



Cardiac Catheterisation Laboratory Competency

Document Contributors

PiCSA Board
Canberra Health Services

Revision History

Version	Date	Pages Revised/Brief explanation
V1	June 2023	
V2		

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Abbreviations

AP – Allied professional	LV – Left Ventricle
ACCP – Australian Council for Clinical Physiologists	NSQHSS – National Safety and Quality Health Service Standards
ACS – Acute Coronary Syndrome	PA – Pulmonary Artery
Ao – Aorta	PCI – Percutaneous Coronary Intervention
CA – Coronary Angiogram	PCWP – Pulmonary Capillary Wedge
CCL – Cardiac Catheterisation Laboratory	RA – Right Atrium
CO – Cardiac Output	RHC – Right Heart Catheterisation
CP – Cardiac Physiologist	RV – Right Ventricle
CTO – Chronic Total Occlusion	TIMI – Thrombolysis in Myocardial Infarction
HP – Health Professional	VSD – Ventricular Septal Defect
LA – Left Atrium	

Outcome Statement

This competency evaluation document assesses the skills and knowledge required of the Cardiac Physiologist who work in the Cardiac Catheterisation Laboratory (CCL). The individual will be assigned a trainer(s) and commence at the base level (“Not Assessed”) and gradually progress through the other levels through supervised learning.

Initial learning is expected to take a minimum of **2-4 weeks***, depending on the individual’s background, aptitude for learning, and time allocated for training. After this period, consolidation of foundational skills and development of areas that have not yet been addressed will take an additional **2-6 months***. Through discussion and feedback, the supervisor should consider how the individual is progressing and use this document to commence formal assessment for competency signoff.

PiCSA recognises that this document may include competencies outside the scope of practice for some CCLs. In this case, assessors should mark N/A (not assessed) against the relevant competencies.

Competency Terms

Competent (C):	The individual demonstrates mastery of the procedure. Slight or no prompting was required. No significant errors were noted.
Requires Supervision (RS):	The individual demonstrates a level close to proficiency. Slight prompting was required with minimal supervision. Some minor errors were noted and would benefit from additional practice.
Requires Development (RD):	The individual demonstrates some understanding of this procedure. Prompting was required. Some errors were noted and requires additional supervision, practice, and training.
Not Assessed (N/A):	The individual performed a procedure with significant errors. The individual was unable or not required to perform this procedure.

*Time frames listed are guidance only

NSQHSS Standards Referenced in this Competency Evaluation

Standard 1	Governance for Safety and Quality in Health Service Organisations
Standard 2	Partnering with Consumers
Standard 3	Healthcare Associated Infections
Standard 4	Medication Safety
Standard 5	Patient ID and Procedure Matching
Standard 6	Clinical Handover
Standard 8	Pressure Injuries
Standard 9	Clinical Deterioration
Standard 10	Preventing Falls

Cardiac Catheterisation Laboratory Competency Evaluation

Assessment Stage: Student Initial Ongoing Assessment Date: / /

Name: _____

Position:

Assessor: _____

Position:

Method of Evaluation Key: O= Observation (in clinical setting) RD= Return Demonstration T= Written Test V= Verbal Review	Outcome: Competent (C) Requires Supervision (RS) Requires Development (RD) Not Assessed (N/A)	Validation of Competency			
		Method of Evaluation	C RS RD N/A	Comments	Assessor Initials

Professional Conduct				
NSQHSS Standard 1, 2, 3, 5, 6, 9, and 10				
Patient Interaction and Preparation				
Correctly identifies the patient (including the performance of 'Time-Out' with the CCL team), introduces self and role, and ensures patient care needs are addressed.				
Communicates appropriately with patients and all members of the multidisciplinary team.				
Adheres to Risk Management policies for both staff and patient, including adhering to manual handling requirements.				
Observes privacy and confidentiality guidelines.				
Infection Control				
Checks notes for any known infection risk or contact precautions.				
Wears gloves and any additional PPE required and washes hands following the '5 moments of hand hygiene'.				
Disposes of clinical waste appropriately.				
Adheres to universal Infection Control procedures for reprocessing equipment.				
Documentation				
Generates report promptly. Reviews report ensuring all information is entered correctly.				
Accurately collects and records information for research databases.				



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Scientific Knowledge

NSQHSS Standard 1 and 9

Knowledge Base

Left Heart Catheterisation

1. Describe the indications and contraindications for **coronary angiography, percutaneous coronary intervention (PCI) and primary PCI**, and the risks associated with these procedures.
2. Understand the different methods of **arterial access and closure**, including retrograde and antegrade, as well as how this may depend on whether there have been harvested vessels.
3. Describe different **pressure waveforms and expected pressure values** in the Ao & LV.
4. Describe the utility for utilising **multiple/simultaneous pressure waveforms**.
5. Identify **coronary anatomy** and the location of lesions.
6. Identify **coronary artery dominance**.
7. Identify **collateral circulation** and its physiological basis.
8. Identify **coronary artery bypass graft anatomy** and to which vessels the grafts are supplying.

Left Ventriculography (LV ventriculogram, LV gram)

1. Describe the utility of left ventriculography (refer to Appendix 1a).
2. Describe how an LV gram is performed
3. Describe the purpose of the catheter having side holes (refer to Appendix 1b).
4. Describe the X-Ray views that can be used and what regions of wall motion contractility are identified (refer to Appendix 1c).

Describe the utility of **Aortography**.

Describe **other Cardiac Catheterisation Laboratory procedures** such as aortic balloon pump insertion, Impella heart pump, thrombectomy, temporary pacing wire insertion, Rotablation and pericardiocentesis.



<p>Right Heart Catheterisation (RHC) and Cardiac Output (CO)</p> <ol style="list-style-type: none"> 1. Understand normal values. 2. Describe the indications, contraindications and risks associated with this procedure. 3. Understand the different methods of venous access and closure. 4. Describe different pressure waveforms and expected pressure values in the RA, RV, PA and PCW. 5. Identify where in the heart the catheter is and what pressure signal is being derived. 6. Understand the deflections on the waveforms and what they represent. 7. Distinguish between the five types of pulmonary hypertension. 8. Understand and explain the mechanism for how the pulmonary capillary wedge pressure is generated. 9. Able to distinguish between pre-capillary, post-capillary and combined pre and post pulmonary hypertension based on the relevant haemodynamic values. 10. Able to calculate the systolic and diastolic transpulmonary gradient. 11. Able to describe the mechanism of how cardiac output is generated using both the Fick and Thermodilution methods. 12. Able to calculate pulmonary vascular resistance. 13. Understand how an oximetry run or shunt study is performed and what values suggest a left-to-right shunt versus a right-to-left shunt. 						
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<p>Pathophysiology</p> <ol style="list-style-type: none"> 1. Describe the types of acute coronary syndrome (ACS) and their sub-types. 2. Describe the mimics of ACS and identify markers for these conditions (refer to Appendix 2a). 3. Understand the difference between acute and chronic lesions and the utility of percutaneous coronary intervention for treatment. 4. Understand the pathophysiology of bifurcation lesions and various PCI techniques (refer to Appendix 2b). 5. Describe the pathophysiology of coronary bridging and likelihood of the patient having symptoms, and the order of treatment where appropriate. 6. Describe the pathophysiology of spontaneous coronary artery dissection, the likelihood of the patient having symptoms and the order of treatment where appropriate. 				
<p>Understand the utility of the various Structural Heart Disease procedures, including Aortic, Mitral and Pulmonary Valvuloplasty, PFO/ASD closure, coils, VSD closure, percutaneous paravalvular leak closure, LAA closure, TAVI, Mitra Clip, Transcatheter Mitral Valve and Septal ablation with alcohol.</p>				
<p>Equipment</p> <ol style="list-style-type: none"> 1. Understand the difference between compliant, semi-compliant and non-compliant balloons and their utility. 2. Understand the utility of Drug Eluting and Cutting balloons. 3. Understand the difference between Drug Eluting and Bare Metal stents and their utility. 4. Understand the difference between the following stents – scaffolds, self-expandable and covered stents. 5. Understand the equipment and principles used for Chronic Total Occlusions (CTOs) and Rotablation. 				



<p>Percutaneous Coronary Intervention (PCI)</p> <ol style="list-style-type: none"> 1. Understand Thrombolysis in Myocardial Infarction (TIMI) and the various flow grades. 2. Understand the utility of performing pre-dilation during PCI. 3. Understand the utility of performing post dilation stent expansion post PCI. 4. Describe situations when direct stenting may be indicated. 5. Understand potential procedural complications during PCI including coronary dissection, coronary perforation, distal stent edge dissection and potential treatments/outcomes. 				
<p>Identify medications commonly used in CCL procedures including antiplatelet agents, anticoagulants, direct thrombin inhibitors, fibrinolytics, thrombolytics, contrast agents, anti-arrhythmics, nitrates, vasopressors/inotropes, vasodilators, sedatives, reversal agents and antibiotics.</p>				
<p>Aware of Life Support medical systems that may be encountered within the Cath Lab including ECMO, LUCAS and intubation.</p>				
<p>Understand radiation terminology and radiation risks and protection.</p>				
<p>Understand contrast injection systems and techniques.</p>				
<p>Understand laboratory results including chemistry, cardiac enzymes, electrolytes, haematology and lipid panel.</p>				



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Clinical Skills and Procedural Proficiency				
NSQHSS Standard 1, 4, 6, and 9				
Initial Preparation				
Dress in appropriate theatre attire.				
Ensure procedure table is clean and made up.				
Ensure adequate supplies for the case are in the laboratory.				
Check patient notes for indication, risk factors and referring physician.				
Patient Interaction and Set-up				
Introduce self and explain set up procedure to patient including: <ul style="list-style-type: none"> Removal of gown Removal of old ECG dots on the chest Skin preparation such as shaving, sandpaper if required 				
Provide arm supports via arm boards and understand different set up requirements for radial and femoral access.				
Correctly apply ECG electrodes and ensuring good quality of trace. Troubleshoot ECG tracings.				
Correctly apply a blood pressure cuff on the correct limb based on laboratory setup and patient medical history e.g. fistula, mastectomy.				
Correctly apply oximetry probe and select the correct probe based on laboratory setup and patient medical history.				
Perform set up in a timely manner.				
Perform set up quickly in an urgent/primary setting and ensure ECG monitoring is continuous.				
Correctly enter patient details and procedure into Haemodynamic Recording system. Select correct lab and procedure type.				

Procedure				
<p>Haemodynamic status</p> <ol style="list-style-type: none"> 1. Identify, interpret, and notify regarding pressure damping and/or other anomalies (Appendix 3). 2. Identify, interpret and notify regarding complications of MI (Appendix 4). 3. Identify, interpret and notify regarding abnormal ECGs in the Cath Lab (Appendix 5) in a timely manner. 4. Recognise deteriorating patient status and understand the physiologists' role in an Emergency Response call. 5. Identify which TIMI flow grade an artery has and also when the flow changes during PCI or with a complication. 				
<p>Documentation</p> <ol style="list-style-type: none"> 1. Accurately record the equipment used during the procedure. 2. Accurately record the time and dose of medications administered during the procedure. 3. Accurately record the inflation data and correct vessel/valve. 				
<p>Right Heart Catheterisation</p> <ol style="list-style-type: none"> 1. Able to guide the physician for when to sample pressure waveforms 2. Able to guide the physician on the correct pressure waveform values and the possible diagnose 				
<p>Cardiac output</p> <ol style="list-style-type: none"> 1. Able to perform cardiac output using thermodilution method 2. Able to perform cardiac output using Fick method 3. Connects trunk cable/thermistor cable and selects correct Swan-Ganz catheter size in haemodynamic system 				
<p>Fractional Flow Reserve (FFR)</p> <ol style="list-style-type: none"> 1. Able to direct physician where to equalise pressures 2. Understand when an effective equalisation of pressures has been completed versus an ineffective one 3. Understand the concept of drift and ways to rectify it 4. Clarify where the distal pressure sensor is to be optimally located in relation to a lesion 				

<p>Instantaneous Wave-Free Ratio (iFR)</p> <ol style="list-style-type: none"> 1. Able to direct physician where to equalise pressures. 2. Understand when an effective equalisation of pressures has been completed versus an ineffective one. 3. Understand the concept of drift and ways to rectify it. 4. Clarify where distal pressure sensor is to be optimally located in relation to a lesion. 					
<p>Intravascular Ultrasound (IVUS)</p> <ul style="list-style-type: none"> • Able to guide the physician on correct flushing of IVUS equipment. • Able to guide the physician on the correct time to connect the catheter to the imaging console. • Able to perform a mechanical pullback at the appropriate rate and/or guide the physician in performing a slow manual pullback. • Able to perform measurements including the calibre of the interrogated vessel. 					
<p>Optical Computerised Tomography (OCT)</p> <ol style="list-style-type: none"> 1. Able to setup the OCT machine and understands the principles behind the procedure 2. Able to setup the catheter using automated calibration and automatic connection to the controller 3. Able to initiate an automatic imaging pullback with a small contrast injection for precise, hands-free use 4. Able to initiate an automatic imaging pullback with a small contrast injection for precise, hands-free use 5. Can produce the variable axis lateral view (L mode) for visualisation of the full image length 6. Can drag the frame location marker for quick relocation 7. The ability to troubleshoot any machine malfunctions or incorrect use 					
<p>Able to perform Structural Heart procedures (see pg 7) and understands the CP's role within such procedures.</p>					
<p>Basic Life Support certified and recommended to attain Advanced Life Support competence.</p>					
<p>Understands and recognises the different routes of Medication administration and their utility including intraarterial (IA), intracoronary (IC), intravenous (IV), sublingual (SL), oral (PO) and topical.</p>					

Haemodynamic Recording System				
Measurements				
1. Demonstrate ability to perform real time pressure and pullback measurements .				
2. Demonstrate ability to perform pressure measurements retrospectively when required.				
Change pressure label, sweep speed, scale, ECG leads, colour and cycle blood pressure.				
Modify pressure calculations (change analysis window, move pressure markers).				
Set up for procedures using dual transducers and change between transducers.				
Calibrate transducers and troubleshoot transducer signal issues.				
Able to troubleshoot any machine malfunctions or incorrect use.				
Post Procedure				
Assist with disconnecting monitoring equipment from patient and patient transfer.				
Clean and appropriately store ECG leads, BP cuff and oximetry probe. Clean and prepare bed for next case.				

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Professional Development				
NSQHSS Standard 1-10				
Actively engages in reflective practice of clinical and professional performance.				
Actively seeks advice and responds appropriately to feedback.				
Completes continuing professional development (CPD) activities at regular intervals*.				

* PiCSA strongly recommends that Cardiac Cath Lab Physiologists are publicly registered as Accredited Clinical Physiologists (Cardiac) through the Australian Council for Clinical Physiologists (the ACCP) and complete a minimum of 20 CPD points per year. Please find more information at www.theaccp.org.au

Performance Deficiencies: (Check those that apply)

- Excessive time needed to complete procedure
- Significant inaccuracy noted
- Incorrect procedure/sequence
- Incorrect equipment assembly/usage
- Unable to operate software and perform general data management tasks
- Unable to correctly answer questions about rationale and/or theory related to procedure
- Other _____

Assessor's Comments:

Participant's Comments:

Overall Assessment: (please circle)

Competent / Requires Supervision* / Requires Development*

* If the trainee 'Requires supervision' or 'Requires Development' please use the "Agreed Action Plan" on the next page

Agreed Action Plan				
GOAL	STEPS TO ADDRESS GOAL	DEADLINE (date)	ACCOUNTABILITY (Staff member and/or supervisor involved)	OUTCOME / ACTION POINTS

Assessor's Signature: _____

Date: _____

Participant's Signature: _____

Date: _____

References

1. Cardiac Catheterisation Laboratory Competency Evaluation. Canberra Health Services, 2022.
2. A Cardiac Catheterisation Laboratory Core Curriculum Competencies “log book.” European Society of Cardiology, 2016.
3. A Cardiac Catheterisation Laboratory Core Curriculum for the Continuing Professional Development of Nurses and Allied Health Professions. EAPCI, ESC 2016.
4. The Core Curriculum for Cardiovascular Nurses and Allied professionals. Lis Neubeck, ESC, 2023
5. National Safety and Quality in Healthcare Standards. Australian Commission on Safety and Quality in Healthcare, 2022

Appendix 1a – The utility of Left Ventriculography

- Demonstrates global left ventricular function
- Demonstrates segmental left ventricular function
- Demonstrates the extent of aortic regurgitation
- Demonstrates the extent of mitral regurgitation

Appendix 1b – Purpose of catheter having side holes

A large amount of contrast delivered rapidly is necessary to opacify the left ventricular cavity, therefore a pigtail catheter with multiple side holes is often used.

The side holes facilitate multi-directional distribution of flow that minimises arrhythmia and risk of perforation.

Appendix 1c – X-Ray views used and the regions of Wall Motion contractility identified

1. RAO view, showing LV segments:
 - a. Anterolateral
 - b. Apical
 - c. Inferior and
 - d. Posterobasal
2. LAO view, showing LV segments:
 - a. Posterolateral
 - b. Lateral
 - c. Septal

Appendix 2a – Mimics and markers of ACS

Takotsubo Cardiomyopathy (TCM)

- The most common symptoms are chest pain and dyspnoea but can also present with syncope and acute pulmonary oedema. Ventricular arrhythmias and cardiogenic shock occur less frequently in patient with TCM

Acute Pulmonary Embolus

- May present with chest pain, hypotension, dyspnoea, syncope, hypoxia, tachycardia, and tachypnoea, in addition to abnormal ECG and cardiac biomarkers.

Appendix 2b – Pathophysiology of bifurcation lesions and various PCI techniques

Bifurcation lesions

- A bifurcation stenosis is defined as a coronary artery narrowing occurring adjacent to and/or involving the origin of a significant side branch.
- Bifurcation lesions, by virtue of their anatomy are susceptible to side branch damage such as worsening stenosis and potentially complete side branch occlusion.

PCI techniques

- There are various techniques that have been recommended to optimise stent apposition, correct stent deformation or distortion, and improve side branch access. This may involve simultaneous inflation of a main vessel balloon and a side branch balloon
 - Provisional Side branch technique
 - Bailout two stent technique
 - Bailout T stent technique
 - T and protrusion technique
 - Internal crush technique
 - Bailout culotte technique
 - T stenting technique
 - Crush technique
 - Double kiss crush technique

Appendix 3 - Pressure damping and other anomalies

- Ostial lesions:
 - Catheter vessel occlusion
 - Plaque dislodgement
- Catheter is not coaxial with vessel lumen
- Accidental engagement of small calibre vessels
- Contrast injection into small calibre vessels
- Coronary spasm
- Ventricularisation of pressure
- Air or clot in the catheter or manifold
- Differentiate pressure artifact from damping
- Wire whipping during pressure wire testing and notify where appropriate
- Ramifications of atrial ectopics occurring while the catheter is in the left ventricle and notifies where appropriate
- The utility for using a Guideliner and its effects on haemodynamics
 - Haemodynamic changes as a result of using a Guideliner
 - Physician notification of haemodynamic changes prior to contrast being injected
 - Understand the potential ramifications of injecting “forceful” contrast when arterial pressure has significantly declined
 - Promptly identify ST changes
 - Contraindications for the use of a Guideliner

Appendix 4 - Complications of MI

- Conduction system / arrhythmias
- Cardiogenic shock
- Cardiac Tamponade
- Ventricular thrombus and embolism
- Tissue necrosis – ventricular rupture and tamponade
- Tissue necrosis – VSD
- Tissue necrosis – papillary muscle rupture
- Pericardial inflammation
- Coronary dissection
- Vasovagal

Appendix 5 - Abnormal ECGs in the Cath Lab

- Variances of reperfusion arrhythmias
- Bradycardia
- Tachycardia
- Ectopic atrial rhythm
- Junctional rhythm
- Ventricular escape rhythm
- First, second and third degree AV block
- Two types of fascicular block
- Two types of bundle branch block
- Atrial fibrillation
- Atrial flutter
- Supraventricular tachycardia
- Ventricular tachyarrhythmias including monomorphic VT, polymorphic VT and VF
- Isorhythmic AV dissociation
- Myocardial infarction
- Wellens pattern
- De Winters T waves
- Sgarbossa criteria
- Pathological Q waves
- Ventricular aneurysm
- Pericardial effusion
- Paced rhythms
- Pericarditis