improved following the procedure, and 71 of 94 (75.5%) were in NYHA class I heart failure at 6 months. Over the course of follow-up, stent fractures were diagnosed in 25 of 124 (20.2%) patients, and 9 of 124 (7.3%) required implantation of a second valve.

Cheatham et al (2015) reported on outcomes up to 7 years following TPVI for the 148 patients who received and were discharged with a TPV in the Melody TPV trial (out of 171 patients enrolled). Of a total of 171 patients enrolled, 167 underwent catheterization, 150 had a Melody valve implanted, and 148 of those survived to discharge with the Melody valve in place. On echocardiogram at discharge, pulmonary regurgitation was absent/trivial or mild in 140 patients and 5 patients, respectively, which represented a significant improvement from baseline. Over a median follow-up of 4.5 years (range 0.4 to 7.0 years), 4 deaths occurred. During the follow- up period, 32 patients required a reintervention on RV outflow tract, 25 of which were transcatheter TPV reinterventions. A total of 11 patients required Melody valve explantation. Among the 113 patients who were alive and free from reintervention a median of 4.5 years after implantation, the most recent RVOT gradient was unchanged from early after valve implantation. Functional outcomes generally improved over the course of the study: before TPVI, 14% of patients were in New York Heart Association (NYHA) class I and 17% were in class III or IV. At every postimplantation annual evaluation, at least 74% of patients were in class I and no more than 1% to 2% were in class III or IV.

A secondary publication (2012) from the US Melody TPV trial focused on the change in exercise function following TPVI. Patients completed a standardized cardiopulmonary regimen 2 months prior to TPVI and 6 months following TPVI. Results of pre- and postexercise parameters were available for 94-114 patients, depending on the specific outcome. There were numerous physiologic outcome measures reported, with some of these showing a statistically significant change between the 2 time points, and others not showing a significant change. For example, there was a significant increase in the percent predicted maximal workload from 65.0% at baseline to 68.3% at follow-up ($p<0.001$) and a significant decrease in the ratio of minute ventilation to CO2 production from 30.8 at baseline to 29.1 at follow-up ($p<0.001$). In contrast, there were no significant changes in peak oxygen consumption or in spirometric measures of pulmonary function. This study reports modest benefits in exercise parameters for patients treated with TPVI. The results are limited by the lack of a control group and by the large number of patients who did not have completed exercise results available (approximately one-third of total).

The 2015 premarket approval (PMA) of the Melody Transcatheter Pulmonary Valve (TPV) was based on the interim analysis and a retrospective pooling analysis of the 2 postapproval studies conditioned by the prior humanitarian device exemption. An additional supplemental dataset from the Melody TPV European and Canadian Post-Market Surveillance Study (PMSS) was included in the PMA.

Armstrong et al published 1 year follow-up results of the Melody TPVI post-approval study (PAS), a prospective study designed to evaluate the short-term hemodynamic changes following device implantation. The study used historical controls from the Melody IDE trial (described above) to investigate whether the short-term effectiveness of the device is noninferior to results shown in the IDE trial. The study enrolled 120 subjects, 101 of whom underwent attempted TPVI. Patient selection was based on the criteria used in the IDE trial, but did not include the age (5 years of age and older) and weight (≥30 kg) limitations. Procedure-related significant adverse events occurred in 16 patients (13.3% of total cohort of 120; 15.8% of those who had an attempted TPVI); the most common of which was a confined conduit tear. Procedural success occurred in 99 subjects (98% of those with an attempted TPVI). At 1 year follow-up, the proportion of patients in New York Heart Association (NYHA) Class I heart failure increased from 35% at baseline to 89%. Of the 99 patients implanted for at least 24 hours, 87 had acceptable TPV hemodynamic function confirmed at 6 months (96.7% of those with evaluable echocardiographic data and 87.9% of entire cohort) and 82 had acceptable TPV hemodynamic function at 1 year (94.3% of those with evaluable echocardiographic data and 82.8% of the entire cohort). Following the procedural period, serious device-related adverse events occurred in 8%, most commonly endocarditis (n=3 patients).

Gillespie et al evaluated results of TPVI after a Ross procedure in a retrospective review of pooled findings from the Melody TPV trial and post-approval study and an additional European registry, the manufacturer-sponsored Melody TPV Post-Market Surveillance Study which was conducted in Canada and Europe (NCT00688571). In the pooled sample (n=358), 67 (19%) had a prior Ross procedure. A Melody valve was successfully implanted in 56/67 (84%) of the Ross patients who underwent catheterization with intent for TPVI. Six patients (9%) had symptomatic coronary artery compression after TPVI or did not undergo implantation due to the risk of

compression. Right ventricular hemodynamics generally improved after TPVI, but RVOT reinterventions were required in 12 of 55 patients who were discharged from the implant hospitalization with the Melody valve in place.

The Melody TPV New Enrollment Study was intended to roll in the new patient enrollment study specified as a condition of approval for the Melody TPV HDE on January 25, 2010. This study used the protocol dated September 24, 2013, Version 2, included in H080002/S015.

The study is a prospective, nonrandomized, multicenter, historically controlled clinical trial, designed to assess the postmarket performance of the Melody TPV in a representative population of providers and patients, with 5-year follow-up. The primary endpoint is freedom from TPV dysfunction, with a performance goal of 75% or greater at 6 months. Secondary endpoints include procedural success, serious procedural- and device-related adverse events, stent fracture, reintervention on the TPV, surgical replacement of the RVOT conduit, death (all-cause, procedure-related, and device-related), and NYHA classification.

The February 2017 approval of the Melody system expanded to include patients with a dysfunctional surgical bioprosthetic valve (valve in valve) is based on data pooled from 3 sources:

- Melody TPV Long-term Follow-up Post Approval Study (PAS): 8 patients
- Melody TPV New Enrollment PAS: 17 patients
- Real-World Data: 100 patients

Of 125 patients pooled from the 3 studies outlined above, 56.8% (71) patients were available for analysis at the completion of the study, the 1-year postimplant visit. Baseline pooled subject median age was 22.0 years (range, 5.0-79 years) with 45.6% female and 54.4% male. Tetralogy of Fallot was the most common CHD diagnosis recorded in 72.8% of subjects; 66.4% of whom had pulmonary stenosis or atresia. There was no mortality for any cause, major stent fracture, occurrence of endocarditis, RVOT reoperation, catheter reintervention among available patients at 1 year. Procedural failure as defined by more than trivial pulmonary regurgitation by angiography postimplant occurred in 10.1% (12/119) subjects. There were no device explants within 24 hours of implantation. The mean RVOT gradient was reduced from 29.5 mm Hg (SD=12.6) at baseline to 14.3 mm Hg (SD=6.6) at 1 year postimplantation. In this premarket application, existing clinical data was not leveraged to support approval of a pediatric patient population. This submission included pediatric data to support the pediatric indication and no extrapolation was necessary.

Additional Noncomparative Studies

A number of publications have reported on series of patients treated with TPVI. Some of the larger series are discussed in detail.

Lurz et al (2008) reported on 163 patients who underwent attempted TPVI from 4 clinical centers in Europe. Eligibility for the procedure included elevated right ventricular (RV) systolic pressure, increased RVOT dimensions, and either symptoms or evidence of severe RV dysfunction. Procedural success was achieved in 155/163 patients (95.1%). Procedural complications occurred in 12/163 (7.4%), 8 of which were considered serious and 5 of which

required open surgery. The median follow-up was 28.4 months. Over the course of follow-up, 4/155 patients (2.6%) died, and an additional 5/155 patients (3.2%) developed infective endocarditis. At 12 month follow-up, greater than 90% of patients had absent or mild valve dysfunction as measured by echocardiography.

Eicken et al (2011) reported on 102 consecutive patients (mean age, 21.5 years) undergoing transcatheter pulmonary valve implantation at 2 centers in Germany. Eligibility for the procedure included RVOT dysfunction with evidence of RV compromise or increased RV pressure. There was 1 death (1.0%) that occurred as a result of compression of the left coronary artery. Two patients (2.0%) had evidence of stent fracture immediately postprocedure, and 1 additional patient (1.0%) developed infective endocarditis at 6-month follow-up. At a median follow-up of 357 days, there was a significant decrease in the RVOT gradient from a median of 36 to 15 mm Hg ($p<0.0001$). However, there was no significant change in exercise capacity as measures by maximal oxygen uptake.

Other case series reported on smaller numbers of patients, with patient populations ranging from 7 to 64. These publications reported generally similar results as the larger series, with high procedural success and relatively low rates of serious complications. The longest follow-up was reported by Borik et al, in a report on 51 patients who underwent TPVI with the Melody valve at a single institution. Over a mean follow-up of 4.5 years (range 0.9 to 6.9 years), freedom from any reintervention was 87% and 68% at 3 and 5 years, and freedom from surgery was 90% at 5 years. Overall, right ventricular functional parameters did not change with longer follow-up.

An Australian prospective observational registry reported information accumulated on 17 patients implanted with Melody device between 2009 and 2016. Mixed valvular dysfunction was present in 7 (41%) patients and 11 (59%) had corrected tetralogy of Fallot. Device implantation was successful in all patients. Peak RVOT gradient was significantly reduced and there was no significant regurgitation postprocedure. There was 1 (6%) major procedural adverse event and 2 (12%) major adverse events at last recorded follow-up. There were no patient deaths. Follow-up cardiac magnetic resonance imaging (MRI) revealed a significant reduction in indexed right ventricular end diastolic volume.

Edwards Sapien XT Transcatheter Heart Valve (Pulmonic) The device sponsor for the PMA application (Edwards Lifesciences) performed a clinical study to establish a reasonable assurance of safety and effectiveness of pulmonic implantation with the Edwards SAPIEN (Transcatheter Heart Valve) THV in patients with dysfunctional RVOT conduits in the US under IDE # G060242 (entitled the COngenital Multicenter trial of Pulmonic vAlve regurgitation Studying the SAPIEN InterventIONal THV, COMPASSION trial). Data from this clinical study were the basis for the PMA decision for the pulmonary valve implantation indication.

Patients were treated between April 17, 2008, and November 24, 2014. The database supplement reflected data collected through March 6, 2015, and included 81 patients. There were 7 investigational sites.

The study was a prospective, nonrandomized, multicenter clinical study to assess the safety and effectiveness of pulmonic implantation of the SAPIEN THV in patients with dysfunctional

RVOT conduits requiring treatment for moderate or severe pulmonary regurgitation by transthoracic echocardiography (TTE) and/or RVOT conduit obstruction with a mean gradient of 35 mm Hg or higher by TTE. The SAPIEN THV is the first-generation valve of the SAPIEN device line and is no longer available for distribution. The valve sizes used in the COMPASSION trial included the 23- and 26-mm sizes which were the only available sizes for the SAPIEN THV. The 29-mm valve size was not evaluated in the COMPASSION trial and therefore data for this device size is unavailable. The majority of data were derived from patients who received the 23-mm THV size. Aortic experience with the 29-mm SAPIEN XT THV showed no significant difference in long term performance in comparison to the 23- and 26-mm SAPIEN XT THV sizes. Furthermore, no observed results suggest that the 29-mm valve size would perform worse than other available sizes in the pulmonic location.

Enrollment in the COMPASSION study was limited to patients who met the following inclusion criteria:

- Weight ≥ 35 kilograms.
- In situ conduit size of 20-26 mm in diameter.
- Moderate or severe pulmonary regurgitation defined as ≥ 3+ pulmonary regurgitation by TTE or
- RVOT conduit obstruction with a mean gradient of ≥35 mm Hg by TTE.
- Symptomatic as evidenced by cardiopulmonary exercise testing.
- Catheterization was determined to be feasible by the treating physician.

All patients were scheduled to return for follow-up examinations at day 1 postprocedure, discharge, 30 days, 6 months, 12 months, and annually thereafter for 5 years postoperatively. Baseline evaluation included TTE, x-ray, MRI, or computed tomography (CT), angiogram, electroencephalograph. Assessment of NYHA class, MRI or CT and angiogram were part of the 6-month evaluation.

The primary end point was freedom from device- or procedure-related death and/or reintervention at 1 year. The secondary end points were:

- Freedom from major adverse cardiac and cerebrovascular events (MACCE) at 6 months. MACCE was defined as all-cause mortality, myocardial infarction, reintervention, vascular injury resulting in the need for an unplanned vascular intervention, stroke, and pulmonary embolism.
- Functional improvement at 6 months as defined by:
    - Improved valve hemodynamics as demonstrated via TTE:
        - Decrease in pulmonary regurgitation to mild or less for regurgitant lesions
        - Decrease in mean pulmonary gradient to less than 30 mm Hg for stenotic lesions
        - Improvement in both pulmonary regurgitation and gradient (above) for mixed lesions.
    - Improvement of ≥1 NYHA functional class from baseline for patients with NYHA functional class ≥2 at baseline.
    - Freedom from recurrent pulmonary stenosis.

Of 81 patients enrolled in the PMA study, 2 enrolled patients were screen failures and did not undergo the index procedure; therefore, there were 79 patients in the safety population. A device was not used or inserted into the vascular system in 9 patients in the safety population. Therefore, there were 70 patients in the attempted implant population and one patient did not have a SAPIEN THV implanted in the target location. Therefore, there were 69 patients available for analysis in the valve implant population at the completion of the study.

Median duration of follow-up for the safety population was 3.04 years (range, 0-5.31 years). Males were 65.8% of the population and 63.3% were 22 years of age or older. The primary indications for valve implantation were pulmonary stenosis (8.9%), pulmonary regurgitation (12.7%), and both stenosis and regurgitation (78.5%). The primary etiology requiring reconstruction of the RVOT and placement of a pulmonary conduit for the safety population was tetralogy of Fallot (42%).

The prespecified performance goal for the primary end point was 75%. This goral was met with a 1-year freedom from device or device-related death of 100% and 3 reintervention events. At 5 years, the freedom from device- or procedure-related death and/or reintervention using a Kaplan-Meier estimate was 77.1%. As there were no device- or procedure-related patient deaths at 5 years, the incidence of reinterventions solely contributed to the estimate.

Freedom from reintervention to 5 years for the valve implant population using a Kaplan-Meier estimate was reported by type of reintervention: (a) freedom from surgical pulmonic valve repair was 98.3% at 1 year and 91.8% at 5 years; (b) freedom from transcatheter pulmonic valve implantation was 97.1% at 1 year and 85.8% at 5 years; (c) freedom from balloon valvuloplasty was 100% at 1 year and 93.7% at 5 years; and (d) freedom from other types of reintervention was 100% at 1 year and 97.9% at 5 years.

For secondary outcomes, freedom from MACCE at 6 months in the valve implant population was 94.1%. Two (2.5%) of 79 patients experienced a device migration early in the trial. The instructions for use were modified; no other device migrations subsequently occurred in the trial. Serious adverse events for RVOT conduit ruptures occurred in 5 (6.3%) of 79 patients. These 5 ruptures were related to balloon valvuloplasty or placement of a prestent and no ruptures occurred during placement of the SAPIEN THV. There was 1 neurologic event (not stroke), 1 thromboembolism, and 4 endocarditis events at 1 year of follow-up.

Adjunctive analyses of safety and effectiveness stratified by patients' ages 21 years or younger at baseline versus patients' ages 22 years or older at baseline was conducted. The COMPASSION study was not designed to investigate the differences in outcomes between age groups and, therefore, no statistical inferences can be made. The analysis of functional improvement outcomes by age group is summarized in Table 1.

Table 1. Edwards Sapien XT Transcatheter Heart Valve (Pulmonic) PMA Approval Study: Overall Functional Improvement by Age Group for Valve Implanted Population

End Points	Age 21 or Younger (n=27)		Age 22 or Older (n=42)	
	Outcome Rate, n/N (%)		Outcome Rate, n/N (%)	
	1 Year	5 Year	1 Year	5 Year
Overall functional improvement	18/22 (85.7%)	3/7 (42.9%)	29/33 (87.9%)	5/8 (62.5%)
Improved valve function	19/19 (100.0%)	5/5 (100.0%)	28/30 (93.3%)	6/6 (100.0%)
Functional improvement in NYHA	13/14 (92.9%)	4/4 (100.0%)	32/33 (97.0%)	8/8 (100.0%)
Freedom from recurrent pulmonary stenosis	18/19 (94.7%)	5/9 (55.6%)	31/31 (100.0%)	7/10 (70.0%)
Improved gradient	7/8 (87.5%)	3/3 (100.0%)	7/8 (87.5%)	2/2 (100.0%)

NYHA: New York Heart Association.

As listed in Table 1, overall functional improvement was defined by the following 4 categories: (a) improved valve function demonstrated by a decrease in pulmonary regurgitation to mild or less per TTE at visit for patients with moderate or more (>2) pulmonary regurgitation at baseline, (b) functional improvement from baseline of 1 or more NYHA functional classes at visit for patients with baseline NYHA functional class of 2 or higher, (c) freedom from recurrent pulmonary stenosis at visit, and (d) improved valve function demonstrated by a decrease in pulmonary stenosis mean gradient to less than 30 mm Hg for patients with pulmonary stenosis mean gradient greater than 30 mm Hg at baseline. Patients with mild or less (≤2+) pulmonary regurgitation at baseline only use categories b, c, and d to determine overall functional improvement. Patients with NYHA functional class of less than 2 at baseline only use categories a, c, and d to determine overall functional improvement. Patients treated for indications other than pulmonary stenosis only use categories a, b, and d for overall functional improvement. Patients with pulmonary stenosis mean gradient less than 30 mm Hg at baseline only use categories a, b, and c for overall functional improvement.

A small number of retrospective, comparative studies have compared outcomes of the Edwards Sapien and the Melody valves. Boshoff et al (2013) described the off-label uses in 21 patients treated with the Melody valve and 2 patients treated with the Edwards Sapien pulmonic valve. Use has included native RVOT obstruction, in conduits smaller than the FDA-labeled indications, and large RVOT with a dynamic outflow aneurysm. No deaths or major procedural complications were reported for these patients. Clinical outcomes data were lacking or very limited in this publication.

Faza et al (2013) reported on 20 patients who underwent successful implantation of the Edwards Sapien pulmonic valve at 1 clinical center. There were no periprocedural deaths, and all but 1 patient had no or trivial pulmonic regurgitation on latest follow-up. A comparison of hemodynamic parameters in these 20 patients was made with 13 patients treated with the Melody valve. Immediately postprocedure, transvalvular gradients were similar between groups. At last follow-up, mean residual transvalvular gradient was higher for patients receiving the Sapien valve (18.4 mm Hg vs 11.2 mm Hg, p=0.016), but this difference was disappeared when patients were matched for length of follow-up.

A few other small case series reporting on the use of the Edwards Sapien pulmonic valve for RVOT obstruction have been published. For example, Kenny et al (2011) reported on a phase 1

multicenter study of the Sapien valve in 36 patients from 4 clinical centers. Procedural success was reported in 97% of patients. Procedural complications occurred in 19% (7/36) of patients, including valve migration (n=3), pulmonary hemorrhage (n=2), ventricular fibrillation (n=1), and stent migration (n=1). At 6-month follow-up, there were no deaths and 75% (27/36) of patients were in NYHA class I, compared with 14% at baseline. Freedom from reintervention at 6 months was 97%.

Section Summary: Studies Using Valves Approved by the U.S. Food and Drug Administration
The evidence for the use of TPVI with the Melody valve consists of the prospective, interventional, noncomparative pivotal study on which the device's FDA approval was based, along with a post-approval registry study and a number of additional case series. Overall, the evidence suggests that TPVI is associated with high rates of short-term technical success and improvements in heart failure-related symptoms and hemodynamic parameters. Studies with follow-up extending to a maximum of 7 years post-procedure suggest that the functional and hemodynamic improvements are durable, but a relatively high proportion of patients (approximately 20-30%) require reintervention on the pulmonary valve.

Non-FDA Approved Uses of TPVI
There are a variety of potential off-label uses of TPVI that have been reported in the literature. These include use of devices for approved devices for non-FDA-approved indications.

Non-FDA-Approved Indications
Analysis of data from the Valve-in-Valve International Database (VIVID) multicenter registry evaluated the off-label use of transcatheter aortic and TPVI prostheses for tricuspid valve-in-valve implantation (TVIV). There were 150 out of 156 patients in the registry in whom TVIV was successful with a Melody (n=93) or Sapien (n=57) valve. During a median of 13.3 months of follow-up, 22 (15%) patients died, all with NYHA class III or IV. There were 10 tricuspid valve re-interventions (6.6%) and 3 additional patients (2%) who had significant recurrent dysfunction of the valve. Before intervention 71% of patients were NYHA class III or IV, while at follow-up 77% of surviving patients were NYHA class I or II ($p<0.001$).

A few case series have been reported on use of the Melody valve in patients with clinical characteristics that do not correspond to FDA-approved indications. These have included use in valves other than the pulmonic position, patients with conduit sizes that do not correspond to the FDA indications, and patients with prior congenital heart repair surgery that did not involve construction of a right ventricular outflow tract (RVOT) conduit. In general, these case series have reported high rates of procedural success with low rates of peri-procedural complications, but evidence on longer term outcomes is lacking.

Although most studies have evaluated the use of TPV implantation in patients with a constructed RVOT conduit, a few studies have evaluated TPV implantation with either the Melody or Edwards SAPIEN pulmonary valve in a native RVOT or RVOT without a circumferential conduit. Meadows et al reported results from a retrospective, 5-center review of patients who underwent TPV placement in a nonconduit RVOT, with native tissue comprising at least part of the circumference. Thirty-one patients were included, with indications for RVOT intervention including primarily valvular insufficiency in 14 (45%), obstruction in 3 (10%), and mixed

obstruction and insufficiency in 14 (45%). TPV implantation was successful in all patients, but serious complications occurred in two patients (6%). At a median follow-up of 15 months (range, 1 month to 3.8 years), all patients were alive, and no patient had greater than mild pulmonary regurgitation. Among the 19 patients with adequate imaging at follow-up, 6 (32%) had evidence of stent fracture. Three patients were treated for endocarditis or bloodstream infection. Malekzadeh-Milani reported outcomes for 34 patients with a native or patched noncircular RVOT who underwent Melody TPV insertion at a single center. The procedure was technically successful in all patients, although early complications occurred in 8.8%. At a mean follow up of 2.6 years, no patients had stent fracture or stent migration, and 32/34 (94.1%) had absent or trivial pulmonary regurgitation.

Several other small case series by Demkow et al (N=10 patients) and Odemis et al (N=7 patients) report on the use of the Edwards SAPIEN pulmonary valve for noncircumferential RVOT patch and large-diameter conduits, respectively. The authors report high rates of successful valve implantation, but long-term follow-up is not reported.

Adverse Events

In addition to the adverse events reported in the case series, several publications have focused on adverse events following TPVI.

The FDA reviewed results from the US Melody TPV trial as part of the FDA approval process and reported detailed data on complications from the procedure. At that time, data were available for 99 patients enrolled between January 2007 and December 2008. A total of 90 patients were deemed suitable for implantation following catheterization, and 87/90 patients had successful implantation. There was one procedural-related death (1.1%).

The following table is adapted from the FDA summary of safety and probable benefit:

Table 2: Device-Related Adverse Effects (N=89 Subjects)

Adverse Events	Subjects With Event n (%)	Freedom From Event at 12 Months (SE)
Stent fracture (all)	16 (18%)	77.1% (7.5)
Minor [a]	11 (12%)	84.1% (6.7)
Major [a]	5 (6%)	90.6% (5.2)
Valve stenosis	6 (7%)	90.5% (4.8)
Worsening tricuspid regurgitation	1 (1%)	100% (--)
Reintervention [b]	6 (7%)	93.5% (4.3)
Reoperation	1 (1%)	98.6% (2.2)

[a] Stent fractures that did not require intervention were defined as minor; those that required reintervention were defined as major.
[b] Re-interventions were balloon angioplasty in 1 patient; repeat implantation of a second TPV in 5 patients.

There were 64 patients in the FDA analysis who reached 6 months of follow-up. Of these, 56 of 64 (87.5%) had acceptable hemodynamic function of the valve by Doppler echocardiography. At 6 months, approximately 75% of patients were in NYHA Class I, and 25% were in NYHA Class II. Pulmonary regurgitation that was mild or worse was present in 6.2% of patients.

Another publication focusing on adverse events in the US Melody TPV trial was published in 2011. This publication reported on adverse events at a median follow-up of 30 months in 150

patients. Stent fracture occurred in 26% (39/150) of patients. The estimated freedom from stent fracture was 77% at 14 months and 60% at 39 months. Freedom from re-interventions for all patients was estimated to be 86% at 27 months, and freedom from re-interventions for patients with stent fracture was estimated at 49% at 2 years.

McElhinney (2013) reported rates of infective endocarditis from 3 prospective cases series' enrolling a total of 311 patients followed for a median of 2.5 years. There were a total of 16 patients (5.1%) diagnosed with endocarditis at any location and 6 patients (1.9%) who had endocarditis at the pulmonic valve location. This corresponded to an annualized rate of pulmonic valve endocarditis of 0.88%/patient-year. Malekzadeh-Milani et al evaluated patients with right-sided infective endocarditis at a single center to evaluate endocarditis rates in patients with TPVs compared with surgically-paced pulmonary valves. Thirty-one patients with right-sided endocarditis and pulmonary valve implantation for congenital heart disease were included. Rates of endocarditis were 1.2 and 3.9 cases/100 person-years in patients with surgically-implanted valves and TPVs, respectively (p=0.03).

Boudjemline et al (2016) conducted a prospective observational study to evaluate predictors of conduit rupture during the preparation of the RVOT for TPVI in a cohort of patients older than age 5 years with RVOT obstruction, pulmonary regurgitation, or mixed lesions, who underwent transcatheter therapies, including balloon dilatation, bare metal stent placement, or TPV placement. Ninety-nine patients were included, 56 of whom were adults. Of the total cohort, 83.8% underwent Melody TPV implantation. Conduit rupture occurred in 9 patients (9.09%). In 2 of the 9 patients, conduit rupture was angiographically obvious and severe with extension, causing hemodynamic instability. All conduit ruptures occurred during balloon dilatation, and all occurred in patients with RVOT obstruction. Heavy calcification and the presence of a homograft were associated with conduit rupture risk.

Coronary artery compression during balloon angioplasty or stent placement in the RVOT conduit is considered a relative contraindication to TPV placement. Several studies have evaluated to incidence of coronary artery compression. Morray et al reported the incidence of coronary artery compression in a 4-center series of 404 patients who underwent attempted TPV implantation. Three hundred forty-three patients (85% of total) underwent TPV implantation, and 21 patients (5% of total) had evidence of coronary artery compression. Most patients (N=19) with coronary artery compression did not undergo TPV placement. Using the same cohort reported in the Boudjemline et al study, Fraisse et al reported the incidence, diagnosis, and outcome of coronary compression among patients treated with transcathether RVOT interventions for RVOT obstruction, pulmonary regurgitation, or mixed lesions. All patients underwent balloon dilatation and coronary assessment with angiography, which was followed by TPV placement if there was ongoing RVOT dysfunction. Of 100 patients evaluated, 83% had implantation of a Melody TPV. Coronary artery compression occurred in six cases, all of which could be diagnosed by selective coronary angiogram and/or aortic root angiogram during balloon dilation of the RVOT. No specific risk factors for coronary artery compression were identified.

Van Dijck et al (2015) compared rates of infective endocarditis between transcathether pulmonary valves and surgically-implanted pulmonary valves in a retrospective, single-center study which included 677 patients (738 conduits). Patients who underwent procedures from 1989

to 2013 were included. A total of 107 Melody conduits were implanted in 107 patients. A total of 577 pulmonary valve cryopreserved homografts were implanted in 517 patients, and 54 Contegra grafts were implanted in 53 patients. Freedom from infective endocarditis at 5 years by Kaplan-Meier analysis was 84.9%, 87.8%, and 98.7% for patients with Melody conduits, Contegra grafts, or cryopreserved homografts, respectively.

Malekzadeh-Milani et al (2015) reported on the incidence of infective endocarditis among 86 prospectively-enrolled consecutive patients who underwent TPVI with the Melody valve. Over a mean follow-up of 23.6 months (range 2.6 to 28.3 months) after Melody implantation, 5 patients developed infective endocarditis (5.8%, 95% CI 0.9 to 10.7%). Factors related to demographics, conduit type, procedural success, residual gradient, and duration of Melody valve implantation did not differ significantly between patients who did/did not develop infective endocarditis. Patients with infective endocarditis were more likely to have undergone invasive procedures after TPVI without antibiotic prophylaxis (OR 13.69, 95% CI 1.98 to 94.52, P=0.014), and aspirin use was preventive for infective endocarditis (relative risk [RR] 20.1, 95% CI 3.34 to 120.9, P=0.001), although confidence intervals around risk estimates for both factors were wide.

A retrospective review of 25 patients undergoing Melody TPVI and 178 surgical pulmonic valve surgeries (bioprostheses and homografts) was reported from New Zealand for the period of October 2009 to May 2015. A total of 4 (16%) implant patients experienced endocarditis. Two patients presented with life-threatening endocarditis and obstructive vegetation at 14 and 26 months postimplant, respectively. Two additional patients presented with subacute endocarditis at 5.5 years postimplant. At a median follow-up of 2.9 years, 4 (2%) patients had developed endocarditis in the surgical group.

Summary

For individuals with a history of congenital heart disease and current RVOT obstruction who receive TPVI with an FDA-approved device according to FDA indications, the evidence includes the prospective, interventional, noncomparative studies and multiple prospective and retrospective case series. Relevant outcomes are overall survival, symptoms, functional outcomes, quality of life, hospitalizations, and treatment-related morbidity and mortality. The results of the case series indicate that there is a high rate of procedural success and low procedural mortality, although the rate of serious procedural adverse events reported in these series ranges from 3.0% to 7.4%. Most valves demonstrate competent functioning by Doppler echocardiography at 6- to 12-month follow-up, but complications (e.g. stent fractures, need for reinterventions) were reported in an FDA analysis to occur at rates of 18% and 7%, respectively. Other publications with longer follow-up have reported stent fractures in up to 26% of patients; however, most stent fractures have not required reintervention. Studies with follow-up extending to a maximum of 7 years postprocedure suggest that the functional and hemodynamic improvements are durable, but a relatively high proportion of patients (approximately 20%-30%) require reintervention on the pulmonary valve. Although there is limited evidence, patients who are not good surgical candidates for open surgery may benefit from this procedure.

In patients who are not candidates for open surgery or who are at high risk for surgery due to other medical comorbidities, alternative treatment options are limited. Clinical vetting in 2011 indicated near uniform support for use of TPVI in patients who were not candidates for open

repair or who were at high risk for open surgery. Based on this clinical vetting and evidence on short-term success, TPVI can be considered medically necessary for patients who are not candidates for open repair or who are at high risk for open repair.

Clinical input obtained in 2018 supports that the following indications provide a clinically meaningful improvement in net health outcome and are consistent with generally accepted medical practice.

- Use of TPVI for individuals with right ventricle-to-pulmonary artery conduit with or without bioprosthetic valve with at least moderate pulmonic regurgitation;
- Use of TPVI for individuals with native or patched RVOT with at least moderate pulmonic regurgitation;
- Use of TPVI for individuals with right ventricle-to-pulmonary artery conduit with or without bioprosthetic valve with pulmonic stenosis (mean RVOT gradient at least 35 mm Hg); or
- Use of TPVI for individuals with native or patched RVOT with pulmonic stenosis (mean RVOT gradient at least 35 mm Hg).

For individuals with a history of congenital heart disease and current RVOT obstruction who receive TPVI with a non-FDA-approved indication or device, the evidence includes case series. Relevant outcomes are overall survival, symptoms, functional outcomes, quality of life, hospitalizations, and treatment-related morbidity and mortality. There is currently limited published evidence on the off-label use of TPVI, including implantation of a non-FDA-approved valve, or use of an approved valve for a non-FDA-approved indication. The published evidence consists of relatively small case series that are heterogeneous in terms of the device used and the indications for TPVI. The evidence is insufficient to determine the effects of the technology on health outcomes.

Practice Guidelines and Position Statements

Society for Cardiovascular Angiography and Interventions et al

In 2015, the Society for Cardiovascular Angiography and Interventions (SCAI), American Association for Thoracic Surgery (AATS), American College of Cardiology (ACC) and the Society of Thoracic Surgeons (STS) published a consensus-based report on operator and institutional requirements for TPVI. Recommendations to qualify for a TPVI program included 150 catheterizations/year, association with a surgical program, submission of all cases to a national registry, and for patients, 80% freedom from re-intervention at 1-year.

American Heart Association and American College of Cardiology

In 2008, the AHA/ACC issued guidelines for the management of adults with congenital heart disease. For patients with isolated valvular pulmonary stenosis, the guidelines make recommendations regarding balloon valvulotomy or surgical; however, TPVI is not addressed.

In 2014, The American Heart Association (AHA) and American College of Cardiology (ACC) issued guidelines for the management of patients with valvular disease. These guidelines do not make specific recommendations regarding the treatment of primary pulmonary valve disease

(stenosis or regurgitation), but instead refer to the 2008 guidelines for the management of adults with congenital heart disease.

In 2015, an AHA scientific statement on CHD in older adults was published and meant to be complementary to the 2008 ACC and AHA guidelines for adults with congestive heart disease (CHD). The intent was to orient the reader to the natural history, ramifications of childhood repair, and late initial diagnosis of CHD in the older adult. The statement comments on the emerging use of the currently available transcatheter valve repair devices for both pulmonary stenosis and pulmonary valve regurgitation primarily after repair of Tetralogy of Fallot. There is a specific comment that contemporary morbidity, mortality, and durability of surgical pulmonary valve regurgitation are not known, and therefore, there is no contemporaneous benchmark against which to compare transcatheter valve implantation.

In 2017, the AHA and ACC issued a focused update of the 2014 AHA/ACC Guideline for the management of patients with valvular disease. They did not make a specific recommendation regarding TPVI, but instead refer to the 2008 guidelines for the management of adults with congenital heart disease.

U.S. Preventive Services Task Force Recommendations
Not applicable.

Key Words:

Pulmonary valve prosthesis, endovascular implantation, transcatheter pulmonary valve, TPVI, Melody, Ensemble Transcatheter Valve Delivery System, Edwards SAPIEN® Pulmonic Valve, right ventricular outflow tract, RVOT, percutaneous pulmonary valve implantation, PPVI

Approved by Governing Bodies:

Devices for transcatheter pulmonary valve implantation were initially available through a humanitarian device exemption (HDE) or used off-label until full premarket approval (PMA) of 2 devices between 2015 and 2016 (see Table 3).

Table 3. Regulatory Status of Transcatheter Pulmonary Valve Implantation Devices

Device	Manufacturer	Date Cleared	PMA No.	Indications
Melody® Transcatheter Pulmonary Valve (TPV)	Medtronic	Jan 2010	H080002 (HDE)	Pulmonary valve replacement for pediatric and adult patients with a dysfunctional, noncompliant RVOT conduit
Melody TPV	Medtronic	Jan 2015	P140017	Pulmonary valve replacement for pediatric and adult patients with a dysfunctional, noncompliant RVOT

				conduit
Melody TPV	Medtronic	Feb 2017	P140017/S005	Valve-in-valve for patients with a dysfunctional surgical bioprosthetic pulmonary valve
SAPIEN XT™ Transcatheter Heart Valve (pulmonic)	Edwards Lifesciences	Feb 2016	P130009/S037	Pulmonary valve replacement for pediatric and adult patients with a dysfunctional, noncompliant RVOT conduit

HDE: humanitarian device exemption; PMA: premarket approval; RVOT: right ventricular outflow tract.

The Melody® Transcatheter Pulmonary Valve (TPV) and the Ensemble® Transcatheter Valve Delivery System are used together for percutaneous replacement of a dysfunctional pulmonary valve. The Melody valve consists of a section of bovine jugular vein with an intact native venous valve. The valve and surrounding tissue is sutured within a platinum-iridium stent scaffolding. The transcatheter delivery system consists of a balloon-in-balloon catheter with a retractable sheath and distal cup into which the valve is placed. The procedure is performed on the beating heart without use of cardiopulmonary bypass.

The Melody valve is first crimped to fit into the delivery system. It is introduced through the femoral vein and advanced into the right side of the heart and put into place at the site of the pulmonary valve. The inner balloon is inflated to open the artificial valve, and then the outer balloon is inflated to position the valve into place.

On January 25, 2010, the Melody® Transcatheter Pulmonary Valve (TPV) and the Ensemble® Transcatheter Valve Delivery System (Medtronic, Minneapolis, MN) were approved by the U.S. Food and Drug Administration (FDA) under the HDE program for use as an adjunct to surgery in the management of pediatric and adult patients with the following clinical conditions:

- Existence of a full (circumferential) right ventricular outflow tract (RVOT) conduit that is 16 mm or greater in diameter when originally implanted, and
- Dysfunctional RVOT conduits with clinical indication for intervention, and either:
    - regurgitation: moderate-to-severe regurgitation, or
    - stenosis: mean RVOT gradient ≥35 mm Hg.

On January 27, 2015, approval of the Melody® system was amended to a PMA because FDA determined that the device represented a breakthrough technology. The PMA was based, in part, on 2 prospective clinical studies, the Melody® TPV Long-term Follow-up Post Approval Study (PAS) and the Melody TPV New Enrollment PAS.

On February 24, 2017, approval of the Melody® system was expanded to include patients with a dysfunctional surgical bioprosthetic valve (valve in valve).

The Edwards Sapien XT™ Transcatheter Heart Valve (Pulmonic) (Edwards Lifesciences) is composed of a stainless steel frame with bovine pericardial tissue leaflets and available in 23- and 26-mm sizes. It includes a delivery accessories system. On February 29, 2016, it was approved by FDA as a supplement "for use in pediatric and adult patients with a dysfunctional, noncompliant Right Ventricular Outflow Tract (RVOT) conduit with a clinical indication for intervention and:

- pulmonary regurgitation ≥ moderate and/or
- mean RVOT gradient ≥ 35 mmHg."

The approval for the pulmonic valve indication is a supplement to the 2014 premarket approval for use of the Edwards SAPIEN XT™ Transcatheter Heart Valve (THV) System for relief of aortic stenosis in patients with symptomatic heart disease due to severe native calcific aortic stenosis and who are judged by a heart team, including a cardiac surgeon, to be at high or greater risk for open surgical therapy (i.e., Society of Thoracic Surgeons operative risk score ≥8% or at a ≥15% risk of mortality at 30 days). FDA product code: NPV.

Benefit Application:

Coverage is subject to member's specific benefits. Group specific policy will supersede this policy when applicable.
ITS: Home Policy provisions apply.
FEP: Special benefit consideration may apply. Refer to member's benefit plan. FEP does not consider investigational if FDA approved and will be reviewed for medical necessity.

Current Coding:

CPT codes:

33477	Transcatheter pulmonary valve implantation, percutaneous approach, including pre-stenting of the valve delivery site, when performed. **(Effective 01/01/16)**

Previous Coding:

CPT codes:

0262T	Implantation of catheter-delivered prosthetic pulmonary valve, endovascular approach **(Deleted effective 01/01/2016)**

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Policy History:

Medical Policy Group **(2):** November 2011
Medical Policy Administration Committee, November 2011
Available for comment December 19, 2011 through February 1, 2012
Medical Policy Panel, November 2012
Medical Policy Group **(2):** November 2012 Medically necessary statement amended to include "when performed according to FDA-approved indications". Key Points, Key Words, and References updated to support policy statement change.
Medical Policy Administration Committee, December 2012
Available for comments December 12, 2012 through January 26, 2013
Medical Policy Panel, November 2013
Medical Policy Group (**4**)**:** Updated Key Points and References. No changes to the policy at this time.
Medical Policy Panel, November 2014
Medical Policy Group, November 2014 **(3):** Update to Description, Key Points, Approved Governing Bodies, and References. No change to policy statement.
Medical Policy Group, November 2015: 2016 Annual Coding Update. Added new CPT code 33477 to current coding. Created a previous coding section and moved deleted CPT code 0262T from current coding to previous coding.
Medical Policy Panel, November 2015
Medical Policy Group, December 2015 **(4)**: Updates to Description, Key Points, Approved Governing Bodies, and References. No change to policy statement.
Medical Policy Panel, June 2016
Medical Policy Group, July 2016 (**4**): Updates to Key Points, Key Words and References. Updated policy statement, but no change to intent of statement.
Medical Policy Panel, May 2018
Medical Policy Group, May 2018 **(4):** Updates to Description, Policy, Key Points, Approved by Governing Bodies, and References. Updated policy statements to allow coverage per FDA indications of device.
Medical Policy Administration Committee: June 2018
Available for comment: May 24 through July 7, 2018

This policy is intended to be used for adjudication of claims (including pre-admission certification, pre-determinations, and pre-procedure review) in Blue Cross and Blue Shield's administration of plan contracts.