Australian Government

Department of Health

Ratified
PICO Confirmation

Application 1354.1

Intravascular Ultrasound Guided Coronary Stent Insertion

Summary of PICO/PPICO criteria to define the question(s) to be addressed in an Assessment Report to the Medical Services Advisory Committee (MSAC)

Component	Description
Patients	Two population options have been proposed: 1. Patients undergoing PCI who have a coronary lesion eligible for DES implantation. This option means that all patients eligible for PCI would be eligible for IVUS; 'all comers'. 2. Patients undergoing PCI who have had a coronary lesion eligible for DES implantation with either: a. lesions associated with the left main coronary artery; and/or where suitability of percutaneous coronary intervention has appropriately been determined by a Heart Team approach for significant stenoses (≥50% as defined by the coronary angiogram) of the left main coronary artery, including in cases of unprotected left-main disease; and/or b. other lesion locations where lesion length is ≥28 mm. To note for both options, new MBS items related to PCI and stent insertion (see Table 3) are planned to be implemented on 1 July 2021, which may impact the population criteria for IVUS and significantly, the financial estimates.
Prior tests (for investigative medical services only)	Prior tests for suitability for invasive coronary angiogram and percutaneous angioplasty or transluminal insertion of stent(s) will need to be documented.
Intervention	Intravascular ultrasound guided coronary stent insertion as an adjunct to invasive coronary angiogram and percutaneous angioplasty or transluminal insertion of stent(s) (i.e. angiographic + IVUS guided coronary stent insertion).
Comparator	Invasive coronary angiogram and percutaneous angioplasty or transluminal insertion of stent(s) (i.e. angiographic alone guided coronary stent insertion).
Outcomes	Safety: any adverse events or complications that occur as a result of the use of the intervention will be considered a safety concern; including in-hospital events. Efficacy / effectiveness: Cardiac mortality, myocardial infarction, target lesion revascularisation and definitive/probable stent thrombosis. Information on HRQoL, overall survival and MACE would also be valuable. Healthcare resources: 30 day rehospitalisation, length of stay, in-hospital events, revascularisation procedures. Cost-effectiveness: cost per QALY preferred. Total Australian Government healthcare costs.

DES = drug-eluting stent, HRQoL = health-related quality of life, IVUS = intravascular ultrasound, MACE = major adverse cardiovascular events, PCI = Percutaneous coronary intervention, QALY = quality adjusted life year.

Background

Applications for the use of intravascular ultrasound (IVUS) have previously been submitted to MSAC on two occasions. The first application was submitted in 2001 (application 1032). In this application, IVUS was assessed as both a diagnostic and as an adjunct for therapeutic cardiac stent optimisation, however MSAC deemed the clinical evidence and cost-effectiveness data insufficient to support IVUS use.

In 2015, Boston Scientific submitted an MSAC application for IVUS as an adjunct for optimisation of drug-eluting stent (DES) or bare metal stent (BMS) placement (application 1354). The MSAC did not support the application due to uncertain clinical effectiveness and cost-effectiveness. In application 1354, the proposed patient population in the published protocol was defined as 'high-risk' based on coronary anatomy, lesion type and complexity:

- intermediate left main coronary stenosis;
- complex coronary lesions (e.g. ostial or bifurcation lesions, calcified lesions, chronic total occlusions);
- challenging coronary anatomy (e.g. coronary artery ectasia, giant coronary arteries, hazy coronary lesions); and
- previous stents.

Application 1354 included clinical evidence from meta-analyses which included a broader patient population than the published protocol (termed 'all comers'). The economic analyses presented in the submission provided a high-risk subgroup analysis, although due to a lack of evidence, the patient criteria did not align specifically with the high-risk definition in the published protocol.

The application was not supported by the MSAC, noting several key matters of concern:

- There were differences between the clinical algorithm in the final submission and the clinical algorithm in the protocol which increased the level of clinical uncertainty. It was noted that the algorithm in the submission allows 'low/medium risk' patients to receive IVUS guidance. However, in the protocol, IVUS guidance was restricted to only 'high-risk' patients.
- There was a limited number of primary studies included in the analysis and the reliance on systematic reviews and meta-analyses, which do not allow assessment of the safety and efficacy of IVUS guidance for stent insertion of either BMS or DES for the types of 'high-risk' patients nominated in the protocol.
- The data were heterogeneous and therefore the 95% confidence intervals (CIs) approached 1. MSAC was concerned that there were no significant differences in important clinical outcomes such as myocardial infarctions (MIs) and mortality and that pooling of major adverse cardiac events (MACE) may be inappropriate. In addition, due to the short follow-up (2-3 years) in the clinical evidence base, it is not possible to assess whether the short-term benefits of IVUS are maintained over a longer period of time.

PICO or PPICO rationale for therapeutic and investigative medical services only

Population

The intervention is proposed for patients eligible for coronary revascularisation undergoing percutaneous coronary intervention (PCI) with coronary stent insertion. PCI and coronary stent implantation has become the standard revascularisation therapy for most patients with obstructive coronary artery disease. As the purpose of the intervention is therapeutic, this is a group of patients that has committed for PCI.

The proposed population are patients with ischaemic heart disease (IHD) or coronary artery disease (CAD). This is a medical condition that includes narrowing of the coronary arteries. Patients may present with stable coronary artery disease causes episodes of angina pectoris which settle spontaneously. They may also present with an acute myocardial infarction or unstable angina.

These patients can be treated with a revascularisation strategy that can include PCI, (angioplasty and/or stent insertion) coronary artery bypass surgery or medical therapy. The specific patient population is those patients requiring myocardial revascularisation for which the decision is to do PCI with drug eluting (DES) coronary stents. It is assumed that the tests required to determine the most appropriate treatment have already been conducted, and these are patients eligible for invasive coronary angiogram and percutaneous angioplasty or transluminal insertion of stent(s) as required under the MBS items for this procedure.

Definition of population as defined in application

The application defines two options, which have subsequently been amended to the following:

1) Patients undergoing PCI who have a coronary lesion eligible for DES implantation.
2) Patients undergoing PCI who have a coronary lesion eligible for DES implantation with either:
    a. Lesions associated with the left main coronary artery; and/or where suitability of percutaneous coronary intervention has appropriately been determined by a Heart Team approach for significant stenoses (≥50% as defined by the coronary angiogram) of the left main coronary artery including in cases of unprotected left main disease; or
    b. Other lesion locations (i.e. left anterior descending artery, left circumflex artery, right coronary artery) where lesion length is ≥28mm.

Page 14 of the application refers to the use of IVUS in patients who cannot tolerate contrast dye.

"….in some cases, such as patients with renal impairment, IVUS may be used as a replacement for angiography, in order to avoid the use of contrast dyes."

Aside from this comment, the application does not expand on this proposed population by describing the use of IVUS further in the population or provide an item descriptor for use of IVUS without coronary angiogram.

PASC noted the applicant's advice that in patients with renal impairment, IVUS has advantages in minimising or using zero contrast for PCI.

The applicant's response to the pre-PASC PICO stated that the current application does not intend to

cover the use of IVUS for diagnostic purposes, therefore subgroups of the population who are unable to have coronary angiogram are not the subject of this application.

Option One (1) would allow any patient currently eligible for MBS reimbursement for PCI with coronary stents to also be eligible for IVUS. The application states that this population is a broader population based on the patients included in the ULTIMATE trial (Zhang 2018[1]). The ULTIMATE trial refers to the included population as 'all comers' and includes patients with high through to low-risk lesions. Given the proposed new MBS items (see Table 3), the applicant may need to review whether these patients would fit within the description of the population eligible for invasive coronary angiography and percutaneous angioplasty or transluminal insertion of stents. For example, in the ULTIMATE trial approximately 33% included were classified as A/B1 lesions which are reported to be low risk with a high risk of success. The need for this population to receive IVUS assistance is not articulated in the application.

As noted in the application, Option Two (2) is proposed as alternative definition of 'high risk' patients compared with that considered in the MSAC 1354 application (see Table 1). This alternative definition was proposed by the applicant's expert panel for the therapeutic use of IVUS and presents "characteristics with an objective and measurable definition (e.g. lesion length ≥28mm and lesions associated with the left main coronary artery)." The application presents as part of its criteria significant stenoses (≥50% as defined on IVUS**)** which appears to represent the use of IVUS for diagnostic purposes used in the clinical trial but which could not be used in Australia, as IVUS for diagnostic use is not available on the MBS for this purpose and is not part of this application.

PASC noted in defining the population options that IVUS will not be used for diagnostic purposes so that its reference in the options and item descriptor needs to be removed.

The applicant's response to pre-PASC PICO stated that it is not intended to use IVUS for diagnostic purposes, so prior diagnostic angiography or other assessments would be used to diagnose patient's suitability for IVUS under this Option.

The application used inclusion criteria from the IVUS-XPL trial (Hong 2015) to define 'high risk' lesions. One of the issues with this approach is that the trial itself does not define this group of patients as 'high risk'. The clinical expert for the applicant noted that in current clinical practice, IVUS would be the preferred choice for patients with complex anatomy, such as left main lesions, long lesions, chronic total occlusion (CTO), ectatic vessels (dilated to more than 1.5 times 'normal' diameter), bifurcation lesions, and in patients with poor renal function (contrast dye contraindications). However, they noted that robust clinical trials on specific patient subgroups are only available for left main and long lesions. The definition of 'high-risk' lesions in the application therefore includes a subset of patients.

Thus, PASC agreed that the two populations proposed in the PICO should not be defined in terms of risk. PASC noted the complexity associated with defining the patient population options by risk as there are multiple factors (patient and anatomy) that can classify those as high risk. PASC noted that Option 1 is an 'all comers' population and Option 2 was a more well defined subpopulation described by anatomical characteristics of the coronary lesion (see PICO summary table).

PASC also noted that the two options overlap rather than being two distinct populations.

Table 1: Comparison of the definition of patients in the MSAC 1354 PICO and MSAC PSD and those proposed in the current application (MSAC 1354.1)

1354 Protocol	MSAC PSD*	MSAC 1354.1 application
Eligible for coronary revascularisation undergoing PCI with coronary stent insertion - initial stent insertion, or re-stenting or assessment for other interventions if there are complications or failure of the stent.	Patients eligible for coronary revascularisation undergoing PCI with coronary stent insertion	Patients undergoing PCI who have had a coronary lesion eligible for DES implantation.
Sub Population: "high-risk" based on their coronary anatomy, lesion type and complexity. They may include patients with: • intermediate left main coronary stenosis; • complex coronary lesions (e.g. ostial or bifurcation lesions, calcified lesions, chronic total occlusions); • challenging coronary anatomy (e.g. coronary artery ectasia, giant coronary arteries, hazy coronary lesions); and • previous stents.	The definition of 'high-risk' in the MSAC PSD: • intermediate left main coronary stenosis • complex coronary lesions (e.g. ostial or bifurcation lesions, calcified lesions, chronic total occlusions) • challenging coronary anatomy (e.g. coronary artery ectasia, giant coronary arteries, hazy coronary lesions) • previous stents Expanded to include clinical variables: • previous myocardial infarction (MI) • acute coronary syndrome • diabetes • renal insufficiency.	Patients undergoing PCI who have had a coronary lesion eligible for DES implantation with either: a. Lesions associated with the left main coronary artery; and/or where suitability of percutaneous coronary intervention has appropriately been determined by a Heart Team approach for significant stenoses (≥50% as defined on IVUS) of the left main coronary artery, including in cases of unprotected left-main disease; or b. Lesion length ≥28mm.

* MSAC 63rd meeting, 1-2 April 2015

To summarise, the definition of 'high risk' was based on coronary anatomy, lesion specificities and complexity of the lesions with MSAC adding specific clinical characteristics into the definition of 'high risk'. This application has sought to narrow the definition of 'high risk' to objective and measurable criteria.

In reading the relevant clinical trials, it was noted patients are mainly included on the basis of complex lesions, not according to 'high-risk', whereas other clinical trials classify patients according to whether they have A, B, C characteristic lesions or combinations of them e.g. AB or BC grouping, which are based on early guidelines for PCI (Ryan 1988[2]), see Figure 1.

Table 1. Characteristics of Type A, B and C Lesions

Lesion-Specific Characteristics	
Type A Lesions (high success, >85%; low risk)	
• Discrete (<10 mm length)	• Little or no calcification
• Concentric	• Less than totally occlusive
• Readily accessible	• Not ostial in location
• Nonangulated segment, <45°	• No major branch involvement
• Smooth contour	• Absence of thrombus
Type B Lesions (moderate success, 60 to 85%; moderate risk)	
• Tubular (10 to 20 mm length)	• Moderate to heavy calcification
• Eccentric	• Total occlusions <3 months old
• Moderate tortuosity of proximal segment	• Ostial in location
• Moderately angulated segment, >45°, <90°	• Bifurcation lesions requiring double guide wires
• Irregular contour	• Some thrombus present
Type C Lesions (low success, <60%; high risk)	
• Diffuse (>2 cm length)	• Total occlusion >3 months old
• Excessive tortuosity of proximal segment	• Inability to protect major side branches
• Extremely angulated segments >90°	• Degenerated vein grafts with friable lesions

*Although the risk of abrupt vessel closure is moderate, in certain instances the likelihood of a major complication may be low as in dilation of total occlusions <3 months old or when abundant collateral channels supply the distal vessel.

Figure 1: Characteristics of Types A, B and C lesions
Source: Ryan 1988, Table 1

Type A lesions have those characteristics that allow an anticipated success rate of ≥85% and a low risk of abrupt vessel closure.

Type B lesions have those characteristics that result in a lower than optimal success rate ranging from 60 to 85% or have a moderate risk of abrupt vessel closure, or both.

Type C lesions have those characteristics that result in an unacceptably low success rate (<60%) or have a high risk of abrupt closure, or both.

As stated in Ryan (1998), the approach to angioplasty procedures weighs the likelihood of a successful procedure (defined as one in which a ≥20% change in luminal diameter is achieved with the final diameter stenosis <50%, without the occurrence of death, acute myocardial infarction, or bypass operation during hospitalisation) and the risk of complications (abrupt vessel closure, morbidity, mortality, and restenosis).

Prognostic factors favouring a successful procedure are age<65 years, male gender, single vessel disease, single lesion angioplasty, subtotal occlusions, absence of calcification, accessibility of the lesion and normal ventricular function. Counterbalancing these variables that support the likelihood of successful angioplasty are the preprocedural factors that favour abrupt vessel closure during or shortly after angioplasty, these are length of lesion, eccentric lesions, bifurcation/side branch

lesions, angulation of the segment being dilated, other stenoses in the same vessel and the presence of thrombus.

The clinical variables that have been associated with increased procedural mortality are currently identified as age >65 years, female gender, a history of hypertension, diabetes, prior myocardial infarction, prior bypass surgery, multivessel disease, left main coronary disease, a large area of myocardium at risk, impairment of left ventricular function and collateral vessels that supply significant areas of myocardium and original distal to the segment to be dilated (Ryan 1988).

The factors associated with restenosis are currently recognised as recent onset of angina (<3 months), unstable angina, variant angina, diabetes mellitus, multivessel disease, right ostial lesions, lesions located at the origin of the left anterior descending coronary artery, lesions in the proximal anastomoses or body of a vein graft, chronic total occlusions, presence of thrombus, severity of residual lesion (>30%) and a significant residual gradient (>15 to 20 mmHg) (Ryan 1988).

According to Ryan (1988) considering these variables should allow for formulation of likelihood estimates (high, moderate or low) for any given procedure according to:

1) the likelihood of a successful dilation,
2) the likelihood of abrupt vessel closure with subsequent morbidity and mortality, and
3) the likelihood of restenosis.

These likelihood estimates, although from 1988, clearly elaborate what is being discussed by the term low/medium/high risk lesions. It would have been helpful for the application to have explained how for the different nominated populations, the use of IVUS would result in improvements in the likelihood of success.

Since Ryan (1998) was written there has been ongoing growth and development in this area. In particular, the use of DES (it is estimated that over 80% of PCI procedures in the US are performed with DES (Amin 2012[3]; Krone 2006[4]). The principal advantages of DES over BMS is reported as the decreased risk of restenosis and lower likelihood of needing to undergo a repeat revascularisation procedure (Moses 2003[5]; Samo 2012[6]). In Victoria, DES accounted for 99% of all stents implanted (Lefkovits 2020).

The MBS currently includes a definition of complex lesion (included in the relevant MBS items 38312 and 38318, PCI and stent insertion that includes percutaneous transluminal rotation atherectomy); a procedure that may also be done using IVUS. The definition is:

> "TN 8.41 A coronary artery lesion is considered to be complex when the lesion is a chronic total occlusion, located at an ostial site, angulated, tortuous or greater than 1cm in length. Percutaneous transluminal coronary rotational atherectomy is suitable for revascularisation of complex and heavily calcified coronary artery stenoses in patients for whom coronary artery bypass graft surgery is contraindicated".

Complicating this issue further is that the MBS Review Taskforce—Cardiac Services has made its recommendations (MBS Review Taskforce-Cardiac Services Report). These recommendations are likely to result in major changes to patient characteristics for coronary angiography and PCI with stent insertion. The recommendations to coronary angiography, include more specific reference to

the patients' coronary heart disease, type of angina, myocardial ischaemia, functional testing, and level of stenosis compared to the current MBS items. The recommendations restructure the seven existing MBS items for PCI into eight new or amended items that include associated imaging:

- Three items (for one, two and three coronary vascular territories) for ST elevation myocardial infarction (STEMI),
- Three items for troponin negative Acute Coronary Syndromes (ACS) or stable CAD,
- One item for rotational atherectomy (rotablation), as an add-on to PCI (amendment to item 38309), and
- One item for standalone angioplasty (amendment to item 38303).

Although this was the recommendation of the MBS Taskforce, the resulting MBS item numbers have been increased to twelve new items which are described below (Fees not yet available) but are not yet publicly available online. These new items are specific to the degree of cardiac disease that is documented, the requirement for previous medical therapy and other requirements such as the need for Heart Team recommendations, types of pre-testing, staged procedures, with or without prior coronary angiogram in the previous three-month period and documentation of how the procedure meets the item descriptor. A description of the twelve new MBS items that will replace the current MBS item 38306 (Table 2), are presented in Table 3.

Table 2: MBS item 38306

38306 Transluminal insertion of stent or stents into one occlusional site, including associated balloon dilatation of coronary artery, percutaneous or by open exposure, excluding associated radiological services, radiological preparation and after-care Multiple Operation Rule (Anaes.) (Assist.) Fee: $786.15 Benefit: 75% = $589.65 85% = $701.45 (See para TN.8.62 of explanatory notes to this Category)

Table 3: Twelve MBS items for PCI and coronary stenting introduced according to the MBS Taskforce Recommendation to replace 38306

38307 Invasive coronary angiography and percutaneous angioplasty or transluminal insertion of stent(s), when invasive coronary angiography has not been completed in the previous 3 months, in a single coronary vascular territory (Left Anterior Descending, Circumflex or Right Coronary Artery distribution) for the treatment of a patient with: 1. An acute coronary syndrome evidenced by: (i) ST segment elevation (or new left bundle branch block); or (ii) troponin elevation above the local upper reference limit; or (iii) resting wall motion abnormality or perfusion defect; or (iv) cardiogenic shock, resuscitated cardiac arrest, ventricular fibrillation or sustained ventricular tachycardia; or 2. Unstable angina or angina equivalent with a crescendo pattern or rest pain or high-risk clinical or angiographic features (see Explanatory notes); or 3. Significant left main coronary artery disease (>50% stenosis or cross-sectional area <6 mm^2) or severe proximal left anterior descending coronary artery disease (>70% stenosis or cross-sectional area <4 mm^2 before the first major diagonal branch) detected on computed tomography coronary angiography. Including any associated balloon dilatation and angiography (imaging, catheter & contrast). Procedure report to include documentation of how the indication requirements of this descriptor were met. Excluding associated after-care. Claimable once in any 3-month period unless a new acute coronary syndrome or equivalent occurs within this period and meets the requirements of 1 or 2. If a staged procedure is appropriately performed over multiple days, items 38316, 38317 or 38319 must be used for subsequent stages. Staging of a percutaneous coronary intervention is permissible up 3 months preceding the initial stage. Not being a service associated with a service to which items 38200, 38203, 38206, 38244, 38247, 38248, 38249, 38251, 38252, 38308, 38310, 38311, 38313, 38314, 38316, 38317, 38319, 38320, 38322 or 38323 apply. The item number claimed should reflect the number of coronary vascular territories (Left Anterior Descending, Circumflex or Right Coronary Artery distribution) that are stented during the procedure, not the total number of stented territories the patient has received to date. (Anaes.) (Assist.)
38308 Invasive coronary angiography and percutaneous angioplasty or transluminal insertion of stent(s), when invasive coronary angiography has not been completed in the previous 3 months, in two coronary vascular territories (Left Anterior Descending, Circumflex or Right Coronary Artery distribution) for the treatment of a patient with: 1. An acute coronary syndrome evidenced by: (i) ST segment elevation (or new left bundle branch block); or (ii) troponin elevation above the local upper reference limit; or (iii) resting wall motion abnormality or perfusion defect; or (iv) cardiogenic shock, resuscitated cardiac arrest, ventricular fibrillation or sustained ventricular tachycardia; or 2. Unstable angina or angina equivalent with a crescendo pattern or rest pain or high-risk clinical or angiographic features (see Explanatory notes); or 3. Significant left main coronary artery disease (>50% stenosis or cross-sectional area <6 mm^2) or severe proximal left anterior descending coronary artery disease (>70% stenosis or cross-sectional area <4 mm^2 before the first major diagonal branch) detected on computed tomography coronary angiography. Including any associated balloon dilatation and angiography (imaging, catheter & contrast).

Procedure report to include documentation of how the indication requirements of this descriptor were met.

Excluding associated after-care.

Claimable once in any 3-month period unless a new acute coronary syndrome or equivalent occurs within this period and meets the requirements of 1 or 2.

If a staged procedure is appropriately performed over multiple days, items 38316, 38317 or 38319 must be used for subsequent stages. Staging of a percutaneous coronary intervention is permissible up 3 months preceding the initial stage.

Not being a service associated with a service to which items 38200, 38203, 38206, 38244, 38247, 38248, 38249, 38251, 38252, 38307, 38310, 38311, 38313, 38314, 38316, 38317, 38319, 38320, 38322 or 38323 apply.

The item number claimed should reflect the number of coronary vascular territories (Left Anterior Descending, Circumflex or Right Coronary Artery distribution) that are stented during the procedure, not the total number of stented territories the patient has received to date.
(Anaes.) (Assist.)

38310
Invasive coronary angiography and percutaneous angioplasty or transluminal insertion of stent(s), when invasive coronary angiography has not been completed in the previous 3 months, in three coronary vascular territories (Left Anterior Descending, Circumflex or Right Coronary Artery distribution) for the treatment of a patient with:
1. An acute coronary syndrome evidenced by:
(i) ST segment elevation (or new LBBB); or
(ii) troponin elevation above the local upper reference limit; or
(iii) resting wall motion abnormality or perfusion defect; or
(iv) cardiogenic shock, resuscitated cardiac arrest, ventricular fibrillation or sustained VT; or
2. Unstable angina or angina equivalent with a crescendo pattern or rest pain or high-risk clinical or angiographic features (see Explanatory notes); or
3. Significant left main coronary artery disease (>50% stenosis or cross-sectional area <6 mm^2) or severe proximal left anterior descending coronary artery disease (>70% stenosis or cross-sectional area <4 mm^2 before the first major diagonal branch) detected on computed tomography coronary angiography.

Including any associated balloon dilatation and angiography (imaging, catheter & contrast).
Procedure report to include documentation of how the indication requirements of this descriptor were met.

Excluding associated after-care.

Not being a service associated with a service to which items 38200, 38203, 38206, 38244, 38247, 38248, 38249, 38251, 38252, 38307, 38308, 38311, 38313, 38314, 38316, 38317, 38319, 38320, 38322 or 38323 apply.

Claimable once in any 3-month period unless a new acute coronary syndrome or equivalent occurs within this period and meets the requirements of 1 or 2.

If a staged procedure is appropriately performed over multiple days, items 38316, 38317 or 38319 must be used for subsequent stages. Staging of percutaneous coronary intervention is permissible up 3 months preceding the initial stage.

The item number claimed should reflect the number of coronary vascular territories (Left Anterior Descending, Circumflex or Right Coronary Artery distribution) that are stented during the procedure, not the total number of stented territories the patient has received to date.

(Anaes.) (Assist.)

38311
Invasive coronary angiography and percutaneous angioplasty or transluminal insertion of stent(s), when invasive coronary angiography has not been completed in the previous 3 months, in a single coronary vascular territory (Left Anterior Descending Artery, Circumflex Artery or Right Coronary Artery distribution) in a patient satisfying the following criteria:
1. A Heart Team Conference has recommended the intervention; or
2. Both of the following conditions are met:
(a) The patient has:
(i) limiting angina or angina equivalent (Canadian Cardiovascular Society class II-IV) despite an adequate trial of optimal medical therapy; or
(ii) myocardial ischaemia demonstrated on functional imaging; or
(iii) Stress electrocardiogram testing with high risk features (ST segment elevation or sustained ST depression, hypotension, Duke treadmill score <= -11); and
(b) fulfils at least one of the following conditions in the vascular territory treated:
(i) A stenosis >70%; or
(ii) A Fractional Flow Reserve (FFR) or Instantaneous wave-free ratio (iFR) distal to the lesions that is ≤0.80 or ≤0.89, respectively.

Only claimable in patients with triple vessel disease where they meet the indication requirements for item 38314.

Including any associated balloon dilatation, including associated angiography.

Excluding associated after-care.

If a staged procedure is appropriately performed over multiple days, items 38320, 38322 or 38323 must be used for subsequent stages. Staging of percutaneous coronary intervention is permissible up 3 months proceeding the initial stage.

Requires documentation in the procedure report of how the indication requirements of this descriptor were met for each territory treated.

Not being a service associated with a service to which items 38200, 38203, 38206, 38244, 38247, 38248, 38249, 38251, 38252, 38307, 38308, 38310, 38313, 38314, 38316, 38317, 38319, 38320, 38322 or 38323 apply.

(Anaes.) (Assist.)

38313
Invasive coronary angiography and percutaneous angioplasty or transluminal insertion of stents, when invasive coronary angiography has not been completed in the previous 3 months, in any two coronary vascular territories (Left Anterior Descending Artery, Circumflex Artery or Right Coronary Artery distribution) in a patient satisfying the following criteria:
1. A Heart Team Conference has recommended the intervention; or
2. Both of the following conditions are met:
(a) The patient has:
(i) limiting angina or angina equivalent (Canadian Cardiovascular Society class II-IV) despite an adequate trial of optimal medical therapy; or
(ii) myocardial ischaemia demonstrated on functional imaging; or
(iii) Stress electrocardiogram testing with high risk features (ST segment elevation or sustained ST depression, hypotension, Duke treadmill score <= -11); and
(b) fulfils at least one of the following conditions in the vascular territory treated:
(i) A stenosis >70%; or
(ii) A Fractional Flow Reserve (FFR) or Instantaneous wave-free ratio (iFR) distal to the lesions that is ≤0.80 or ≤0.89, respectively.

Including any associated balloon dilatation, including associated angiography.

Excluding associated after-care.

Requires documentation in the procedure report of how the indication requirements of this descriptor were met for each territory treated.

Only claimable in patients with triple vessel disease where they meet the indication requirements for item 38314.

If a staged procedure is appropriately performed over multiple days, items 38320, 38322 or 38323 must be used for subsequent stages. Staging of percutaneous coronary intervention is permissible up 3 months preceding the initial stage.

Not being a service associated with a service to which items 38200, 38203, 38206, 38244, 38247, 38248, 38249, 38251, 38252, 38307, 38308, 38310, 38311, 38314, 38316, 38317, 38319, 38320, 38322 or 38323 apply.

(Anaes.) (Assist.)

38314

Invasive coronary angiography and percutaneous angioplasty or transluminal insertion of stents, when invasive coronary angiography has not been completed in the previous 3 months, in all three coronary vascular territories (Left Anterior Descending Artery, Circumflex Artery or Right Coronary Artery distribution) in a patient satisfying the following criteria:
1. A Heart Team Conference has recommended the intervention; or
2. Has limiting angina or angina equivalent (Canadian Cardiovascular Society class II-IV) despite an adequate trial of optimal medical therapy, or where myocardial ischaemia is demonstrated on functional imaging or stress electrocardiogram testing with high risk features (ST segment elevation or sustained ST depression, hypotension, Duke treadmill score <= -11) and where both of the following conditions are met:
(a) each vascular territory treated has:
i. A stenosis >70%; or
ii. A Fractional Flow Reserve or Instantaneous wave-free ratio distal to the lesions that is ≤0.80 or ≤0.89, respectively; AND
(b) The patient does not have diabetes mellitus and the multi-vessel coronary artery disease is non-complex and does not involve any of the following:
i. A stenosis >50% in the left main coronary artery; or
ii. Bifurcation lesions involving side branches with a diameter >2.75mm; or
iii. Chronic vessel occlusions (>3 months); or
iv. Severely angulated or severely calcified lesions; or
v. SYNTAX score >23; or
3. The patient expresses a preference for catheter-based intervention, even when objective assessment indicates surgery would be preferable as per the criteria outlined in this descriptor.

Including any associated balloon dilatation, including associated angiography.

Excluding associated after-care.

Requires documentation in the procedure report of how the indication requirements of this descriptor were met for each territory treated.

If a staged procedure is appropriately performed over multiple days, items 38320, 38322 or 38323 must be used for subsequent stages. Staging of percutaneous coronary intervention is permissible up 3 months preceding the initial stage.

Not being a service associated with a service to which items 38200, 38203, 38206, 38244, 38247, 38248, 38249, 38251, 38252, 38307, 38308, 38310, 38311, 38313, 38316, 38317, 38319, 38320, 38322 or 38323 apply.

(Anaes.) (Assist.)

38316

Invasive coronary angiography and percutaneous angioplasty or transluminal insertion of stent(s), when invasive coronary angiography has been completed in the previous 3 months, in a single coronary vascular territory (Left Anterior Descending, Circumflex or Right Coronary Artery distribution) for the treatment of a patient with:
1. An acute coronary syndrome evidenced by:
(i) ST segment elevation (or new left bundle branch block); or
(ii) troponin elevation above the local upper reference limit; or
(iii) resting wall motion abnormality or perfusion defect; or
(iv) cardiogenic shock, resuscitated cardiac arrest, ventricular fibrillation or sustained ventricular tachycardia; or
2. Unstable angina or angina equivalent with a crescendo pattern or rest pain or high-risk clinical or angiographic features (see Explanatory notes); or
3. Significant left main coronary artery disease (>50% stenosis or cross-sectional area <6 mm^2) or severe proximal left anterior descending coronary artery disease (>70% stenosis or cross-sectional area <4 mm^2 before the first major diagonal branch) detected on computed tomography coronary angiography.

Including any associated balloon dilatation and angiography (imaging, catheter & contrast).

Excluding associated after-care.

Procedure report to include documentation of how the indication requirements of this descriptor were met.

Claimable:
(a) once in any 3 month period unless a new acute coronary syndrome or equivalent occurs within this period and meets the requirements of 1 or 2.; or
(b) for subsequent stages of an appropriately staged percutaneous coronary intervention service to which items 38307, 38308, 38310, 38316, 38317 or 38319 applies.

Not being a service associated with a service to which items 38200, 38203, 38206, 38244, 38247, 38248, 38249, 38251, 38252, 38307, 38308, 38310, 38311, 38313, 38314, 38317, 38319, 38320, 38322 or 38323 apply.

The item number claimed should reflect the number of coronary vascular territories (Left Anterior Descending, Circumflex or Right Coronary Artery distribution) that are stented during the procedure, not the total number of stented territories the patient has received to date.

(Anaes.) (Assist.)

38317

Invasive coronary angiography and percutaneous angioplasty or transluminal insertion of stent(s), when invasive coronary angiography has been completed in the previous 3 months, in two coronary vascular territories (Left Anterior Descending, Circumflex or Right Coronary Artery distribution) for the treatment of a patient with:
1. An acute coronary syndrome evidenced by:
(i) ST segment elevation (or new LBBB); or
(ii) troponin elevation above the local upper reference limit; or
(iii) resting wall motion abnormality or perfusion defect; or
(iv) cardiogenic shock, resuscitated cardiac arrest, ventricular fibrillation or sustained VT; or
2. Unstable angina or angina equivalent with a crescendo pattern or rest pain or high-risk clinical or angiographic features (see Explanatory notes); or
3. Significant left main coronary artery disease (>50% stenosis or cross-sectional area <6 mm^2) or severe proximal left anterior descending coronary artery disease (>70% stenosis or cross-sectional area <4 mm^2 before the first major diagonal branch) detected on computed tomography coronary angiography.

Including any associated balloon dilatation and angiography (imaging, catheter & contrast).

Excluding associated after-care.

Procedure report to include documentation of how the indication requirements of this descriptor were met.

Claimable:
(a) once in any 3 month period unless a new acute coronary syndrome or equivalent occurs within this period and meets the requirements of 1 or 2.; or
(b) for subsequent stages of an appropriately staged percutaneous coronary intervention service to which items 38307, 38308, 38310, 38316, 38317 or 38319 applies.

Not being a service associated with a service to which items 38200, 38203, 38206, 38244, 38247, 38248, 38249, 38251, 38252, 38307, 3808, 38310, 38311, 38313, 38314, 38316, 38319, 38320, 38322 or 38323 apply.

The item number claimed should reflect the number of coronary vascular territories (Left Anterior Descending, Circumflex or Right Coronary Artery distribution) that are stented during the procedure, not the total number of stented territories the patient has received to date.

(Anaes.) (Assist.)

38319
Invasive coronary angiography and percutaneous angioplasty or transluminal insertion of stent(s), when invasive coronary angiography has been completed in the previous 3 months, in three coronary vascular territories (Left Anterior Descending, Circumflex or Right Coronary Artery distribution) for the treatment of a patient with:
1. An acute coronary syndrome evidenced by:
(i) ST segment elevation (or new left bundle branch block); or
(ii) troponin elevation above the local upper reference limit; or
(iii) resting wall motion abnormality or perfusion defect; or
(iv) cardiogenic shock, resuscitated cardiac arrest, ventricular fibrillation or sustained ventricular tachycardia; or
2. Unstable angina or angina equivalent with a crescendo pattern or rest pain or high-risk clinical or angiographic features (see Explanatory notes); or
3. Significant left main coronary artery disease (>50% stenosis or cross-sectional area <6 mm^2) or severe proximal left anterior descending coronary artery disease (>70% stenosis or cross-sectional area <4 mm^2 before the first major diagonal branch) detected on computed tomography coronary angiography.

Including any associated balloon dilatation and angiography (imaging, catheter & contrast).

Excluding associated after-care.

Procedure report to include documentation of how the indication requirements of this descriptor were met.

Claimable:
(a) once in any 3 month period unless a new acute coronary syndrome or equivalent occurs within this period and meets the requirements of 1 or 2.; or
(b) for subsequent stages of an appropriately staged percutaneous coronary intervention service to which items 38307, 38308, 38310, 38316, 38317 or 38319 applies.

Not being a service associated with a service to which items 38200, 38203, 38206, 38244, 38247, 38248, 38249, 38251, 38252, 38307, 38308, 38310, 38311, 38313, 38314, 38316, 38317, 38320, 38322 or 38323 apply.

The item number claimed should reflect the number of coronary vascular territories (Left Anterior Descending, Circumflex or Right Coronary Artery distribution) that are stented during the procedure, not the total number of stented territories the patient has received to date.

(Anaes.) (Assist.)

38320

Invasive coronary angiography and percutaneous angioplasty or transluminal insertion of stent(s), when invasive coronary angiography has been completed in the previous 3 months, in a single coronary vascular territory (Left Anterior Descending Artery, Circumflex Artery or Right Coronary Artery distribution) in a patient satisfying the following criteria:
1. A Heart Team Conference* has recommended the intervention; or
2. Both of the following conditions are met:
(a) The patient has:
(i) limiting angina or angina equivalent (Canadian Cardiovascular Society class II-IV) despite an adequate trial of optimal medical therapy; or
(ii) myocardial ischaemia demonstrated on functional imaging; or
(iii) Stress electrocardiogram testing with high risk features (ST segment elevation or sustained ST depression, hypotension, Duke treadmill score <= -11); and
(b) fulfils at least one of the following conditions in the vascular territory treated:
i. A stenosis >70%; or
ii. A Fractional Flow Reserve (FFR) or Instantaneous wave-free ratio (iFR) distal to the lesions that is ≤0.80 or ≤0.89, respectively.

Only claimable in patients with triple vessel disease where they meet the indication requirements for item 38314

Including any associated balloon dilatation, including associated angiography.

Excluding associated after-care.

Requires documentation in the procedure report of how the indication requirements of this descriptor were met for each territory treated.

Claimable for subsequent stages of an appropriately staged percutaneous coronary intervention service to which items 38311, 38313, 38314, 38320, 38322 or 38323 applies. Staging of percutaneous coronary intervention is permissible up 3 months preceding the initial stage.

Not being a service associated with a service to which items 38200, 38203, 38206, 38244, 38247, 38248, 38249, 38251, 38252, 38307, 38308, 38310, 38311, 38313, 38314, 38316, 38317, 38319, 38322 or 38323 apply.

(Anaes.) (Assist.)

38322

Invasive coronary angiography and percutaneous angioplasty or transluminal insertion of stents, when invasive coronary angiography has been completed in the previous 3 months, in any two coronary vascular territories (Left Anterior Descending Artery, Circumflex Artery or Right Coronary Artery distribution) in a patient satisfying the following criteria:
1. A Heart Team Conference has recommended the intervention; or
2. Both of the following conditions are met:
(a) The patient has:
(i) limiting angina or angina equivalent (Canadian Cardiovascular Society class II-IV) despite an adequate trial of optimal medical therapy; or
(ii) myocardial ischaemia demonstrated on functional imaging; or
(iii) Stress electrocardiogram testing with high risk features (ST segment elevation or sustained ST depression, hypotension, Duke treadmill score <= -11); and
(b) fulfils at least one of the following conditions in the vascular territory treated:
i. A stenosis >70%; or
ii. A Fractional Flow Reserve (FFR) or Instantaneous wave-free ratio (iFR) distal to the lesions that is ≤0.80 or ≤0.89, respectively; or
3. For subsequent stages of an appropriately staged acute coronary syndrome percutaneous coronary intervention

Including any associated balloon dilatation, including associated angiography.

Excluding associated after-care.

Requires documentation in the procedure report of how the indication requirements of this descriptor were met for each territory treated.

Only claimable in patients with triple vessel disease where they meet the indication requirements for item 38314.

Claimable for subsequent stages of an appropriately staged percutaneous coronary intervention service to which items 38311, 38313, 38314, 38320, 38322 or 38323 applies. Staging of percutaneous coronary intervention is permissible up 3 months preceding the initial stage.

Not being a service associated with a service to which items 38200, 38203, 38206, 38244, 38247, 38248, 38249, 38251, 38252, 38307, 38308, 38310, 38311, 38313, 38314, 38316, 38317, 38319, 38320 or 38323 apply.

(Anaes.) (Assist.)

38323

Invasive coronary angiography and percutaneous angioplasty or transluminal insertion of stents, when invasive coronary angiography has been completed in the previous 3 months, in all three coronary vascular territories (Left Anterior Descending Artery, Circumflex Artery or Right Coronary Artery distribution) in a patient satisfying the following criteria:
1. A Heart Team Conference has recommended the intervention; or
2. Has limiting angina or angina equivalent (Canadian Cardiovascular Society class II-IV) despite an adequate trial of optimal medical therapy, or where myocardial ischaemia is demonstrated on functional imaging or Stress electrocardiogram testing with high risk features (ST segment elevation or sustained ST depression, hypotension, Duke treadmill score <= -11) and where both of the following conditions are met:
(a) each vascular territory treated has:
i. A stenosis >70%; or
ii. A Fractional Flow Reserve or Instantaneous wave-free ratio distal to the lesions that is ≤0.80 or ≤0.89, respectively; AND
(b) The patient does not have diabetes mellitus and the multi-vessel coronary artery disease is non-complex and does not involve any of the following:
i. A stenosis >50% in the left main coronary artery; or
ii. Bifurcation lesions involving side branches with a diameter >2.75mm; or

iii. Chronic vessel occlusions (>3 months); or
iv. Severely angulated or severely calcified lesions; or
v. SYNTAX score >23; or
3. The patient expresses a preference for catheter-based intervention, even when objective assessment indicates surgery would be preferable as per the criteria outlined in this descriptor.

Including any associated balloon dilatation, including associated angiography.

Excluding associated after-care.

Requires documentation in the procedure report of how the indication requirements of this descriptor were met for each territory treated.

Claimable for subsequent stages of an appropriately staged percutaneous coronary intervention service to which items 38311, 38313, 38314, 38320, 38322 or 38323 applies. Staging of percutaneous coronary intervention is permissible up 3 months preceding the initial stage.

Not being a service associated with a service to which items 38200, 38203, 38206, 38244, 38247, 38248, 38249, 38251, 38252, 38307, 38308, 38310, 38311, 38313, 38314, 38316, 38317, 38319, 38320 or 38322 apply.

(Anaes.) (Assist.)

* Recommendation 13.2 Δ Items 38300, 38312, 38315 and 38318 should be considered obsolete and removed from the MBS.

Under the recommended changes to the MBS items for PCI, the procedure will only be claimable for the arteries where there is evidence of ischaemia. PCI will be paid for each coronary vascular territory (Left Anterior Descending Artery, Circumflex Artery or Right Coronary Artery distribution)), not for each stent inserted. Patients should be more likely to only receive this procedure if there is evidence that a blood vessel is causing symptoms or heart problems, in line with best-practice guidelines. This change would mean that patients receive fewer unnecessary stents. These changes should mean that if a doctor chooses one long stent for their patient instead of two short stents, the MBS rebate does not change. Ensuring that doctors can decide what is best for their patient (Report from the Cardiac Services Clinical Committee).

The changes to the MBS items for percutaneous coronary intervention (PCI) also known as 'stenting' or 'angioplasty' is to:

- To align the items with best-practice guidelines to ensure that PCI is only performed on patients where stenting is their best treatment option based on their individual symptoms and condition.
- Some patients were receiving stents that they did not need, which may not have led to better outcomes. Stents have some risks and should not be put in when they are not needed. These changes encourage best-practice of only treating vessels where there is evidence that there is a blockage which is affecting blood flow to the heart.
- There were financial implications for the number of stents used to treat a vessel and this is not a helpful incentive so these changes remove that incentive by making the same fee for whatever number and length of stents are used to treat each vessel.

In summary, the use of the term 'high risk' to describe the patient population is confusing and conflicts with other definitions already in use. In response to questions to the applicant, they stated that the proposed definition of high-risk lesion anatomy is consistent with numerous RCTs and acknowledge the complexity of coronary lesions determines the clinical outcomes after PCI. They further stated that, "the proposed definition is an anatomical definition of high risk, where the identified lesion anatomies are associated with poorer clinical outcomes if IVUS is not used for stent optimisation". As noted by the applicant, they are willing to remove the nomenclature 'high-risk' for Option Two as this was used only for descriptive purposes and it is not included in the proposed item descriptor. The decision to use IVUS is driven by lesion anatomy and its complexity.

PASC noted that the proposed options will need to agree with the populations for the new MBS items, bundled coronary angiography with percutaneous angioplasty or transluminal insertion of stent(s) that are coming in July 2021 (see the Section: Proposed Item Descriptor).

The applicant has indicated that they are willing to amend the item descriptors to reflect new MBS items.

Utilisation data

The following tables present recent utilisation data of hospital procedures specific to PCI and coronary stenting (Table 4), MBS data for coronary artery procedures (Table 5) and MBS data for PCI (Table 6).

Table 4: Hospital Procedures 2018-19 specific to PCI and coronary stenting (public and private hospitals) Australia

0667-0681 Coronary Arteries	Summary	Individual procedure counts
0668 Coronary angiography	156929	
-38215-00 Coronary angiography		32429
-38218-00 Coronary angiography with left heart catheterisation		109550
-38218-01 Coronary angiography with right heart catheterisation		1470
-38218-02 Coronary angiography with left and right heart catheterisation		4528
-38241-00 Coronary artery blood flow measurement		8952
0671 Transluminal coronary angioplasty with stenting	46205	
-38306-00 Percutaneous insertion of 1 transluminal stent into single coronary artery		30919
-38306-01 Percutaneous insertion of >= 2 transluminal stents into single coronary artery		8713
-38306-02 Percutaneous insertion of >= 2 transluminal stents into multiple coronary arteries		6538
-38306-03 Open insertion of 1 transluminal stent into single coronary artery		25
n.p		10

Source: AIHW data cubes 2018-19

Table 5: MBS data for coronary artery procedures

MBS item	Fee	Statistics (calendar year) 2020
Coronary angiogram		
38246 SELECTIVE CORONARY ANGIOGRAPHY, placement of catheters and injection of opaque material with right or left heart catheterisation or both, or aortography followed by placement of catheters prior to any coronary interventional procedure, not being a service associated with a service to which item 38215, 38218, 38220, 38222, 38225, 38228, 38231, 38234, 38237, 38240 or 38243 applies (Anaes.)	$914.90	17,934
38243 PLACEMENT OF CATHETER(S) and injection of opaque material into any coronary vessel(s) or graft(s) prior to any coronary interventional procedure, not being a service associated with a service to which item 38246 applies (Anaes.)	$457.45	6,893
38215 SELECTIVE CORONARY ANGIOGRAPHY, placement of catheters and injection of opaque material into the native coronary arteries, not being a service associated with a service to which item 38218, 38220, 38222, 38225, 38228, 38231, 38234, 38237, 38240 or 38246 applies	$366.00	7,242

TN 8.52 Notes Each item in the range 38215-38240 describes an episode of service. As such, only one item in this range can be claimed in a single episode. Item 38243 may be billed once only immediately prior to any coronary interventional procedure, including situations where a second operator performs any coronary interventional procedure after diagnostic angiography by the first operator. Item 38246 may be billed when the same operator performs diagnostic coronary angiography and then proceeds directly with any coronary interventional procedure during the same occasion of service. Consequently, it may not be billed in conjunction with items 38215, 38218, 38220, 38222, 38225, 38228, 38231, 38234, 38237, 38240 or 38243. In the event that the same operator performed any coronary interventional procedure immediately after the diagnostic procedure described by item 38231, 38237 or 38240, that item may be billed as an alternative to item 38246. Items in the range 38215 - 38246 cannot be claimed for any intravascular ultrasound (IVUS) procedure therefore Medicare Benefits are not payable for IVUS.

Table 6: Number of services for MBS items in the calendar years of 2018, 2019 and 2020

PCI with stenting	Fee	2018	2019	2020
38306 Transluminal insertion of stent or stents into one occlusional site, including associated balloon dilatation of coronary artery, percutaneous or by open exposure, excluding associated radiological services, radiological preparation and after-care TN 8.62	$786.15	28,375	29,982	28,994
38312 PERCUTANEOUS TRANSLUMINAL ROTATIONAL ATHERECTOMY of 1 coronary artery, including balloon angioplasty with insertion of 1 or more stents, where: - no lesion of the coronary artery has been stented; and - each lesion of the coronary artery is complex and heavily calcified; and - balloon angioplasty with or without stenting is not suitable; Excluding associated radiological services or preparation, and excluding aftercare TN 8.41	$1,167.70	388	537	572
38318 PERCUTANEOUS TRANSLUMINAL ROTATIONAL ATHERECTOMY of more than 1 coronary artery, including balloon angioplasty, with insertion of 1 or more stents, where: - no lesion of the coronary arteries has been stented; and - each lesion of the coronary arteries is complex and heavily calcified; and - balloon angioplasty with or without stenting is not suitable, Excluding associated radiological services or preparation, and excluding aftercare TN 8.41	$1,635.95	80	95	102

TN 8.41 A coronary artery lesion is considered to be complex when the lesion is a chronic total occlusion, located at an ostial site, angulated, tortuous or greater than 1cm in length. Percutaneous transluminal coronary rotational atherectomy is suitable for revascularisation of complex and heavily calcified coronary artery stenoses in patients for whom coronary artery bypass graft surgery is contraindicated.

TN 8.62 Item 38306 should only be billed once per occlusional site. It is not appropriate to bill item 38306 multiple times for the insertion of more than one stent at the same occlusional site in the same artery. However, it would be appropriate to claim this item multiple times for insertion of stents into the same artery at different occlusional sites or into another artery or occlusional site. It is expected that the practitioner will note the details of the artery or site into which the stents were placed, in order for the Department of Human Services to process the claims

Based on the current statistics for Medicare Item 38306, the maximum population for IVUS would be approximately 29,000 patients (in 2019, 12,353 patients had PCI in Victoria, 43% in the private system-5,312). It was reported on behalf of the Victorian Cardiac Outcomes Registry (VCOR) that overall, left main lesion accounted for 2% of patients undergoing PCI, and long lesions for 4% (Lefkovits 2019[7]).

In Victoria, just under half the PCI cases in 2019 presented with ACS, with the majority (76%) treated in public hospitals (14 public and 18 private hospitals). The majority of patients undergoing PCI were male (76%) and the mean age was 67 years. Patients treated in private hospitals were six years older on average than public patients. For patients with stable (non-ACS) 67% had symptoms of stable angina. A high-grade stenosis was recorded in 91% and a positive function test in 60%. A total of 89% of non-ACS patients had at least two of these three key clinical factors. Particular lesion subsets, including unprotected left main cases (2%), chronic total occlusion (3.8%) and in-stent restenosis (4.4%) were performed in similar numbers to previous years. DES accounted for 99% of all stents implanted. Re-stent stenosis accounted for 5.6% of cases in private hospitals. Stents were implanted

in 93.5% of PCI cases with the majority (66%) receiving a single stent. The average summed total length of stents deployed per case for hospitals ranged between 15-34mm. The overall median total stent length per case was 23mm. IVUS use was reported in 1.6% of cases (Lefkovits 2020). Table 7 summarises the in-hospital mortality rates for selected clinical presentation 2014-2019, Victoria reported in Lefkovits (2020).

Table 7: In hospital mortality rates for selected clinical presentation 2014-2019, Victoria

	2014 (N=8329)	2015 (N=9230)	2016 (N=10036)	2017 (N=11002)	2018 (N=12447)	2019 (N=12353)
Patient category	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
All PCI patients	174 (2.1)	155 (1.7)	193 (1.9)	204 (1.9)	174 (1.4)	212 (1.7)
STEMI	140 (7.6)	113 (5.7)	138 (6.4)	145 (6.4)	119 (4.7)	148 (6.2)
Shock and/or intubated Out-of-Hospital Cardiac Arrest (OHCA)	107 (44.8)	102 (40.3)	119 (38.5)	133 (42.9)	115 (35.1)	137 (42.8)
Non-ST Elevation Acute Coronary Syndrome (NSTE-ACS)	16 (0.6)	25 (0.9)	29 (0.9)	34 (1.0)	29 (0.8)	27 (0.8)
Non-ACS	18 (0.5)	17 (0.4)	26 (0.6)	25 (0.5)	26 (0.4)	37 (0.6)

Source: Lefkovits 2020, Table 18

Rationale

The application stated that there was uncertainty with respect to the correct patient population, thus proposing two options. The applicant convened an expert KOL panel in August 2020; KOL feedback indicated that the MSAC proposed criteria in the MSAC 1354 application would capture the vast majority of their current patient cohort with some notable exceptions. KOLs advised the high-risk definition previously proposed by MSAC [in application 1354] would be more suitable for a diagnostic rather than therapeutic use of IVUS. The KOL preferred indication for therapeutic use would include characteristics with an objective and measurable definition (e.g., lesion length ≥28mm and lesions associated with the left main coronary artery).

KOLs also noted that there is now published randomised evidence covering a broader population (through the ULTIMATE trial (Zhang 2018) and a narrower population relative to the MSAC definition included in the Public Summary Document (noted above in Table 1). Based on this, the KOL panel recommended the two patient populations outlined above.

A recent meta-analysis reported by Elgendy (2020[8]) included 10 randomised controlled trials comparing IVUS-guided PCI versus angiography-guided PCI for DES implantation. Elgendy (2020) described the trials as evaluating "the effect of IVUS on complex lesions (e.g., long lesions, chronic total occlusion, left main disease), except for the ULTIMATE trial, which enrolled all-comers." See Table 12 for details of the included trials.

Figure 2 presents the results of the meta-analyses reported in Elgendy (2020). Notably, no single trial reported statistically significant differences between IVUS and angiography for any outcome, with the exception of the IVUS-XPL trial for target lesion revascularisation and the AIR-CTO trial for definitive/probable stent thrombosis. However, the meta-analyses including all trials reported statistically significantly better outcomes with IVUS compared with angiography alone for

cardiovascular mortality, myocardial infarction, target lesion revascularisation and definitive/probable stent thrombosis.

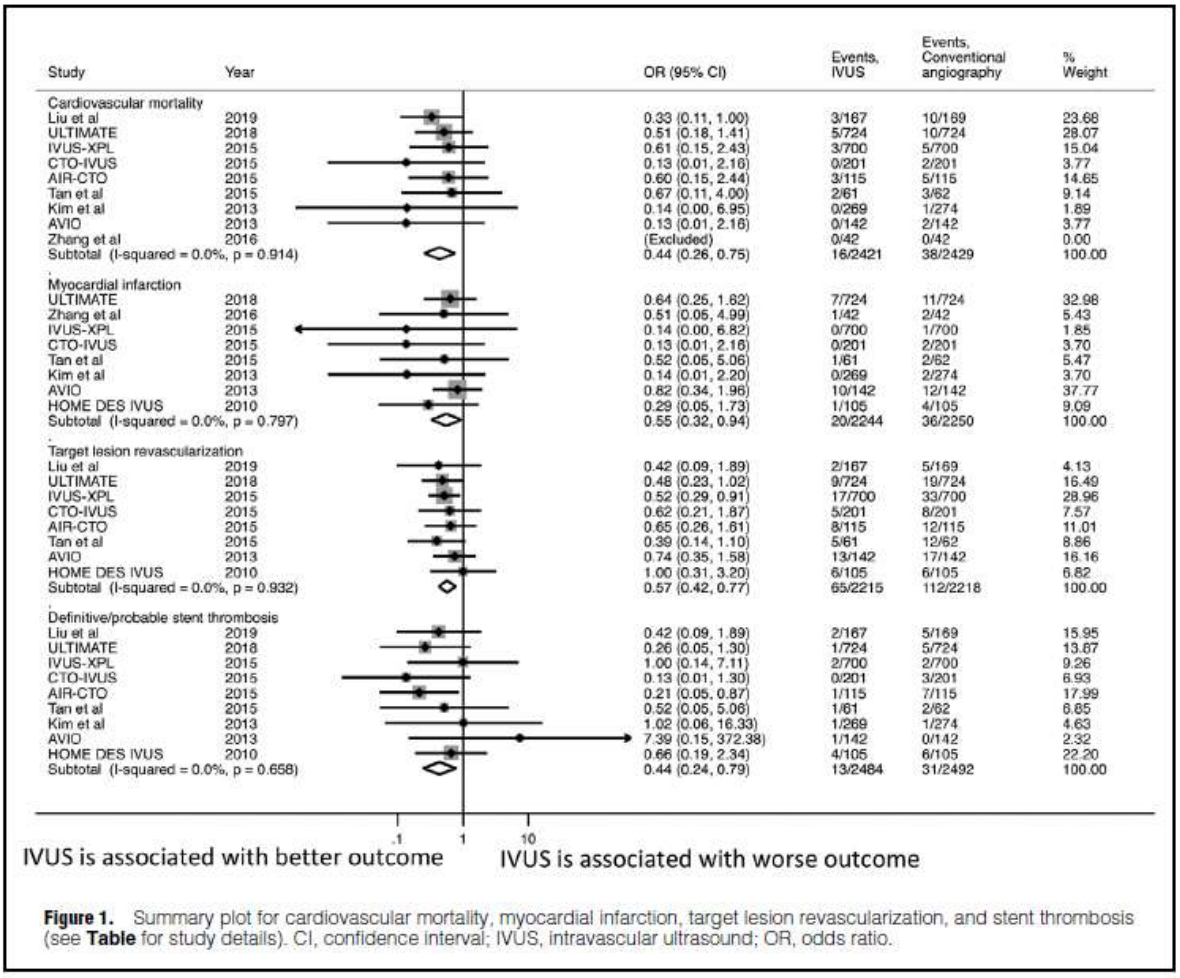

Figure 1. Summary plot for cardiovascular mortality, myocardial infarction, target lesion revascularization, and stent thrombosis (see **Table** for study details). CI, confidence interval; IVUS, intravascular ultrasound; OR, odds ratio.

Figure 2: Results of the meta-analysis reported by Elgendy (2020)

Source: Figure 1, p1411 Elgendy (2020)

The applicant noted that they intend to provide evidence and cost-effectiveness assessments for both populations as options for reimbursement of IVUS by MSAC.

Prior test

This is a patient population that will require significant prior cardiac function testing and disease status to be eligible for invasive coronary angiogram and percutaneous angioplasty or transluminal stent(s). This testing will determine the presence of left coronary artery disease, and/or significant stenoses (≥50%) of the left main coronary artery, including in cases of unprotected left-main disease; or lesion length ≥28mm to be eligible for IVUS as an adjunct to the procedure.

Intervention

The intervention is intravascular ultrasound (IVUS)-guided coronary stent insertion for patients undergoing percutaneous coronary intervention. The intervention has a diagnostic and therapeutic purpose, but this application only focuses on the therapeutic use of IVUS for coronary stent insertion for patients undergoing PCI. The intervention is for IVUS guided drug-eluting stent (DES). IVUS will be used as an adjunct to invasive coronary angiography and percutaneous angioplasty or transluminal insertion of stent(s) (i.e. angiographic + IVUS guided coronary stent insertion).

PASC noted that the application is only requesting funding of IVUS as an adjunct for guiding therapeutic PCI and not as a diagnostic tool (although there is potential for IVUS to be used diagnostically during therapeutic procedures).

IVUS is the generic name for any ultrasound technology that provides tomographic, 3-dimensional 360-degree images from inside the lumen of a blood vessel. It will be performed simultaneously to coronary angioplasty, although not necessarily at the same time. The exception, it is proposed in the application, will be for patients with renal impairment or for other conditions, for whom the use of contrast dyes is contraindicated. IVUS can be used alone in this patient population, however, the applicant has advised this subgroup are not included in this application.

The following description of the intervention is from the prior Final Protocol for MSAC 1354.

An IVUS system consists of an imaging catheter, a mini-transducer connected at the tip of the catheter (Figure 3), and a console. Ultrasound transducers generate, transmit and receive sound of an appropriate frequency and pulse rate. Sound is then processed by an ultrasound processor to generate on-screen. The catheter delivers the transducer at the narrowed coronary vessel (Figure 4). The transducer may be mechanical, consisting of a single rotating transducer driven by a flexible drive cable, or it may be electronic, where the scanning is performed using an array of multiple transducing crystals (Figure 4).

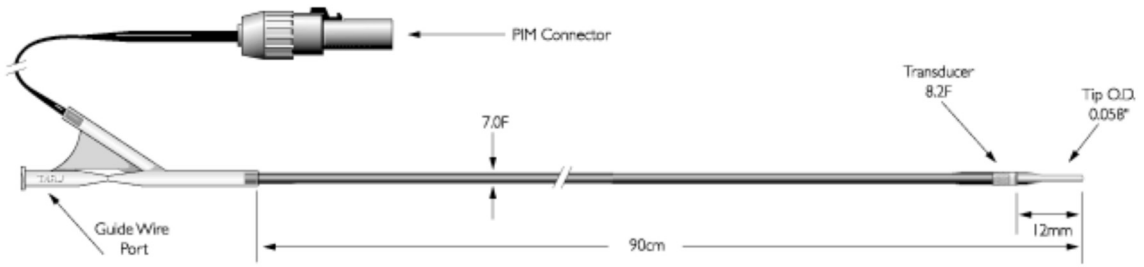

Figure 3: Intravascular ultrasound imaging catheter

Source: Medical Advisory Secretariat Ontario 2006[9]

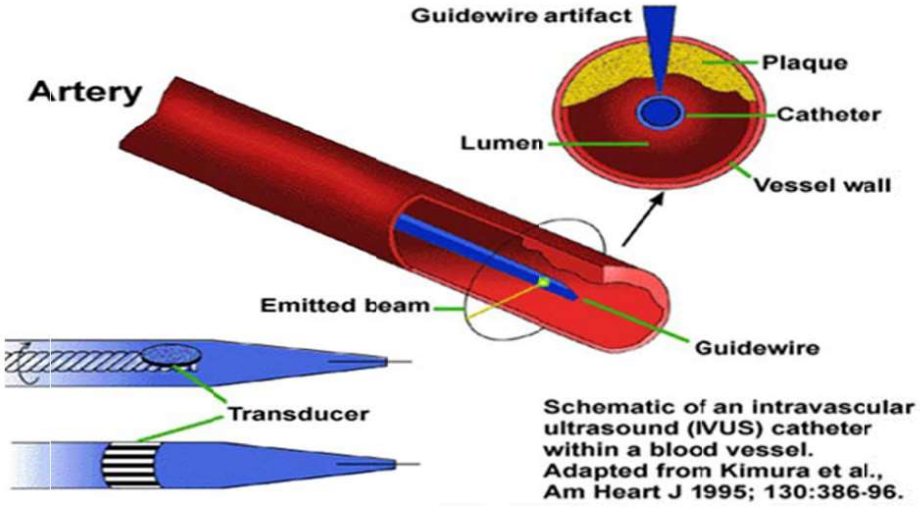

Figure 4: Schematic of an intravascular ultrasound catheter within a blood vessel
Source: Medical Advisory Secretariat Ontario

The transducer produces high frequency sound waves. Structures such as blood, tissues, and plaques in the artery reflect sound waves differently because of differences in density. The reflected ultrasound waves are processed electronically to reconstruct black and white images that are displayed and recorded on the console. These images are interpreted to obtain information about lumen dimensions, plaque structure, extent and composition, presence of dissection, plaque rupture and thrombus, and to determine lumen area. This may provide physicians with a better understanding of atherosclerotic vessels to determine appropriate treatment strategy, stent selection and placement, and adequate deployment to restore blood flow.

Complications of PCI

In-stent restenosis and stent thrombosis are two major complications limiting the benefits of PCI. The emergence of drug-eluting stents has considerably reduced the occurrence of in-stent thrombosis, stent thrombosis—which is associated with high incidences of fatal and nonfatal myocardial infarction (MI)—remains an unsolved problem (Lee 2012[10]). It is reported that late stent thrombosis occurs more frequently following drug-eluting stent than bare metal stent implantation (Stone 2007[11]).

Stand-alone x-ray angiography is the traditional imaging method guiding PCI and is still used in the majority of the procedures. Coronary angiography depicts vessel images that are simple to comprehend, making PCI procedures easy to perform. However, stand-alone angiographic guidance has some inherent inadequacies and limitations which can result in suboptimal procedural outcomes, as well as acute and long-term complications.

- Angiography merely produces a planar silhouette of the contrast-filled lumen. The severity of the lesion can vary widely with different x-ray projection angles.
- Visual interpretation of angiography exhibits significant interobserver variability and correlates poorly with post-mortem examination.

- Coronary angiography is essentially a "lumenography", which provides no insight to the amount, tissue composition, distribution of coronary plaque, as well as coronary remodelling pattern.
- After coronary stent implantation, angiography has limited ability to assess the adequacy of stent expansion and stent strut apposition.

IVUS provides tomographic views of coronary arteries and quantitative measurements of various vascular parameters that cannot be obtained by angiography. There are several potential utilisations of IVUS when a coronary stenosis is detected by angiography. Once committed for PCI (which is the relevant population for this PICO), IVUS assists in procedural strategy and device selection. It was reported, in a single-centre study, 40% of the original revascularisation strategies planned were changed after preintervention IVUS imaging of the target lesion (Mintz 1994[12]). Following stent implantation, IVUS play a crucial role in optimising the procedural outcomes, through assessment on adequacy of stent expansion, completeness of stent strut apposition, and presence of unrecognised dissection or residual stenosis, which in turn determines the risk of future complications.

Table 8 lists IVUS parameters that have been reported to be relevant to the pathogenesis of stent thrombosis and in-stent restenosis.

Table 8: IVUS parameters that have been reported to be relevant to the pathogenesis of stent thrombosis and in-stent restenosis

	Quantitative	Assessment	Qualitative	Assessment
	Aims	**Parameters**	**Aims**	**Parameters**
Preintervention	Functional significance of lesions	Minimal lumen area, plaque burden, lesion length	Plaque composition	Calcification, thrombosis
	Selection of appropriate stent size	Diameter of proximal and distal reference segment lumen		
Postintervention	Assessment of stent expansion	Minimal stent area, reference segment (using either proximal, distal, or average of proximal and distal) lumen area	Assessment of stent apposition	Completeness of stent struts apposition
	Residual disease	Residual edge plaque burden	Dissection	Presence or absence of stent edge dissection

Source: Lee 2012 (Table 1)

In response to a question to the applicant that the ULTIMATE trial reported on a change in clinical management as a result of the use of IVUS, and whether IVUS combines a diagnostic alongside its therapeutic use the clinical expert stated that:

> "The therapeutic use of IVUS to optimise stent insertion during PCI does not represent a diagnosis in the true sense of the word, which relates to determining the extent or nature of the disease. IVUS has a pre-stent insertion diagnostic role to guide the procedure, but this is as part of the PCI procedure, rather than to perform a diagnosis. IVUS provides tomographic, 3-dimensional, 360-degree images from inside the lumen of a blood vessel. Compared to angiography, IVUS provides physicians with a better understanding of atherosclerotic vessels to determine appropriate treatment strategy in terms of appropriate stent selection (stent sizing), the need for calcium modification via atherectomy, and implantation (adequate stent apposition to the arterial wall), and adequate deployment to restore blood flow."

PASC advised that the intervention is the therapeutic use of IVUS associated with the services to which item 38306 applies (current MBS item for PCI), for optimisation of stent placement; although this item will become redundant with the introduction of the new MBS items (see Proposed item descriptor).

PASC agreed that the intervention is limited to the data that identifies the benefit of IVUS in guiding stenting, that is, better visualisation for stenting not for diagnostic purposes.

Rationale

The rationale for the use of IVUS, is that in-stent restenosis and stent thrombosis are two major complications which are associated with a high incidence of fatal and nonfatal myocardial infarction limiting the benefit of PCI. The use of IVUS is to optimise stent expansion during stent implantation.

Although, the use of DES has resulted in a reduced occurrence of in-stent restenosis, stent thrombosis, these remain serious complications. For this intervention, IVUS is to be used with DES and not with bare metal stents (BMS). Some of the evidence presented previously, MSAC 1354 included a meta-analysis (Parise 2011), for BMS, with inconsistent results. It is proposed that for this application IVUS will be used with DES alone, and only evidence of IVUS use with DES will be presented.

Comparator

The comparator is invasive coronary angiography and percutaneous angioplasty or transluminal insertion of stent(s) alone (i.e. angiographic alone guided coronary stent insertion).

PASC agreed the nominated comparator was appropriate. PASC noted that the comparator will also need to agree with the new MBS items which includes in its description wording that stenting will not always occur as planned: refers to "OR transluminal insertion of stent(s) after percutaneous angioplasty". PASC also noted the applicant's advice that there is a 96% success rate for successful stenting, so 4% of stenting procedures are unsuccessful (see Outcomes).

Coronary angiography is an established procedure and is considered the gold standard for diagnosis of IHD. It provides key information about coronary lesions, allowing clinicians to decide on best management strategies from medical therapy, angioplasty, stenting or coronary artery bypass grafting (CABG). Angiography is also the most commonly used imaging modality to guide percutaneous coronary procedures such as stenting. Angiography involves the insertion of a catheter to administer a contrast agent selectively into the coronary arteries to locate any lesions, assess left ventricular function, and to measure haemodynamic pressures. X-ray monitors the flow of the contrast agent through the arteries. It is a two-dimensional imaging technique, which depicts the cross-sectional coronary anatomy as a planar silhouette of the contrast-filled vessel lumen. Images may be interpreted using direct visual assessment of lesions or by quantitative assessment using computer software. Images of the coronary vasculature depict any narrowing or lesions. Table 9 presents the MBS item descriptor for the comparator, angiography.

The MBS currently has separate MBS items for invasive coronary angiography and percutaneous angioplasty or transluminal insertion of stent(s). These items are presented below.

Table 9: MBS items for comparator

Category 3 – THERAPEUTIC PROCEDURES
item 38246 SELECTIVE CORONARY ANGIOGRAPHY, placement of catheters and injection of opaque material with right or left heart catheterisation or both, or aortography followed by placement of catheters prior to any coronary interventional procedure, not being a service associated with a service to which item 38215, 38218, 38220, 38222, 38225, 38228, 38231, 38234, 38237, 38240 or 38243 applies (Anaes.) Multiple Operation Rule
Fee: $914.90 Benefit: 75% = $686.20 85% = $830.20 (See para TN.8.52 of explanatory notes to this Category)
Category 3 – THERAPEUTIC PROCEDURES
Item 38306 Transluminal insertion of stent or stents into one occlusional site, including associated balloon dilatation of coronary artery, percutaneous or by open exposure, excluding associated radiological services, radiological preparation and after-care Multiple Operation Rule (Anaes.) (Assist.)
Fee: $786.15 Benefit: 75% = $589.65 85% = $701.45 (See para TN.8.62 of explanatory notes to this Category)

Note: These MBS item will change

Rationale

Two MBS items are included in the comparator, the first 38246, allows for the radiological preparation of the arteries, the injection of opaque material prior to the insertion of the stents and the second item, 38306, is the item for the transluminal insertion of stent/s. They are the currently used items for this procedure. Item 38306 is the item that IVUS proposes to be used as an adjunct. Item 38246 is not an item that is used for diagnostic purposes. New MBS items have been proposed for both coronary angiogram and for PCI in the future (July 2021).

Outcomes

The following outcomes are proposed:

Safety Outcomes:

Per application 1354, any adverse events or complications that occur as a result of the use of the intervention will be considered a safety concern. These include untoward medical conditions that result in mortality; are considered life-threatening; require hospitalisation; prolong existing hospitalisation; or result in persistent or significant disability. For example,

- in-hospital mortality
- in-hospital major bleeding
- length of stay
- 30-day rehospitalisation
- worsening renal impairment
- in-hospital unplanned revascularisation.

Clinical Effectiveness Outcomes:

Primary

Immediate

- Proportion proceeding with stent

The following outcomes should then be reported for those who do, and do not have a successful stent insertion. *PASC noted the applicant's advice that failure of stents is uncommon (96% success rate), and the use of IVUS doesn't increase the proportion of stents that are successfully placed, rather more optimises stent insertion (e.g. calcification identification/removal and stent sizing). PASC agreed this outcome (Proportion with successful stent insertion) can be removed from the PICO, providing there is published evidence to support the statement. PASC also noted the proportion proceeding with stent may be a relevant outcome.*

30-day follow-up

- 30-day risk-adjusted mortality
- Myocardial Infarction (target vessel, periprocedural, spontaneous)
- Clinically driven target vessel revascularisation (TVR) (target-lesion revascularisation (TLR))
- Stroke
- Definite or probable stent thrombosis

At 1-year follow up

- Target vessel failure
- Cardiac death
- Target-vessel MI, spontaneous MI
- Clinically driven TVR (TLR)
- Coronary artery by-pass grafting
- Target-lesion failure
- Definite or probable stent thrombosis
- Stroke

Longer term outcomes

- Late stent thrombosis
- Myocardial infarction
- Survival

The application has nominated cardiac mortality, myocardial infarction, target lesion revascularisation and definitive/probable stent thrombosis. This is consistent with the outcomes reported in the Elgendy (2020) meta-analyses.

The nominated clinical effectiveness outcomes differ to those in MSAC 1354:

- Primary: Late stent thrombosis/restenosis.
- Secondary: health-related quality of life (HRQoL), survival, major adverse cardiovascular events (MACE), target lesion/vessel revascularisation.

The outcomes suggested by the application are reasonable, however including data on HRQoL, overall survival and MACE would be valuable. These are outcomes reported by the Victorian Cardiac Outcomes Registry.

PASC noted that MACE is differentially defined in studies, and there is a need to be careful with what is being compared.

Angiographic and Procedural comparative outcomes:

- Complete revascularisation
- Angiographic success

Rationale

The outcomes selected reflect the likely safety concerns of using IVUS which will result in a longer procedure time and may increase the contrast dye burden. Outcomes selected reflect short term safety outcomes from the surgery to the medium to longer term. Outcomes measure the procedure's success over the short term and longer term. If IVUS results in better stent selection, successful insertion rate, and improved myocardial revascularisation this should be reflected in improved cardiac function, a reduction in cardiac events over the medium to longer follow-up. Follow-up will need to be of a sufficient duration to be able to detect whether there is any difference in the rate of some of the rarer cardiac events.

Current clinical management algorithm for identified population

The current and proposed clinical management algorithms included in the application are provided below (Figure 6 and Figure 7 in Attachment 1, respectively). The clinical management algorithms presented in the application needed to be reworked to better identify the population targeted by IVUS. For example, the population that was labelled low/medium risk was based on a trial that was for all-comers therefore only 33% could be identified as low/medium risk and the population labelled 'high-risk' are only a subgroup of patients previously identified as 'high-risk' patients in the Final Protocol for 1354. Additionally, the current clinical management algorithm and the proposed clinical management algorithm will need to include likely changes to the clinical management of patients as a result of the new MBS items (July 2021) for both coronary angiogram and for PCI.

Changes to the proposed clinical management algorithm were made by the applicant, see Figure 5. Option One has removed reference to risk and the patients included are 'all-comers' who require PCI/stenting as an elective, *ad hoc* or emergency procedure. Option Two has removed the reference to 'high-risk' for these patients who are now described in measurable and objective terms.

PASC confirmed that the proposed clinical management algorithm for the two options provided in the applicant response to the PICO was appropriate, and aligned with the agreed population options (see Intervention). PASC noted the applicant would also need to provide an updated current clinical management algorithm.

Proposed clinical management algorithm for identified population

The applicant provided a new proposed clinical management algorithm that addresses the concerns raised by PASC and clearly presents the two Options (Figure 5).

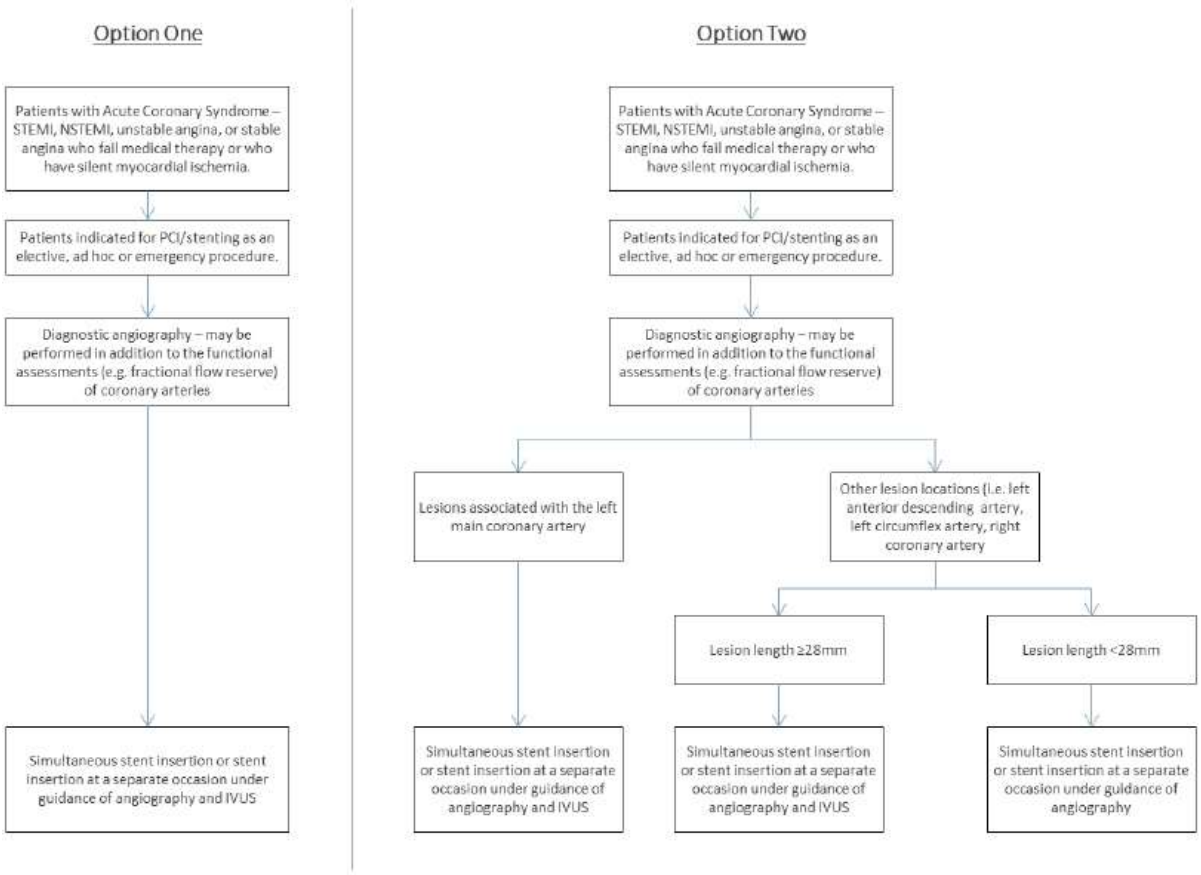

Figure 5: Proposed clinical management algorithm for the identified options (revised)

Proposed economic evaluation

The clinical claim is that use of IVUS to guide PCI with coronary stents insertion is expected to enhance post-procedure clinical outcomes. The intervention is expected to be superior in terms of effectiveness, and non-inferior in terms of safety compared to guidance with angiography without IVUS.

PASC noted the clinical claim.

A cost-effectiveness analysis (preferably a cost-utility analysis) would be appropriate based on the clinical claim.

The clinical claim remains unchanged from the published protocol for MSAC 1354.

Proposed item descriptor

The application proposed two MBS item numbers for reimbursement, one each for the two proposed populations (i) all patients undergoing PCI (Table 10) and (ii) the narrower population undergoing PCI (Table 11).

Table 10: Option one - patients undergoing PCI who have had a coronary lesion eligible for DES implantation

Category 3-THERAPEUTIC PROCEDURES
MBS XXXX Therapeutic use of Intravascular Ultrasound (IVUS) associated with the service to which item 38306 applies, for optimisation of stent placement in coronary vessels with significant stenoses (≥50% as defined on IVUS) Multiple Service Rule (Anaes.) Fee: $484.35 Benefit 75% = $383.30 85%=411.70 [Relevant explanatory notes] Fee only payable when the service is provided in associated with insertion of coronary stent/s (item 38306)

Issues identified with the proposed MBS item descriptor for the population defined as Option One:

- The population does not accord with the first patient population option defined in the application as a broad population (including low/medium risk). This population did not include the characteristic of significant stenoses (≥50% as defined on IVUS). It was a population that was to reflect the 'all comers' population included in the ULTIMATE trial (Zhang 2018).
- The requirement that the population be diagnosed using IVUS is inappropriate as IVUS is not available on the MBS for diagnostic purposes. The applicant subsequently indicated they are happy to amend the proposed item descriptor to read ">50% stenosis as defined by the diagnostic angiography".
- Given the new MBS items for invasive coronary angiogram and PCI with transluminal stents, the applicant may need to determine whether this population accords with the specific populations as now defined that can be reimbursed for PCI procedure.
- The use of item 38306 will be redundant with the introduction of the new MBS items for PCI, so this item will need to be rewritten.

PASC noted that the applicant's proposed item descriptors would need to be revised to address several issues: (i) remove the reference to item 38306; (ii) remove the reference to require IVUS to be used diagnostically; and (iii) agree with the new PCI item structure. To address (ii), PASC agreed the applicant could amend the proposed item descriptor to read ">50% stenosis as defined by the diagnostic angiogram".

Table 11: Option Two – narrower population undergoing PCI who have had a coronary lesion eligible for DES implantation

Category 3-THERAPEUTIC PROCEDURES
MBS XXXX Therapeutic use of Intravascular Ultrasound (IVUS) associated with the service to which item 38306 applies, for optimisation of stent placement in: either (a) Lesions with significant stenosis (≥50% as defined on IVUS) associated with the left main coronary artery, and/or where suitability of percutaneous coronary intervention has appropriately been determined by a Heart Team approach for significant stenoses (≥50% as defined on IVUS) of the left main coronary artery, including in cases of unprotected left-main disease; or (b) Coronary lesion length ≥28mm, as defined on IVUS Multiple Service Rule (Anaes.) Fee: $484.35 Benefit 75% = $383.30 85%=411.70 [Relevant explanatory notes] Fee only payable when the service is provided in associated with insertion of coronary stent/s (item 38306)

The population identified in Option Two accords with that described in the application but again has the circular reference to IVUS as a diagnostic tool to determine the extent of the coronary artery disease or the degree and type of coronary lesion. As for the above, the applicant subsequently indicated they are happy to amend the proposed item descriptor to read ">50% stenosis as defined by the diagnostic angiography". This should resolve the issue around the circular reference.

As noted in the application the proposed MBS item Fee for IVUS is based on MBS item 38241 (use of coronary pressure wire during selective coronary angiography to measure fractional flow reserve (FFR) and coronary flow reserve (CFR) in one or more intermediate coronary artery or graft lesions (stenosis of 30-70%), to determine whether revascularisation should be performed where previous stress testing has either not been performed or the results are inconclusive), as the item that most closely resembles IVUS in terms of complexity and time.

The reference to item 38306 will be redundant as it will be replaced with the expanded number of MBS items for invasive coronary angiogram and PCI. As noted by the applicant's clinical expert, the clinical presentation of the patient (ACS or stable) would inform the choice of stent insertion item code as newly defined (see Table 3). The clinician would need to provide documented evidence that the procedure meets the descriptor for the invasive coronary angiogram and PCI as well as that for IVUS.

As an example, the item descriptor could be re-written as:

Category 3-THERAPEUTIC PROCEDURES
Item XXXX *Use of Intravascular Ultrasound (IVUS) during invasive coronary angiogram and percutaneous angioplasty or transluminal insertion of stents, to optimise procedural strategy, appropriate stent size and assessment of stent apposition for patients documented with:* *a) Left main coronary artery lesions, and/or where suitability of percutaneous coronary intervention has appropriately been determined by a Heart Team ; or* *b) Other lesion locations with lesion length ≥28mm* *Being a service associated with items 38307, 38308, 38310, 38311, 38313, 38314, 38316, 38317, 38319, 38320, 38322, 38323).* (Anaes.) (Assist.) Multiple Operation Rule Fee: $ (proposed fee) See Explanatory Notes XXXX

Until the new MBS item descriptors are provided publicly the new proposed item descriptor cannot be accurately transcribed nor the likely financial implications estimated.

PASC noted that there are new MBS items coming through for PCI in July that bundle coronary angiography with percutaneous angioplasty OR transluminal insertion of stents (s). This has two implications for the proposed introduction of IVUS:

1. *The need for the options for IVUS to align with the population for PCI under the new items; and*
2. *Whether IVUS should be added to the new bundled MBS items or to be stand-alone item.*

A policy question was also raised whether the MBS item should be a standalone in T8 (Surgical operations group under Therapeutic procedures) or if this is a diagnostic service and would sit in the DIST. It was noted this would be highly dependent on the MSAC decision on the population options. PASC advised that a decision of whether the proposed MBS item for IVUS would be included with the new bundled MBS items or be a stand-alone MBS item would need to be made.

PASC noted that the proposed MBS fee was twice as high as that for TOE (transoesophageal echocardiography) which was described as a comparable modality.

PASC noted that the reimbursement fees associated with the new MBS items are likely to be available in the next month.

Consultation feedback

There were no targeted consultation responses received for this application.

PASC noted there was no targeted consultation feedback.

Next steps

PASC advised that, upon ratification of the post-PASC PICO, the application can proceed to the Evaluation Sub-Committee (ESC) stage of the MSAC process.

PASC noted the applicant has elected to progress its application as an ADAR.

Applicant Comments on the PICO Confirmation

Population

The applicant acknowledged the PASC assessment on the proposed population options, which are in line with the current clinical evidence available for IVUS.

The applicant will seek clinicians' advice to ensure the proposed population will agree with the populations for the new MBS items, bundled coronary angiography with percutaneous angioplasty or transluminal insertion of stent(s) that will be implemented in July 2021.

Current and proposed clinical management algorithm for identified population

The applicant acknowledged the need to provide an update current and proposed clinical management algorithm due to the introduction of the new MBS items, and will seek clinicians' advice to ensure the algorithms are aligned with Australian clinical practice.

Proposed item descriptor

The applicant acknowledges the need to be revised the proposed item descriptors due to the introduction of the new MBS items and PCI structure, and will seek clinicians' advice to ensure the descriptors are aligned with Australian clinical practice. The applicant will remove the reference to require IVUS to be used diagnostically, by amending the proposed descriptor to read ">50% stenosis as defined by the diagnostic angiogram".

The applicant proposes the MBS item to be a standalone in T8 (Surgical operations group under Therapeutic procedures). Nonetheless, the applicant is willing to discuss with the Department whether any modification of the item descriptor will be needed to ensure full integration with the new MBS items.

In relation to the PASC note about transoesophageal echocardiography (TOE), while the applicant acknowledges that they are both ultrasound technologies, the TOE procedure differs to the IVUS procedure in the following ways:

- *Procedure: access site is via mouth rather than groin*
- *Indication: impaired heart valves, a tear in the aorta, congenital heart lesions or endocarditis, rather than symptomatic coronary artery disease*
- *Nature of procedure: diagnose problems in heart's structure rather than vessels (arteries)*
- *Healthcare resource utilisation:*
    - *TOE requires a specialised technician to assist with the procedure*
    - *TOE requires high dose sedative agents to be administered during procedure*
    - *TOE requires an anaesthetist to be present due to high dose sedatives being administered*

The applicant therefore believes that TOE is substantially different to IVUS, and the total costs of TOE may far outweigh that of IVUS, as it requires presence of additional experts (TOE technician and anaesthetist) and additional drugs. By comparison, IVUS is performed as an adjunct therapeutic procedure during PCI, by the same interventional cardiologist performing the PCI procedure without the requirement of any additional drugs, or experts to facilitate the procedure.

FFR by comparison is similar to IVUS in terms of procedural access site, indication (symptomatic coronary artery disease) with no additional requirement of healthcare resources, as it is performed by the same interventional cardiologist who may perform the PCI procedure.

Next Steps

To adequately incorporate PASC advice and obtain clinicians' feedback, the applicant advised they are planning to submit the application to the February 2022 ESC/MSAC meeting.

Table 12: Individual studies comparing IVUS-guided versus angiography-guided insertion of drug eluting stents included in the Elgendy (2020) meta-analysis

Individual studies	Trial design	Inclusion	Exclusion	Study Length	Outcomes	Procedure success
Zhang 2018 ULTIMATE trial, 12-month outcomes	RCT N=1,448 Operators >200 PCI cases/year 1:1 randomised to IVUS or angiography guidance IVUS=724 Angiography=724	"All-comer patients" Silent ischaemia, stable or unstable angina, MI (STEMI, NSTEMI) >24 hrs from onset of chest pain to admission, de novo coronary lesion eligible for DES implantation	Co-morbidities, intolerant of antithrombotic therapy, CTO lesion in either the LADCA or left circumflex artery or RCA not recanalized, severe calcification needing rotation atherectomy	Clinical follow-up at 12 months: IVUS=722 Angiography=722 Angiographic follow-up at 13 months: IVUS=478 Angiography=446	Primary: TVF at 12 months (composite of cardiac death, TVMI, clinically driven TVR)	Angiographic success: TIMI grade 3, residual stenosis <20%, and absence of ≥Type B dissection IVUS success: 1) MLA in the stent segmented segment is >5.0mm^2 or 90% of MLA at distant reference segments; 2) plaque burden 5-mm proximal or distal to the stent edge is <50%; and 3) no edge dissection involves media with a length >3mm.
Gao 2021 ULTIMATE trial, 3-years outcomes	RCT N=1,448 Operators >200 PCI cases/year 1:1 randomised to IVUS or angiography guidance IVUS=724 Angiography=724	"All-comer patients" Silent ischaemia, stable or unstable angina, MI (STEMI, NSTEMI) >24 hrs from onset of chest pain to admission, de novo coronary lesion eligible for DES implantation	Co-morbidities, intolerant of antithrombotic therapy, CTO lesion in either the LADCA or left circumflex artery or RCA not recanalized, severe calcification needing rotation atherectomy	Clinical follow-up at 3 years: IVUS=714 Angiography=709 Angiographic follow-up at 3 months: IVUS=488 Angiography=507	TVF at 3 years (composite of cardiac death, TVMI, clinically driven TVR)	Angiographic success: TIMI grade 3, residual stenosis <20%, and absence of ≥Type B dissection IVUS success: 1) MLA in the stent segmented segment is >5.0mm^2 or 90% of MLA at distant reference segments; 2) plaque burden 5-mm proximal or distal to the stent edge is <50%; and 3) no edge dissection involves media with a length >3mm.
Liu 2019[13]	RCT, open-label, single-blind N=348 Procedures conducted by 5 experienced primary interventionists Patients randomised: IVUS-guided=174 control group=174 Patients enrolled: IVUS-guided=167 control group=169	Adult patients (age 18 to 75 years) with unprotected left main coronary artery stenosis (ULMCA) lesions and planned for receiving DES implantation, compliance with antiplatelet therapy post PCI	Acute MI (≤24 h), cardiogenic shock, high-risk factors for bleeding, renal or hepatic failure or carcinoma, CTO in the LADCA or left circumflex artery with no successful recanalisation before randomisation or complicated with severe calcification needing rotational atherectomy.	1 year clinical follow-up IVUS=163 control=164	Primary: MACE at 1 year (composite of cardiac death, MI, TVR) Other: Cardiac death, MI, stent thrombosis	Successful PCI: TIMI grade 3 and residual stenosis <10% were achieved. Successful PCI proven by IVUS: minimum stent lumen cross-sectional area >6.9 mm^2, full apposition, and expansion of stents with no observed dissection.
Zhang 2016 (abstract only) N=84	RCT N=84 IVUS=42 Angiography=42	Non-diabetic patients with CHD and with a single de novo lesion in a small	NR	12 months	Primary: post-procedure MLD	NR

Individual studies	Trial design	Inclusion	Exclusion	Study Length	Outcomes	Procedure success
		vessel (diameter range ≥2.25 and ≤2.75 mm)			Other: combined MACE at 1, 6, 9, and 12 months	
Hong 2015[14] IVUS-XPL Intravascular Ultrasound Guidance on Outcomes of Xience Prime Stents in Long Lesions trial	RCT N=1400 IVUS=700 Angiography=700	Patients with typical chest pain or myocardial ischemia and stent length ≥28 mm based on angiographic estimation, significant coronary artery stenosis (>50% based on visual estimate)	Acute ST-segment elevation or MI within 48 h, contraindication for anti-platelet agents and bleeding history within prior 3 months, >80 years, CTO, bifurcation lesion with 2-stent technique, significant renal dysfunction (serum creatinine >2.0 mg/dl	1 year IVUS=660 Angiography=663	Primary: MACE at 1 year Other: cardiac death, target lesion-related MI, TLR, stent thrombosis	Angiographic optimal result: angiographic residual diameter stenosis <30% by visual estimation and the absence of angiographically detected dissection. IVUS criteria for stent optimisation after PCI: a minimal lumen cross-sectional area greater than the lumen cross-sectional area at the distal reference segments.
Hong 2020[15] IVUS-XPL Update of Hong 2015, IVUS-XPL trial	RCT N=1400 IVUS=700 Angiography=700	Patients with typical chest pain or myocardial ischemia and stent length ≥28 mm based on angiographic estimation, significant coronary artery stenosis (>50% based on visual estimate)	Acute ST-segment elevation or MI within 48 h, contraindication for anti-platelet agents and bleeding history within prior 3 months, >80 years; CTO, bifurcation lesion with 2-stent technique, significant renal dysfunction (serum creatinine >2.0 mg/dl	5 years Completed 5-year follow-up: IVUS=589 Angiography=594	Primary: MACE at 5 years	Angiographic optimal result: angiographic residual diameter stenosis <30% by visual estimation and the absence of angiographically detected dissection. IVUS criteria for stent optimisation defined as a minimal lumen cross-sectional area greater than the lumen cross-sectional area at the distal reference segments
Kim 2015[16] CTO IVUS **Patients randomised twice** to (1) IVUS or angiography and then (2) Resolute zotarolimus-eluting stents or Nobori biolimus-eluting stents	RCT N=402 IVUS=201 Angiography=201	Patients with CTOs, aged 20 to 80 years and typical symptomatic angina or positive for functional evaluation of ischemia.	Unprotected left main disease or in-stent restenosis, presentation of acute coronary syndrome at CTO intervention, left ventricle ejection fraction <30% and IVUS use before randomisation	Clinical follow-up for 12 months	Primary: cardiac death Other: MACE (composite of cardiac death, MI, or TVR) at 12 months	Procedure success: final thrombolysis in MI flow grade ≥2 without death or fatal complication during the procedure requiring emergent operation. Device success: residual stenosis ≤30% by visual assessment after successful stent implantation.
Tian 2015[17] AIR-CTO	RCT N=230 IVUS=115	Patients with ≥1 CTO lesion (TIMI grade 0 and occlusion duration >3 months)	Age >80 years, liver dysfunction, major bleeding or stroke within 6 months, failure	Clinical follow-up at 12 months IVUS=114	Primary: in-stent late lumen loss at 12 months	IVUS-defined success criteria: good apposition, stent minimal stent area (MSA) >80% of reference vessel area,

Individual studies	Trial design	Inclusion	Exclusion	Study Length	Outcomes	Procedure success
	Angiography=115	successfully recanalized, age 18-80 years, diagnosis of silent ischaemia, stable angina, unstable angina or previous MI	of recanalisation in a CTO lesion or presence of STEMI <24 hours from the onset of chest pain to the time of hospital admission	Angiography=112	Other: all-cause death, cardiac death, MI, ISR, TLR and TVR, stent thrombosis	symmetry index >70% and no >Type B dissection. Angiographic success: achievement of TIMI grade 3 and residual stenosis of <30%. Procedural success: achievement of angiographic success and the absence of in-hospital MACE.
Tan 2015[18]	N=123 IVUS=61 Angiography=62	Patients with unprotected left main coronary artery stenosis (ULMCA), age ≥ 70 years	Severe left ventricular dysfunction (ejection fraction <30%), cardiogenic shock, acute MI, carcinoma	2 years	Primary: MACE at 2 years (death, non-fatal MI, TLR) Other: death, non-fatal MI, TLR and stent thrombosis	Procedural success: lumen stenosis <30% by final coronary angiography. IVUS, successful stent expansion: lumen area 90% or greater of the average reference lumen area pre-intervention.
Kim 2013[19] **Patients randomised twice** to (1) Endeavor Sprint zotarolimus-eluting (E-ZES) stents or everolimus-eluting stent, (2) IVUS or angiography	RCT, open-label N=543 IVUS=269 Angiography=274 13 IVUS patients crossed over, 41 angiography patients crossed over	Patients over 20 years of age and had a de novo lesion requiring a stent ≥28 mm in length in a vessel with a distal reference diameter Angiography=≥2.5 mm by visual angiographic estimation.	Patients with CTO, prior PCI with DES, bifurcation lesions treated with a 2-stent technique, left main disease requiring PCI, peripheral artery occlusive diseases, thromboembolic disease, stent thrombosis, cardiogenic shock, left ventricular ejection fraction <40%, or STEMI within 48 h after onset of symptoms	Clinical follow-up at 1 year ITT analysis: IVUS=269 Angiography=274 Per protocol analysis: ITT analysis: IVUS=297 Angio=246	Primary: MACE at 12 months (cardiovascular death, MI, TVR or stent thrombosis)	Optimal result: angiographic residual diameter stenosis <30% and absence of angiographically detected dissection.
Chieffo 2013[20] AVIO	RCT, open label N=284 IVUS=142 Angiography=142	Complex lesions suitable for DES implantation: long lesions (>28 mm), CTO (a total occlusion of duration > 3-months), lesions involving a bifurcation; small vessels (≤2.5mm) and patients requiring ≥4 stents	Ejection fraction <30%, significant comorbidities, MI in the prior 48 hours, instentrestenosis, prior brachytherapy; venous or arterial grafts, unprotected left main stem stenosis	Clinical follow-up at 24 months ITT analysis: IVUS=142 Angiography=142 Per protocol analysis: IVUS=142 Angiography=139	Primary: post-procedure in-lesion MLD Other: MACE, TLV, TVL, MI stent thrombosis	AVIO criteria for inside stent cross sectional area less than the following targets was considered under expanded.

Optimal balloon size, mm	Nominal balloon area mm^2	Target area mm^2
2.50	4.91	4
3.0	7.07	6
3.5	9.62	8
4.0	12.56	10
4.5	15.90	12

Individual studies	Trial design	Inclusion	Exclusion	Study Length	Outcomes	Procedure success
Jakabcin 2010[21] HOME DES IVUS	RCT N=210 IVUS=105 Without IVUS=105	Complex lesions or characteristics - Lesion type B2 and C according to the AHA, proximal LADCA, left main disease, reference vessel diameter <2.5 mm, lesion length >20 mm, in-stent restenosis, insulin dependent diabetes mellitus and ACS	NR	18 months follow-up: IVUS=105 Without IVUS=105	Primary: MACE (death, MI, reintervention) Other: stent thrombosis	Criteria for the optimal stent deployment: good apposition (apposition of all stent struts to the vessel wall), optimal stent expansion [with minimal stents area of 5 mm^2] or cross sectional area > 90% of distal reference lumen CSA for small vessel/ and no edge dissection

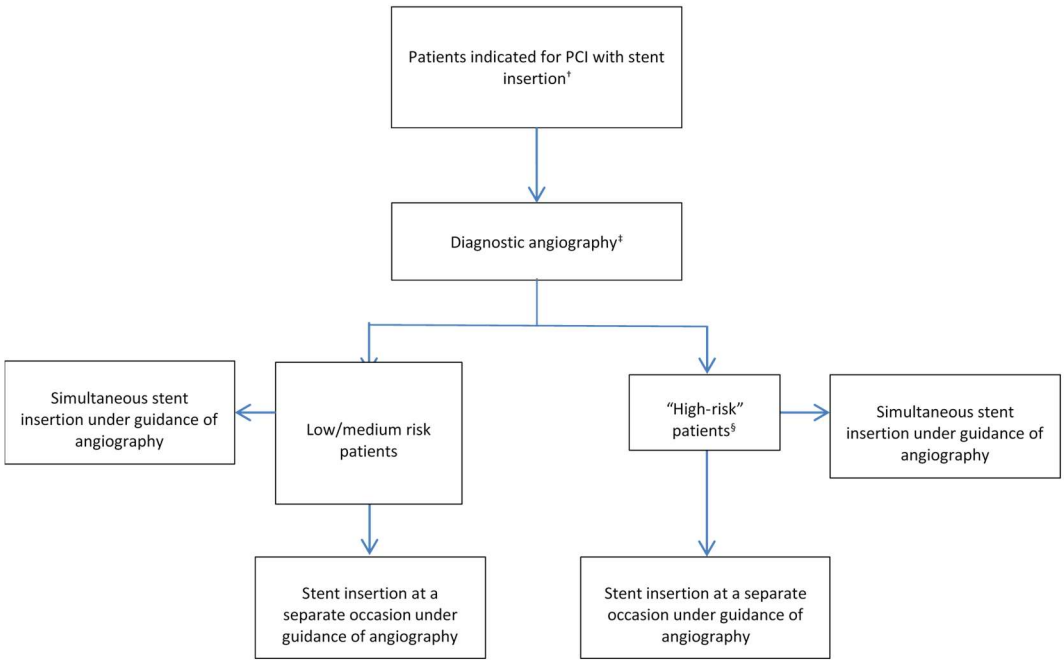

Figure 6: Current clinical decision algorithm for patients indicated for coronary stent insertion presented in the application

† Patients with acute coronary syndrome – STEMI, NSTEMI with higher risk of a cardiac event, unstable angina, stable angina who fail medical therapy or who have silent myocardial ischemia may be indicated for PCI/stenting as an elective, ad hoc or emergency procedure. Patients may undergo initial stent insertion, or re-stenting or assessment for other interventions if there are complications or failure of the stent.

‡ Diagnostic angiography may be performed in addition to the functional assessments (e.g. fractional flow reserve) of coronary arteries.

§ "High-risk" patients are identified based on their coronary anatomy, and the type and complexity of coronary lesions.

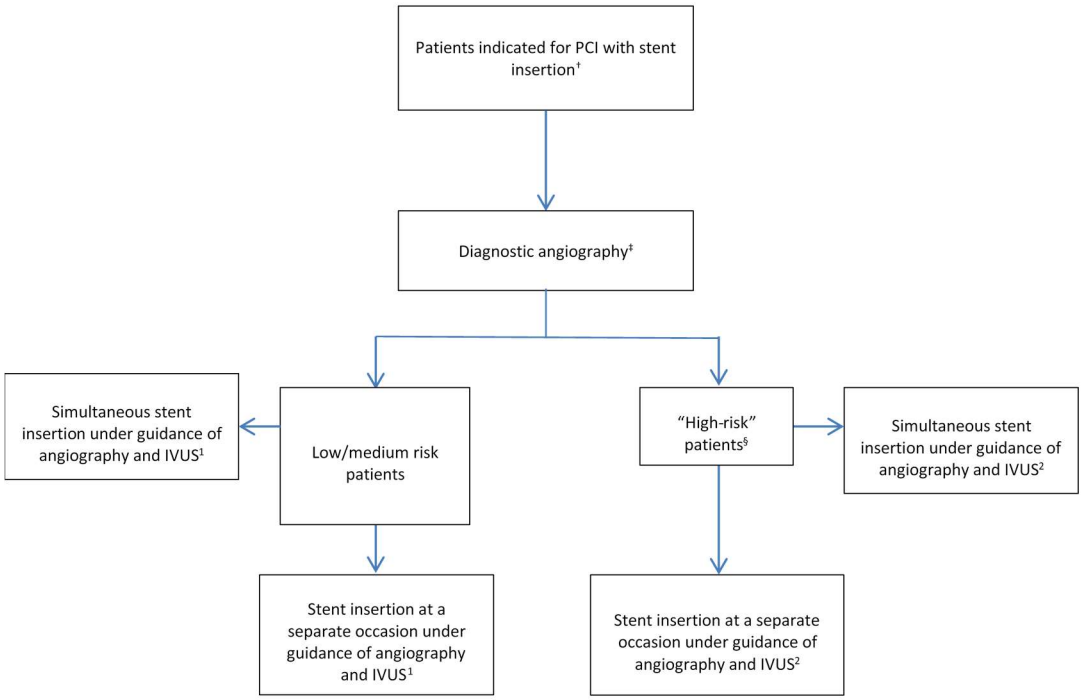

Figure 7: Proposed clinical decision algorithm for patients indicated for coronary stent insertion presented in the application

† Patients with acute coronary syndrome – STEMI, NSTEMI with higher risk of a cardiac event, unstable angina, stable angina who fail medical therapy or who have silent myocardial ischemia may be indicated for PCI/stenting as an elective, ad hoc or emergency procedure. Patients may undergo initial stent insertion, or re-stenting or assessment for other interventions if there are complications or failure of the stent.

‡ Diagnostic angiography may be performed in addition to the functional assessments (e.g. fractional flow reserve) of coronary arteries.

§ "High-risk" patients are identified based on their coronary anatomy, and the type and complexity of coronary lesions.

1 Population option 1: patients undergoing PCI who have had a coronary lesion eligible for DES implantation

2 Population option 2: patients undergoing PCI who have had a coronary lesion eligible for DES implantation with either:

- Lesions associated with the left main coronary artery ; and/or where suitability of percutaneous coronary intervention has appropriately been determined by a Heart Team approach for significant stenoses (≥50% as defined on IVUS) of the left main coronary artery, including in cases of unprotected left-main disease; or
- Lesion length ≥ 28mm

References

[1] Zhang J, Gao X, Kan J, Ge Z, Han L, Lu S, et al. Intravascular Ultrasound Versus Angiography-Guided Stent Drug-Eluting Stent Implantation: The ULTIMATE Trial. Journal of the American College of Cardiology. 2018;72(24):3126-37Implantation: A meta-analysis

[2] Ryan TJ et al. AQCC/AHA Task Force Report. Guidelines for Percutaneous Transluminal Coronary Angioplasty. A report of the American College of Cardiology/American Heart Association Task Force on Assessment of Diagnostic and Therapeutic Cardiovascular Procedures (Subcommittee on Percutaneous Transluminal Coronary Angioplasty). JACC. 1988;12(2):529-545

[3] Amin AP, Spertus JA, Cohen DJ, Chhatriwalla A, Kennedy KF, Vilain K, Salisbury AC, Venkitachalam L, Lai SM, Mauri L, et al. Use of drug-eluting stents as a function of predicted benefit: clinical and economic implications of current practice. Arch Intern Med. 2012;172(15):1145–52.

[4] Krone RJ, Shaw RE, Klein LW, Blankenship JC, Weintraub WS. Ad hoc percutaneous coronary interventions in patients with stable coronary artery disease–a study of prevalence, safety, and variation in use from the American College of Cardiology National Cardiovascular Data Registry (ACC-NCDR) Catheter Cardiovasc Interv. 2006;68(5):696–703.

[5] Moses JW, Leon MB, Popma JJ, Fitzgerald PJ, Holmes DR, O'Shaughnessy C, Caputo RP, Kereiakes DJ, Williams DO, Teirstein PS, et al. Sirolimus-eluting stents versus standard stents in patients with stenosis in a native coronary artery. N Engl J Med. 2003;349(14):1315–23.

[6] Sarno G, Lagerqvist B, Frobert O, Nilsson J, Olivecrona G, Omerovic E, Saleh N, Venetzanos D, James S. Lower risk of stent thrombosis and restenosis with unrestricted use of 'new-generation' drug-eluting stents: a report from the nationwide Swedish Coronary Angiography and Angioplasty Registry (SCAAR) Eur Heart J. 2012;33(5):606–13

[7] Lefkovits J, Brennan A, Dinh D, Carruthers H, Doyle J, Scanlon P, Lucas M and Reid C on behalf of the VCOR. The Victorian Cardiac Outcomes Registry Annual Report 2019. Monash University, SPHPM September 2020, Report No 7, pages 78.

[8] Elgendy I, Mahmoud A, Elgendy A, Mintz G. Intravascular Ultrasound-Guidance Is Associated with Lower Cardiovascular Mortality and Myocarial Infarction for Drug-Eluting Stent Implantation—Insights From an Updated Meta-Analysis of Randomized Trials—. Cieculation Journal. 2019;83:1410-1413

[9] Medical Advisory Secretariat. Intravascular ultrasound to guide percutaneous coronary interventions: an evidence-based analysis Ontario Health Technology Assessment Series. 2006;6(12):1-97

[10] Lee Chi-Hang. Intravascular Ultrasound Guided Percutaneous Coronary Intervention: A Practical Approach. Journal of Interventional Cardiology. 2012;25(1):86-95

[11] Stone GW, Moses JWm Ellis SG, et al. Safety and efficacy of sirolimus-and paclitaxel-eluting coronary stents. N Engl J Med. 2007;356:998-1008

[12] Mintz GS, Pichard AD, Kovach JA, et al. Impact of preintervention intravascular ultrasound imaging on transcather treatment strategies in coronary artery disease. Am J Cardio.1994;73:423-430

[13] Liu X-M, Yang Z-M, Liu X-K, Zhang Q, Liu C-Q et al. Intravascular ultrasound-guided drug-eluting stent implantation for patients with unprotected left main coronary artery lesions: A single-center randomized trial.Anatol J Cardiol. 2019; 21:83-90

[14] Hong S-J, Kim K-B, Shin D-H, Nam C-M et al. Effect of Intravascular Ultrasound-Guided vs Angiography-Guided Everolimus-Eluting Stent Implantation: The IVUS-XPL Randomized Clinical Trial. JAMA. 2015;314(20):2155-2163

[15] Hong S-J, Mintz G, Ahn C-M, Kim J-S, Kim B-K et al. Effect of Intravascular Ultrasound-Guided Drug-Eluting Stent Implantation. 5-Year Follow-Up of the IVUS-XPL Randomized Trial. JACC: Cardiovascular Intervention. 2020; 13(1):62-71

[16] Kim B-K, Shin D-H, Hong M-K, Park H, Rha S-W et al. Clinical Impact of Intravascular Ultrasound-Guided Chronic Total Occlusion Intervention with Zotarolimus-Eluting Versus Biolimus-Eluting Stent Implantation: Randomized study. Circ Cardiovasc Interv. 2015;8: e002592. DOI: 10.1161/CIRCINTERVENTIONS.115.002592

[17] Tian N, Gami S-K, Ye F, Zhang J-J et al. Angiographic and clinical comparisons of intravascular ultrasound-versus angiography-guided drug-eluting stent implantation for patients with chronic total occlusion lesions: Two-year results from a randomised AIR-CTO study. EuroIntervention 2015;10(12):1409-17

[18] Tan Q, Wang Q, Liu D, Zhang S, Zhang Y, Li Y. Intravascular ultrasound-guided unprotected left main coronary artery stenting in the elderly. Saudi Med J. 2015;36(5):549-553

[19] Kim J-S, Kang T-S, Mintz G, Park B-E et al. Randomized Comparison of Clinical Outcomes Between Intravascular Ultrasound and Angiography-Guided Drug-Eluting Stent Implantation for Long Coronary Artery Stenoses. JACC: Cardiovascular Interventions. 2013;6(4):369-76

[20] Chieffo A, Latib A, Caussin C, Presbitero P et al. A prospective, randomized trial of intravascular-ultrasound guided compared to angiography guided stent implantation in complex coronary lesions: The AVIO trial. Am Heart J. 2013; 165:65-73

[21] Jakabcin J, Spacek R, Bystron M, Kvasnak M et al. Long-Term Health Outcome and Mortality Evaluation After Invasive Coronary Treatment Using Drug Eluting Stents with or without the IVUS Guidance. Randomized Control Trial. HOME DES IVUS. Catheterization and Cardiovascular Interventions. 2010;75:578-583.