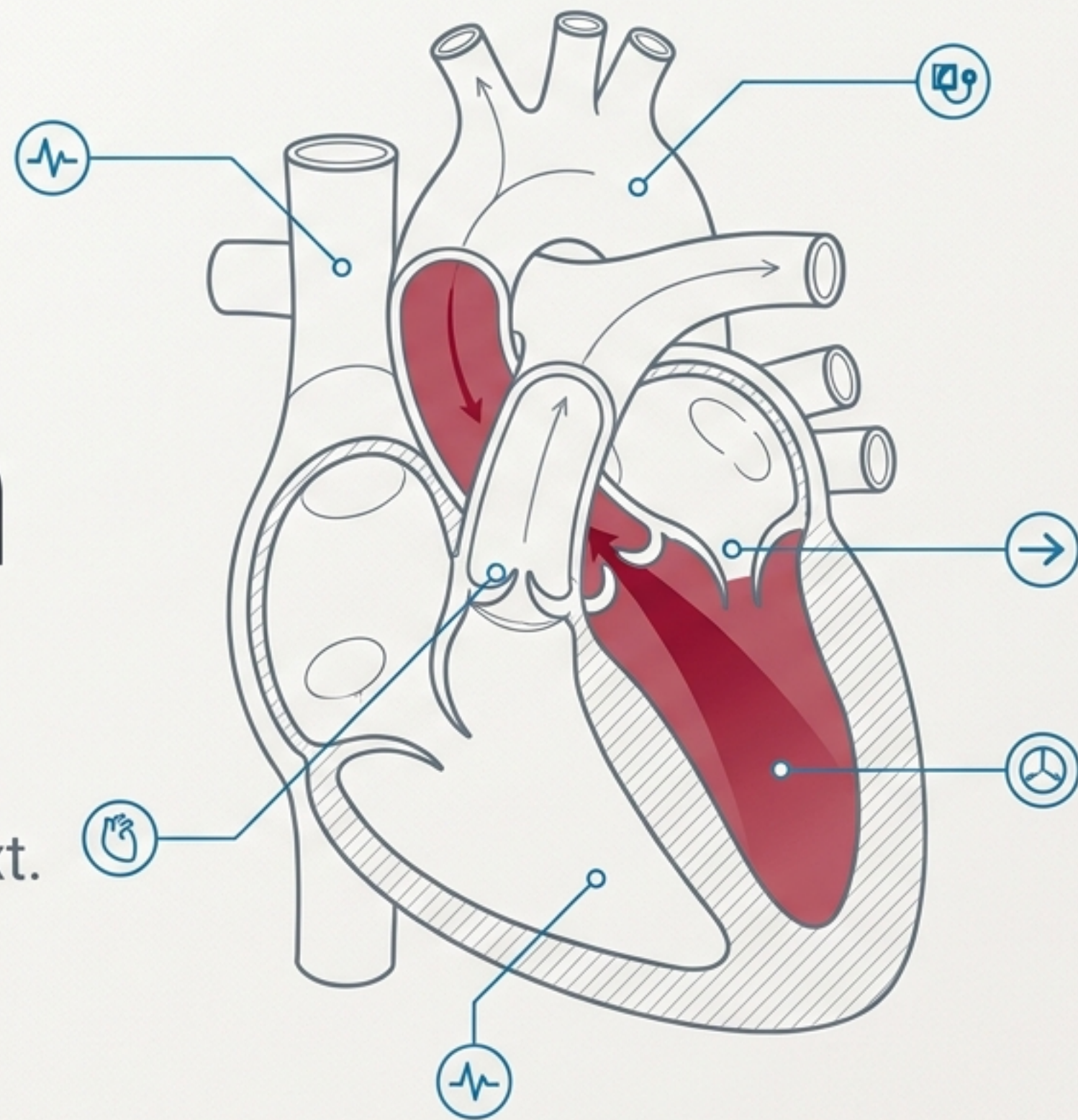


Aortic Regurgitation

The Hemodynamic Blueprint

Clinical Diagnosis, Surgical Pathways, and Medical Management in the Australian Context.



Curated for Cardiology Trainees & Clinical Practitioners.

The fundamental mechanics of retrograde volume overload

1

The Mechanical Failure

Incompetence of aortic valve cusps or aortic root dilatation allows diastolic retrograde flow.

2

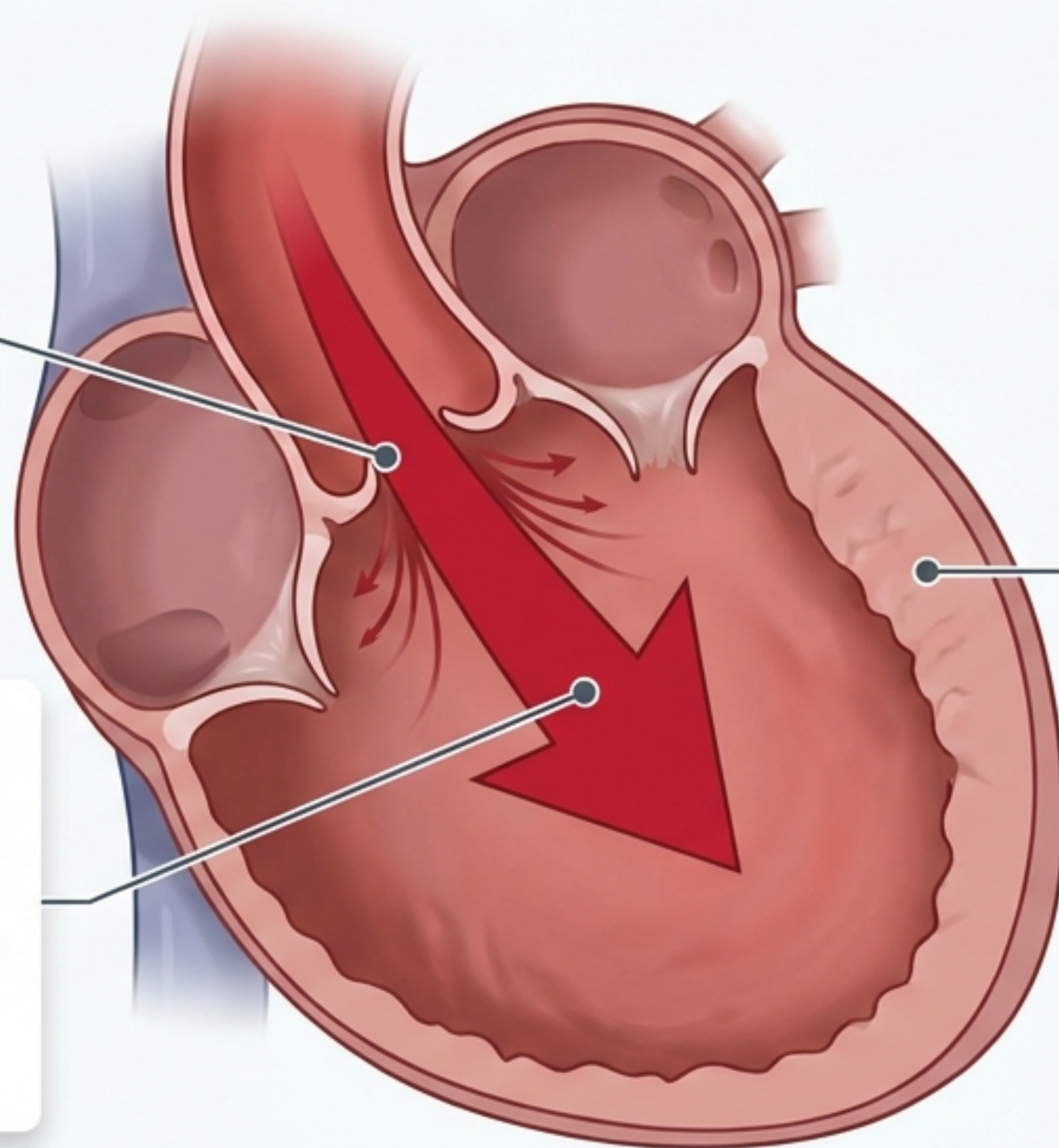
The Hemodynamic Consequence

Massive volume overload and increased end-diastolic pressure in the Left Ventricle (LV).

3

The Structural Adaptation

Progressive LV eccentric hypertrophy and increased end-diastolic volume. Frank-Starling compensation maintains stroke volume initially, leading eventually to systolic dysfunction.



The dual epidemiology of Aortic Regurgitation in Australia



General Population

Vector: Clinical Cerulean

Profile: Older, urban-dwelling adults.

Primary Aetiology: Degenerative aortic valve disease & Bicuspid Aortic Valve (affects 1-2% of population).

Presentation: Insidious, late-onset timeline.



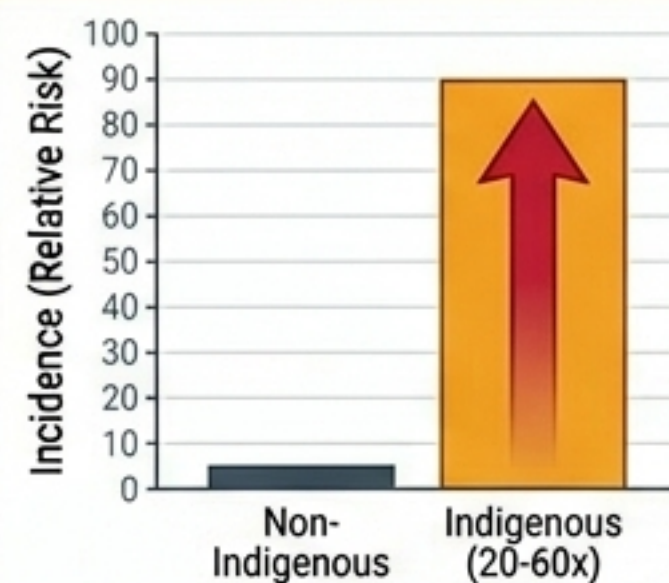
Aboriginal & Torres Strait Islander Populations

Remote: Surgical Amber

Profile: Adolescents and younger adults in remote/rural communities (NT, QLD, WA).

Primary Aetiology: Rheumatic Heart Disease (RHD).

The Severity Gap: Incidence is 20–60x higher than non-Indigenous populations, compounded by barriers to surgical access.



The Hemodynamic Divide: Acute versus Chronic presentations

Parameter	Acute AR	Chronic AR
Onset	Minutes to hours	Months to years
LV Adaptation	No time for dilatation; non-compliant ventricle	Eccentric hypertrophy; massive end-diastolic volume
Diastolic BP & Pulse	Very low, narrow pulse pressure	Low, progressively widening pulse pressure with collapsing pulse
Clinical Hallmarks	Early severe pulmonary edema, cardiogenic shock	Often asymptomatic for decades; Corrigan's pulse, Austin Flint murmur

Acute Aortic Regurgitation is a surgical emergency

EMERGENCY: Mortality exceeds 75% with medical therapy alone. Urgent surgical aortic valve replacement (or root repair) is mandatory. Do not delay for antibiotic response.



Infective Endocarditis

The Pathology: Vegetation destruction or root abscess.

Australian Context: Streptococcus most common; *S. aureus* rising with IVDU.

Surgical Trigger: Heart failure, large vegetation (>10mm), or perivalvular extension.



Type A Aortic Dissection

The Pathology: Dissection flap involves the root, preventing cusp coaptation.

The Fix: Requires emergency Bentall procedure or valve-sparing root replacement.

Mapping regurgitation via Transthoracic Echocardiography (TTE)

Vena Contracta

The narrowest width of the regurgitant jet at the valve level.

PISA Method

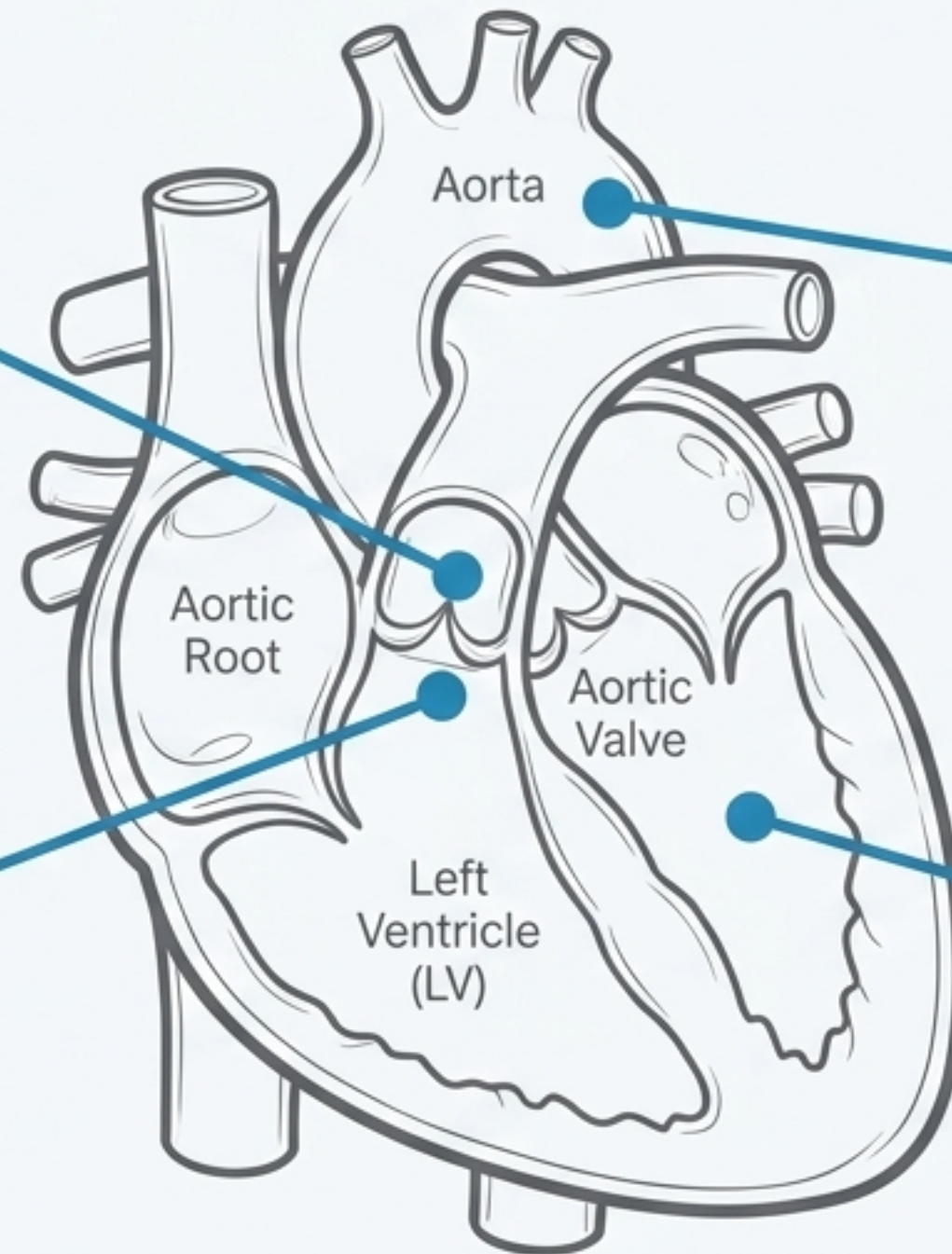
(Proximal Isovelocity Surface Area). Calculates Effective Regurgitant Orifice Area (EROA) and Regurgitant Volume.

Flow Reversal

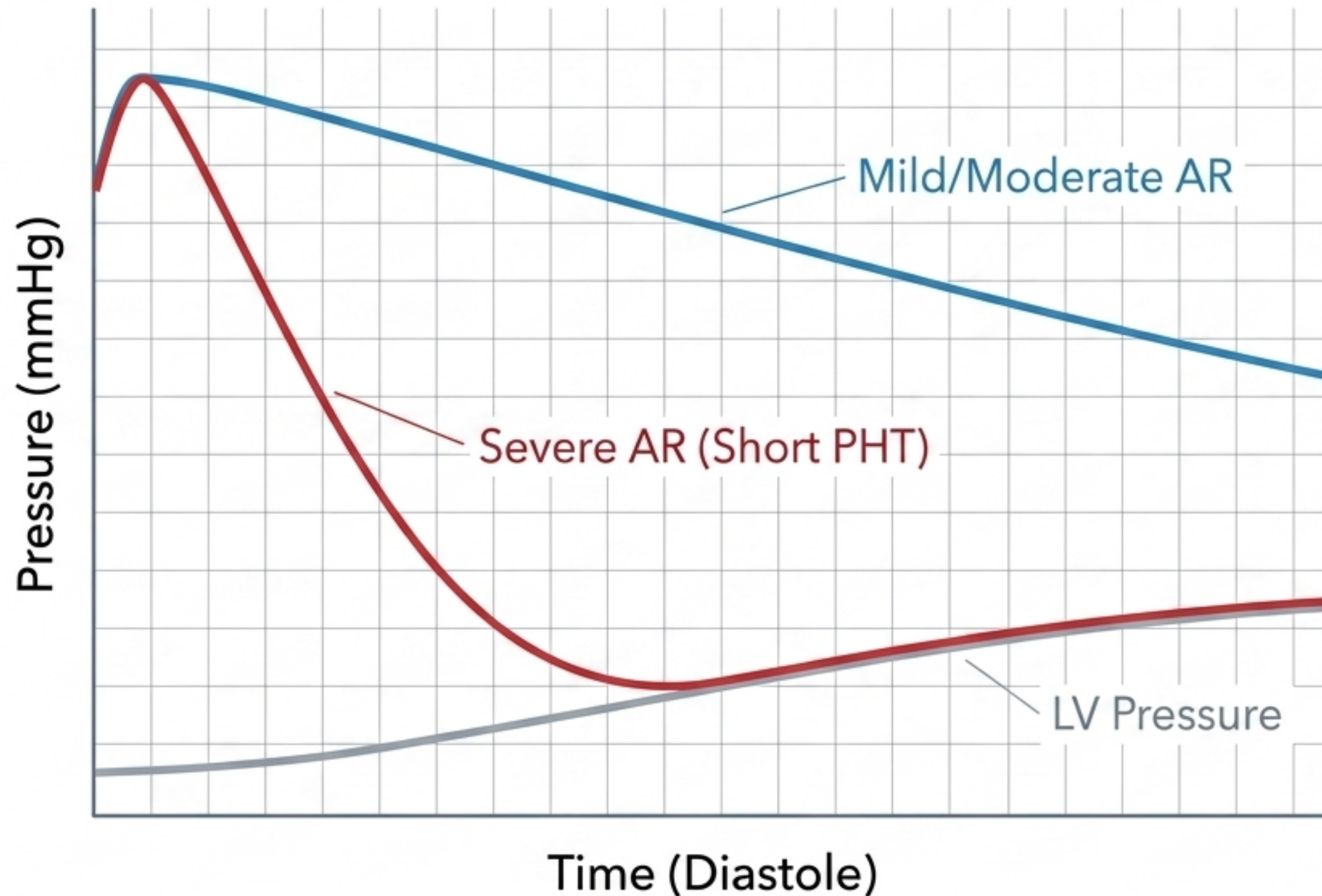
Holodiastolic flow reversal indicates severe volume leaking back into the LV.

LV Dimensions

Tracking End-Diastolic (LVEDD) and End-Systolic (LVESD) dimensions to monitor decompensation.



The physics of severe AR: Pressure Half-Time (PHT)



What it measures

The time for the peak aortic-LV diastolic pressure gradient to fall by half.

The Clinical Translation

A short PHT (≤ 200 ms) reflects rapid pressure equalization. The 'leak' is so massive that the aorta empties instantly into the LV.

Diagnostic thresholds for Severe Aortic Regurgitation

Vena Contracta Width

≥ 0.6 cm

Pressure Half-Time (PHT)

≤ 200 ms

Regurgitant Volume

≥ 60 mL/beat

Regurgitant Fraction

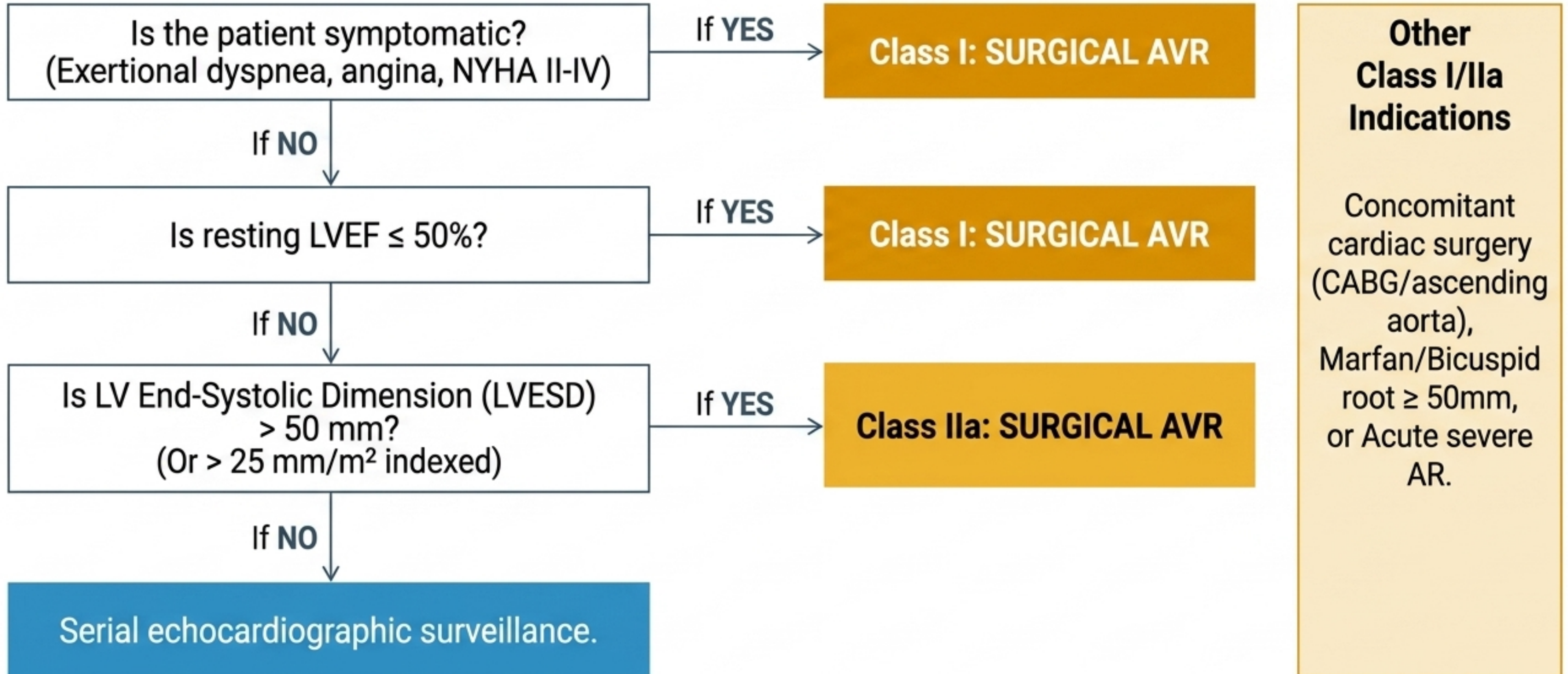
$\geq 50\%$

Descending Aorta

**Holodiastolic
reversal**

Integrated approach required. PHT may be shortened by elevated LVEDP or prolonged by vasodilators.

The Surgical Pathway: Indications for Intervention



Choosing the intervention: Valve and Root Procedures

Mechanical Prosthesis

- 🕒 **Durability:** 20-30+ years.
- 💊 **Anticoagulation:** Lifelong Warfarin (INR 2.0-3.0).
- 🎯 **Target:** Age < 50-55.

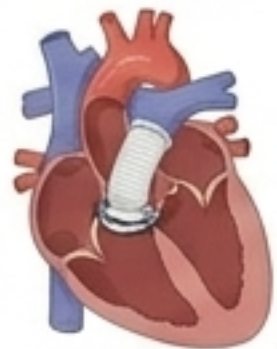
Bioprosthetic (Tissue) Valve

- 🕒 **Durability:** 10-20 years.
- 🚫💊 **Anticoagulation:** Not required long-term.
- 🎯 **Target:** Age > 65 or contraindications to anticoagulants.

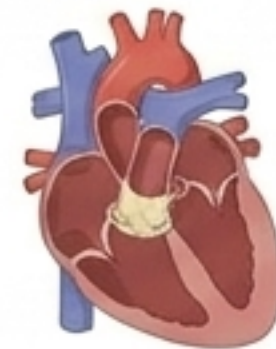
Ross Procedure

- ❤️ **Mechanism:** Pulmonary autograft to aortic position.
- 📈 **Durability:** Excellent hemodynamics.
- 🎯 **Target:** Younger patients, women of childbearing age.

Root Procedures

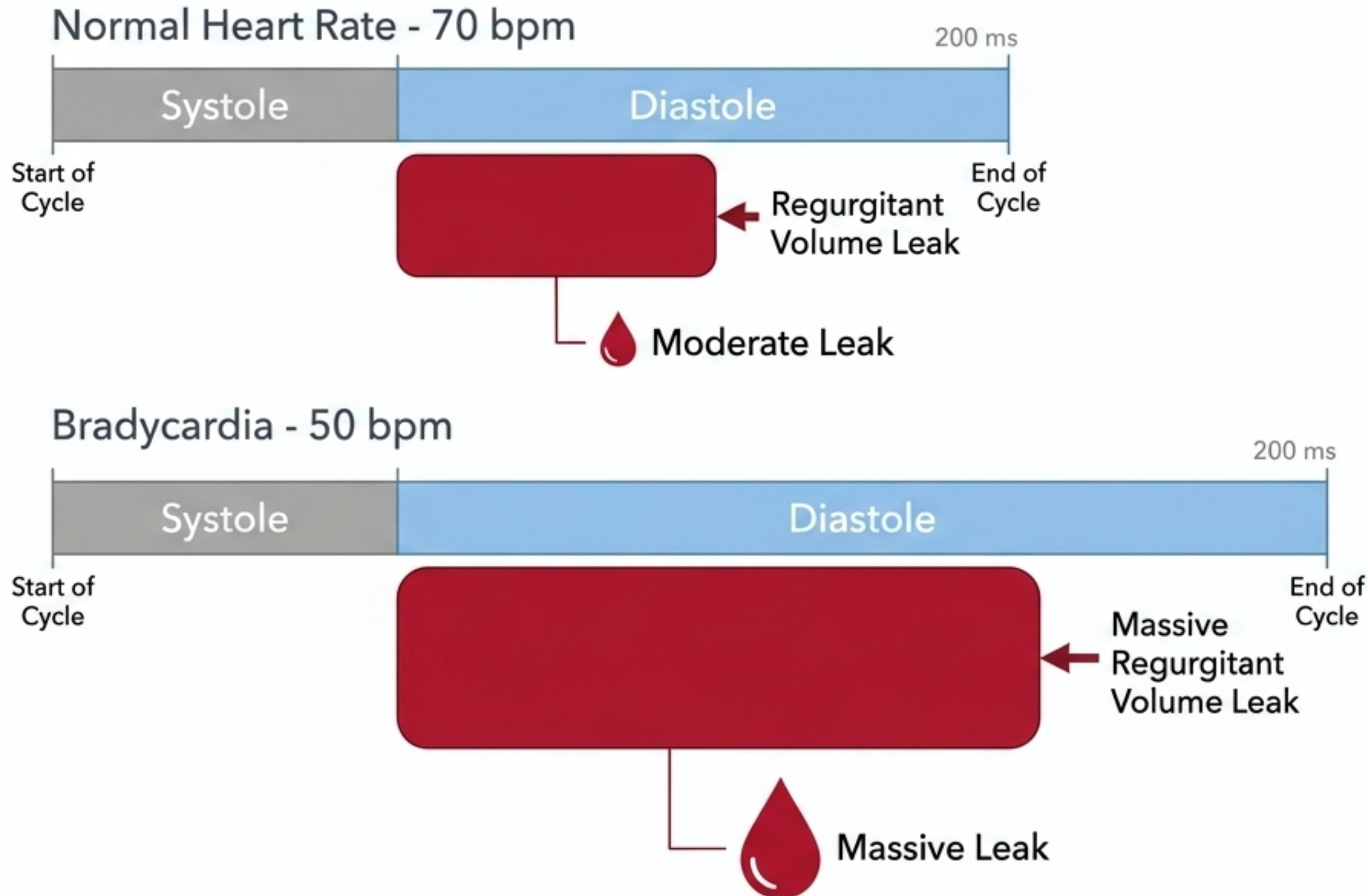


Bentall Procedure: Composite valve-graft for aneurysm.



David Procedure: Valve-sparing root replacement for pliable cusps.

The Hemodynamic Trap: Why bradycardia worsens regurgitation



Key Insight

Lowering the heart rate disproportionately prolongs diastole. More time in diastole = more time for blood to leak backward. This drastically increases regurgitant volume, spikes LV filling pressures, and precipitates failure.

Avoid rate-limiting agents in uncompensated AR.

Afterload Reduction: Chronic AR Pharmacotherapy

The Goal: Target systolic BP < 140 mmHg to minimize regurgitant volume.
Vasodilators delay remodeling but are **NOT** a substitute for surgery.



ACE Inhibitors

Ramipril / Perindopril

- **Dose:** Ramipril 2.5mg-10mg daily.
- **Caution:** Hyperkalemia, avoid in pregnancy. eGFR adjustments required.



ARBs

Irbesartan

- **Dose:** 150mg-300mg daily.
- **Caution:** Use when ACEi intolerant. Avoid dual ACEi/ARB therapy.



CCBs

Amlodipine

- **Dose:** 5mg-10mg daily.
- **Benefit:** Does not affect heart rate (avoids the bradycardia trap).



Direct Vasodilators

Hydralazine

- **Dose:** 10-75mg TDS.
- **Use:** Second-line or pregnancy-related AR.

Managing Decompensation: Acute Bridge and HFrEF

The Acute Bridge



Sodium Nitroprusside (IV)

Direct nitrovasodilator. 0.5–5 mcg/kg/min continuous infusion.

Function: Drastically reduces afterload to force forward cardiac output while awaiting theater. Requires arterial line.



Guideline-Directed Medical Therapy

For when AR causes systolic dysfunction (LVEF < 50%)



Carvedilol: **CAUTION** - use only when euvolemic. Avoid if hemodynamically uncompensated.



Spirolactone: MRA. Monitor K⁺ and eGFR.



Entresto (Sacubitril/valsartan): PBS authority for LVEF ≤ 35%.

Endocarditis Prophylaxis: Who actually requires it?



Current Australian (CSANZ) guidelines **DO NOT** recommend routine antibiotic prophylaxis for native valve AR, including bicuspid aortic valves.



Prophylaxis is reserved for highest-risk scenarios:

- Prosthetic heart valves (mechanical, bio, TAVR).
- Previous infective endocarditis.
- Repaired congenital defects with residual shunts.

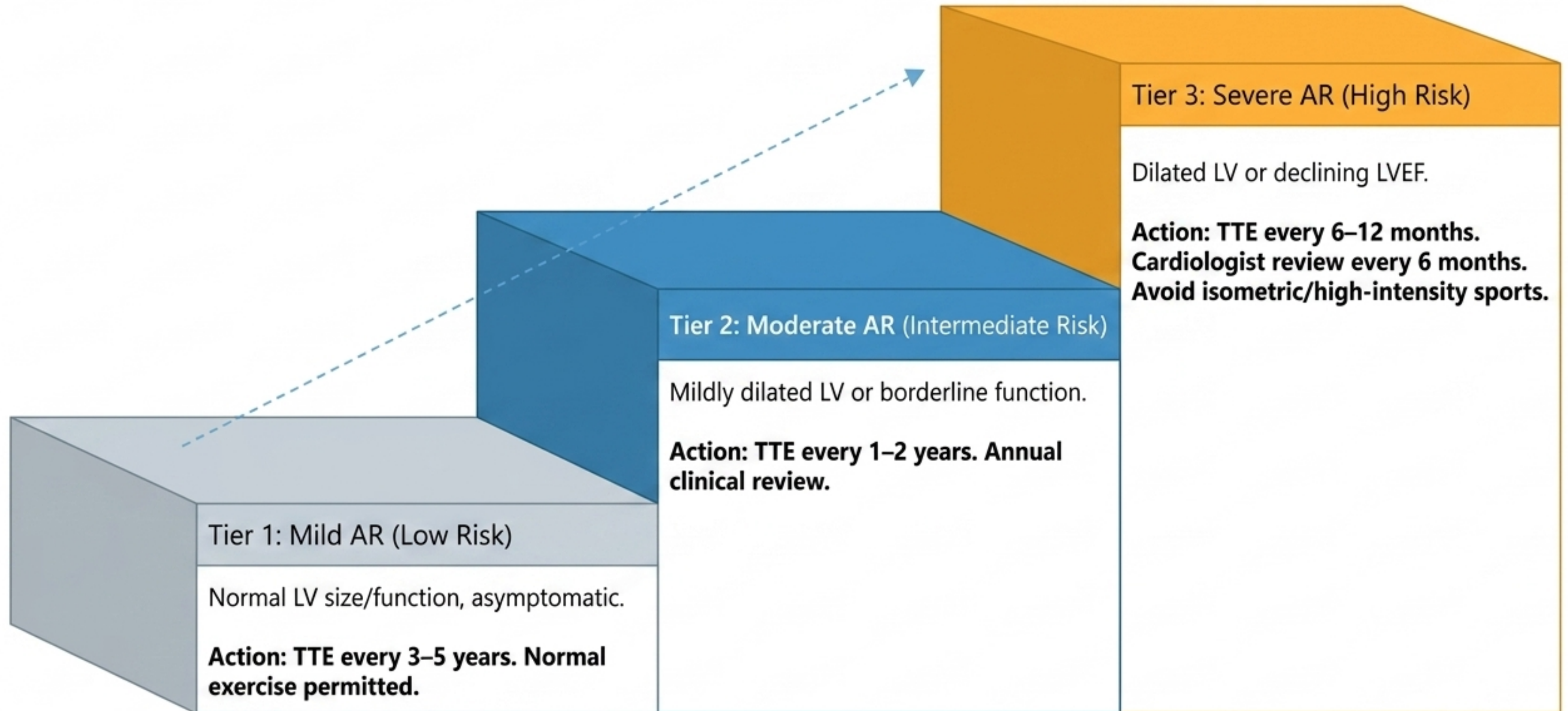
Drug Card



The Regimen

Amoxicillin 2g PO, 30–60 minutes prior to high-risk dental procedures (Clindamycin 600mg if allergic).

The Surveillance Schedule: Tracking LV Decompensation



Adapting the Pathway: Pregnancy & Paediatrics

Pregnancy



Hemodynamics

40–50% blood volume increase stresses the LV

Pharmacotherapy Rules

ACE inhibitors and ARBs are strictly contraindicated (teratogenic). Use methyldopa or nifedipine for BP

Anticoagulation

Warfarin is teratogenic in 1st trimester; switch to enoxaparin at 36 weeks

Paediatrics



Aetiology

Bicuspid valve (most common) & RHD (Indigenous youth)

Surgical Timing

Delayed to allow growth. Valve repair preferred.

The Ross Procedure

Utilized to avoid lifelong anticoagulation in growing children.

Adapting the Pathway: Renal, Hepatic & Elderly



Renal Impairment

- ACEi/ARB caution. Allow up to 30% creatinine rise; **stop if >30% or K+ >6.0.**
- Nitroprusside risk: accumulation of **cyanide/thiocyanate metabolites.**



Hepatic Impairment

- Ramipril/perindopril require hepatic activation. **Prefer enalapril (renally cleared) or hydralazine** in severe liver disease.
- **Coagulopathy** increases **surgical bleeding risk.**

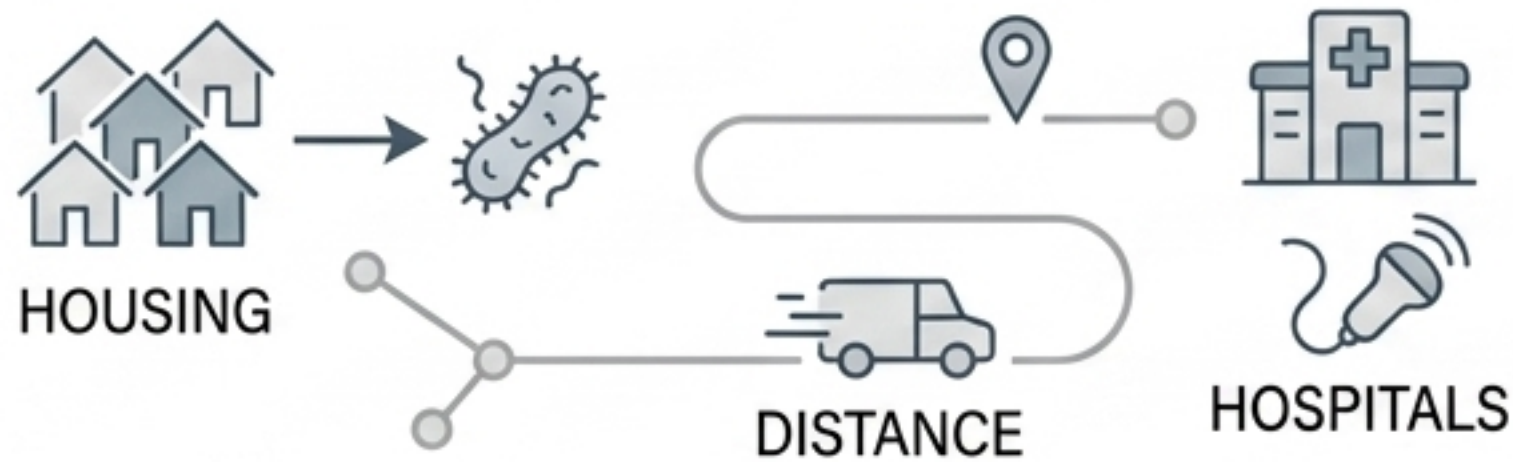


The Elderly

- Strong preference for **Bioprosthetic (tissue) valves** in >65-70 years to avoid **falls/bleeding risks from warfarin.**
- High susceptibility to **vasodilator-induced hypotension.**

Rheumatic Heart Disease: Systemic Barriers & Prophylaxis

The Landscape



Early Onset

AR presents decades earlier (ages 10-30) compared to degenerative disease.

Systemic Barriers

Overcrowded housing drives strep transmission. Remote geography limits TTE, specialist access, and timely surgical intervention.

The Clinical Mandate

- **Secondary Prophylaxis**
Benzathine Penicillin G (BPG) 1.2M units IM every 21–28 days is the cornerstone of preventing progression.
- **Engagement**
Utilize Indigenous liaison officers, patient transport schemes (PATs), and RHD Australia registries to ensure follow-up.

Synthesis: The 4 Golden Rules of AR Management



Principle 1: The Mechanical Rule

Acute severe AR is a surgical emergency. Medical therapy is only a bridge to the operating theatre. Do not wait for antibiotics to work.



Principle 2: The Hemodynamic Rule

Aggressively reduce afterload in chronic AR. Target a systolic BP < 140 mmHg using ACEi, ARBs, or CCBs.



Principle 3: The Never Rule

Never use beta-blockers or rate-limiting agents in uncompensated AR. Bradycardia drastically increases regurgitant volume.



Principle 4: The Surveillance Rule

Intervene before irreversible systolic dysfunction occurs. Relentlessly track LV dimensions (LVESD > 50mm) and LVEF ($\leq 50\%$).