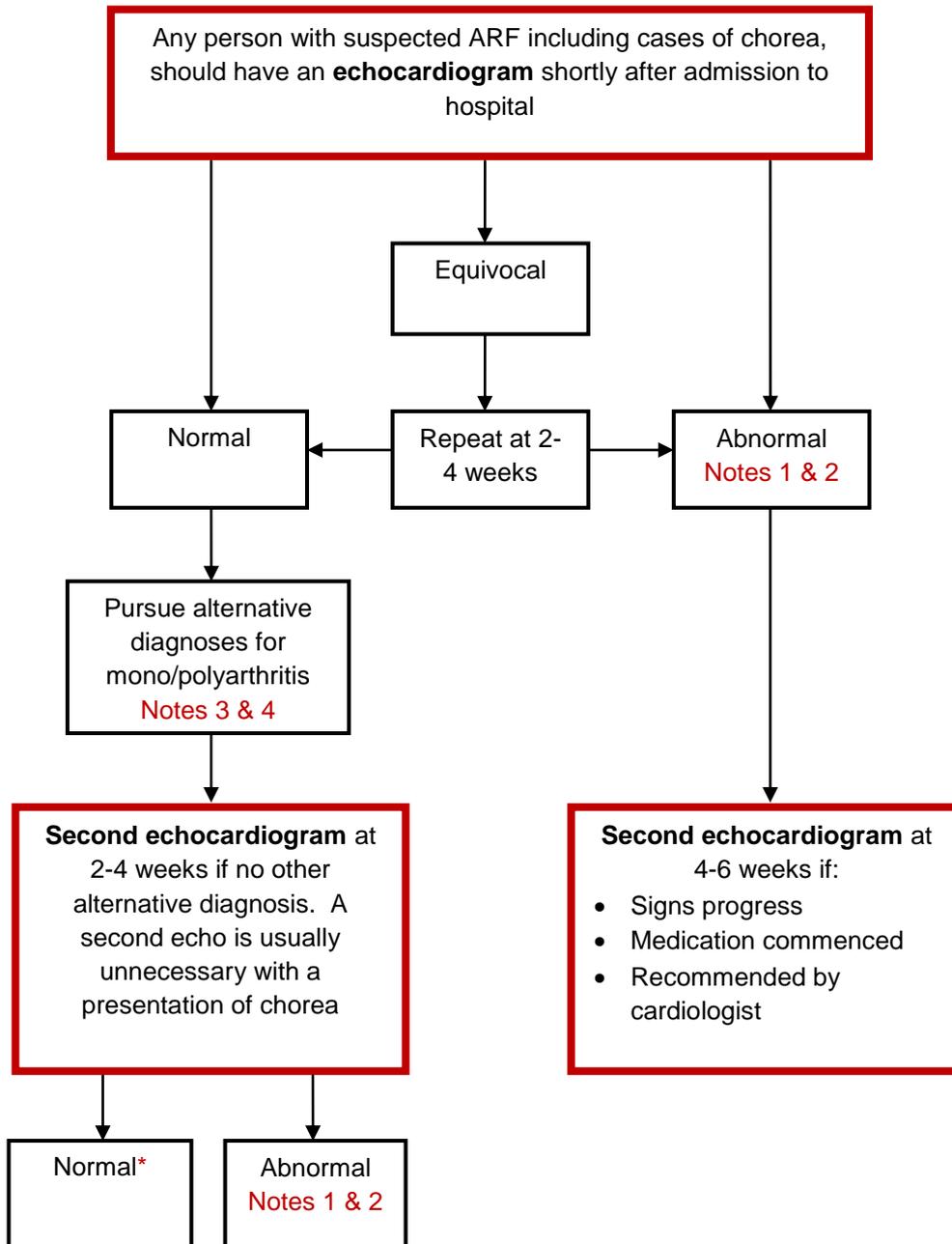


Algorithm 2: Guide for the use of echocardiography in acute rheumatic fever (ARF)



Footnote:

* The diagnosis of ARF can still be made in the absence of abnormal echo change.



Note 1

Minimal Echocardiographic Criteria to Allow a Diagnosis of Pathological Valvular Regurgitation¹

Mitral Regurgitation

- Seen in 2 views
- In at least 1 view jet length >2cm*
- Peak velocity \geq 3m/sec
- Pan-systolic jet in at least one envelope

Aortic Regurgitation

- Seen in 2 views
- In at least one view jet length >1cm*
- Peak velocity \geq 3m/sec
- Pan-diastolic jet in at least one envelope

These criteria can usually readily distinguish a small colour jet of physiological regurgitation in a normal child from pathological regurgitation in a child with ARF or RHD. The proportion of children with physiological valve regurgitation in a New Zealand population was 15%² and this proportion increases in later decades³

If the aetiology of aortic or mitral regurgitation on Doppler echocardiography is not clear, the following features support a diagnosis of rheumatic valve damage:

- Both mitral and aortic valves have pathological regurgitation
- The mitral regurgitant jet is directed posteriorly, as excessive leaflet motion of the tip of anterior mitral valve leaflet (often referred to as prolapse) is the commonest mechanism of mitral regurgitation. Anterior valve prolapse is more common than posterior valve prolapse
- Multiple jets of mitral regurgitation
- The presence of morphological or anatomical changes consistent with chronic RHD¹ (see guideline update), are:
 - Excessive leaflet motion of the tips of the AMVL or PMVL
 - Restrictive leaflet motion (including subchordal thickening)^{†,‡}
 - Definite thickening of anterior mitral valve leaflets > 3mm
 - Mitral stenosis with a mean valve gradient \geq 4mmHg

Source: Original studies described by Wilson N J. & Neutze J M.³ These criteria further evolved as part of the development of both the New Zealand and the Australian guidelines on rheumatic fever diagnosis (2006)^{4,5,6} and the WHO working groups on echocardiography⁷ and most recently in the 2012 WHF guidelines for echocardiographic diagnosis of rheumatic heart disease¹

* *Echocardiography allows the operator to comment on the appearance of valves that are affected by rheumatic inflammation. The degree of thickening gives some insight into the duration of valvulitis, no significant thickening occurs in the first weeks of acute rheumatic carditis (Level IV – see guideline update)*

† *Only after several months is immobility of the subchordal apparatus and posterior leaflet observed. Several other findings have also been reported, including acute nodules, seen as a beaded appearance of the mitral valve leaflets.⁸ Although none of these morphological features are unique to ARF, the experienced echocardiographic operator can use their presence as supportive evidence of a rheumatic aetiology of valvulitis*

‡ *It is recommended that descriptive terms such as 'elbow' or 'dog leg' or 'hockey stick' deformity of anterior mitral valve leaflet be avoided: such appearances are due to the combination of valve thickening and restrictive valve motion.¹*

Note 2

Severity of ARF Carditis

Mild Carditis*

- Mild mitral or aortic regurgitation clinically and/or on echocardiography (fulfilling the minimal echo standards in [Note 1](#)) without heart failure, without cardiac chamber enlargement on CXR, ECG or echocardiography

Moderate Carditis

- Any valve lesion of moderate severity clinically on clinical examination **or**
- Cardiac chamber enlargement seen on echocardiogram **or**
- Any valve lesion graded as moderate on echocardiogram:[†]
 - Regurgitation is considered moderate if there is a broad high-intensity proximal jet filling half the left atrium i.e. Mitral or a lesser volume high-intensity jet producing prominent blunting of pulmonary venous inflow⁹
 - Aortic regurgitation is considered moderate if the diameter of the regurgitant jet is 15% to 30% of the diameter of the left ventricular outflow tract with flow reversal in upper descending aorta⁹

Severe Carditis

- Any impending or previous cardiac surgery for RHD, **or**
- Any valve lesion associated with significant cardiomegaly or heart failure, **or** graded as severe on clinical examination
- Any valve lesion graded as severe on echocardiogram:
 - An abnormal regurgitant colour and Doppler flow patterns in pulmonary veins is a prerequisite for severe mitral regurgitation in children⁹
 - Doppler reversal in lower descending aorta is required for the diagnosis of severe aortic regurgitation in children.⁹
 - In adults, Doppler flow reversal in the pulmonary veins (for severe MR) or abdominal aorta (for severe AR) is specific if present, but can be more difficult to detect; their absence does not exclude severe regurgitation if not detected.

* *Valvular regurgitation is usually relatively mild in the absence of pre-existing disease; in first episodes of ARF, severe mitral and aortic regurgitation occurred in less than 10% of patients in New Zealand⁹*

† *When there is both mitral and aortic regurgitation, one of them must be moderate by echo criteria in order for the carditis to be classified of moderate severity.*

Tricuspid and pulmonary regurgitation graded mild or greater may be seen in people with normal hearts who have fever, volume overload or pulmonary hypertension. **For this reason a diagnosis of carditis should not be based on right-side regurgitation alone.** Although pulmonary and tricuspid regurgitation are often seen in association with left-sided lesions in ARF, pressure and volume overload must be excluded before attributing even moderate tricuspid regurgitation to valvulitis. If both left and right-sided lesions coexist in ARF carditis, then the predominant influence for diagnosis is the severity of the left-sided lesion.

Note 3

Differential Diagnoses of Common Major Manifestations of ARF^{10,11}

ARF is still an uncommon condition and all potential cases should be discussed with an expert to aid diagnosis and management.

Presentation			
	Polyarthritits and fever	Carditis	Chorea
Differential diagnosis	<ul style="list-style-type: none"> • Other infections* (including gonococcal) • Connective tissue and other auto-immune disease[†] • Reactive arthropathy • Sickle cell anaemia • Infective endocarditis • Leukaemia or lymphoma • Gout and pseudogout • Henoch-Schonlein purpura • Post-streptococcal reactive arthritis[‡] • Other, e.g. HIV/AIDS, leukaemia 	<ul style="list-style-type: none"> • Innocent murmur • Mitral valve prolapse • Congenital heart disease • Infective endocarditis • Hypertrophic cardiomyopathy • Myocarditis - viral or idiopathic • Pericarditis - viral or idiopathic 	<ul style="list-style-type: none"> • Systemic lupus erythematosus¹² • Drug ingestion (extrapyramidal syndrome) [§] • Wilson's disease (usually adult onset) • Tic disorder • Congenital, e.g. hyperbilirubinaemia • Choreoathetoid cerebral palsy • Encephalitis • Familial chorea (including Huntington's) • Intracranial tumour • Hormonal [¶] • Metabolic, e.g. Lesch-Nyhan, hyperalanaemia, ataxia, telangiectasia • Antiphospholipid antibody

* *Includes septic arthritis (e.g. Staphylococcus aureus, Neisseria gonorrhoea), and reactive arthritis from e.g. cytomegalovirus, Epstein-Barr Virus, mycoplasma, rubella (also post-vaccination), hepatitis B, parvovirus, and Yersinia species and other gastrointestinal pathogens*

† *Includes rheumatoid arthritis, juvenile chronic arthritis, inflammatory bowel disease, systemic lupus erythematosus, systemic vasculitis and sarcoidosis, among others*

‡ *Some patients present with arthritis not typical of ARF, but with evidence of recent streptococcal infection and are said to have poststreptococcal reactive arthritis. In these cases the arthritis may affect joints that are not commonly affected in ARF (such as the small joints of the hand), and is less responsive to anti-inflammatory treatment. These patients are said not to be at risk of carditis, and therefore do not require secondary*

prophylaxis. However, some patients diagnosed with post-streptococcal reactive arthritis have developed later episodes of ARF, indicating that the initial diagnosis should have been atypical ARF (Level IV)^{13,14}

It is recommended that the diagnosis of post-streptococcal reactive arthritis should rarely, if ever, be made in high-risk populations and with caution in low-risk populations (Grade C). Patients so diagnosed should receive secondary prophylaxis for at least 5 years (Grade D). Echocardiography (see above) should be used to confirm the absence of valvular damage in all of these cases before discontinuing secondary prophylaxis (Grade D)

§ Drugs and toxins include anticonvulsants, antidepressants, lithium, scopolamine, calcium channel blockers, methylphenidate, theophylline and antihistamines

|| Some cases of chorea are mild or atypical and may be confused with motor tics or the involuntary jerks of Tourette's syndrome. There may therefore be confusion between Sydenham's chorea and these conditions. The term PANDAS (Pediatric Auto-immune Neuropsychiatric Disorder Associated with Streptococcal infection) refers to a subgroup of children with tic or obsessive-compulsive disorders (OCD), whose symptoms may develop or worsen following GAS infection.

Five criteria have been used to define the PANDAS subgroup:^{15,16}

- The presence of a Tic disorder and/or OCD
- Pre-pubertal age of onset (usually between 3 and 12 years of age)
- Abrupt symptom onset and/or episodic course of symptom severity
- Temporal association between symptom exacerbations and streptococcal infection (approx 7-14 days)
- Presence of neurologic abnormalities during periods of symptom exacerbation (typically adventitious movements or motoric hyperactivity)

However, the evidence supporting PANDAS as a distinct disease entity has been questioned.¹⁶ Hence, in New Zealand populations with a high prevalence of ARF, clinicians should rarely (if ever) make a diagnosis of PANDAS, and should rather err on the side of over-diagnosis of ARF and secondary prophylaxis (Grade D). If ARF is excluded, secondary prophylaxis is not needed, but such cases should be carefully followed up to ensure that they do not develop carditis in the long term

† Includes oral contraceptives, pregnancy (chorea gravidarum), hyperthyroidism and hypoparathyroidism.

Note 4

Investigations in Suspected ARF

Recommended for all cases

- White blood cell count
- Erythrocyte sedimentation rate (repeat weekly once diagnosis confirmed)
- C-reactive protein
- Blood cultures if febrile
- Electrocardiogram (repeat as necessary if conduction abnormality more than first degree)
- Chest x-ray if clinical or echocardiographic evidence of carditis
- Echocardiogram (repeat as necessary in 2-4 weeks if equivocal, or if serious carditis)
- Throat swab (preferably before giving antibiotics) - culture for group A streptococcus
- Anti-streptococcal serology: both anti-streptolysin O and anti-DNase B titres, if available (repeat 10-14 days later if first test not confirmatory)

Tests for alternative diagnoses, depending on clinical features

- Serology or reactive arthritis*
- Anti Nuclear Antibody (ANA) for autoimmune arthritis
- Repeated blood cultures if possible endocarditis or septic arthritis
- Joint aspirate (microscopy and culture) for possible septic arthritis†
- Joint X-ray
- Copper, caeruloplasmin, anti-nuclear antibody, drug screen, and consider CT/MRI head for choreiform movements‡

* Includes reactive arthritis from e.g. cytomegalovirus, Epstein-Barr Virus, mycoplasma, rubella (also post-vaccination), hepatitis B, parvovirus, influenza, and Yersinia species and other gastrointestinal pathogens

† Typically, the synovial fluid in joints affected by ARF contains 10,000 to 100,000 white blood cells/mm³ (predominantly neutrophils). The protein concentration is approximately 4g/dL, glucose levels are normal, gram stain negative and a good mucin clot is present¹⁷

‡ The chorea of ARF can be readily diagnosed on the basis of history, physical examination and laboratory evaluation. Neuroimaging is not necessary and should be reserved for patients who have an atypical presentation, such as hemichorea.¹⁸

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