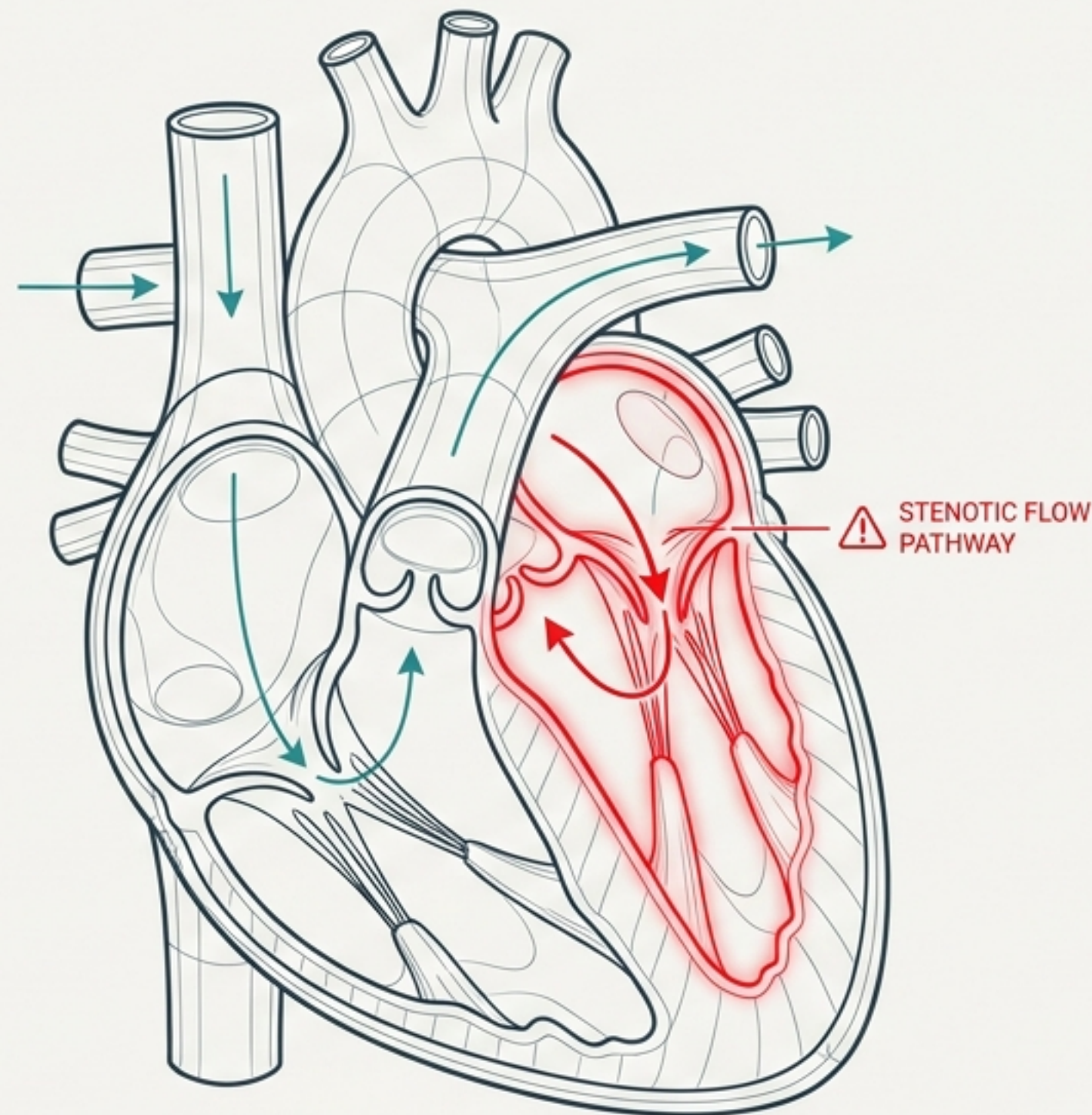
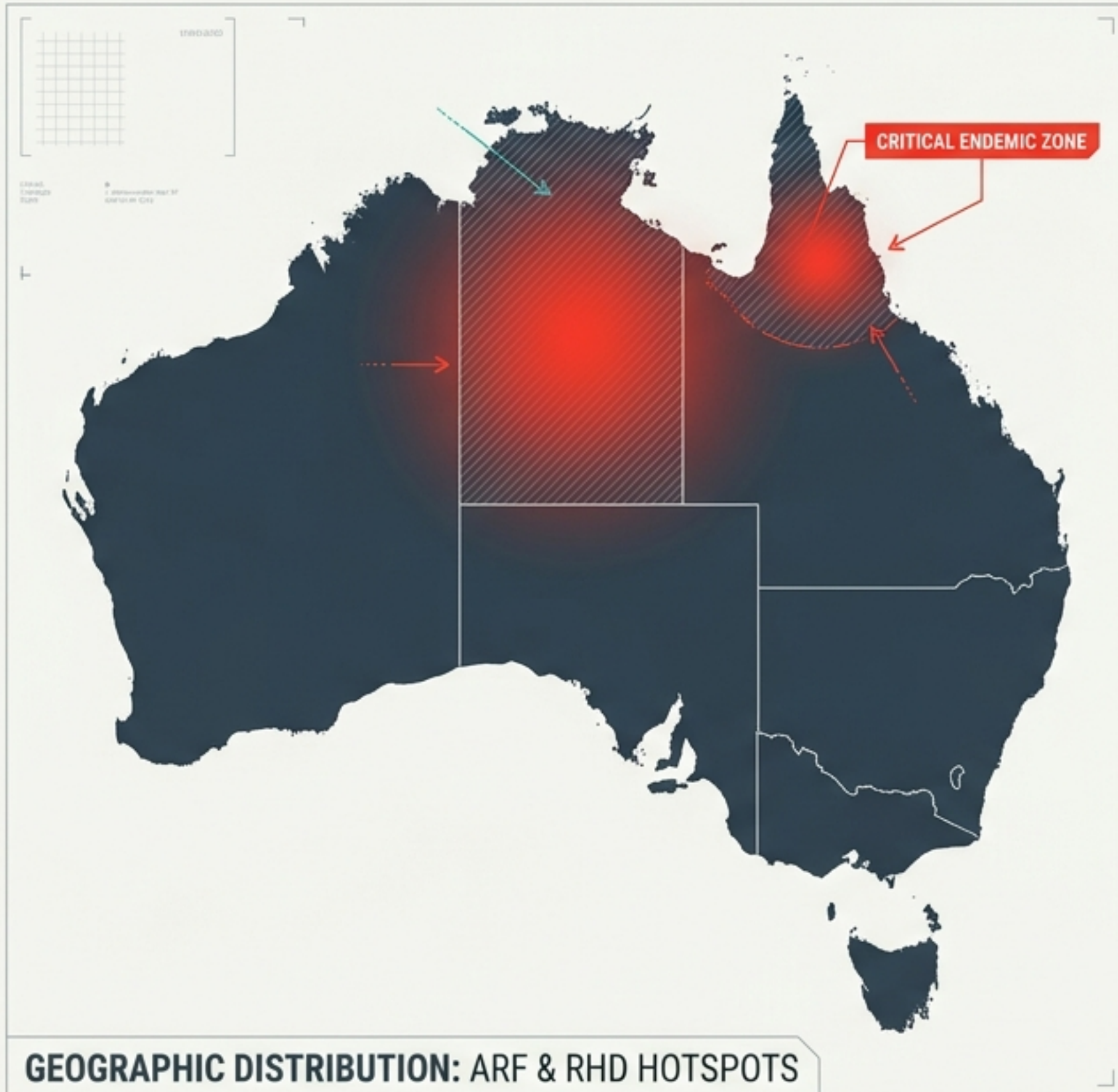


Mitral Stenosis: The Clinical Blueprint

A diagnostic and therapeutic dossier
for Australian clinical practice.



THE BURDEN OF RHEUMATIC HEART DISEASE (RHD)



THE GAP

Acute Rheumatic Fever (ARF) Incidence

54 per 100,000 vs **<2 per 100,000**

First Nations Australians

Non-Indigenous








THE DEMOGRAPHICS

- ✓ Highest global notification rates in the NT.
- ✓ Children 5–14 most affected.
- ✓ Progression to MS occurs in 20s–40s (15–20 years earlier than degenerative MS).



#1 SOURCE: 2000-2010-2015-2020-2025-2030-2035-2040-2045-2050-2055-2060-2065-2070-2075-2080-2085-2090-2095-2100-2105-2110-2115-2120-2125-2130-2135-2140-2145-2150-2155-2160-2165-2170-2175-2180-2185-2190-2195-2200-2205-2210-2215-2220-2225-2230-2235-2240-2245-2250-2255-2260-2265-2270-2275-2280-2285-2290-2295-2300-2305-2310-2315-2320-2325-2330-2335-2340-2345-2350-2355-2360-2365-2370-2375-2380-2385-2390-2395-2400-2405-2410-2415-2420-2425-2430-2435-2440-2445-2450-2455-2460-2465-2470-2475-2480-2485-2490-2495-2500-2505-2510-2515-2520-2525-2530-2535-2540-2545-2550-2555-2560-2565-2570-2575-2580-2585-2590-2595-2600-2605-2610-2615-2620-2625-2630-2635-2640-2645-2650-2655-2660-2665-2670-2675-2680-2685-2690-2695-2700-2705-2710-2715-2720-2725-2730-2735-2740-2745-2750-2755-2760-2765-2770-2775-2780-2785-2790-2795-2800-2805-2810-2815-2820-2825-2830-2835-2840-2845-2850-2855-2860-2865-2870-2875-2880-2885-2890-2895-2900-2905-2910-2915-2920-2925-2930-2935-2940-2945-2950-2955-2960-2965-2970-2975-2980-2985-2990-2995-3000-3005-3010-3015-3020-3025-3030-3035-3040-3045-3050-3055-3060-3065-3070-3075-3080-3085-3090-3095-3100-3105-3110-3115-3120-3125-3130-3135-3140-3145-3150-3155-3160-3165-3170-3175-3180-3185-3190-3195-3200-3205-3210-3215-3220-3225-3230-3235-3240-3245-3250-3255-3260-3265-3270-3275-3280-3285-3290-3295-3300-3305-3310-3315-3320-3325-3330-3335-3340-3345-3350-3355-3360-3365-3370-3375-3380-3385-3390-3395-3400-3405-3410-3415-3420-3425-3430-3435-3440-3445-3450-3455-3460-3465-3470-3475-3480-3485-3490-3495-3500-3505-3510-3515-3520-3525-3530-3535-3540-3545-3550-3555-3560-3565-3570-3575-3580-3585-3590-3595-3600-3605-3610-3615-3620-3625-3630-3635-3640-3645-3650-3655-3660-3665-3670-3675-3680-3685-3690-3695-3700-3705-3710-3715-3720-3725-3730-3735-3740-3745-3750-3755-3760-3765-3770-3775-3780-3785-3790-3795-3800-3805-3810-3815-3820-3825-3830-3835-3840-3845-3850-3855-3860-3865-3870-3875-3880-3885-3890-3895-3900-3905-3910-3915-3920-3925-3930-3935-3940-3945-3950-3955-3960-3965-3970-3975-3980-3985-3990-3995-4000-4005-4010-4015-4020-4025-4030-4035-4040-4045-4050-4055-4060-4065-4070-4075-4080-4085-4090-4095-4100-4105-4110-4115-4120-4125-4130-4135-4140-4145-4150-4155-4160-4165-4170-4175-4180-4185-4190-4195-4200-4205-4210-4215-4220-4225-4230-4235-4240-4245-4250-4255-4260-4265-4270-4275-4280-4285-4290-4295-4300-4305-4310-4315-4320-4325-4330-4335-4340-4345-4350-4355-4360-4365-4370-4375-4380-4385-4390-4395-4400-4405-4410-4415-4420-4425-4430-4435-4440-4445-4450-4455-4460-4465-4470-4475-4480-4485-4490-4495-4500-4505-4510-4515-4520-4525-4530-4535-4540-4545-4550-4555-4560-4565-4570-4575-4580-4585-4590-4595-4600-4605-4610-4615-4620-4625-4630-4635-4640-4645-4650-4655-4660-4665-4670-4675-4680-4685-4690-4695-4700-4705-4710-4715-4720-4725-4730-4735-4740-4745-4750-4755-4760-4765-4770-4775-4780-4785-4790-4795-4800-4805-4810-4815-4820-4825-4830-4835-4840-4845-4850-4855-4860-4865-4870-4875-4880-4885-4890-4895-4900-4905-4910-4915-4920-4925-4930-4935-4940-4945-4950-4955-4960-4965-4970-4975-4980-4985-4990-4995-5000-5005-5010-5015-5020-5025-5030-5035-5040-5045-5050-5055-5060-5065-5070-5075-5080-5085-5090-5095-5100-5105-5110-5115-5120-5125-5130-5135-5140-5145-5150-5155-5160-5165-5170-5175-5180-5185-5190-5195-5200-5205-5210-5215-5220-5225-5230-5235-5240-5245-5250-5255-5260-5265-5270-5275-5280-5285-5290-5295-5300-5305-5310-5315-5320-5325-5330-5335-5340-5345-5350-5355-5360-5365-5370-5375-5380-5385-5390-5395-5400-5405-5410-5415-5420-5425-5430-5435-5440-5445-5450-5455-5460-5465-5470-5475-5480-5485-5490-5495-5500-5505-5510-5515-5520-5525-5530-5535-5540-5545-5550-5555-5560-5565-5570-5575-5580-5585-5590-5595-5600-5605-5610-5615-5620-5625-5630-5635-5640-5645-5650-5655-5660-5665-5670-5675-5680-5685-5690-5695-5700-5705-5710-5715-5720-5725-5730-5735-5740-5745-5750-5755-5760-5765-5770-5775-5780-5785-5790-5795-5800-5805-5810-5815-5820-5825-5830-5835-5840-5845-5850-5855-5860-5865-5870-5875-5880-5885-5890-5895-5900-5905-5910-5915-5920-5925-5930-5935-5940-5945-5950-5955-5960-5965-5970-5975-5980-5985-5990-5995-6000-6005-6010-6015-6020-6025-6030-6035-6040-6045-6050-6055-6060-6065-6070-6075-6080-6085-6090-6095-6100-6105-6110-6115-6120-6125-6130-6135-6140-6145-6150-6155-6160-6165-6170-6175-6180-6185-6190-6195-6200-6205-6210-6215-6220-6225-6230-6235-6240-6245-6250-6255-6260-6265-6270-6275-6280-6285-6290-6295-6300-6305-6310-6315-6320-6325-6330-6335-6340-6345-6350-6355-6360-6365-6370-6375-6380-6385-6390-6395-6400-6405-6410-6415-6420-6425-6430-6435-6440-6445-6450-6455-6460-6465-6470-6475-6480-6485-6490-6495-6500-6505-6510-6515-6520-6525-6530-6535-6540-6545-6550-6555-6560-6565-6570-6575-6580-6585-6590-6595-6600-6605-6610-6615-6620-6625-6630-6635-6640-6645-6650-6655-6660-6665-6670-6675-6680-6685-6690-6695-6700-6705-6710-6715-6720-6725-6730-6735-6740-6745-6750-6755-6760-6765-6770-6775-6780-6785-6790-6795-6800-6805-6810-6815-6820-6825-6830-6835-6840-6845-6850-6855-6860-6865-6870-6875-6880-6885-6890-6895-6900-6905-6910-6915-6920-6925-6930-6935-6940-6945-6950-6955-6960-6965-6970-6975-6980-6985-6990-6995-7000-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Etiology Profile

Icon	Aetiology	Mechanism	Australian Context
	Rheumatic Heart Disease (>90% globally)	Inflammatory commissural fusion, chordal shortening, calcification.	Leading cause in First Nations Australians; peak onset 20–40 years.
	Congenital MS	Parachute valve, double-orifice, supra-annular ring.	Rare; infant presentation; Shone complex association.
	Prosthetic Valve Stenosis	Thrombus, pannus, calcification.	Increasing in ageing surgical population.
	Mitral Annular Calcification (MAC)	Severe calcification encroaching on leaflets.	Elderly, CKD, metabolic bone disease.
	Infiltrative / Mass	Left atrial myxoma, Libman-Sacks (SLE), carcinoid.	Rare; requires high clinical suspicion.

The Pathophysiology Cascade

1. The Trigger

Fixed obstruction to LV inflow ($MVA < 2.0 \text{ cm}^2$)

2. Atrial Impact

Left Atrial (LA) pressure elevation → LA dilation → Atrial Fibrillation (30–40% of patients)

3. Pulmonary Impact

Passive pulmonary venous congestion → Dyspnea, orthopnea, PND

4. Vascular Impact

Reactive pulmonary arterial vasoconstriction → Pulmonary Arterial Hypertension (PAH)

5. Right Heart Impact

RV pressure overload → RV dilatation → Tricuspid regurgitation → Right heart failure

6. Systemic Impact

Low cardiac output → Fatigue and systemic hypoperfusion

Hemodynamics: The Rate-Pressure Fulcrum



Core Principle

The transmitral gradient depends on valve area and transvalvular flow. Tachycardia shortens diastolic filling time, disproportionately driving up Left Atrial pressure.

Therapeutic Axiom

Heart rate control is critical. MS is a preload-dependent lesion. Excessive diuresis or vasodilation causes immediate hemodynamic collapse.

Echocardiographic Severity Grading

Mild

MVA $> 1.5 \text{ cm}^2$
Mean Gradient $< 5 \text{ mmHg}$
PASP $< 30 \text{ mmHg}$ (rest)
Asymptomatic.

Action:
Monitor every 1–2 years.

Moderate

MVA $1.0\text{--}1.5 \text{ cm}^2$
Mean Gradient $5\text{--}10 \text{ mmHg}$
PASP $30\text{--}50 \text{ mmHg}$
Symptoms on exertion
(NYHA II-III).

Action:
Cardiology review, consider
intervention.

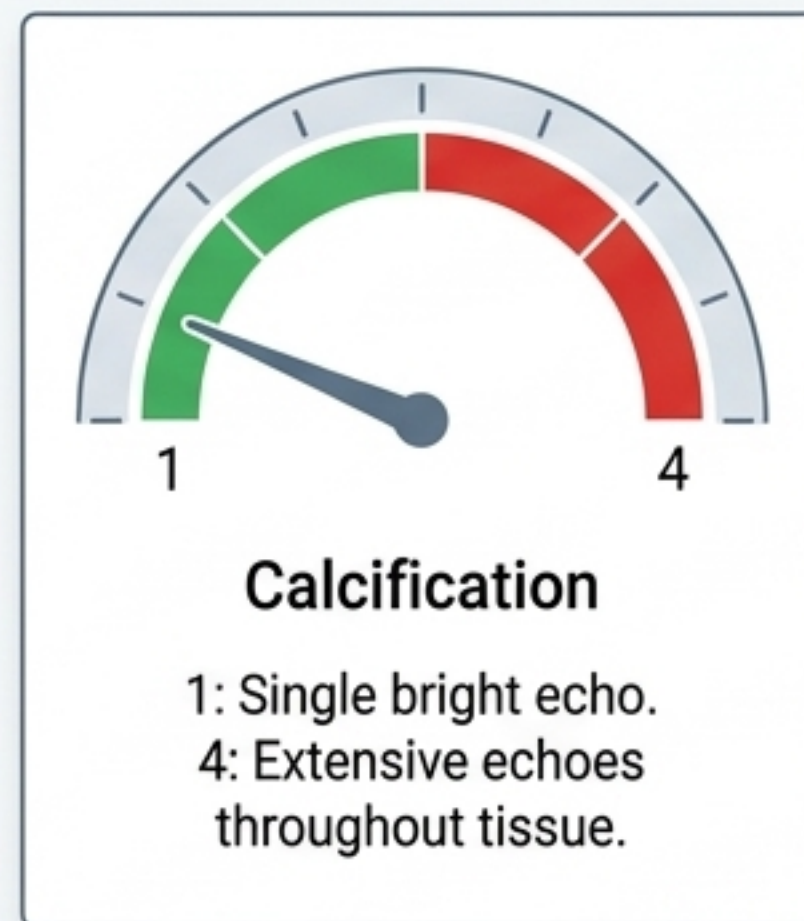
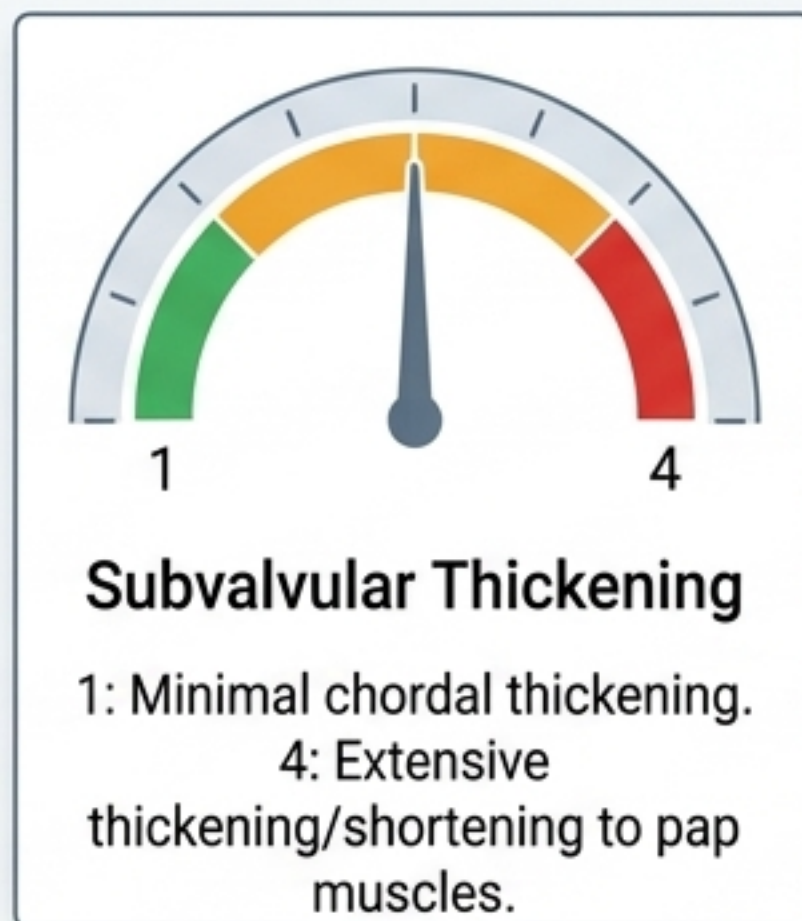
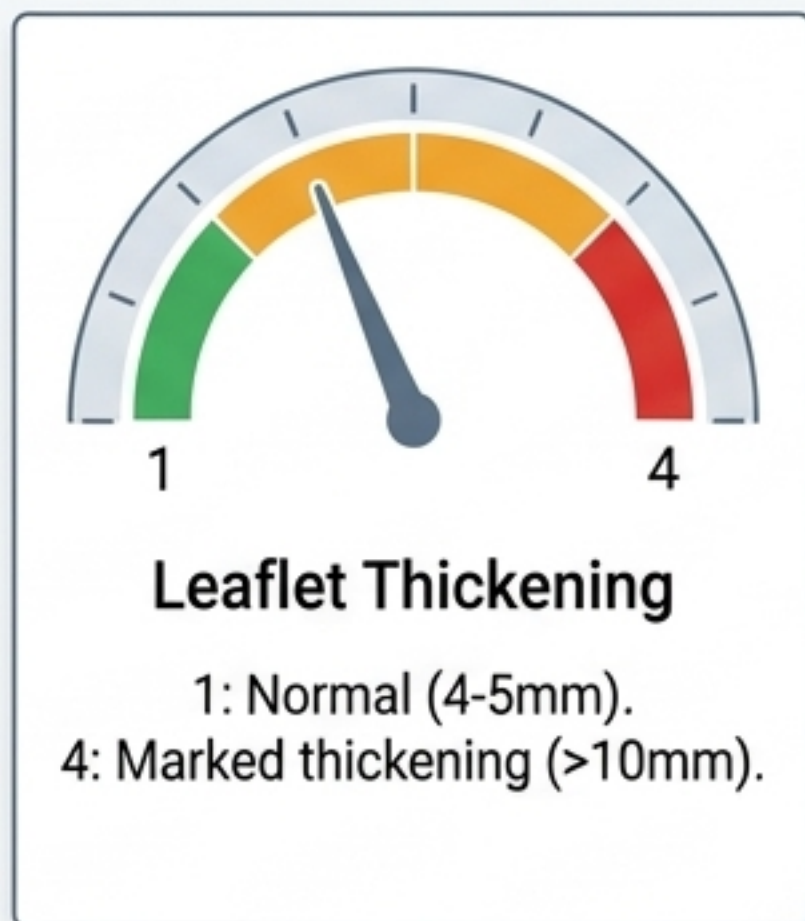
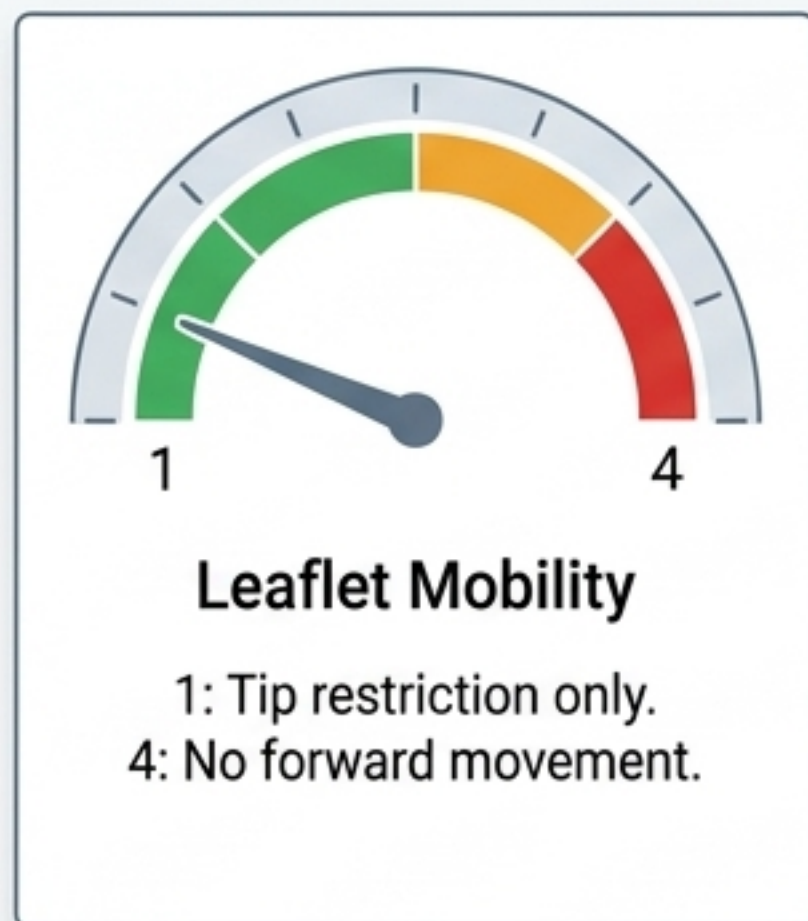
Severe

MVA $< 1.0 \text{ cm}^2$
Mean Gradient $> 10 \text{ mmHg}$
PASP $> 50 \text{ mmHg}$ (rest)
Symptoms at rest
(NYHA III-IV).

Action:
Urgent referral, intervention
indicated.

Echocardiographic Notes: Planimetry (direct tip measurement) is the most accurate method. Normal MVA is $4.0\text{--}6.0 \text{ cm}^2$. Pressure half-time (PHT) is less reliable post-PMBC or with aortic regurgitation.

The Wilkins Score (PMBC Suitability)



Total Score Interpretation (Range 4-16)

Surgical teal

Clinical amber

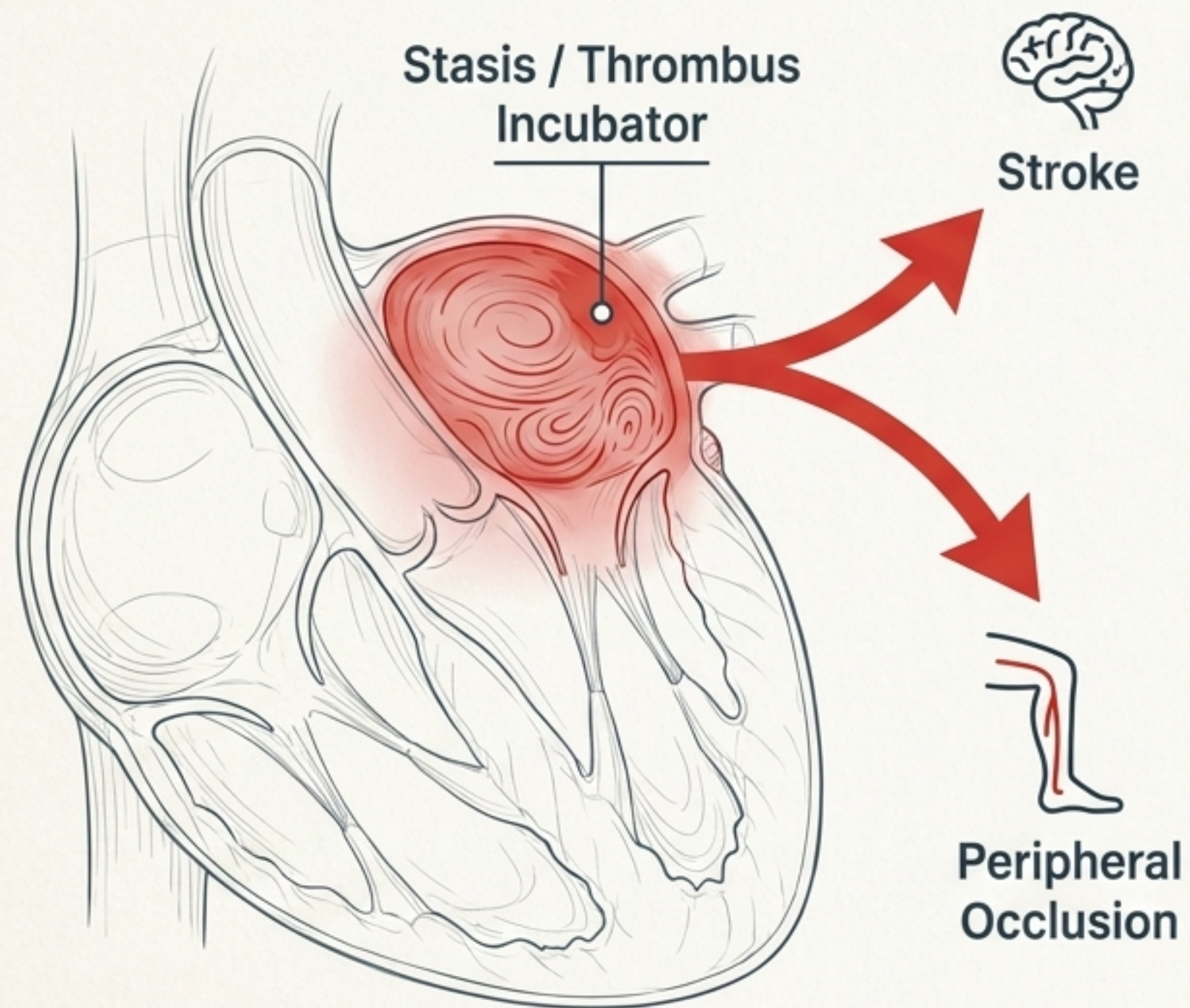
Arterial red

Score ≤ 8 : Good PMBC candidate.

Score 9-11: Borderline (Heart Team/TOE).

Score ≥ 12 : PMBC contraindicated (Surgery).

The Thromboembolic Milieu



The Mechanism

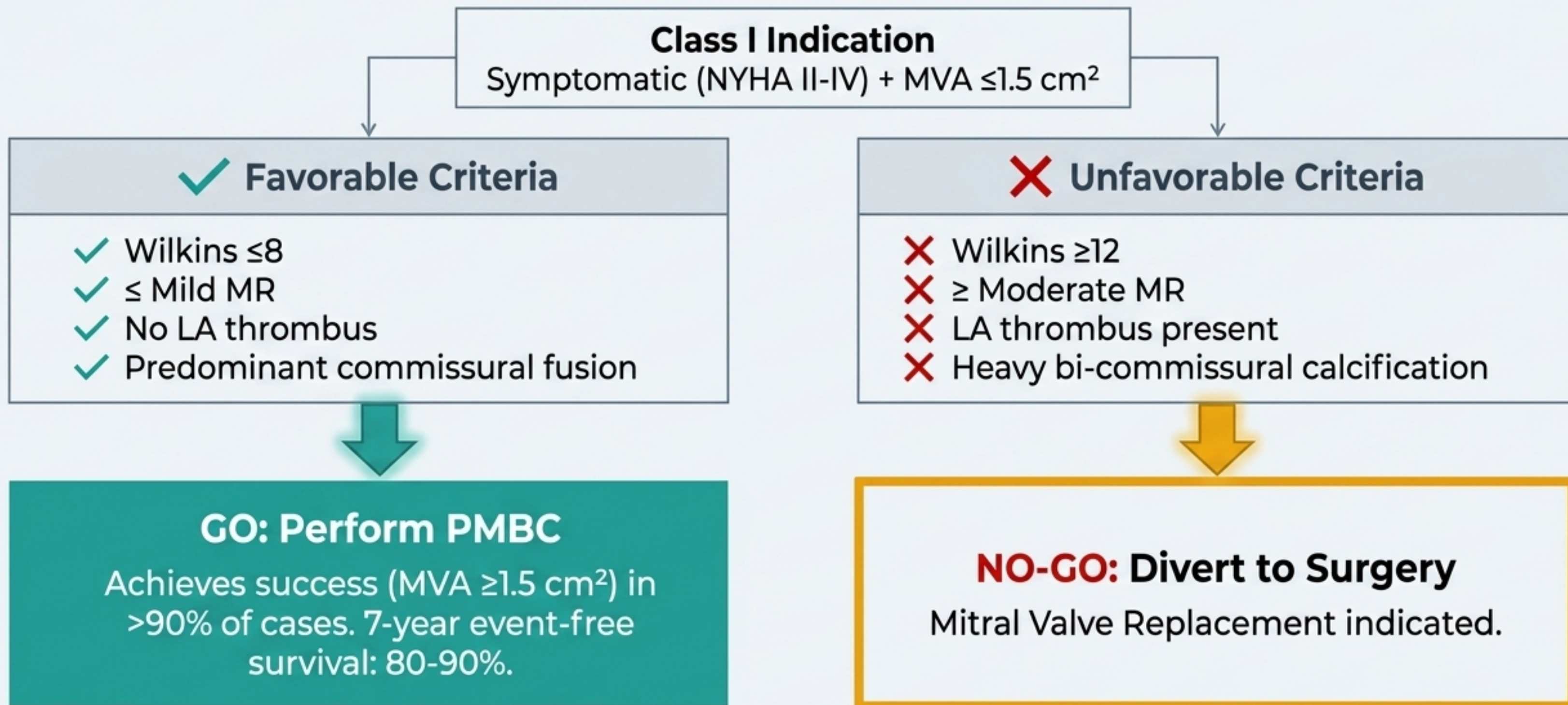
Left Atrial dilation combined with Atrial Fibrillation creates a highly pro-thrombotic environment. The LAA is the primary site of thrombus formation.

The Impact

Systemic embolization (stroke, peripheral arterial occlusion) occurs in 10–20% of patients with MS and AF.

PROCEDURAL MANDATE: Transesophageal Echocardiography (TOE) is strictly mandatory before PMBC or cardioversion to exclude LAA thrombus.

Intervention Algorithm: PMBC



PMBC Complications to Monitor: Severe MR (2-5%), Tamponade (0.5-1%), Embolization (0.5-2%), Residual ASD (20-40%).

The Intervention Spectrum



Percutaneous Mitral Balloon Commissurotomy (PMBC)

- **Ideal Profile:** Pliable valves, Wilkins ≤ 8 , young patients.
- **Advantage:** Minimally invasive, >90% success in expert centers.
- **Drawback:** Cannot fix heavily calcified or subvalvular disease.



Open Commissurotomy

- **Ideal Profile:** Young, pliable subvalvular apparatus, PMBC unavailable or failed.
- **Advantage:** Preserves native valve, avoids lifelong anticoagulation.
- **Drawback:** 10-20% restenosis at 10 years, 1-2% operative mortality.



Mitral Valve Replacement (MVR)

- **Ideal Profile:** Severely distorted/calcified valve (Wilkins ≥ 12), failed PMBC, severe MR.
- **Advantage:** Definitive treatment for complex anatomy.
- **Drawback:** 2-5% mortality, requires lifelong anticoagulation or accepts limited bioprosthetic durability.

Prosthetic Selection Matrix



Mechanical Prosthesis

- ⦿ **Target Age:** <60 years.
- ⦿ **Durability:** Excellent / Lifelong (degeneration <0.5%/yr).
- ⦿ **Anticoagulation:** Lifelong Warfarin required (Target INR 2.5–3.5).
- ⦿ **Key Risks:** Bleeding (1-3%/yr), Thromboembolism (1-2%/yr).
- ⦿ **Contraindicated:** Pregnancy planning, inability to comply with INR monitoring.






Bioprosthetic Prosthesis



- ⦿ **Target Age:** ≥60 years (or contraindications to Warfarin).
- ⦿ **Durability:** 10–20 years (faster deterioration in younger patients).
- ⦿ **Anticoagulation:** Warfarin for 3–6 months, then Aspirin only.
- ⦿ **Advantage:** Lower thrombogenicity, safe for pregnancy.
- ⦿ **Drawback:** Structural valve deterioration requiring reoperation.

Emerging Tech Note: Transcatheter Mitral Valve Replacement (TMVR) is emerging for valve-in-valve or MAC, but is NOT standard therapy for native MS.

Medical Arsenal: Rate Control (AF)

Rx	Rx: Beta-Blockers (First-Line)	
	Drugs: Atenolol (25-100mg), Metoprolol SR (47.5-190mg). Target: Resting HR <90 bpm. Adjustment: Atenolol requires dose reduction if eGFR <30.	Status: General Benefit 
Rx	Rx: Non-Dihydropyridine CCBs	
	Drugs: Verapamil SR (180-480mg), Diltiazem CD (180-360mg). Warning: Strictly contraindicated with HFrEF. Do not combine with beta-blockers.	Status: General Benefit 
Rx	Rx: Digoxin (Adjunct)	
	Dose: 62.5–250 mcg daily (Level 0.5–0.9 ng/mL). Role: Adjunct for persistent symptoms or co-existing HFrEF. Adjustment: Reduce dose by 50% if eGFR 10–30.	Status: General Benefit 

Medical Arsenal: Volume & Rhythm

Rx	Rx: Frusemide	
	Dose: 20-80mg PO daily. 20-40mg IV for acute edema. Warning: Excessive diuresis drops preload and causes critical loss of Adjustment: Escalate doses (up to 250mg IV) in severe CKD.	Status: General Benefit 
Rx	Rx: Spironolactone	
	Dose: 25-50mg PO daily. Role: Mild potassium-sparing adjunct diuretic. Warning: Contraindicated if K ⁺ >5.0 or eGFR <30.	Status: General Benefit 
Rx	Rx: Amiodarone (Rhythm Control)	
	Role: Consider only after successful mechanical intervention reduces LA pressure. Warning: Interacts with Warfarin (increases effect by 30-50%). Requires TFT/LFT monitoring. Cardioversion Caveat: If AF >48h, TOE is mandatory to exclude LAA thrombus prior to cardioversion.	

Medical Arsenal: Anticoagulation

Rx

Rx: Warfarin

Indications:

AF with MS, Mechanical valve,
Prior embolism, LA >55mm.

Targets:

INR 2.0–3.0 (AF);
INR 2.5–3.5 (Mechanical Valve).

Warnings:

Teratogenic (Category X).
High drug and food interactions.

Status: **General Benefit** 



**DIRECT ORAL ANTICOAGULANTS
ARE NOT RECOMMENDED.**

DOACs are strictly contraindicated for MS-related AF. Major trials (e.g., ENGAGE AF-TIMI 48) excluded patients with significant Mitral Stenosis.

**Warfarin remains the mandatory
standard of care.**

Medical Arsenal: Secondary Prophylaxis

Rx

Rx: Benzathine Penicillin G (BPG) – The Preventative Cornerstone

- **Adult Dose:** 1.2 million units IM every 28 days (21 days if breakthrough).
- **Peds Dose:** 600,000 units (<30kg).
- **Duration:** Minimum 10 years or age 21; often lifelong for severe MS.
- **Logistics:** Deep IM injection, rotate sites, cold chain maintenance is essential.

Status: 
General Benefit



Endocarditis Guidelines

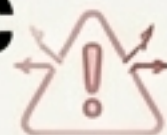
Routine antibiotic prophylaxis for infective endocarditis is NOT recommended for native valve MS prior to dental procedures.

Reserve prophylaxis strictly for patients with prosthetic valves or a prior history of endocarditis.

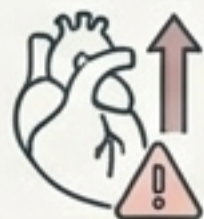


Contextual Care: Pregnancy

The Hemodynamic Trap



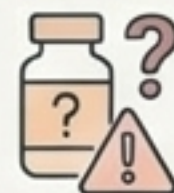
Pregnancy increases cardiac output (30-50%) and heart rate.



A fixed MS obstruction creates **extreme vulnerability** to sudden pulmonary edema, peaking in the 2nd trimester and peripartum period.

(Risk: WHO III/IV).

The Warfarin Dilemma



Warfarin is highly teratogenic (weeks 6-12).

Strategy: Transition to LMWH in the 1st trimester, switch back to Warfarin for 2nd/3rd, and use UFH for the peripartum delivery window.



Intervention & Delivery



PMBC can be safely performed in the 2nd trimester using fetal shielding.



Vaginal delivery is preferred (utilizing epidural to blunt pain-induced tachycardia).

Preconception PMBC is strongly advised.



Contextual Care: Age & Organ Function



Elderly Populations

Non-Indigenous MS is predominantly due to Mitral Annular Calcification (MAC). High frailty and bleeding risks (calculate HAS-BLED). Bioprosthetic valves are preferred. PMBC is often impossible due to heavy calcification.



Renal Impairment

Furosemide requirements increase drastically with lower eGFR. Digoxin mandates a 50% dose reduction (or alternate days if eGFR <10). MAC prevalence and severity are heavily accelerated in dialysis cohorts.

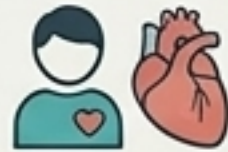


Hepatic Impairment

Right heart failure directly causes congestive hepatopathy. Liver dysfunction significantly increases Warfarin sensitivity (initiate at low doses of 1-2 mg). Avoid Amiodarone in severe disease.

Contextual Care: Pediatrics & Immunosuppression

Pediatric Considerations



Congenital MS

Presents in infancy with failure to thrive and pulmonary edema, frequently associated with Shone complex.



Rheumatic Disease

First Nations children present with ARF as young as 5 years old. Severe MS can develop by early adolescence if secondary prophylaxis fails.



Surgical Choice

Bioprosthetics are preferred to **avoid Warfarin** in growing children, despite lacking long-term durability.

Immunocompromised Patients



Endocarditis Risk

Exceedingly high risk of infective endocarditis during bacteremia. High mortality associated with prosthetic valve infections.



RHD Overlap

Must continue BPG prophylaxis. Immunosuppressive therapy does **NOT** alter the risk of Group A Strep recurrence, but it may mask the clinical presentation of ARF.

The Dual Paradigm of Mitral Stenosis

High-Tech (The Palliative)

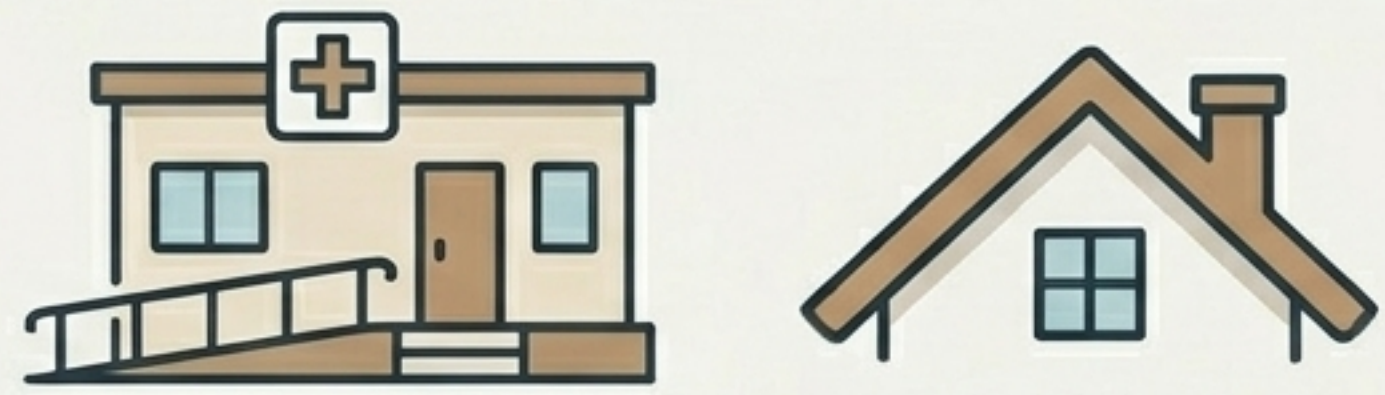


Focus: Tertiary Care.

Tools: PMBC, Transseptal punctures, Mechanical valves, TOE.

Insight: Fixing the valve treats the immediate mechanical failure, but is fundamentally palliative. It does not arrest the underlying disease process.

High-Touch (The Preventative)

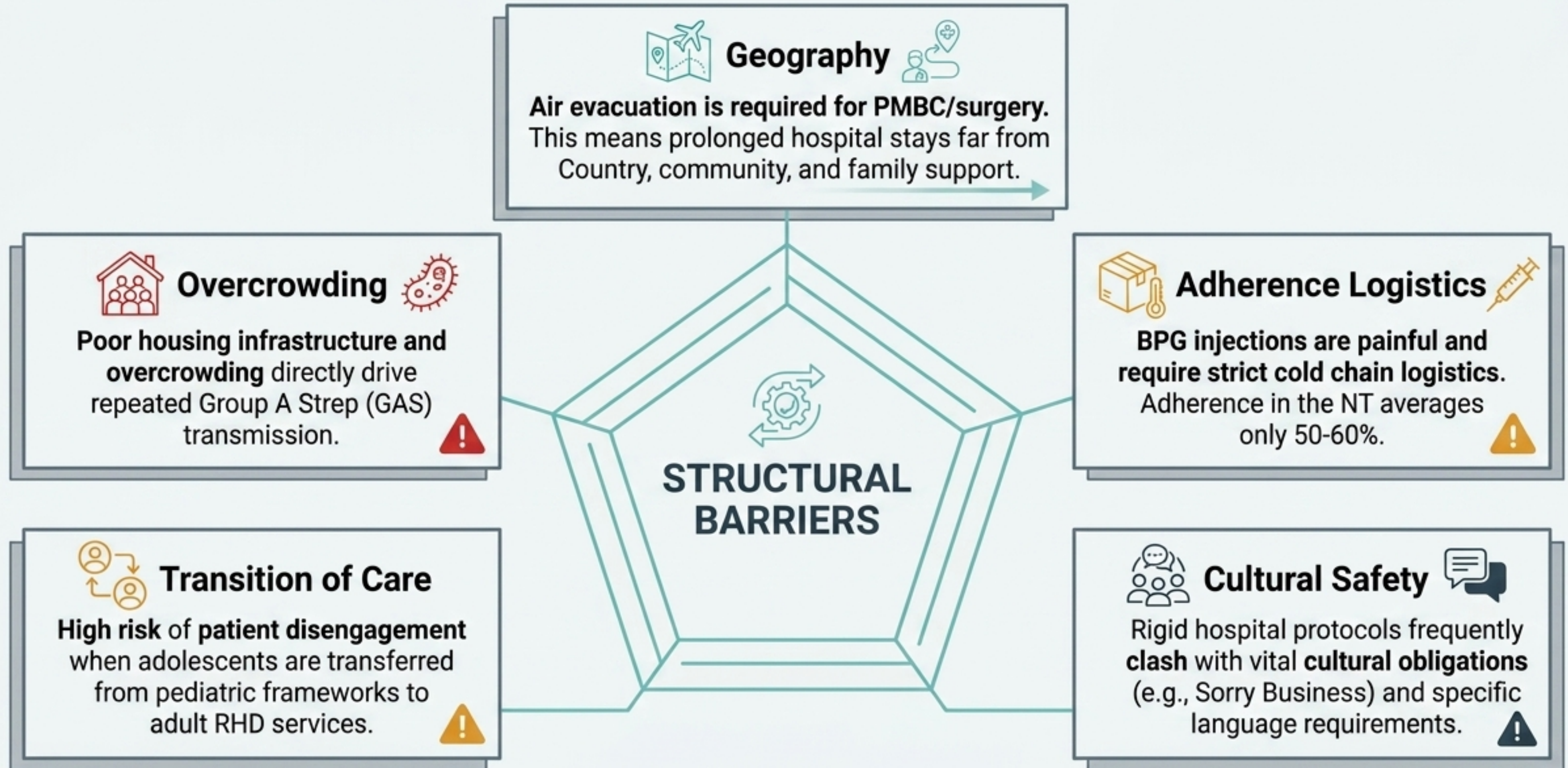


Focus: Primary Care & Public Health.

Tools: BPG injections, Culturally safe clinics, Housing infrastructure.

Insight: Fixing the environment and ensuring prophylaxis adherence is preventative. It stops the mechanical lesion from ever forming.

First Nations Context: Structural Barriers



Recommended Actions for Clinicians



1 Register: Mandate registration of patients on jurisdictional RHD databases (e.g., NT RHD Australia) to ensure recall.



2 Adherence: Liaise actively with community health to guarantee the 28-day BPG injection is administered on time.



3 Cultural Safety: Engage Aboriginal health workers and systematically utilize professional interpreter services.



4 Screen: Offer GAS screening and treatment to all household contacts of ARF cases.



5 Refer Early: Plan for PMBC or Surgery long before severe RV failure develops. Utilize telehealth to bridge geography.

HEALTH EQUITY IMPERATIVE: MS is a disease of inequity. Under the National Agreement on Closing the Gap, all clinicians share a mandate to advocate for the structural determinants that perpetuate RHD.