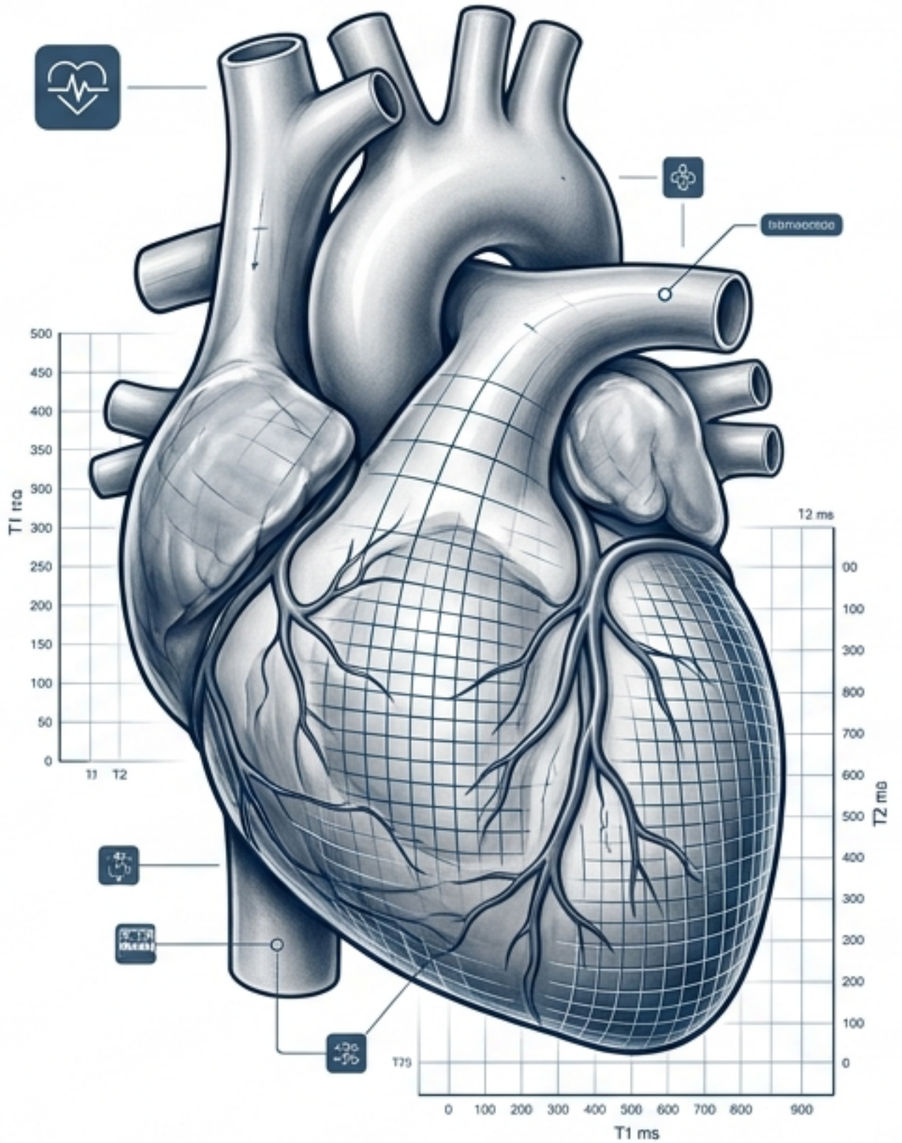
# Diagnosing and Managing Acute Myocarditis

## A **Clinical** Dashboard for the Australian **Practitioner**




**Source:** Med2Date Clinical Guidelines

**Framework:** 2018 Lake Louise & 2020 ESC Criteria

**Last Updated:** 15 May 2026

## THE BASELINE BURDEN

**4-14 cases** per **100,000** persons annually in Australia.

**Underestimated** due to limited regional CMR access.

**Median age:** 30-40 years. Male:Female ratio 1.5-2:1.

## THE LETHAL TAIL

**5-12%** of **Sudden Cardiac Death** in young adults.

Accounts for up to **9%** of unexplained dilated cardiomyopathy presentations nationally.

## THE COVID-19 ERA

NCIRS data shows increased incidence from both **SARS-CoV-2 infection** (20-30% of hospitalized patients show myocardial injury) and **mRNA vaccination** (active TGA surveillance).

**CLINICAL RED FLAG: Maintain a low diagnostic threshold for young patients presenting with chest pain, troponin elevation, and non-ischaemic ECG changes.**

# THE ETIOLOGY MATRIX

## VIRAL (Most Common)

**Pathogenesis:** Direct cytopathic effects followed by immune-mediated response.

**Key Agents:**
- Parvovirus B19 (30-50% by PCR, endothelial tropism)
- Coxsackievirus B (15-25%, direct myocyte lysis, summer/autumn)
- HHV-6
- Adenovirus (paediatric)
- SARS-CoV-2

## IMMUNE-MEDIATED

**Pathogenesis:** Aberrant immune activation requiring targeted therapy.

**Key Subtypes:**
- Giant-Cell Myocarditis (Fulminant, young adults, poor prognosis without transplant)
- Eosinophilic (Drug reactions, EGPA)
- Cardiac Sarcoidosis
- Autoimmune (SLE, rheumatoid arthritis)

## DRUG-INDUCED

**Pathogenesis:** Toxic or hypersensitivity reactions. Key emerging causes.

**Key Agents:**
- Immune Checkpoint Inhibitors (Nivolumab, Pembrolizumab - 0.3-1.5% risk, fulminant onset <6 weeks)
- Clozapine (Requires baseline, 4wk, 12wk troponin per TGA)
- Antimicrobials
- Recreational (Methamphetamine)

# The Clinical Spectrum Matrix

## Mild / Acute Subclinical

- **Setting:** Ward / Outpatient
- **Presentation:** Pleuritic/atypical chest pain, viral prodrome 1-4 weeks prior.
- **Parameters:** Mild troponin elevation, normal/mildly reduced LVEF (>50%), non-specific ST-T changes.

## Moderate / Acute Symptomatic

- **Setting:** Cardiac monitoring ward / CCU
- **Presentation:** Significant chest pain mimicking ACS, dyspnoea, palpitations.
- **Parameters:** Troponin >5x ULN, elevated BNP, LVEF 30-50%, regional wall motion abnormalities, pericardial effusion (~30%).

## Severe / Fulminant

- **Setting:** ICU / Transplant-capable centre
- **Presentation:** Rapid-onset cardiogenic shock, multi-organ dysfunction.
- **Parameters:** LVEF <30%, biventricular failure, high-degree AV block, ventricular arrhythmias. Mortality 50-70% without Mechanical Circulatory Support.

# DIFFERENTIAL DIAGNOSIS MATRIX

| DIAGNOSIS | CLINICAL PARAMETERS |
| --- | --- |
| **Myocarditis** | ✓ Atypical/variable pain<br>✓ Diffuse concave-up ST elevation (non-coronary)<br>✓ Troponin elevated beyond expected ACS curve-RWMA in non-coronary distribution on Echo |
| **Acute Coronary Syndrome (ACS)** | ✗ Exclude via coronary angiography if patient >40 or has cardiovascular risk factors.<br>✗ Variable presentation<br>✓ Typical coronary ST-T changes<br>✓ Expected troponin curve |
| **Acute Pericarditis** | ✓ Predominant pleuritic pain, pericardial rub<br>✓ PR depression<br>✓ Diffuse ST elevation<br>✓ Normal troponin and normal ventricular function |
| **Takotsubo Cardiomyopathy** | ✓ Apical ballooning pattern on Echo/CMR<br>✓ Triggered by emotional/physical stress<br>✓ Reversible ventricular dysfunction<br>✓ Trygersible ventricular dysfuncion<br>✓ Modest troponin elevation |
| **Pulmonary Embolism** | ✓ Acute right heart strain (Echo/ECG)<br>✓ D-dimer elevation<br>✓ CTPA diagnostic<br>✓ D-dimer elevation<br>✓ Sinus tachycardia |

# Initial Non-Invasive Workup


## 1. High-sensitivity Troponin

- **Elevated** in >90%. Serial measurements at 0, 3, 6 hours.
- Abnormal rise/fall trajectory is key. (MBS 66504).

## 2. 12-lead ECG

- **Abnormal** in 90%. Look for diffuse ST elevation, T-wave inversions, low voltage QRS, or new bundle branch blocks.
- **Note:** High-degree AV block suggests Giant-Cell or Sarcoidosis.

## 3. Transthoracic Echo (TTE)

- Assess LVEF, regional wall motion abnormalities, myocardial wall thickness (transient oedema hypertrophy), and pericardial effusion.
- Excludes valvular disease.

## 4. Bloods & Serology

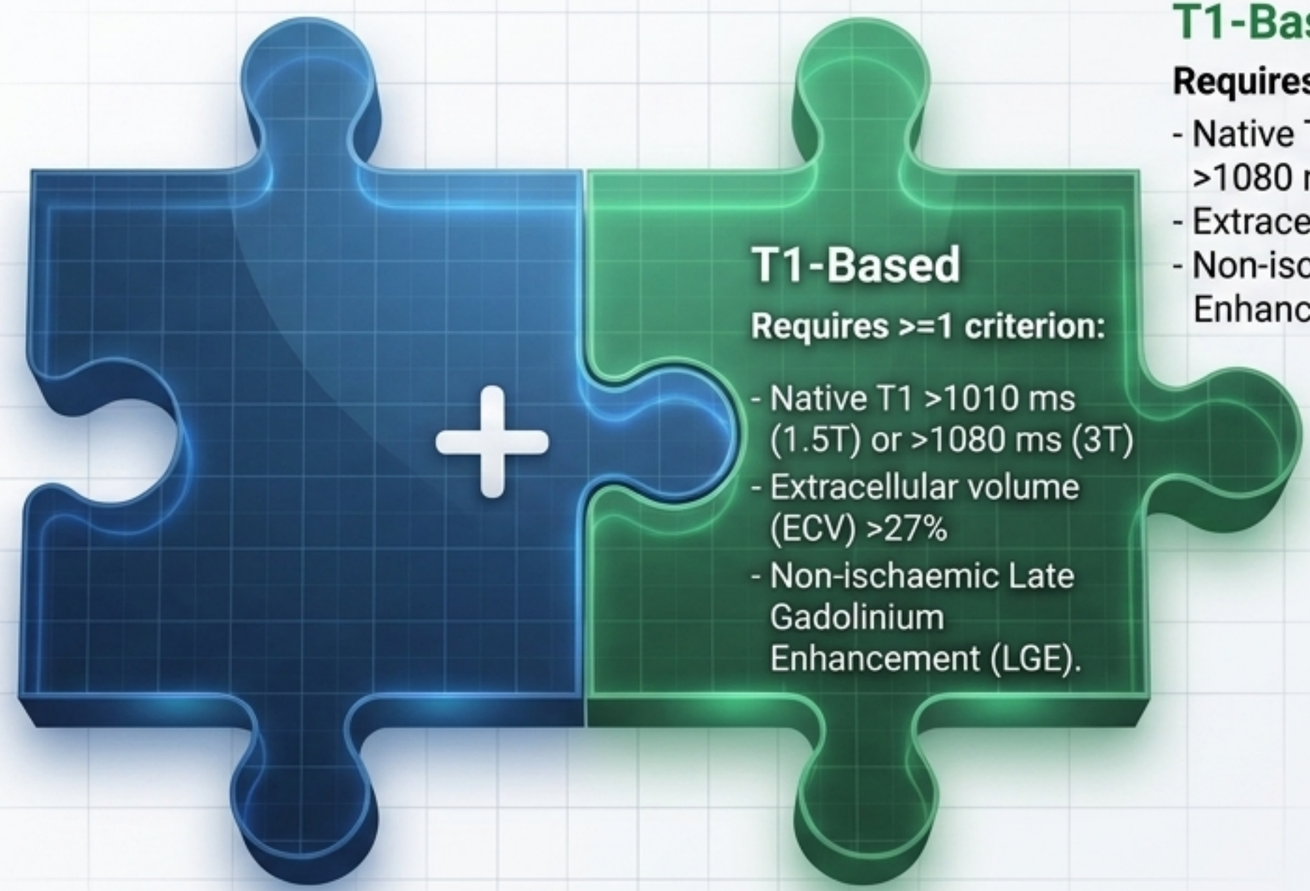
- BNP/NT-proBNP for prognostication.
- Autoimmune markers (ESR, CRP, ANA) and Viral PCR/Serology (Coxsackie, Parvovirus, HIV, SARS-CoV-2) where available.

# The 2018 Lake Louise Intersection Diagram

## T2-Based (Oedema)

**Requires >=1 criterion:**

- T2 ratio >1.9 (STIR)
- Native T2 >52 ms (1.5T) or >54 ms (3T)
- Elevated T2 signal >=2 SD above normal.




## T1-Based (Injury/Fibrosis)

**Requires >=1 criterion:**

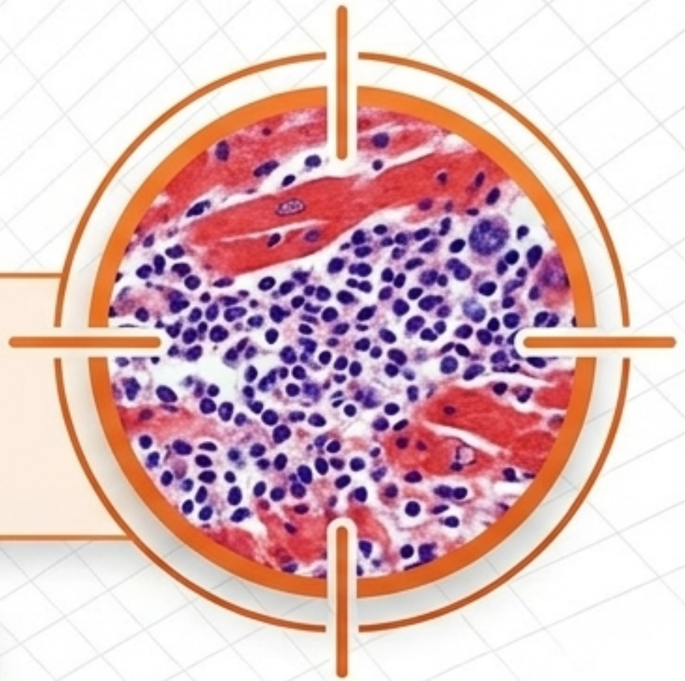
- Native T1 >1010 ms (1.5T) or >1080 ms (3T)
- Extracellular volume (ECV) >27%
- Non-ischaemic Late Gadolinium Enhancement (LGE).

= ✓

**Positive CMR Diagnosis**

**Note:** A CMR study is negative for acute myocarditis if neither T2 oedema nor T1 injury criteria are present.

# Endomyocardial Biopsy (EMB): The Histological Gold Standard

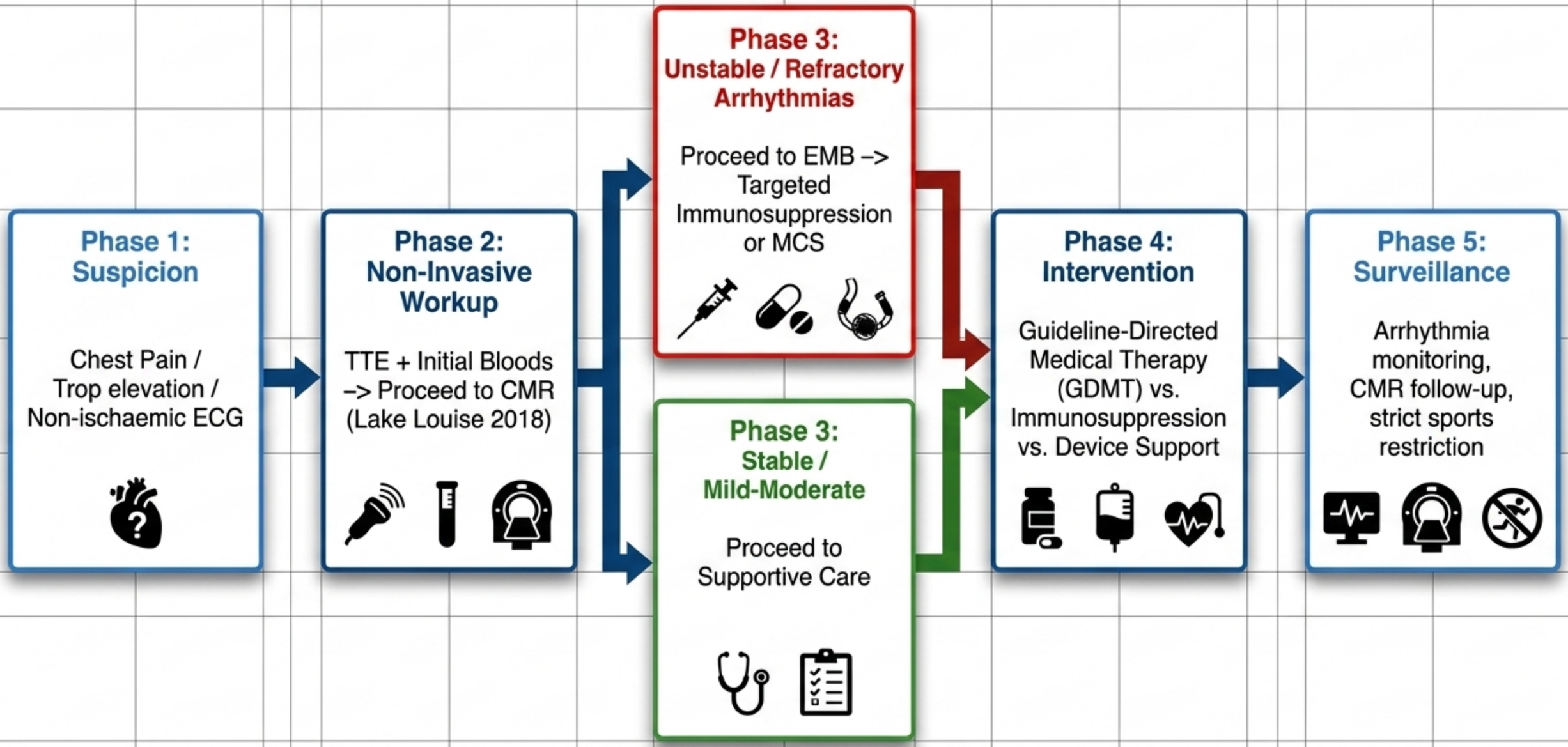


**Dallas criteria** requires lymphocytic infiltrate >=14 cells/mm2 with myocyte necrosis. Yield improved via immunohistochemistry (CD3, CD68) and viral PCR.

## Hard Indications (CSANZ/AHA/ESC)

- ✔ 1. **Fulminant heart failure** with haemodynamic instability (suspect Giant-Cell or Eosinophilic).
- ✔ 2. **Progressive LV dysfunction** refractory to standard therapy for >=2 weeks.
- ✔ 3. Suspected **cardiac sarcoidosis** or **eosinophilic myocarditis** where CMR is non-diagnostic.
- ✔ 4. **New-onset HF** (<2 weeks) with LV dilation and new ventricular arrhythmias or AV block.
- ✔ 5. **HF** associated with **cutaneous drug rash**, eosinophilia, or immune checkpoint inhibitors.

# The Master Care Pathway



# Medication Dashboard

## Perindopril (ACEi)

**Adult**: 2mg PO daily, titrate to 5-10mg.

**Renal**: Start 2mg every other day if eGFR <30.

## Carvedilol (Beta-Blocker)

Initiate only when stable.

**Adult**: 3.125mg PO BD, titrate to 25-50mg BD based on weight.

**Avoid NSAIDs** (increases injury/fluid retention).
**Complete alcohol cessation.**
**Strict exercise restriction.**

## Spironolactone (MRA)

**Adult:** 12.5-25mg PO daily.

Contraindicated if eGFR <30 or $K^+$ >5.0.

## Frusemide (Diuretic)

**Adult:** 20-80mg IV/PO daily for congestion.

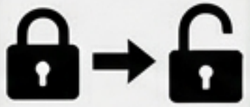
**Note:** Anticoagulation reserved for LVEF <30%, thrombus, or AF.

# Critical Safety Principle: Immunosuppression

**Immunosuppression is CONTRAINDICATED** in **active viral myocarditis (PCR-positive on EMB).** It impairs viral clearance and worsens outcomes.

### The "Lock" (Do Not Give)

Empiric treatment for standard lymphocytic/viral myocarditis.



### The "Unlock" (Mandatory Indication)

Biopsy-proven, PCR-negative immune-mediated subtypes. Requires distinct histologic proof (Giant cells, Eosinophils, non-caseating granulomas) before initiating high-dose steroids.

# Targeted Immunosuppressive Regimens

| | |
|---|---|
| **Giant-Cell Myocarditis** | **Methylprednisolone** 1g IV x3 days → **Prednisolone** 1mg/kg taper. 2nd line: **Ciclosporin** or **Azathioprine + ATG**. Requires lifelong immunosuppression and early transplant evaluation. |
| **Eosinophilic Myocarditis** | **Methylprednisolone → Prednisolone** taper over 2-3 months. 2nd line: **Mepolizumab** 300mg SC (for EGPA). Minimum 6-12 months therapy. |
| **Cardiac Sarcoidosis** | **Prednisolone** for 4-8 weeks, taper over 6-12 months. 2nd line: **Methotrexate, Mycophenolate.** Minimum 12-24 months therapy. |
| **ICI-Related Myocarditis** | **Stop ICI** immediately. **Methylprednisolone** 1-2g IV x3-5 days. 2nd line: **Abatacept** for fulminant cases. |

# The Fulminant Escalation Staircase

**Rapid Haemodynamic Failure**

## IABP
(Intra-Aortic Balloon Pump)

For cardiogenic shock with adequate but depressed LV function.
**Reduces afterload.**

## Impella / pVAD

For isolated LV failure; provides up to 5.5 L/min unloading.
**Bridge to decision.**


## VA-ECMO

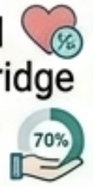
For refractory shock / biventricular failure / arrest. Full circulatory/respiratory
**Requires tertiary retrieval.**

## VAD
(Ventricular Assist Device)

Durable LVAD/BiVAD requiring sternotomy. Bridge to transplant.

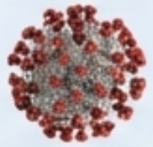
## Prognostic Insight: The Fulminant Paradox

Despite 40-50% in-hospital mortality, survivors who bridge the acute phase with MCS have excellent long-term ventricular recovery (70-90%).



# COVID-19: Infection vs. Vaccination

## COVID-19 Infection



- **Direct invasion via ACE2, cytokine storm.**
  - Troponin elevated in 20-30% of hospitalized cases.
  - Clinical myocarditis in 2-5%.
  - CMR shows oedema/fibrosis in 30-60% of post-COVID patients.

## mRNA Vaccines

- **Highest risk in males aged 12-30 after dose 2 (BNT162b2 or mRNA-1273).**
- Onset: 1-7 days post-vax.
- TGA data: ~30/100k for males 12-17.
- Prognosis: Excellent, typical LVEF >50%, resolves in 1-7 days.

**Clinical Guidance:**

Avoid further doses of the same mRNA platform; consult cardiology for alternatives (Novavax). Echo follow-up at 3-6 months.

# The Australian Context: Remote Practice & ATSI Health

### Rheumatic Heart Disease Overlap

ARF/RHD rates are significantly higher and can mimic or coexist with viral myocarditis, complicating diagnosis in remote communities.

### Geographical Diagnostics

CMR is limited to major centers (Perth, Brisbane, Adelaide).

Remote diagnosis relies heavily on Point-of-care Echo by remote area nurses/FIFO cardiologists.

Early retrieval is critical.

### Cultural Safety & Access

Emphasize yarning-based approaches for explaining rest requirements. Utilize Aboriginal Health Workers (AHWs) in care planning.

### Medication Adherence


Ensure PBS Close the Gap (CTG) utilization for zero/low-cost long-term heart failure medication access.

# Special Populations Management

## Pregnancy

**Overlap:** Difficult to differentiate from Peripartum Cardiomyopathy.

**Med Safety:** ACEi/ARBs are strictly **CONTRAINDICATED** (fetopathy).
Use Hydralazine + Nitrates.
Spironolactone is anti-androgenic (**avoid**).
Metoprolol preferred.

**Delivery:** MDT required if LVEF <40%; vaginal delivery with epidural preferred over C-section unless unstable.

## Paediatrics

**Neonates:** High **fulminant risk**, **50-70% mortality** in shock.

**Intervention:** IVIG (1-2 g/kg) is commonly used empirically despite limited RCTs. ECMO is the primary MCS modality.

**Sports:** Minimum 6 months **strict restriction**.

# The Recovery Roadmap Timeline


## 2-4 Weeks

- Repeat TTE to check LVEF trajectory.
- Repeat Trop/BNP.
- Optimize heart failure meds.

## 3 Months

- Repeat TTE.
- 24-hour Holter monitor for arrhythmias.
- Consider repeat CMR if LVEF isn't normalizing.

## 6 Months

- Repeat CMR (check for residual oedema/LGE).
- If LVEF normal + no LGE -> begin graduated activity.
- Repeat Holter.

## 12 Months

- Comprehensive review (CMR, TTE, Holter, CPET).
- If fully recovered, consider weaning GDMT.
- If persistent LV dysfunction, GDMT is indefinite.

## Annually

- Cardiology review + Echo for at least 5 years.

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# Exercise & Return to Sport

**The Pathophysiology Note:**
Myocardial inflammation renders the heart electrically unstable. Catecholamines from exercise trigger lethal arrhythmias.


## Red Zone (0-3 Months)

Complete avoidance of competitive sport and moderate/vigorous exercise. Light walking only.

## Yellow Zone (3-6 Months)

Re-assessment. If LVEF normalized and Holter clear, start graduated recreational exercise under guidance.

## Green Zone (6-12 Months)

Return to competitive sport ONLY if: LVEF >=55%, **NO** residual oedema/LGE on CMR, **NO** arrhythmias on Holter, normal BNP, and normal CPET.

# Chronic Sequelae & Surveillance Dashboard

## Dilated Cardiomyopathy (DCM)

20-30% of biopsy-proven cases progress to DCM over 5-10 years.

Genetic testing recommended.

## Arrhythmia Surveillance

ILR for unexplained syncope.

ICD indicated if LVEF <=35% persists beyond 3-6 months or secondary prevention for VF/VT.

## Recurrence

Relapse rate is 10-15% for lymphocytic, >50% for Giant-Cell without maintenance immunosuppression.

## Psychological Impact

High rates of anxiety/depression.

Routine screening with PHQ-9/GAD-7 and referral to cardiac rehab recommended.

Recovery is a continuum. Lifelong surveillance for structural **and electrical stability** is the final cornerstone of care.