

APPROPRIATENESS GUIDELINE FOR ADULT ECHOCARDIOGRAPHY (NEW ZEALAND)

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The presented guidelines were originally developed for Wellington Hospital Cardiology and later adopted for the clinical standards guideline in the Central Region of New Zealand. The guideline aims to capture the majority of indications in stable patients for transthoracic echo and the need for follow up examinations.

They are based on previous local guidelines and are developed under the consideration of the draft on "Appropriateness Criteria for Echocardiography" by the CSANZ, the Northland/Auckland Follow Up Echo Guideline from November 2014, the "Usage Criteria for Echocardiography in Nelson Marlborough" as well as a number of international guidelines referenced at the end of the document. In particular the ASE/AHA 'Appropriate Use Criteria for Echocardiography' (2011) (1) were taken into consideration.

These guidelines were reviewed by the Imaging and Heart Failure working group of the NZ committee of CSANZ. They were ratified by the board of CSANZ on March 31 2017.

For more general echocardiography guidelines regarding training, CME and service structure please refer to the 'New Zealand Guidelines for Adult Echocardiography' (NZMJ (2016), vol. 128, number 1430).

Trans-oesophageal echo, stress echo and paediatric echo are beyond the scope of this document.

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CONTENT

Key Principles for Echo referral: -----	3
Initial Examination - General Echo Criteria-----	3
Valvular Heart Disease -----	4
Established Valvular Heart Disease -----	4
Prosthetic Valves-----	7
Echo in Heart Failure and Cardiomyopathy -----	8
Echo in the diagnosis of suspected Heart Failure-----	8
Echo in surveillance of heart failure-----	9
Hypertrophic cardiomyopathy -----	9
Pulmonary Hypertension -----	10
Atrial Fibrillation and Arrhythmia -----	10
Acute Coronary Syndrome and Myocardial Infarction -----	11
Initial Echo-----	11
Follow Up Echo-----	11
Post CABG-----	11
Stroke - Cardiac Source of Embolism -----	12
Aortic Dimension -----	13
Evaluation of intracardiac and extracardiac structures and chambers--	15
General Consideration in Provision and Request of Echo-----	15
Timing and Triage of Echo-----	15
Standards of Echocardiography-----	16
References -----	17

KEY PRINCIPLES FOR ECHO REFERRAL:

1. The result of the echo should be relevant to clinical management.
2. Consider the following points when ordering an echo:
 - a. Co-morbidities
 - b. Extremes of age and patient frailty.
 - c. Previous other test results.
 - d. Previous echo results, especially < 12 months.
3. Echo is a diagnostic tool, it should not delay patient treatment.
4. All echo referrals should be triaged by a cardiologist or a physician trained in echocardiography.
5. All echos should be reported or signed off by a cardiologist¹ within the timeframe recommended by the initial triage. Timeframe between referral for an echo and the report being available for a *routine* priority outpatient echo should be < 3 months.
6. All declined echo referrals should be returned to the referrer with an explanation.

INITIAL EXAMINATION - GENERAL ECHO CRITERIA

Heart murmur or abnormal finding that is

associated with clinical symptoms or a change in clinical symptoms.

associated with abnormal test results (BNP, ECG) or other relevant abnormal test results.

cannot be sufficiently explained by the physiological condition (fever, pregnancy, anemia, etc.).

REASONABLE INDICATION FOR ECHO

with ≥ 2 criteria met unless other clinical criteria apply or the echo result is likely to change clinical management.

Reference: (1), (2)

¹ As per CSANZ/NZ echo guidelines echo training level 1 required for sign off for transthoracic echos.

VALVULAR HEART DISEASE

ESTABLISHED VALVULAR HEART DISEASE

These recommendations imply that the patient has not yet met criteria for surgery / intervention (stage D) but rather suggest timing for echo follow up.



AORTIC STENOSIS

Stage	Progressive (B)		Severe (C)
Severity	Mild	Moderate	Severe
V_{\max}^2	2.0-2.9 m/s	3.0-3.9 m/s	> 4.0 m/s
Echo FU	GP	1-2 years	1 year

Mild AS: Refer back to GP, although reasonable to repeat echo in 5 years if clinically appropriate (particularly in younger patients, rheumatic valvular heart disease, renal disease). Ten per cent of aortic sclerosis < 2.5 m/s may progress to severe AS in 5 years (3).

Moderate AS: Consider 1 year follow up scan in initial diagnosis of moderate aortic stenosis to determine rate of progression. Otherwise surveillance echo in 2 years.

Severe AS: Without change in symptoms surveillance echo within one year.³

Progression of aortic valve disease and LV size / function are relevant independent criteria to consider.

² V_{\max} chosen for simplicity. Alternatively choose AVA with cutoff 1.5 cm² and 1.0 cm² or mean pressure gradient (MPG) with cutoff 25 mmHg and 40 mmHg between mild/moderate and moderate/severe respectively.

³ ESC Guidelines on severe AS follow up: Asymptomatic severe AS should be re-evaluated at least every 6 months for the occurrence of symptoms, change in exercise tolerance (ideally using exercise testing if symptoms are unclear), and change in echo parameters. Measurement of natriuretic peptides may be considered.

BICUSPID AORTIC VALVE:

- Baseline assessment of aortic size and morphology (consider aortic coarctation).
- Aorta > 4.5 cm annual FU. Consider MRI or CT.
- Otherwise follow table above.

AORTIC REGURGITATION

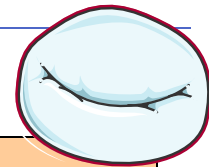
Stage	Progressive (B)		Severe (C)
Severity	Mild	Moderate	Severe
Echo FU	None	2 years	1-2 year

Mild AR: Discharge. Further echo only when general echo criteria are met.

Moderate AR: Consider LV size and function, if normal and patient asymptomatic refer back to GP. Otherwise echo FU in 2 years.

Severe AR: Consider LV size and function. Echo FU in 1-2 yearly if remains asymptomatic

MITRAL STENOSIS



Stage	Progressive (B)		Severe (C)
Severity	Mild	Moderate	Severe
MVA ⁴	> 1.5 cm ²	1.0 - 1.5 cm ²	< 1.0 cm ²
Echo FU	3-5 years	1-2 years	yearly

Mild MS: Refer back to GP. Consider surveillance echo in > 3 years particularly in younger patients, rheumatic valvular heart disease, renal disease.

Moderate MS: Surveillance echo in 1-2 years.

Severe MS: Without change in symptoms yearly echo.

MITRAL REGURGITATION

Stage	Progressive (B)			Severe (C)
Severity	Mild	Moderate		Severe
		Normal LV	Dilated LV	
Echo FU	None	2 years	1-2 years	1 year

Mild MR: Discharge. Further echo only when general echo criteria are met (page 4).

Moderate MR: Surveillance echo in 1-2 years depending on LV function. Consider discharge to GP if serial echos show no significant change. Take aetiology (primary/secondary MR) into account.

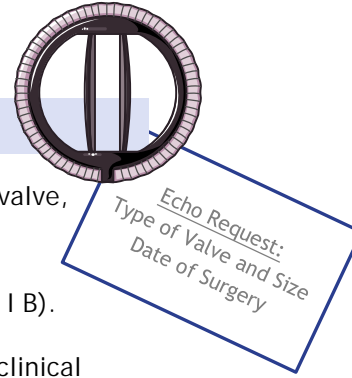
Severe MR: Surveillance echo at one year. Consider baseline TOE to identify repairable valve (Class I C).

Consider cardiac MRI for LV/RV function assessment in progressive and severe MR (Class I B).

Reference (1), (3), (4)

⁴ Alternatively use mean pressure gradient. MPG ≥ 5 mmHg for moderate MS, MPG ≥ 10 mmHg for severe MS.

PROSTHETIC VALVES



Pre-discharge in-patient echo: Consider a limited echo study pre discharge (LV, valve, pericardial effusion).

Establish baseline with early post-operative echo 6-12 weeks post surgery (Class I B).

Further follow up echo according to Table 1 or with change of symptoms / new clinical findings suggesting valve dysfunction (Class I C). Consider TOE to investigate abnormal prosthetic valve (Class I C).

Bioprosthetic valve	First 10 years every 2-3 years.
	After 10 years annually (change to annual assessment at any stage if concern regarding valve abnormality)
Mechanical valve	3-5 years
Valve repair	3-5 years ⁵ . Consider discharge from surveillance if stable repair after 5 years
TAVI	Annually {Pislaru:2016fs}.

Table 1: Routine surveillance echo in stable prosthetic valve patients.

SPECIAL CONSIDERATIONS IN PROSTHETIC VALVES

The timing of follow up might have to be adapted under special circumstances:

- Prosthetic valve instabilities.
 - Para- or transvalvular leak.
 - Surgical complications.
- Valve replacement for, or complicated by endocarditis.
- Unstable anticoagulation and/or questionable compliance.
- Dysfunction of other heart valves.
- LV dysfunction.
- Pulmonary hypertension and/or RV dysfunction.

In advanced age and frailty consider discharge from follow up if no further surgery or intervention considered.

Reference: (1), (3), (4)

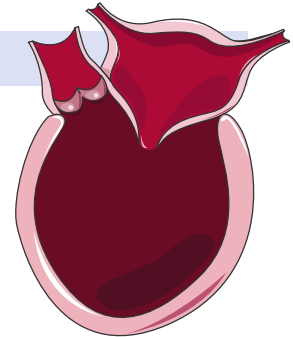
⁵ Limited data available for surveillance echo in valve repair.

Echo remains fundamental in the management of patients with suspected or confirmed heart failure.

ECHO IN THE DIAGNOSIS OF SUSPECTED HEART FAILURE

Initial evaluation of patients with suspected heart failure based on

- Heart failure symptoms,
- Clinical signs consistent with heart failure,
- And may be supported by an abnormal CXR or ECG.



Elevated natriuretic peptide levels (BNP or NT-BNP) are supportive of a diagnosis of heart failure, and are particularly useful in the initial evaluation of possible heart failure with non-specific symptoms and signs (Refer to NZ Heart Foundation Heart Failure Guidelines for cut-off values for BNP and NTproBNP, page Error! Bookmark not defined.).

Clinical heart failure may occur in setting of preserved LV systolic function in up to 30-50% of patients.

Please refer to recently updated guidelines on LV function assessment with 2D, 3D echo, global longitudinal strain (GLS) and reference range for indexed dimensions (5).

Initial treatment, such as with diuretics does not need to be delayed until echocardiography has been performed.

Please be aware heart failure is associated with normal left ventricular ejection fraction (HFNEF, HF-PEF) in 30-50% of patients.

Reference: (1), (6), (5)

ECHO IN SURVEILLANCE OF HEART FAILURE

Titration Phase

- Echo at the end of the titration phase in patients with heart failure with reduced ejection fraction (approx. 3 months on maximum treatment) to determine further management options.

Follow Up:

- Echo with change in clinical status or cardiac exam, if the result would alter clinical managements.

Cardio-oncology

- Baseline and serial re-evaluation in a patient undergoing chemotherapy with cardiotoxic agents.

HYPERTROPHIC CARDIOMYOPATHY

Initial investigation:

- Suspected case of HCM i.e. investigation of increasing shortness of breath, unexplained pre syncope or syncope with abnormal ECG
- Screening of first degree relatives of a known index case (note if proband gene positive and the family has been genetically tested there is no need for echo in gene negative relatives)

Follow up echo of a confirmed case:

- 2-3 yearly if stable.
- Consider earlier follow up if peak resting LVOTO⁶ \geq 50 mmHg, or change in symptoms or clinical signs that could indicate a progression in disease (increasing outflow tract gradient or MR, worsening of left ventricular function.

⁶ LVOTO: Left ventricular outflow tract obstruction

PULMONARY HYPERTENSION

Initial Echo

- Consider echo in unexplained breathlessness with underlying conditions that are associated with pulmonary hypertension.
- Otherwise refer to general heart failure criteria on page 8.

Follow Up

- Consider 1-3 yearly follow up in patients on active treatment for pulmonary hypertension.
- Echo follow up with change in clinical status.
- Consider echo follow up approximately 3 months after pulmonary embolism.

ATRIAL FIBRILLATION AND ARRHYTHMIA

After the initial management of symptoms and complications, underlying causes of AF should be sought. An echocardiogram is useful to detect ventricular, valvular, and atrial disease as well as rare congenital heart disease. Taking the patients circumstances into account a baseline echo is generally felt to be useful although not all guidelines are explicit.

Consider an echo in atrial fibrillation:

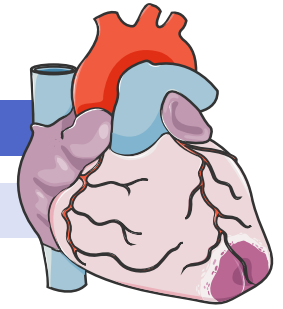
- New diagnosis of AF and influence on management⁷.
- Change in clinical status.
- Suspected underlying structural heart disease and LV dysfunction (page 8).
- In select patients on Class 1A anti-arrhythmic drugs. Consider a stress echo depending on cardiovascular risk profile.
- In advanced age, comorbidity and frailty an echo might not contribute to clinical management.
- LA assessment for planning of cardioversion (DC) or pulmonary vein isolation (PVI).

ARRHYTHMIA

In clinically relevant arrhythmia consider echocardiogram to rule out structural heart disease or help with procedural planning.

⁷ Achieve rate control before initial echo. Assessment of LA size might help determining the patient's management strategy.

ACUTE CORONARY SYNDROME AND MYOCARDIAL INFARCTION



INITIAL ECHO

All patients should have an initial evaluation of ventricular function following a myocardial infarction or ACS.

High Risk Features for requesting Echo

Failure / hypotension / instability

Arrhythmia

New murmur

Large territory of infarction

FOLLOW UP ECHO

No routine follow up echo is usually required if

- EF > 40-50 %.
- No further revascularisation planned.
- No device therapy planned.
- No new clinical findings.
- Medical therapy not influenced by further echo.

Reference: (1)

POST CABG

With known LV dysfunction (EF \leq 40-45%) consider follow up echo on stable heart failure medication > 6 weeks post operation.

With normal pre-operative LV function no echo is required unless there are new clinical signs or symptoms (i.e. suggestive of heart failure or complications such as pericardial tamponade) or abnormal other test results.

Echo guidelines generally acknowledge the use of echocardiography in the work-up of embolic stroke if a cardiac aetiology is suspected (7).

In the presence of known or suspected [atrial fibrillation](#) no echocardiogram is usually required for the management of the atrial fibrillation.

In the absence of atrial fibrillation consider an echocardiogram

- For unexplained strokes in multiple vascular territories to assess for cardio-embolic source (see high and intermediate risk sources below).
- Unexplained embolic stroke⁸ or cryptogenic stroke in patients <60 years of age. Consider exclusion of PFO/ASD - injection of agitated saline echo contrast required (bubble study).
- An echo is not required if a high-risk source is already known.

The role of echo in the assessment of cardiac source of embolism is usually not the detection of an actual thrombus but rather the [identification of risk sources](#) (8):

High-risk sources for cardiac embolism:

1. Atrial Fibrillation
2. LV Dysfunction
 - a. Recent myocardial infarction
 - b. Left ventricular aneurysm
3. Cardiomyopathies
4. Valvular pathology
 - a. Mitral Stenosis
 - b. Endocarditis
 - c. Mechanical valve prosthesis
5. Cardiac Masses

Intermediate risk sources for cardiac embolism:

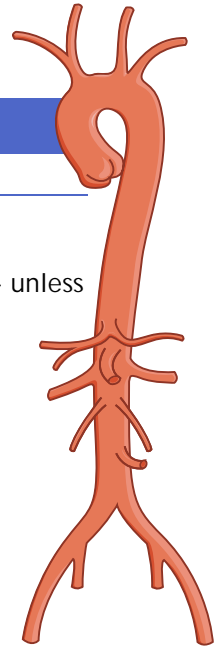
1. Valvular pathology
 - a. Mitral valve prolapse.
 - b. Calcific aortic stenosis
 - c. Mitral annular calcification (MAC)
2. Patent foramen ovale (PFO) and atrial septum aneurysm (ASA)

AORTIC DIMENSION

INITIAL INVESTIGATION

Consider echo referral for the assessment of aortic size in the following conditions - unless other clinical parameter present:

- Connective tissue disorder.
- Bicuspid aortic valve or coarctation.
- Family history of aortic dilatation or dissection.
- Evidence from other tests suggestive of aortic dilatation.
- Turner syndrome.
- Uncontrolled and long standing arterial hypertension.
- Abdominal aortic aneurysm or other relevant peripheral vascular disease.



	Age (y)					
	15-29	30-39	40-49	50-59	60-69	≥70
Men Mean normal (cm)	3.3	3.4	3.5	3.6	3.7	3.8
Men Upper limit (cm)	3.7	3.8	3.9	4.0	4.1	4.2
Women Mean normal (cm)	2.9	3.0	3.2	3.3	3.3	3.4
Women Upper limit (cm)	3.3	3.4	3.6	3.6	3.7	3.9

Table 2: Mean normal and upper limit of normal (95% CI) diameter of the aortic root diameter by age for men and women with a BSA of 2.0 m². Use BSA correction factor for

Men: Add 0.5 mm per 0.1 m² BSA above 2.0 m² OR subtract 0.5 mm per 0.1 m² below 2.0 m².

Women: Add 0.5 mm per 0.1 m² BSA above 1.7 m² OR subtract 0.5 mm per 0.1 m² below 1.7 m².

FOLLOW UP AORTA

Re-evaluation of known ascending aortic dilatation or history of aortic dissection with a change in clinical status or cardiac exam or when findings may alter management or therapy. Follow up only if aortic repair is considered.

- Echo follow up criteria in aortic dilatation are influenced by risk factors and if an underlying aortopathy (such as familial aortopathy, Marfans, bicuspid valve) is suspected.
- Normal ranges of aortic dimensions are influenced by age, gender and BSA; table for reference attached, also refer to ASE/EACI guidelines (9).

Diameter	Aetiology	Recommendation
Within ULN	No aortopathy	Discharge GP
Above ULN / below 47 mm	No aortopathy	3 years for first FU
≥ 47 mm	No aortopathy	Annual follow up
Above ULN	Aortopathy	3 year follow up
≥ 43 mm	Aortopathy	Annual follow up

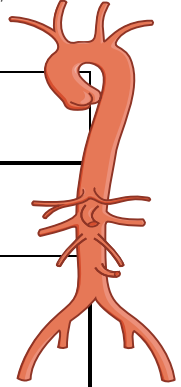


Table 3: Recommendation based on aortic diameter and underlying aortopathy. Take other risk factors into account.

In moderate dilatation consider early scan 1 year after initial diagnosis to establish rate of progression.

Consider [MRI](#) or CT for the assessment of aorta dimensions and configuration. In particular consider CT or MRI when within 0.5 cm of surgical threshold. Direct comparisons should be undertaken in the same imaging modality (Class I C).

Reference: (10), (1)

EVALUATION OF INTRACARDIAC AND EXTRACARDIAC STRUCTURES AND CHAMBERS

Consider echocardiography in the following circumstances:

- Suspected cardiac mass on other imaging.
- Suspected pericardial disease.
 - Re-evaluation of known pericardial effusion to guide management or therapy.
- Initial evaluation of known or suspected adult congenital heart disease.

GENERAL CONSIDERATION IN PROVISION AND REQUEST OF ECHO

TIMING AND TRIAGE OF ECHO

Appropriateness of an echocardiogram will prompt the question of timing. Guidelines give very little recommendation on timing of the initial diagnostic echocardiogram outside apparent emergency indications. Therefore recommendations are established on consensus decision based on the key principles presented earlier. Attempts to control timing and access to medical investigations bear the risk of inappropriate treatment delay. Individual patient decision might have to deviate and triage processes need regular review.

Urgency Criteria Triage

Timeframe

Emergency	Immediate Response
Urgent	ASAP, imminent risk
Semi-Urgent	clinical decision near future
Routine	influence on general clinical course

Table 4: The attached table outlines commonly used triage categories for echo and their basic definitions.

Urgency Criteria Triage				
	In Patient	Example	Out Patient	Example
Emergency	Immediate	Emergency in Cath Lab	NA	NA
Urgent	Within 1-2 days	post STEMI	Within 14 days.	Decompensated HF
Semi-Urgent	Before Discharge	post AVR	Within 4-6 weeks.	New controlled SOB
Routine	As in- or outpatient	Clarification Murmur	Within 3 months	Stable AF Stable murmur

Table 5: Suggested timing of echos for in- and out-patients.

Time period refers to time of the referral until the echo is reported.

The minimum standard for this time period is < 3 months for a routine priority echo.

Patients that cannot be accommodated within that approximate time frame should be reassessed and if appropriate declined and the referrer, GP and patient advised so that alternative arrangements can be made if possible and to facilitate on going management. Long waiting lists for echo investigations should be avoided and the relevant service manager should be involved in monitoring and responding to the clinical demand for this investigation.

STANDARDS OF ECHOCARDIOGRAPHY

Refer to the New Zealand Guidelines for Adult Echocardiography (NZMJ (2016), vol. 128, number 1430) regarding guidelines on the elements of a satisfactory complete transthoracic echocardiogram, limited echo studies as well as point of care cardiac ultrasound (POCUS). Also refer to the CSANZ Echo guidelines regarding regional and local organisation of echo services.

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