Final Decision
Analytic Protocol (DAP) to guide the assessment of transcatheter closure of patent ductus arteriosus

April 2013
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**MSAC and PASC**

The Medical Services Advisory Committee (MSAC) is an independent expert committee appointed by the Australian Government Health Minister to strengthen the role of evidence in health financing decisions in Australia. MSAC advises the Commonwealth Minister for Health on the evidence relating to the safety, effectiveness, and cost-effectiveness of new and existing medical technologies and procedures and under what circumstances public funding should be supported.

The Protocol Advisory Sub-Committee (PASC) is a standing sub-committee of MSAC. Its primary objective is the determination of protocols to guide clinical and economic assessments of medical interventions proposed for public funding.

**Purpose of this document**

This document is intended to provide a decision analytic protocol that will be used to guide the assessment of an intervention for a particular population of patients. The protocol has been finalised after inviting relevant stakeholders to provide input.

The protocol guiding the assessment of the health intervention has been developed using the widely accepted “PICO” approach. The PICO approach involves a clear articulation of the following aspects of the research question that the assessment is intended to answer:

- **Patients** - specification of the characteristics of the patients in whom the intervention is to be considered for use;
- **Intervention** - specification of the proposed intervention
- **Comparator** - specification of the therapy most likely to be replaced by the proposed intervention
- **Outcomes** - specification of the health outcomes and the healthcare resources likely to be affected by the introduction of the proposed intervention
**Purpose of application**

A proposal for an application requesting Medicare Benefits Schedule (MBS) listing of transcatheter closure of patent ductus arteriosus (PDA) for people with clinically significant PDA was received from the Cardiac Society of Australia and New Zealand by the Department of Health and Ageing in September 2012. The proposal relates to a procedure that has been established in the public health system in Australia since the 1990s, and that the CSANZ argues is standard therapy for treatment of PDA. However, there are no MBS items available for transcatheter closure of PDA.

**Background**

The ductus arteriosus is a vessel which is physiologically normal in utero providing a communication between the main pulmonary artery and descending aorta, allowing blood to mostly bypass the pulmonary circulation. In most newborns, as a result of both lung expansion and decrease in pulmonary vascular resistance that occurs at birth, the ductus arteriosus is usually substantially closed within 24 hours of birth and completely sealed after three weeks. PDA is a congenital disorder describing the failure of the ductus arteriosus to close and is either an isolated lesion or may be present in association with other defects. PDA affects females more often than males and may be more common in premature infants and those with neonatal respiratory distress syndrome (Medline 2009). When the PDA fails to close there is a persistent shunt from the aorta to the pulmonary artery which results in increased pulmonary blood flow and volume loading of the left atrium and left ventricle. Symptoms in children include:

- tachycardia
- respiratory problems including shortness of breath
- failure to thrive (US National Heart Lung and Blood Institute 2011a)
- heart murmur
- enlarged heart
- left sub-clavicular thrill
- bounding pulse and/or widened pulse pressure
- differential cyanosis
- hoarse cry or cough
- lower respiratory tract infections
- pneumonia
- atelectasis (Medscape 2012)

A PDA that persists into adult life can be associated with Eisenmenger’s Syndrome, heart murmur, exercise intolerance, pulmonary hypertension, dilated left sided heart structures, atrial fibrillation and/or arrhythmia (Schneider et al 2006).
Patients who have clinically significant PDA with symptomatology of poor perfusion and cardiac failure require immediate intervention to avoid the ongoing effects of left to right shunting. Depending on the shape and size of the ductus, symptomatic patients may be treated either medially or surgically. Patients who are asymptomatic with clinically insignificant PDA may be monitored as outpatients but a subgroup of these patients may require subsequent intervention if significant left to right shunting emerges or is likely to emerge. Patients with ‘ductal dependent’ congenital heart anomalies and those associated with pulmonary vascular obstructive disease should not undergo closure (Rao 2007).

**Incidence**

In the United States, PDA occurs in 2 in every 1000 full term infants each year; it is more common in premature babies, with an average incidence of 8 in every 1000 premature births (US National Heart Lung and Blood Institute 2011b). European statistics indicate an incidence of 1 in 2000 full term infants. A higher prevalence is found in low birth weight premature babies (Orphanet 2009). According to the Applicant, PDA represents around 10% of the burden of congenital heart disease in Australia - the incidence of which is 1 in 100. Therefore the application estimates the incidence of PDA in Australia at around 1 in 1000. The Applicant indicates that there are 200-300 patients with PDAs that require closure in Australia each year.

However, according to the Australian Institute of Health and Welfare the rate of PDA in Australia is 16 per 10,000 (including live births and foetal deaths of at least 20 weeks gestation or at least 400 grams birth weight from all states and territories except the Northern Territory) (AIHW 2011). In 2003, the latest available incidence data, PDA was the second most commonly reported congenital heart condition with 406 cases. There were 550 procedures performed in 2009-10 for closure of patent ductus (AIHW 2009-10).

There is considerable debate in the literature over when a PDA should be treated; there have been trials of treatment approaches involving pre-symptomatic, symptomatic and prophylactic treatment (to reduce the risk of bacterial endocarditis). At present, the therapeutic options in Australia for PDA are medication (indomethacin or ibuprofen), surgery by open approach or minimally invasive video assisted surgery and transcatheter closure.

It is unclear how many of these patients may be managed with medication alone. At present medical devices used in transcatheter closure of PDA are unsuited to closure of very small and very large PDAs. Therefore the target population for this new procedure is a sub-group of the total number of patients with PDAs requiring closure.
Current arrangements for public reimbursement

At present, the majority of transcatheter procedures for closure of PDA are performed in the public sector. The AIHW data indicates that in 2009-10, of the 550 procedures performed for closure of PDA, 160 (29%) of these procedures were performed by percutaneous approach. Infants under 5 years of age accounted for 340 (87%) of a total of 390 surgical procedures and 91 (57%) of the percutaneous procedures. However, it should be noted that this data does not indicate whether the procedure for closure of PDA has been performed as a sole procedure or at the same time as other cardiac surgery.

There are no MBS items for transcatheter closure of PDA and the procedure has not been previously assessed by MSAC. However, medical devices to close the PDA have been listed on the Prostheses List for over seven years. Of these:

- two were listed prior to 2005;
- two were listed in July 2008; and
- three were listed in 2012.

Table 1: PDA Occluder Devices - Prostheses List

<table>
<thead>
<tr>
<th>Code</th>
<th>Previous</th>
<th>Date</th>
<th>Product</th>
<th>Sponsor</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>SJ260</td>
<td>ME065</td>
<td>Bef 2005</td>
<td>Amplatzer Duct Occluder</td>
<td>St Jude Medical Australia Pty Ltd</td>
<td>$10,200</td>
</tr>
<tr>
<td>SJ267</td>
<td>ME187</td>
<td>Bef 2005</td>
<td>Amplatzer Duct Occluder II</td>
<td>St Jude Medical Australia Pty Ltd</td>
<td>$10,200</td>
</tr>
<tr>
<td>DW001</td>
<td></td>
<td>Jul 2008</td>
<td>Nitinol spiral coil and delivery system for transcatheter occlusion of PDA</td>
<td>Denward Dell Pty Ltd TA Surimex</td>
<td>$1,900</td>
</tr>
<tr>
<td>DW002*</td>
<td></td>
<td>Jul 2008</td>
<td>Nitinol spiral coil and delivery system for transcatheter occlusion of PDA (medium)</td>
<td>Denward Dell Pty Ltd TA Surimex</td>
<td>$1,900</td>
</tr>
<tr>
<td>SJ280</td>
<td></td>
<td>Feb 2012</td>
<td>Amplatzer Duct Occluder II Additional Sizes</td>
<td>St Jude Medical Australia Pty Ltd</td>
<td>$10,200</td>
</tr>
<tr>
<td>WC294</td>
<td></td>
<td>Aug 2012</td>
<td>Flipper PDA Closure Detachable Coil Delivery System and Mreye Flipper PDA Detachable Embolisation Coil</td>
<td>Cook Medical Australia Pty Ltd</td>
<td>$600</td>
</tr>
<tr>
<td>WC295</td>
<td></td>
<td>Aug 2012</td>
<td>Mreye Flipper PDA Detachable Embolisation Coil</td>
<td>Cook Medical Australia Pty Ltd</td>
<td>$250</td>
</tr>
</tbody>
</table>

These devices are no-gap prostheses. This means that, assuming patients have appropriate health insurance, they will have no out-of-pocket expenses for the prosthesis. The health insurers are required to pay the benefit in full.

During the period in which these devices have been listed, private health insurance benefits have been paid for their use 63 times in the private sector.
Anecdotal evidence suggests that a small number of transcatheter PDA procedures may be being performed under certain peripheral transcatheter vascular MBS items (not the comparator items identified in this protocol). Therefore it is reasonable to assume that MBS benefits were claimed in association with these private services.

The AIHW data indicates that in 2009-10, only 10% (56) of PDA procedures were performed in private hospitals. However, the data does not provide a breakdown of the surgical approach used (AIHW 2008-09).

**Regulatory status**

The Therapeutic Goods Administration has provided regulatory approval for a range of trademarked PDA closure devices. Details regarding the listings on the Australian Register of Therapeutic Goods (ARTG) are provided in Table 3. The devices currently listed on the ARTG include Flipper coils (FC), Nit-Occlud coils (NOC), Amplatzer Duct Occluder (ADOI), Amplatzer Duct Occluder II (ADOII), Amplatzer Duct Occluder II-Additional Sizes (ADOII-AS). It should be noted that there are a couple of devices for PDA closure currently not listed on the ARTG but which are referred to in the international literature. These include Gianturco coils, the Rashkind PDA occluder (both older technologies) and the Occlutech PDA occluder (an emerging technology currently undergoing phase I trials) (Clinicaltrials.gov - identifier NCT01479218). According to the application, FC and ADO are the devices most commonly used in the current era.
Table 3: PDA Occluder Devices Listed on the ARTG

<table>
<thead>
<tr>
<th>ARTG number</th>
<th>Sponsor name</th>
<th>Registered</th>
<th>ARTG label name</th>
<th>Functional description</th>
</tr>
</thead>
<tbody>
<tr>
<td>162137</td>
<td>St Jude Medical Australia Pty Ltd</td>
<td>1 June 2009</td>
<td>AMPLATZER Cardiac Plug - Cardiac occluder</td>
<td>Cardiac occlude</td>
</tr>
<tr>
<td>134070</td>
<td>St Jude Medical Australia Pty Ltd</td>
<td>20 Dec 2006</td>
<td>AMPLATZER Duct Occluder - Cardiac occluder</td>
<td>Cardiac occlude</td>
</tr>
<tr>
<td>154956</td>
<td>St Jude Medical Australia Pty Ltd</td>
<td>5 Sept 2008</td>
<td>AMPLATZER Duct Occluder II - Cardiac occluder</td>
<td>Cardiac occlude</td>
</tr>
<tr>
<td>191422</td>
<td>St Jude Medical Australia Pty Ltd</td>
<td>2 Nov 2011</td>
<td>AMPLATZER Duct Occluder II Additional Sizes - Cardiac occlude</td>
<td>Cardiac occlude</td>
</tr>
<tr>
<td>188074</td>
<td>William A Cook Australia Pty</td>
<td>18 Aug 2011</td>
<td>Flipper 35 PDA Closure Detachable Coil Delivery System - Embolisation implant inserter</td>
<td>Embolisation implant inserter</td>
</tr>
<tr>
<td>194131</td>
<td>William A Cook Australia Pty</td>
<td>24 Jan 2012</td>
<td>MReye Flipper PDA Closure Detachable Coil - Embolisation implant, non-neurovascular</td>
<td>Embolisation implant, non-neurovascular</td>
</tr>
<tr>
<td>148233</td>
<td>Denward Dell Pty Ltd</td>
<td>6 Dec 2007</td>
<td>Nit-Occlud - Prosthesis, internal, embolisation, intravascular</td>
<td>Prosthesis, internal, embolisation, intravascular</td>
</tr>
<tr>
<td>162140</td>
<td>St Jude Medical Australia Pty Ltd</td>
<td>1 June 2009</td>
<td>AMPLATZER TorqVue 45 X 45 degree Delivery Sheath - Cardiac occluder delivery kit</td>
<td>Cardiac occluder delivery kit</td>
</tr>
<tr>
<td>134074</td>
<td>St Jude Medical Australia Pty Ltd</td>
<td>20 Dec 2006</td>
<td>AMPLATZER TorqVue Delivery System - Cardiac occluder delivery kit</td>
<td>Cardiac occluder delivery kit</td>
</tr>
<tr>
<td>134076</td>
<td>St Jude Medical Australia Pty Ltd</td>
<td>20 Dec 2006</td>
<td>AMPLATZER TorqVue Delivery System with Pusher Catheter - Cardiac occluder delivery kit</td>
<td>Cardiac occluder delivery kit</td>
</tr>
<tr>
<td>134075</td>
<td>St Jude Medical Australia Pty Ltd</td>
<td>20 Dec 2006</td>
<td>AMPLATZER TorqVue Exchange System - Cardiac occluder delivery kit</td>
<td>Cardiac occluder delivery kit</td>
</tr>
<tr>
<td>191136</td>
<td>St Jude Medical Australia Pty Ltd</td>
<td>27.10.2011</td>
<td>AMPLATZER TorqVue LP Catheter - Cardiac occluder delivery kit</td>
<td>Cardiac occluder delivery kit</td>
</tr>
</tbody>
</table>

ARTG: Australian Register of Therapeutic Goods

Patient population

Identifying patients suitable for transcatheter closure of PDA involves transthoracic echocardiography to determine whether the patent duct is suitable to be closed with a coil or occluding device. According to the applicant, there are broad clinical and echocardiographic features which support closure of the PDA with transcatheter techniques:

- Clinical signs of cardiac failure (failure to thrive, tachypnoea, hepatomegaly)
- The presence of typical a continuous murmur
- Echocardiographic evidence of left atrial and left ventricular dilatation
- Echocardiographic evidence of elevation of pulmonary artery pressures

Some of these patients may have previously trialled medication to close their ductus without success or were unable to receive medication due to a contraindication but medication has a limited role in PDA management. Some patients at the point of diagnosis may immediately proceed to transcatheter or surgical intervention if there is evidence of haemodynamic overload. Expert clinical advice is that the minimal indication for PDA closure is the presence of a continuous murmur. The presence of a continual murmur in the absence of heart failure does not preclude PDA closure, as there is an increased risk of sub acute bacterial endocarditis by leaving the ductus patent.
Patients who are potential candidates for transcatheter closure based on the clinical and echocardiographic characteristics outlined above may still have characteristics which render them not suitable for transcatheter closure. According to the Applicant, patients weighing less than six (6) kilograms are usually considered unsuitable for the procedure in Australia. However, parental preference for surgery versus device closure, or cardiologist preference where the duct is large and the baby is small may factor into the decision-making. Further, patient suitability for transcatheter closure is determined following an assessment of PDA anatomy. The shape of PDA varies considerably but most often it has a conical or funnel shape. The aortic end (ampulla) tends to be wide and gradually narrows towards the pulmonary end. The narrowest segment is usually at the pulmonary end but not always. PDA morphology is classified according to the Krichenko classification which is based upon angiographic appearance and includes Type A (conical), type B (window), type C (tubular), Type D (complex) and Type E (elongated) (Krichenko et al 1989). In relation to size, PDA with a minimal ductal diameter of <2 mm are generally regarded as small PDA and ducts with a minimal ductal diameter of 2-4 mm are regarded as medium size PDA and those >4mm classified as large PDA. However, the cut off between what is regarded as small, medium to large varies across the literature. Further ductal length is sometimes measured to guide device selection. The various devices available are designed to accommodate a variation in PDA size and morphology but generally speaking PDA's that are too small or too large in diameter or oddly shaped (non-conical or window like) tend to be unsuited for closure by transcatheter approach. For some of these patients surgical ligation may be the only alternative. There is no strict upper limit on ductal diameter over which transcatheter is no longer suitable as some larger PDAs may be shaped in a way that still make them amendable to transcatheter intervention. Vice versa, some smaller PDAs may not be suitable for transcatheter closure because neither a coil or occluding device are likely to neatly fit into the lumen of the ductus running the risk of protrusion into the pulmonary artery or the aorta.

However, overall it is difficult to be prescriptive regarding age, weight, size of duct etc. Clinical advice indicates that this is a decision best made by clinicians following a consideration of patient circumstances.

**Intervention**

Transcatheter closure of PDA is achieved by one of two methods and the choice of method of transcatheter closure appears to be based primarily on the shape of the PDA and minimal ductal diameter. In the first method, a platinum coil is deployed via a catheter through the femoral artery or femoral vein. This causes thrombosis leading to closure of the open duct. Coils tend to be used in smaller PDAs as the larger PDAs do not always have a significantly constricting neck to trap the body of the coil. In addition, larger PDAs are likely to require multiple coils which may potentially protrude into the lumen of the left pulmonary artery. In the second method, an occluder device is deployed
via a catheter through the pulmonary artery through the PDA. One end of the device hugs the walls of the PDA while the other rests on the aortic side to close the duct. More recent iterations of occluder devices have smaller retention discs than the older versions. The design of such devices is under constant review to maximise the benefit of closure and to minimise protrusion of the device into the adjacent pulmonary artery and aorta.

**Delivery of the intervention**

The procedure is usually performed in a biplane catheterisation laboratory of a large tertiary hospital. However a single plane laboratory may also be used. The staff required to undertake and monitor the patient during the procedure include a:

- paediatric (or adult) interventional cardiologist;
- paediatric and/or surgical assistant;
- nurse assistant to manage cardiac catheters;
- nurse scout;
- radiographer;
- anaesthetic consultant;
- anaesthetic assistant.

The attendant costs of the procedure relate to the costs of maintaining the equipment of a single plane or biplane catheter lab. The cost of the device used to close the PDA will also be included.

The Applicant indicates that the proposed service takes between one and two hours including anaesthetic time. The typical procedural time taken to perform transcatheter closure of a PDA would be 60 minutes. According to the Applicant, complications occur at an incidence of approximately 1%. In the event of a complication, the procedure is significantly prolonged due to the requirement to retrieve the device. Additionally, any vascular occlusion of a femoral vessel may have significant implications for the patient including leg length discrepancy in later life.

This procedure requires an echocardiogram to define the exact anatomy of the PDA. In the paediatric setting, the procedure is usually performed under general anaesthetic. Children are generally admitted to hospital overnight for observation and they would have an echocardiogram and chest x-ray prior to discharge the following day. In the adult environment the procedure may be performed with sedation and local anaesthesia.

Transcatheter closure of a patent ductus arteriosus is a once off procedure resulting in closure of the PDA and resolution of the disease process. There are generally two follow up appointments and most children will be discharged from care one to two years following the procedure.

Most patients would be admitted on the morning of the procedure, following assessment at a preadmission clinic and discharged the following day.
**Prerequisites**

The Applicant indicates that the procedure should be performed by a credentialed Paediatric Interventional Cardiologist or Adult Interventional Cardiologist. In the guidelines for paediatric cardiac catheterisation, closure of an uncomplicated PDA is classified as a level 2 procedure, while closure of a PDA in a patient of less than 10kg is classified as a level 3 procedure. The Applicant recommends that cardiothoracic surgical back up should be available to the catheter lab where these procedures are performed in case surgical intervention is needed and that this procedure should only be funded for services delivered by the designated provider. The Applicant indicates that the current staffing numbers and skill sets within cardiac catheter labs are appropriate for these procedures. The catheter equipment required to perform this procedure is standard equipment present in all cardiac catheter laboratories.

As patients diagnosed with this condition who live in regional or rural areas will need to travel some distance for treatment, the Applicant indicates that there will be a need for patient travel to be supported by the various state and territory patient travel assistance schemes.

**Co-administered and associated interventions**

Under normal circumstances, a patient with a suspected PDA will be referred to a paediatric cardiologist. During this consultation the cardiologist will consider the patient’s symptoms and perform a physical examination and a range of diagnostic tests to determine whether transcatheter or surgical closure is more appropriate. These include:

- CT aortogram;
- chest X-ray and/or radiography;
- transthoracic echocardiogram (MBS item 55113; 55115);
- ECG;

If the patient’s presentation is unusual or if there are other congenital cardiac abnormalities revealed by the diagnostic testing, right and left heart catheterisation may also be indicated.

Once it is established that the PDA is suitable for closure by transcatheter approach, the patient will be referred to an interventional cardiologist (paediatric or adult). A pre-surgical consultation will occur and a transthoracic echocardiogram (MBS items 55113; 55115) will be performed to establish the exact size and shape of the PDA. This is likely to be on the day of the procedure. Following deployment of the device, another echocardiogram is performed to ensure shunt closure. During surgery the shortest duration of radiation exposure for fluoroscopy is in the range of five (5) minutes; should complications occur it can be up to thirty (30) minutes. Paediatric patients usually stay overnight in hospital and a further echocardiogram is performed prior to discharge.
Listing proposed and options for MSAC consideration

Proposed MBS listing

The Applicant has not provided a detailed MBS item descriptor but has indicated a Schedule fee of $963.90 for transcatheater closure of PDA. No explanation has been specifically given for this figure. However, the Applicant has indicated that the technique involved in the procedure and the devices utilised most closely resemble those of MBS item 38272 which covers transcatheater closure of Atrial Septal Defect (ASD). MBS item 38272 has a schedule fee of $912.30 as of 1 November 2012. Clinical advice indicates the proposed MBS listing should only attract a 75% benefit given transcatheater cardiac procedures (be they for PDA, ASD etc) will only be performed on inpatients.

Table 4: Current MBS item descriptor for 38272

<table>
<thead>
<tr>
<th>Category 3 – Cardio-Thoracic</th>
</tr>
</thead>
<tbody>
<tr>
<td>MBS 38272</td>
</tr>
<tr>
<td>Atrial septal defect closure, with septal occluder or other similar device, by transcatheter approach (Anaes.) (Assist.)</td>
</tr>
<tr>
<td>Fee: $912.30</td>
</tr>
<tr>
<td>Benefit: 75% = $684.25</td>
</tr>
<tr>
<td>85% = $837.80</td>
</tr>
</tbody>
</table>

Clinical place for proposed intervention

Management of PDA currently varies. Premature infants may receive medical management i.e. Indomethacin with a view to achieving closure of PDA. Asymptomatic neonates may be monitored as outpatients, while symptomatic patients, depending on the onset and severity of the symptoms, PDA can be treated medically or surgically subject to the severity of the opening. Paediatric patients generally present with tachycardia, breathlessness and/or respiratory problems and poor feeding. Diagnosis is by echocardiogram and in most neonatal intensive care units in Australia the first line medical therapy for symptomatic PDA is usually ‘long courses’ of indomethacin (Hoellering et al 2009). Surgery is considered if the PDA fails to close or reopens following the medical therapy. Traditionally, surgical ligation of the PDA involves a thoracotomy and dissection and ligation of the PDA. The PDA may also be clamped, oversewn or clipped.

Another emerging minimally invasive option is video assisted thoracoscopic surgery (VATS). It is not clear if thoracoscopy provides shorter hospital stays or decreases costs. Additionally, thoracoscopy is contraindicated for adults with calcified PDA. Because of the limited control and visualisation available, thoracoscopic in neonates is not widely advocated; it appears to have no definite advantage, given that the open procedure uses such a small incision. Clinical advice indicates that in Australia, the video assisted thoracoscopic approach is not used for paediatric patients.

The current clinical management algorithm for diagnosing and treating patients with PDA at is illustrated in Figure 1. Given transcatheater closure has been established for some time in the
Australian health care setting, only one clinical management algorithm is presented. It should be noted that the clinical assessment in which patients are selected for either transcatheter or surgical closure of their PDA may be occurring during their initial presentation. The diagram below illustrates this as sequential but in clinical reality many clinicians are ascertaining the characteristics of the PDA immediately on referral.

Figure 1: Broad representation of the clinical management algorithm for diagnosis and treatment of PDA currently in Australia

The Applicant claims transcatheter closure is a direct substitute (i.e. provides patients with a new treatment alternative) for the currently subsidised intervention of surgical ligation of PDA. However, it should be noted that there are some patients for whom transcatheter closure is not an option, such as very small patients and those with very large PDAs.
 Comparator

According to the Applicant, the transcatheter closure of PDA is a direct substitute for surgical ligation of PDA without cardiopulmonary bypass (MBS item 38700) and thus surgical closure is proposed by the applicant as being the appropriate comparator. The Schedule fee for MBS item 38700 as of 1 November 2012 is $1,067.40 which excludes transcatheter techniques.

Surgical closure of PDA has attracted medical benefits for several decades in Australia. Surgical closure with PDA can also be performed with cardiopulmonary bypass (MBS item 38703 – Schedule fee $1,924.10). Both 38700 and 38703 attract a 75% MBS benefit only. However MBS item 38703 is not an appropriate comparator for transcatheter closure of PDA as it is a more complex procedure usually performed with other cardiac procedures.

Table 5: Current MBS item descriptor for 38700

<table>
<thead>
<tr>
<th>Category 3 – Cardio-Thoracic</th>
</tr>
</thead>
<tbody>
<tr>
<td>MBS 38700</td>
</tr>
<tr>
<td>Patent ductus arteriosus, shunt, collateral or other single large vessel, division or ligation of, without cardiopulmonary bypass, for congenital heart disease (H Anaes.) (Assist.)</td>
</tr>
<tr>
<td>Fee: $1,067.40 Benefit: 75% = $800.55</td>
</tr>
</tbody>
</table>

T.8.69 Cardiac and Thoracic Surgical Items

Items 38470 to 3866 must be performed using open exposure or minimally invasive surgery which excludes percutaneous and transcatheter techniques unless otherwise stated in the item.

The utilisation rates for the current MBS items for surgical closure of PDA, without cardiopulmonary bypass, are low. In 2011-12 there were only 41 procedures in total performed. However, the Department is aware that a small number of transcatheter PDA procedures are being performed inappropriately at present, under certain percutaneous vascular MBS items. In 2010-11 private health insurance benefits were paid for 12 PDA devices listed on the Prostheses List. It may be reasonable to assume that MBS benefits were claimed for these procedures.

Table 6: MBS item 38700 – Usage 2007/08 – 2011/12

<table>
<thead>
<tr>
<th></th>
<th></th>
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<td>38700</td>
<td>52</td>
<td>49</td>
<td>38</td>
<td>49</td>
<td>41</td>
</tr>
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</table>

An analysis of MBS expenditure data for 2007-08 to 2011-12 indicates that the surgical closure of PDA (MBS item 38700) has not been bulk-billed during that period. Table 7 shows fees charged, MBS benefits paid and patient contribution for this period. However, Medicare statistics do not include data relating to supplementary payments to patients from private health insurance funds. As a consequence, patient contributions may be over-stated.
Table 7: MBS Item 38700: 2007-08 to 2011-12 Total Services, Fees Charged, Benefits Paid and Patient Contribution

<table>
<thead>
<tr>
<th>Year</th>
<th>Numbers</th>
<th>Fees Charged ($)</th>
<th>Benefits Paid ($)</th>
<th>Patient Contribution ($)</th>
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<tbody>
<tr>
<td>2011-12</td>
<td>41</td>
<td>37,133</td>
<td>19,839</td>
<td>10,682</td>
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<tr>
<td>2010-11</td>
<td>49</td>
<td>51,684</td>
<td>27,507</td>
<td>15,010</td>
</tr>
<tr>
<td>2009-10</td>
<td>38</td>
<td>38,078</td>
<td>19,408</td>
<td>12,201</td>
</tr>
<tr>
<td>2008-09</td>
<td>49</td>
<td>48,613</td>
<td>24,929</td>
<td>15,376</td>
</tr>
<tr>
<td>2007-08</td>
<td>52</td>
<td>49,934</td>
<td>27,119</td>
<td>13,778</td>
</tr>
</tbody>
</table>

Although the literature indicates that PDA occurs at a ratio of approximately 2:1 in females to males, this is not reflected in the use of item 38700 (Table 8). However, this may be due to the reluctance in the Australian setting to resort to surgery.

Table 8: MBS Item 38700: 2007-08 to 2011-12 Total Services by gender

<table>
<thead>
<tr>
<th>Year</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011-12</td>
<td>25</td>
<td>16</td>
</tr>
<tr>
<td>2010-11</td>
<td>20</td>
<td>29</td>
</tr>
<tr>
<td>2009-10</td>
<td>18</td>
<td>20</td>
</tr>
<tr>
<td>2008-09</td>
<td>24</td>
<td>25</td>
</tr>
<tr>
<td>2007-08</td>
<td>25</td>
<td>27</td>
</tr>
</tbody>
</table>

Transcatheter closure is identified by the Applicant as a direct substitute for MBS item 38700, surgical closure of PDA without cardiopulmonary bypass. Table 9 provides an age breakdown of the provision of services for the period 2007-08 to 2011-12 for MBS item 38700. Of the 229 services provided over the past five years, 83 per cent have been provided to children aged 0-4 years. It should be noted that clinical issues and expectations are different for paediatric vs adult patients.

Table 9: MBS Item 38700: 2007-08 to 2011-12 Total Services by Age

<table>
<thead>
<tr>
<th>Year</th>
<th>0-4 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011-12</td>
<td>34</td>
</tr>
<tr>
<td>2010-11</td>
<td>46</td>
</tr>
<tr>
<td>2009-10</td>
<td>30</td>
</tr>
<tr>
<td>2008-09</td>
<td>39</td>
</tr>
<tr>
<td>2007-08</td>
<td>41</td>
</tr>
</tbody>
</table>

**Clinical claim**

As the medical devices to close the PDA are deployed via transcatheter approach, it is possible to avoid a thoracotomy and dissection of friable ductus tissue. As such, it is proposed that treatment via transcatheter closure of PDA may have an arguably lower complication rate, less patient discomfort and shorter patient hospital stays and thus a more favourable safety profile.

The overall clinical claim in terms of clinical effectiveness is that transcatheter closure of PDA will achieve the same long term patient outcome as achieved by surgical ligation (non-inferiority). However, the Applicant indicates that the transcatheter approach may have possible advantages but
the applicant is not explicitly putting forward a therapeutic claim of superiority. The economic evaluation will be based on a cost effectiveness or cost-utility analysis (see Table 10 for details).

### Table 10: Classification of an intervention for determination of economic evaluation to be presented

<table>
<thead>
<tr>
<th>Comparative safety versus comparator</th>
<th>Comparative effectiveness versus comparator</th>
<th>Superior</th>
<th>Non-inferior</th>
<th>Inferior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superior</td>
<td>Net clinical benefit</td>
<td>CEA/CUA</td>
<td>CEA/CUA</td>
<td>CEA/CUA</td>
</tr>
<tr>
<td>Non-inferior</td>
<td>Neutral benefit</td>
<td>CEA/CUA*</td>
<td>None^</td>
<td>None^</td>
</tr>
<tr>
<td>Inferior</td>
<td>Net harms</td>
<td>None^</td>
<td>None^</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations:  CEA = cost-effectiveness analysis; CUA = cost-utility analysis
* May be reduced to cost-minimisation analysis. Cost-minimisation analysis should only be presented when the proposed service has been indisputably demonstrated to be no worse than its main comparator(s) in terms of both effectiveness and safety, so the difference between the service and the appropriate comparator can be reduced to a comparison of costs. In most cases, there will be some uncertainty around such a conclusion (i.e., the conclusion is often not indisputable). Therefore, when an assessment concludes that an intervention was no worse than a comparator, an assessment of the uncertainty around this conclusion should be provided by presentation of cost-effectiveness and/or cost-utility analyses.

^ No economic evaluation needs to be presented; MSAC is unlikely to recommend government subsidy of this intervention.

### Outcomes and health care resources affected by introduction of proposed intervention

#### Outcomes

Potential outcomes for the comparison of relative clinical effectiveness include, but are not limited to:

- successful duct closure without evidence of residual shunt closure after 1 year confirmed by echocardiogram; equivalent long term outcome to surgical ligation;
- resolution of disease process (absence of cardiac failure);
- vascular occlusion;
- tachyarrhythmia;
- bradyarrhythmias;
- patient mortality;
- procedure time;
- duration of hospitalisation post-procedure;
- recovery time post-procedure.

Potential major adverse events that are of interest for the comparison of relative safety of transcatheter closure of PDA and PDA surgical ligation include but are not limited to:

- patient mortality;
- vascular occlusion of a femoral vessel;
• infection;
• bleeding at catheterisation site;
• re-operation for failed transcatheter deployment of device;
• tachyarrhythmia;
• bradyarrhythmias;
• recurrent laryngeal nerve injury;
• incidence of device complications including but not limited to:
  o unable to achieve stable position;
  o migration/dislodgement/protrusion of device;
  o device embolisation;
  o obstruction of aorta or pulmonary artery by device;
  o inappropriate deployment of device;
  o rupture of blood vessels.

Health care resources

Details on the health care resources required should transcatheter closure of PDA be made available are listed in Table 11.

Table 11: List of resources to be considered in the economic analysis (based on 2011-12 financial year)

<table>
<thead>
<tr>
<th>Provider of resource</th>
<th>Setting in which resource is provided</th>
<th>Proportion of patients receiving resource</th>
<th>Number of units of resource per relevant time horizon per patient receiving resource</th>
<th>MBS Schedule fee***</th>
<th>Safety nets*</th>
<th>Other govt budget</th>
<th>Private health insurer</th>
<th>Patient**</th>
<th>Total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT aortogram</td>
<td>Cardiologist</td>
<td>Diagnosis TBD</td>
<td>$230.65 (55113); $232.65 (55114); $234.65 (55115)</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>$66.15</td>
</tr>
<tr>
<td>Transthoracic echocardiography</td>
<td>Cardiologist</td>
<td>Diagnosis TBD</td>
<td>TBD TBD $31.25 (11700) $15.55 (11701) $15.55 (11702)</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>$66.15</td>
</tr>
<tr>
<td>Chest x-ray</td>
<td>Cardiologist</td>
<td>Diagnosis TBD</td>
<td>$47.15 (58503) TBD TBD TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>$19.00</td>
</tr>
<tr>
<td>ECG</td>
<td>Cardiologist</td>
<td>Pre-delivery TBD</td>
<td>TBD TBD TBD $321.55 (38203) $542.65 (38206)</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>$790.55</td>
</tr>
<tr>
<td>Cardiac catheterisation</td>
<td>Cardiologist</td>
<td>Pre-delivery TBD</td>
<td>TBD TBD TBD $85.55 (104)</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>$144.55</td>
</tr>
<tr>
<td>Cardiology consult</td>
<td>Cardiologist</td>
<td>Diagnosis TBD</td>
<td>TBD TBD TBD $963.90 (CSANZ)</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>$282.80</td>
</tr>
<tr>
<td>Surgical consult</td>
<td>Surgeon/ Cardiologist</td>
<td>Pre-delivery TBD</td>
<td>TBD TBD TBD $85.55 (104)</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>$143.55</td>
</tr>
<tr>
<td>Anaesthetic consult</td>
<td>Anaesthesiologist</td>
<td>Pre-delivery TBD</td>
<td>TBD TBD TBD $118.80 (20520)</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>$282.80</td>
</tr>
</tbody>
</table>

Resources provided to identify eligible population should intervention be made available as proposed

Resources provided to deliver proposed intervention

Surgery (incl surgeon) | Cardio-thoracic surgeon | Delivery TBD TBD | $963.90 (CSANZ) $0.00|
Surgical assistant | Cardio-thoracic | Delivery TBD TBD | derived fee $0.00 $0.00 $0.00
<table>
<thead>
<tr>
<th>Provider of resource</th>
<th>Setting in which resource is provided</th>
<th>Proportion of patients receiving resource</th>
<th>Number of units of resource per relevant time horizon per patient receiving resource</th>
<th>MBS Schedule fee***</th>
<th>Safety nets*</th>
<th>Other govt budget</th>
<th>Private health insurer</th>
<th>Patient**</th>
<th>Total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>surgical trainee</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>TBD</td>
</tr>
<tr>
<td>Prosthetic device</td>
<td>Surgeon / cardiologist</td>
<td>Delivery</td>
<td>TBD and TBD</td>
<td>TBD</td>
<td>$0.00</td>
<td>$0.00</td>
<td>TBD</td>
<td>TBD</td>
<td>$10,200 (occluder) $1,900 (spiral coil) $600 (flippercoil)</td>
</tr>
<tr>
<td>Nurse Assist (2)</td>
<td>Hospital</td>
<td>Delivery</td>
<td>TBD and TBD</td>
<td>TBD</td>
<td>$118.80</td>
<td>$0.00</td>
<td>TBD</td>
<td>TBD</td>
<td>$313.80</td>
</tr>
<tr>
<td>Anaesthesiology</td>
<td>Anaesthesiologist</td>
<td>Delivery</td>
<td>TBD and TBD</td>
<td>TBD</td>
<td>$0.00</td>
<td>$0.00</td>
<td>TBD</td>
<td>TBD</td>
<td>$140.00</td>
</tr>
<tr>
<td>Catheterisation lab</td>
<td>Hospital</td>
<td>Delivery</td>
<td>TBD and TBD</td>
<td>TBD</td>
<td>$0.00</td>
<td>$0.00</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>Cardiac ward</td>
<td>Hospital</td>
<td>Delivery</td>
<td>TBD and TBD</td>
<td>TBD</td>
<td>$0.00</td>
<td>$0.00</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>Pharmaceuticals</td>
<td>Hospital</td>
<td>Delivery</td>
<td>TBD and TBD</td>
<td>TBD</td>
<td>$0.00</td>
<td>$0.00</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>Transluminal</td>
<td>Echocardiographer</td>
<td>Pre &amp; post discharge</td>
<td>TBD and TBD</td>
<td>TBD</td>
<td>$275.50</td>
<td>$0.00</td>
<td>TBD</td>
<td>TBD</td>
<td>$147.00</td>
</tr>
<tr>
<td>Chest x-ray</td>
<td>Radiographer</td>
<td>Pre discharge</td>
<td>TBD and TBD</td>
<td>TBD</td>
<td>$47.15</td>
<td>$0.00</td>
<td>TBD</td>
<td>TBD</td>
<td>$66.15</td>
</tr>
<tr>
<td>Cardiology consult</td>
<td>Cardiologist</td>
<td>Pre &amp; post discharge</td>
<td>TBD and TBD aftercare</td>
<td>TBD</td>
<td>$0.00</td>
<td>$0.00</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
</tr>
</tbody>
</table>

**Resources provided post procedure**

| Cardiology consult   | Cardiologist                         | Post procedure                         | TBD and TBD 6wks to 2yrs                                                       | TBD              | $43.00    | $0.00          | TBD                 | TBD       | $102.00    |
| Transluminal         | Echocardiographer                    | Pre & post discharge                    | TBD and TBD                                                                     | TBD              | $275.50   | $0.00          | TBD                 | TBD       | $147.00    |

**Resources provided to identify eligible population for comparator (current scenario)**

| Cardiology consult   | Cardiologist                         | Diagnosis                              | TBD and TBD                                                                     | TBD              | $85.55    | $0.00          | TBD                 | TBD       | $143.55    |
| Transluminal         | Echocardiographer                    | Pre & post discharge                    | TBD and TBD                                                                     | TBD              | $275.50   | $0.00          | TBD                 | TBD       | $147.00    |
| Surgical consult     | Interventional cardiologist          | Pre-delivery                           | TBD and TBD                                                                     | TBD              | $85.55    | $0.00          | TBD                 | TBD       | $143.55    |
| Anaesthetic consult  | Anaesthesiologist                    | Pre-delivery                           | TBD and TBD                                                                     | TBD              | $118.80   | $0.00          | TBD                 | TBD       | $282.80    |

**Resources provided to deliver comparator**

| Surgical ligation    | Interventional cardiologist          | Delivery                               | TBD and TBD                                                                     | TBD              | $1,067.40 | $0.00          | TBD                 | TBD       | $1489.40   |
| Surgical assistant   | Cardiology trainee or registrar      | Delivery                               | TBD and TBD derived fee (51303)                                                | TBD              | $0.00     | $0.00          | TBD                 | TBD       | TBD        |
| Transluminal         | Echocardiographer                    | Pre & post discharge                    | TBD and TBD                                                                     | TBD              | $275.50   | $0.00          | TBD                 | TBD       | $147.00    |
| Anaesthesiology     | Anaesthetist                         | Delivery                               | TBD and TBD                                                                     | TBD              | $118.80   | $0.00          | TBD                 | TBD       | $313.80    |
| Pathology            | Pathologist                          | Delivery                               | TBD and TBD                                                                     | TBD              | $0.00     | $0.00          | TBD                 | TBD       | TBD        |
| Blood transfusion    | Anaesthetist                         | Delivery                               | TBD and TBD                                                                     | TBD              | $0.00     | $0.00          | TBD                 | TBD       | TBD        |
| Pharmaceuticals      | Hospital                             | Delivery                               | TBD and TBD                                                                     | TBD              | $0.00     | $0.00          | TBD                 | TBD       | TBD        |
| Intensive care unit  | Hospital                             | Delivery                               | TBD and TBD 1 day                                                                | TBD              | $0.00     | $0.00          | TBD                 | TBD       | TBD        |
| Cardiac ward         | Hospital                             | Delivery                               | TBD and TBD 3-4 days                                                             | TBD              | $0.00     | $0.00          | TBD                 | TBD       | TBD        |

**Resources provided in association with comparator**

| Blood bank           | TBD                                  | Delivery                               | TBD and TBD                                                                     | TBD              | TBD       | $0.00          | TBD                 | TBD       | TBD        |

**Resources provided post procedure for comparator**

| Cardiology consult   | Cardiologist                         | Post procedure                         | TBD and TBD Up to 2yrs                                                          | TBD              | $43.00    | $0.00          | TBD                 | TBD       | TBD        |
| Transluminal         | Echocardiographer                    | Pre & post discharge                    | TBD and TBD                                                                     | TBD              | $275.50   | $0.00          | TBD                 | TBD       | $147.00    |

* Include costs relating to both the standard and extended safety net; ** Based on patient data for the 2011-12 financial year. Average fee charged minus average non-bulk billed benefit; *** MBS Schedule Fee as at 1 November 2011.
Proposed structure of economic evaluation (decision-analytic)

The PICO criteria for the evaluation are provided in Table 12.

<table>
<thead>
<tr>
<th>Patients</th>
<th>Intervention</th>
<th>Comparator</th>
<th>Outcomes to be assessed</th>
</tr>
</thead>
</table>
| Patients with clinically significant PDA (identified by transthoracic echocardiography) | Transcatheter closure of PDA | Surgical closure of PDA | Effectiveness (including but not limited to:  
- successful duct closure  
- no residual shunt detected  
- equivalent long term outcome to surgical ligation  
- resolution of disease process (absence of cardiac failure)  
- vascular occlusion  
- patient mortality  
- procedure time  
- duration of hospitalisation post-procedure  
- recovery time post-procedure  
Safety (including but not limited to):  
- patient mortality  
- vascular occlusion of a femoral vessel  
- infection  
- bleeding at catheterisation site  
- re-operation for failed transcatheter deployment of device  
- recurrent laryngeal nerve injury  
- incidence of device complications including but not limited to:  
  - unable to achieve stable position  
  - migration/dislodgement/protrusion of device  
  - obstruction of aorta or pulmonary artery by device  
  - device embolisation  
  - inappropriate deployment of device  
  - rupture of blood vessels  
  - tachyarrhythmia/bradyarrhythmia |

Clinical research questions for public funding

1. In the treatment of patients with clinically significant patent ductus arteriosus, what is the safety, effectiveness and cost effectiveness of transcatheter closure of the patent duct compared to surgical ligation?

Decision analytic diagram

The decision analytic for the surgical closure of PDA pathway is presented in Figure 2, while the proposed decision analytic pathway for patients suitable for transcatheter closure of PDA is presented in Figure 3.
Figure 2: Decision analytic pathway for surgical closure of PDA

Patients with PDA

- Inappropriate to undergo transcatheter PDA occlusion
  - Medical management
    - Successful PDA closure
    - Unsuccessful PDA closure
      - Medical management

- Appropriate to receive PDA surgery
  - Surgical closure of PDA
    - Successful PDA closure
    - Unsuccessful PDA closure
      - Medical management
Figure 3: Decision analytic pathway for patients suitable for transcatheter closure of PDA

Patients with PDA

Inappropriate to receive transcatheter PDA occlusion

Medical management

Successful PDA closure

Transcatheter closure of PDA

Unsuccessful PDA closure

Surgical closure of PDA

Unsuccessful PDA closure

Medical management

Successful PDA closure

Surgical ligation

Unsuccessful PDA closure

Surgical closure of PDA

Medical management

Successful PDA closure

Unsuccessful PDA closure

Medical management

Successful PDA closure

Unsuccessful PDA closure

Medical management

Successful PDA closure
References


AIHW Table 1 and 2: Selected separation statistics(a) for procedures in ACHI blocks, public and private hospitals, Australia, 2008-09.

AIHW procedures datacubes

Casemix data

AIHW Table 2: Selected separation statistics(a) for procedures in ACHI blocks, private hospitals, Australia, 2008-09.

Clinicaltrials.gov (identifier - NCT01479218)


Information on state and territory travel schemes can be found at http://www.wacountry.health.wa.gov.au/index.php?id=pats;
http://www.health.nt.gov.au/Hospitals/Patient_Assistance_Travel_Scheme;