**Clinical Review Criteria**

**Ventricular Assistive Devices**
- Implanted Ventricular Assist Devices (VAD)
- Percutaneous Left Ventricular Assist Device (PLVAD)

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### Criteria

**For Medicare Members**

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<tr>
<td>CMS Coverage Manuals</td>
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<td>National Coverage Determinations (NCD)</td>
<td>Artificial Hearts and Related Devices (20.9)</td>
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<td>Local Coverage Article</td>
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**For Non-Medicare Members**

For [Artificial Hearts](#), see specific criteria.

**Implanted Ventricular Assist Devices (VAD)**

- **Post-Cardiotomy Setting/Bridge to Recovery**
  Implantable ventricular assist devices with FDA approval or clearance may be considered medically necessary in the post-cardiotomy setting in patients who are unable to be weaned off cardiopulmonary bypass.

- **Bridge to Transplant**
  Implantable ventricular assist devices with FDA approval or clearance may be considered medically necessary as a bridge to heart transplantation for patients who are currently listed as heart transplantation candidates and not expected to survive until a donor heart can be obtained, or are undergoing evaluation to determine candidacy for heart transplantation.

  Ventricular assist devices with FDA approval or clearance, including humanitarian device exemptions, may be considered medically necessary as a bridge to heart transplantation in children aged 5 to 16 years who are currently listed as heart transplantation candidates and not expected to survive until a donor heart can be obtained, or are undergoing evaluation to determine candidacy for heart transplantation.

- **Destination Therapy**
  Implantable ventricular assist devices with FDA approval or clearance may be considered medically necessary as destination therapy with end-stage heart failure for patients who are ineligible for human heart transplant and who meet the following criteria:
  - New York Heart Association (NYHA) Class IV heart failure for $> 60$ days; OR
  - Patients in NYHA Class III/IV for 28 days, received $> 14$ days support with intra-aortic balloon pump or dependent on IV inotropic agents, with two failed weaning attempts.

  In addition, patients must not be candidates for human heart transplant for one or more of the following reasons:
Background

Implanted Ventricular Assist Devices (VAD)
Heart failure is a clinical condition characterized by the heart’s inability to generate a cardiac output sufficient to meet the body’s circulation demands. It is a major and growing public health problem responsible for high morbidity and mortality, in addition to the economic impact of medical costs, disability, and loss of employment. According to the Heart Failure Society of America, nearly 5 million people suffer from CHF in the United States and it is responsible for about 200,000 deaths each year (Abraham 1998).

The cause of heart failure in many patients is pump failure due to poor left ventricular systolic function, which is often due to myocardial infarction or dilated cardiomyopathy. In approximately 30% of patients with chronic heart failure, the disease process not only depresses cardiac contractility, but also affects the conduction pathways by causing a delay in the onset of right or left ventricular systole, and in turn the loss of coordination of ventricular contraction. This dysynchronous pattern of ventricular contraction is believed to reduce the already diminished contractile reserve of the heart (Nelson 2001).

Patients in end-stage heart failure have two primary treatment options:
1. Pharmacological therapy (including digoxin, ACE inhibitors, diuretics and inotropes), and
2. Heart transplantation.
Both treatments have their limitations. Pharmacological therapy is only palliative and improves the short-term survival for patients. Moreover, as the heart failure worsens, medication becomes ineffective in treating the low contractility and pulmonary venous stasis resulting from the increased dilatation of the heart. Cardiac transplantation on the other hand, is limited to the number of available hearts, and the criteria for being a transplant candidate.

In September 1994, the FDA approved the first pneumatically driven left ventricular assist device (LVAD) from TCI for bridging end-stage patients to cardiac transplantation. Patients on these devices had to stay in the hospital connected to a pneumatic console, or could go home with extensive home health care support. (FDA News 2002). Four years later, in September 1998, the FDA approved two portable heart assist devices (HeartMate and Novocar LVAS) to support patients outside the hospital while they wait for a transplant. These two devices were approved as a bridge to transplant for patients eligible for heart transplants and waiting for an available heart. Eligible patients were those with irreversible heart failure and a rapidly deteriorating condition. In addition, they had to be on their hospital's transplant list in order to qualify for one of these devices (FDA News, September 1998).

The LVAD does not replace the heart. It works along with the patient’s own heart to provide additional strength to the weakened left ventricle to pump blood throughout the body. The portable device consists of a blood pump implanted in the abdominal area and attached to both the left ventricle and the aorta. Blood from the heart flows into the device which then pumps it through the aorta to the rest of the body. The system is also connected by a cable through the skin to a small external computer (the “controller”) worn on the waist. The computer can be powered by a base unit that is plugged into the wall or by batteries worn at the waist or, in the case of the HeartMate device, under the arms.

There are risks associated with the surgery to implant the HeartMate, as well as risks and complications with the device itself such as infections, bleeding, thromboembolism, and stroke. Implanting the device requires a major surgery for already seriously sick patients. Moreover, the device requires a percutaneous line that can become a medium for bacterial and fungal infections that are difficult to treat and may require a change of the device, which increases the morbidity and mortality. Another complication reported by Rose et al (2000), is aortic stenosis of variable severity that may be caused by the device. LVAD may also lead to significant changes in the systemic immunologic and thrombostatic functions of the patients (Itesu S, 2000). Failure and malfunctioning of the device may also occur which may contribute to higher morbidity, mortality, and cost.

The following information was used in the development of this document and is provided as background only. It is not to be used as coverage criteria. Please only refer to the criteria listed above for coverage determinations.
In November 2002, the FDA expanded the use of the HeartMate device to be implanted permanently in certain terminally ill patients; those who have a severe end-stage CHF, are ineligible for heart transplant, and have a body surface area >1.5 sq. m. It required that the manufacturer (Thoratec) conduct a post-approval study to assess the device’s long-term safety and effectiveness for permanent use.

**Percutaneous Left Ventricular Assist Device (PLVAD)**
Cardiogenic shock is a state of inadequate tissue perfusion due to cardiac dysfunction. It occurs in a variety of settings such as myocardial infarction, post-cardiotomy shock, decompensated chronic heart failure, acute valve failure, and myocarditis. Despite the major advances in the treatment and aggressive perfusion strategies, cardiogenic shock is still associated with high in-hospital mortality rates that range from 40% to 80% depending on the clinical circumstances. The Intra-Aortic Balloon Pump (IABP) is the left ventricular mechanical assistance device most commonly used to stabilize patients in cardiogenic shock. It decreases afterload, increases coronary perfusion, and improves cardiac output. However, IABP pump delivers an output of only 0.5 L/min, lacks active cardiac support, does not decrease infarct size, or improve clinical outcomes of patients with acute ST-segment elevation myocardial infarction. New technologies such as percutaneous left ventricular assist devices (LVADs) have been developed to provide more effective hemodynamic short-term support for the failing heart. The three main indications for percutaneous LVAD support include: 1. Reversible left ventricular failure to provide temporary circulatory support until recovery or revascularization, 2. Large ischemic area at risk to provide temporary circulatory support during high-risk percutaneous or surgical revascularization, and 3. Bridging therapy to provide temporary circulatory support as a bridge to a permanent surgical assist device or heart transplantation (Burkoff 2006, Windecker 2007, Seyfarth 2008, Cheng 2009).

Currently two percutaneous LVADs are available for clinical use: The TandemHeart and the Impella Recover system. The TandemHeart utilizes a drainage cannula placed via transseptal puncture into the left atrium to aspirate oxygenated blood, which is then injected through a transfugal pump into the femoral artery, establishing a left-atrial-to-femoral arterial bypass. The Impella Recover is based on a miniaturized impeller (microaxial pump) that can be advanced into the left ventricle through an arterial vascular system. It has a caged blood flow inlet that is placed retrograde into the left ventricle to aspirate oxygenated blood, which is then injected by means of a microaxial pump into the ascending aorta establishing a left ventricular to aortic by-pass. The TandemHeart requires both venous and arterial femoral access whereas the Impella Recover system requires only femoral arterial access. Currently two Impella Recover systems are available: The Impella Recover LP 2.5 and the Impella Recover LP 5.0 models. The Impella LP 2.5 (Abiomed Europe GnbH, Aachen, Germany) is a catheter suitable for percutaneous implantation, while the Impella Recover LP 5.0 catheter requires surgical cut of the femoral artery for device insertion (Windecker 2007).

The Impella Recover LP 2.5 is a catheter-based, impeller-driven, axial-flow pump. It has a diameter of 6.4 mm at the body of the pump and 7.3 mm diameter at the level of the outflow opening. A small electric motor is built into the device, and a thin 2.8 mm cable leading to the device contains the electrical power supply, which is connected to an external control unit as well as a purge line connected to a purge perfuser. Through this perfuser, heparin (in a glucose solution) is flushed continuously in the motor housing and throughout the pump, and the patient does not need systemic anticoagulation. A pressure sensor within the device continuously monitors pressure differences between inflow and outflow. The pump is inserted percutaneously in the catheterization laboratory via a standard guidewire through the femoral artery into the left ventricle. The circulatory support provided by the device can be adjusted at nine different levels of speed. At its maximal rotation speed of 50,000 rpm, the pump can deliver an output of up to 2.5 liters of blood per minute from the left ventricle into the ascending aorta. This actively unloads the ventricle, increases the cardiac output, and increases both coronary and end-organ perfusion. The Impella pumps are indicated for temporary use (up to 6 hours) however, it has been reported that the device can be safely left in place to support hemodynamics for up to 5 days. (Seyfarth 2008, Vecchio 2008, Cheng 2009, Wiktor 2010).

Impella Recover 2.5 and 5.0 devices (ABIOMED Inc) have both received FDA clearance for circulatory support for periods up to 6 hours. The current review focuses on the use of the Impella Recover 2.5.

**Medical Technology Assessment Committee (MTAC)**

**LVAD in the treatment of End Stage Heart Failure**

08/13/2003: MTAC REVIEW

**Evidence Conclusion:** The REMATCH trial reviewed was conducted among a highly selected group of patients with end stage heart failure, and contraindication for heart transplantation. The trial compared the patients who...
received the LVAD to those who were treated medically. The methodology of the trial was generally valid, however it was not blinded. Blinding in such a trial is not possible, and non-blinding may be a source of observation bias. The authors tried to partly overcome this limitation by using independent blinded observers to measure the outcome events. In this trial survival was higher among patients receiving LVAD vs. those in the optimum medical management group. The difference between the two groups was statistically significant, at one year (NNT=4), but not at 2 years. The two years survival among patients receiving the LVAD was only 22%, and according to the survival graph, the 26 months survival was 8%. The LVAD was associated with serious adverse events. Sepsis and device failure were responsible for the majority of deaths in the LVAD group (41.5%, and 17.1% respectively), and left ventricular dysfunction was the cause of death in 92% of the cases in the medical treatment group. The authors concluded that the quality of life was better among LVAD recipients, however the analysis of QoL was only performed among survivors who were able to complete the questionnaires (35% in the LVAD group, and 18% in the medical treatment group). In conclusion the REMATCH trial provides some evidence that LVAD may improve survival, however for a short duration, and not without serious adverse events, among a selected group of patients with end stage heart failure, and who are not candidates for heart transplantation. It does not provide evidence that LVAD may be used as an alternative to transplantation, in patients eligible for a heart transplant.

**Articles:** The search yielded 32 articles many of which were reviews, opinion pieces, or dealt with the technical aspects of the procedure. One randomized controlled trial, 5 case series and several case reports were identified. The RCT was selected for critical appraisal. Rose EA, Gelijns AC, Moskowitz AJ, et al. Long-term use of a left ventricular assist device for end-stage heart failure. N Engl J Med 2001;345:1435-43. See Evidence Table.

The use of LVAD in the treatment of End Stage Heart Failure does meet the Kaiser Permanente Medical Technology Assessment Criteria.

**02/14/2011: MTAC REVIEW**

**Percutaneous Cardiac Support Systems**

**Evidence Conclusion:** The literature search revealed only one small randomized controlled trial that evaluated the safety and efficacy of the Impella Recover LP 2.5 for the treatment of cardiogenic shock caused by myocardial infarction. The trial compared the Impella device with the IABP, the most commonly used device to treat cardiogenic shock. However, the study was too small, blinding and randomization method were not discussed, and it was only powered to detect the difference between the two devices in hemodynamic improvements. It was not powered to evaluate impact on clinical outcomes. The results of the RCT (Evidence table 1) show that the Impella LP 2.5 resulted in better hemodynamic improvement compared to the IABP. However, this was not translated to an improvement in the 30-day survival of the patients in cardiogenic shock after an acute myocardial infarction. Patients treated with the Impella device tended to have more device-related bleeding, and more limb ischemia.

**Articles:** The literature search identified one small randomized controlled trial that compared Impella Recover LP 2.5 device to IABP for the treatment of cardiogenic shock, a meta-analysis of RCTs comparing percutaneous LVAD to IABP for the treatment of cardiogenic shock, and three other case series evaluating the feasibility and safety of the device. The meta-analysis (Cheng 2009) pooled the results of three trials; two evaluated the TandemHeart, and the third evaluated the Impella Recover 2.5 device. The RCT that compared Impella Recover LP 2.5 device to IABP for the treatment of cardiogenic shock was selected for critical appraisal. Seyfarth M, Sibbing D, Bauer I, A randomized clinical trial to evaluate the safety and efficacy of a percutaneous left ventricular assist device versus intra-aortic balloon pumping for treatment of cardiogenic shock caused by myocardial infarction. J Am Coll Cardiol 2008; 52:1584-1588. See Evidence Table.

The use of percutaneous cardiac support systems in the treatment of End Stage Heart Failure does not meet the Kaiser Permanente Medical Technology Assessment Criteria.

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MDCRPC Medical Director Clinical Review and Policy Committee

MPC Medical Policy Committee

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