ECHOCARDIOGRAPHY APPROPRIATENESS GUIDELINE (NEW ZEALAND)

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Earlier versions of this guideline were developed for Wellington Hospital Cardiology and later adopted for the clinical standards guideline in the Central Region of New Zealand. They were based on previous local guidelines and are developed under the consideration of the draft on “Appropriateness Criteria for Echocardiography” by the Cardiac Society of Australia and New Zealand (CSANZ), the Northland/Auckland Follow Up Echocardiogram Guideline from November 2014, the “Usage Criteria for Echocardiography in Nelson Marlborough” as well as a number of international guidelines. The most recent version of this reflects updates in clinical practice, the American Society of Echocardiography (ASE)/American Heart Association (AHA) ‘Appropriate Use Criteria for Echocardiography’ (2011) and the CSANZ position statement (referenced at the end of the document). The purpose is to highlight any variances in the New Zealand context.

These guidelines were reviewed by the Imaging Working Group of the New Zealand committee of CSANZ and endorsed by the National Cardiac Clinical Network.

For more general echocardiography guidelines regarding the performance of transthoracic echocardiography including reporting and quality assurance please refer to alternative guidelines.

The guideline aims to capture the majority of indications in **stable patients for transthoracic echocardiogram** and the need for follow up examinations.

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

CSANZ Cardiac Imaging Working Group Chair, November 2024

Kerryanne Johnson
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CONTENTS

COMMON ABBREVIATIONS AND THEIR MEANINGS

ACS	Acute Coronary Syndrome
AR	Aortic Regurgitation
AS	Aortic Stenosis
ASE	American Society of Echocardiography
AVR	Aortic Valve Replacement
BNP	Brain Natriuretic Peptide
BSA	Body Surface Area
BSE	British Society of Echocardiography
CABG	Coronary Artery Bypass Graft
CRT	Cardiac Resynchronisation Therapy
CSANZ	Cardiac Society of Australia and New Zealand
CT	Computed Tomography
CVD	Cardiovascular Disease
ECG	Electrocardiogram
Echo	Echocardiogram
EF	Ejection Fraction
ESC	European Society of Cardiology
ETT	Exercise tolerance test
GP	General Practitioner
HF	Heart Failure
HFNEF	Heart Failure Normal Ejection Fraction
HFPEF	Heart Failure Preserved Ejection Fraction
LA	Left Atrium
LAA	Left Atrial Appendage
LBBB	Left Bundle Branch Block
LV	Left Ventricle
MI	Myocardial Infarction
MR	Mitral Regurgitation
MRI	Magnetic Resonance Imaging
MS	Mitral Stenosis
NSVT	Non Sustained Ventricular Tachycardia
PCI	Percutaneous Coronary Intervention
PFO	Patent Foramen Ovale
RBBB	Right Bundle Branch Block
RV	Right Ventricle
TAVI	Transcatheter Aortic Valve Implantation
TOE	Transoesophageal echocardiogram
TR	Tricuspid Stenosis
TTE	Transthoracic echocardiogram
VPBs	Ventricular Premature Beats
VT	Ventricular Tachycardia

KEY PRINCIPLES FOR ECHOCARDIOGRAM REFERRAL:

The demands on echocardiography services continue to increase with increasing wait times to access this imaging modality. Therefore it is important that with each referral we consider the following:

1. The result of the echocardiogram should be relevant and provide value to the clinical management of the patient. If there is unlikely to be a change in clinical management, echocardiography should be carefully considered, particularly in resource constrained areas.

2. Consider the following points when ordering an echocardiogram:

    a. Co-morbidities.

    b. Extremes of age and patient frailty.

    c. The results of other test results and investigations.

    d. Previous echocardiogram results, especially if < 12 months.

3. Echocardiogram is a diagnostic tool, it should not delay patient treatment.

4. All echocardiogram referrals should be triaged by those trained in the interpretation and or performance of echocardiography.

5. All echocardiogram should be performed by appropriately trained staff, and unless for the exclusion of immediately life threatening conditions should be performed in line with accepted minimum dataset guidelines.

6. All echocardiograms should be co-reported by a credentialed imaging cardiologist/specialist[1] in accordance with guidelines and within the timeframe recommended by the initial triage.

7. There has been research to suggest that in some clinical scenarios abbreviated studies may be appropriate, especially in low risk patients as a way to identify and prioritize patients that do need a full transthoracic echocardiogram

8. All declined echocardiogram referrals should be returned to the referrer with an explanation.

SUSPICION OF VALVULAR OR STRUCTURAL HEART DISEASE.

INITIAL EXAMINATION – GENERAL ECHOCARDIOGRAM CRITERIA

Prioritised
Heart murmur that is:

Associated with class III/IV **clinical symptoms, syncope** or a change in clinical symptoms.

Associated with **abnormal test results** (e.g BNP[1], ECG) or other relevant abnormal test results.

Known valve disease during pregnancy.

Routine
Heart murmur that is:

Not associated with **clinical symptoms** or a change in clinical symptoms/findings and with normal investigation

And

The patient is likely to be considered appropriate for cardiac intervention, based on goals of care, level of frailty and co-morbidity.

Asymptomatic murmurs with normal investigation including ECG and cardiac biomarkers should undergo echocardiography, as there are subgroups of patients who will have symptoms when formally assessed (e.g on ETT) and/or will have LV systolic impairment. Furthermore diagnosis of severe AS before the development of symptoms will assist in timely destination therapy.

Note that there are separate specific guidelines regarding the use of echocardiography in Rheumatic Heart Disease.

CONDITIONS IN WHICH AN ECHOCARDIOGRAM IS UNLIKELY TO AFFECT PATIENT MANAGEMENT

Assessment of an innocent murmur during physiological states.

Unchanged murmur in an asymptomatic patient with a previous normal echocardiogram within the last five years.

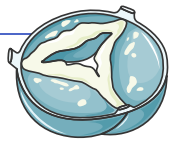
Valve intervention highly unlikely to alter prognosis or quality of life (e.g. terminal illness, significant frailty/co-morbidity).

Intervention is not in alignment with patient goals of care

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 echocardiogram follow up. This is separate from intervals required for review by a specialist.

AORTIC STENOSIS



Stage	At risk (A)	Progressive (B)		Severe (C)
Severity	Nil	Mild	Moderate	Severe
Echocardiogram frequency		3 - 5 years	1 - 2 years	6 - 12 months
During pregnancy		1 - 2 times during pregnancy	Each trimester	1 - 2 months
Bicuspid aortic valve	3 - 5 years	2 years (or as dictated by aortic dimensions if coexistent aortopathy)	1 - 2 years	6 - 12 months

General Considerations

When determining follow-up frequency, the rate of progression of aortic valve disease, changes in LV size or function, and development or progression of symptoms are relevant independent criteria to consider.

Otherwise, recommended frequency of surveillance is outlined below.

At risk	10 percent of aortic sclerosis with aortic Vmax < 2.5 m/s will progress to severe AS in five years, and are 25 times more likely to require aortic valve intervention than those without aortic sclerosis. Therefore in selected patients follow up echocardiography maybe considered, particularly in younger patients with minimal frailty/co-morbidity and who are likely to be suitable for aortic valve intervention.
Mild AS	Echocardiogram in three to five years if clinically appropriate and in alignment with goals of care, level of frailty and comorbidity (particularly in younger patients, rheumatic valvular heart disease, renal disease). If advanced age at diagnosis consider level of frailty, goals of care and likelihood of progression to intervention within lifetime. Consider referral back to GP, particularly if stable on more than one echocardiogram.
Moderate AS	Surveillance echocardiogram in two years unless concerned regarding more rapid progression, or towards the top end of the moderate range.
Severe AS	Surveillance echocardiogram recommended at 12 months or six months if clinical change or concern regarding or has demonstrated rapid progression.[2]

The prevalence of bicuspid aortic valve and/or aortic dilatation has been demonstrated to be seven to nine percent on a 2023 meta-analysis. Therefore screening of first degree relatives would be advantageous however this would likely be dependent on local clinical resource.

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[2]

AORTIC REGURGITATION

Stage	Progressive (B)		Severe (C)
Severity	Mild	Moderate	Severe
Echocardiogram follow up	3 - 5 years**	1 - 2 years	12 months*
Pregnancy	Once or twice during pregnancy	Once or twice during pregnancy	Every trimester

Mild AR Echocardiogram every three to five years if this is in alignment with level of frailty, comorbidity and goals of care.

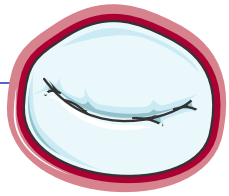
**Discharge if valve is anatomically normal i.e. not due to rheumatic valve disease, previous endocarditis, connective tissue disease, autoimmune disorder, carcinoid, drug or radiotherapy induced.

Moderate AR Consider LV size and function. If normal and patient asymptomatic, echocardiogram in two years.

Severe AR Consider LV size and function. Echocardiogram in one to two years, if the patient remains asymptomatic.

*Initial follow up echocardiogram can be considered at six months if concerned that there may be rapid progression. Increased frequency may be required as ventricular parameters approach surgical threshold, or if there are new concerns regarding LV dilatation or decline in function.

MITRAL STENOSIS



Stage	Progressive (B)		Severe (C)
Severity	Mild	Moderate	Severe
Echocardiogram frequency	3 - 5 years**	2 years	6 - 12 months
Pregnancy	Every trimester and prior to delivery	Every 1 - 2 months depending on tolerance	Every 1 - 2 months depending on tolerance

Mild MS

Echocardiogram in three to five years if clinically appropriate and in alignment with goals of care and frailty (particularly in younger patients, rheumatic valvular heart disease, renal disease).

**Discharge if valve is anatomically normal i.e. not due to rheumatic valve disease, previous endocarditis, connective tissue disease, autoimmune disorder, carcinoid, drug or radiotherapy induced.

If advanced age at diagnosis consider level of frailty and goals of care; consider referral back to GP particularly if stable on more than one echocardiogram.

Moderate MS

Echocardiogram in two to three years.

Severe MS

Annual echocardiogram if no change in symptoms.

MITRAL REGURGITATION

Stage	Progressive (B)			Severe (C)
Severity	Mild	Moderate		Severe
Left Ventricular Parameters		Normal LV EF >60% and normal size	Dilated LV	
Echocardiogram frequency	3 - 5 years*	2 years	12 months	12 months depending on interval change or if approaching surgical threshold by LV size and function**
Pregnancy	Once or twice during pregnancy			Each trimester

Mild MR

Echocardiogram three to five years if clinically appropriate and in alignment with goals of care and level of frailty and co-morbidity.

*If advanced age at diagnosis consider level of frailty and goals of care; consider referral back to GP particularly if stable on more than one echocardiogram, or if unlikely to be suitable for valve intervention. .

Discharge if valve is anatomically normal i.e. not due to rheumatic valve disease, previous endocarditis, connective tissue disease, autoimmune disorder, carcinoid, drug or radiotherapy induced.

Moderate MR	Surveillance echocardiogram in one to two years depending on LV function. Consider discharge to GP if serial echocardiograms show no significant change (depending on aetiology, level of frailty and goals of care.)
Severe MR	Surveillance echocardiogram within one year. Consider baseline TOE to identify repairable valves (Class IC).

**Consider repeat echocardiogram at any stage for new onset atrial arrhythmias or if there is change in the clinical picture

RIGHT SIDED VALVE DISEASE

Stage	Progressive (B) TR		Severe (C)
Severity	Mild	Moderate	Severe
Echocardiogram frequency	**Discharge***	1 - 2 years	12 months

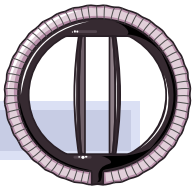
Consider early discharge if intervention is unlikely to be considered.

Mild TR Discharge if valve is anatomically normal i.e. not due to rheumatic valve disease, previous endocarditis, connective tissue disease, autoimmune disorder, carcinoid, drug or radiotherapy induced, especially if there is normal RV size and function.

*Echocardiogram every three to five years for patients who clearly have an abnormal tricuspid valve, and surveillance is in alignment with level of frailty, comorbidity and goals of care, e.g in younger patients, rheumatic valvular heart disease, renal disease.

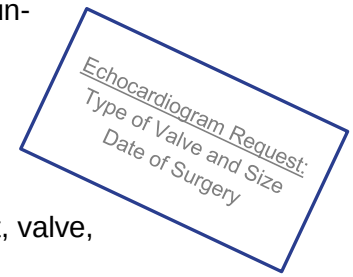
Moderate TR Surveillance echocardiogram in one to two years depending on RV function. Consider discharge to GP if serial echocardiograms show no significant change depending on aetiology, co-morbidity, level of frailty and goals of care.

Severe TR Surveillance echocardiogram in 12 months, earlier if clinical change



SPECIAL CONSIDERATIONS IN PROSTHETIC VALVES

If advanced frailty, co-morbidity and/or goals of care mean that further interventions are unlikely to be offered or are unwanted, consideration should be given to early discharge from routine valve follow up. This may be of particular benefit in resource limited areas, where other patients groups are likely to be disadvantaged by continuing to monitor. This is likely to be the case in those who are undergoing percutaneous valve procedures over surgical valve procedures based on un-modifiable surgical risk.



Pre-discharge inpatient echocardiogram:

Consider a **limited echocardiogram** study pre-discharge (LV assessment, valve, pericardial effusion).

Establish baseline with early post-operative echocardiogram after four to eight weeks post-surgery, at which point the imaging windows are generally more accessible, transient post-surgical changes will have resolved and haemodynamic parameters are stabilised.

Further **follow up echocardiogram** according international valvular guidelines or with change of symptoms / new clinical findings suggesting valve dysfunction (Class I C). Consider TOE to investigate abnormal prosthetic valve (Class I C).

Valve Intervention	**Echocardiogram Frequency**
Surgical bioprosthetic valve	Five years post implantation Unknown valve durability – annual echocardiogram follow up
	Patients <60 years or less durable aortic valves and all mitral valves - echocardiogram after five years and then annual echocardiogram follow up If no durability data – annual echocardiogram from implantation Patients >60 years and durable AVR repeat echocardiogram at 10 years, then annual echocardiogram follow up thereafter

Mechanical valve	Not indicated if baseline echocardiogram demonstrates normal function and no other co-existent valvular/aortic pathology, and not related to rheumatic valve disease*
Ross or aortic valve repair	Annual echocardiogram surveillance
Mitral valve repair	Three months post repair If mild MR or less, for two to three yearly echocardiogram If greater than mild MR, refer to MR recommendations for native valve MR
TAVI	Prior to discharge Day 30 (one month) Annual echocardiogram thereafter where appropriate Increase to two yearly if parameters remain stable Complex cases will need an individualised approach
Transcatheter mitral valve repair/replacement	Pre-discharge 30 days (one month) Annually if residual MR is mild or less Greater than mild will need an individualised approach
Transcatheter tricuspid valve intervention	As per clinical/registry requirements

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

*Surveillance may continue of metallic valves in accordance with rheumatic heart disease guidelines if aetiology is rheumatic heart disease.

PREGNANCY

For patients with valvular heart disease who are considering pregnancy or are pregnant, please refer to the 2018 Cardiovascular Diseases during Pregnancy guidelines which are very comprehensive. In general, cardiac conditions during pregnancy should be managed by specialist with experience in this area and those with high risk cardiac conditions should be managed via a high risk multi-disciplinary team.

Table 3 **Modified World Health Organization classification of maternal cardiovascular risk**

	mWHO I	mWHO II	mWHO II–III	mWHO III	mWHO IV
Diagnosis (if otherwise well and uncomplicated)	Small or mild – pulmonary stenosis – patent ductus arteriosus – mitral valve prolapse Successfully repaired simple lesions (atrial or ventricular septal defect, patent ductus arteriosus, anomalous pulmonary venous drainage) Atrial or ventricular ectopic beats, isolated	Unoperated atrial or ventricular septal defect Repaired tetralogy of Fallot Most arrhythmias (supraventricular arrhythmias) Turner syndrome without aortic dilatation	Mild left ventricular impairment (EF >45%) Hypertrophic cardiomyopathy Native or tissue valve disease not considered WHO I or IV (mild mitral stenosis, moderate aortic stenosis) Marfan or other HTAD syndrome without aortic dilatation Aorta <45 mm in bicuspid aortic valve pathology Repaired coarctation Atrioventricular septal defect	Moderate left ventricular impairment (EF 30–45%) Previous peripartum cardiomyopathy without any residual left ventricular impairment Mechanical valve Systemic right ventricle with good or mildly decreased ventricular function Fontan circulation. If otherwise the patient is well and the cardiac condition uncomplicated Unrepaired cyanotic heart disease Other complex heart disease Moderate mitral stenosis Severe asymptomatic aortic stenosis Moderate aortic dilatation (40–45 mm in Marfan syndrome or other HTAD; 45–50 mm in bicuspid aortic valve, Turner syndrome ASI 20–25 mm/m^2, tetralogy of Fallot <50 mm) Ventricular tachycardia	Pulmonary arterial hypertension Severe systemic ventricular dysfunction (EF <30% or NYHA class III–IV) Previous peripartum cardiomyopathy with any residual left ventricular impairment Severe mitral stenosis Severe symptomatic aortic stenosis Systemic right ventricle with moderate or severely decreased ventricular function Severe aortic dilatation (>45 mm in Marfan syndrome or other HTAD, >50 mm in bicuspid aortic valve, Turner syndrome ASI >25 mm/m^2, tetralogy of Fallot >50 mm) Vascular Ehlers–Danlos Severe (re)coarctation Fontan with any complication
Risk	No detectable increased risk of maternal mortality and no/mild increased risk in morbidity	Small increased risk of maternal mortality or moderate increase in morbidity	Intermediate increased risk of maternal mortality or moderate to severe increase in morbidity	Significantly increased risk of maternal mortality or severe morbidity	Extremely high risk of maternal mortality or severe morbidity
Maternal cardiac event rate	2.5–5%	5.7–10.5%	10–19%	19–27%	40–100%
Counselling	Yes	Yes	Yes	Yes: expert counselling required	Yes: pregnancy contraindicated: if pregnancy occurs, termination should be discussed
Care during pregnancy	Local hospital	Local hospital	Referral hospital	Expert centre for pregnancy and cardiac disease	Expert centre for pregnancy and cardiac disease
Minimal follow-up visits during pregnancy	Once or twice	Once per trimester	Bimonthly	Monthly or bimonthly	Monthly
Location of delivery	Local hospital	Local hospital	Referral hospital	Expert centre for pregnancy and cardiac disease	Expert centre for pregnancy and cardiac disease

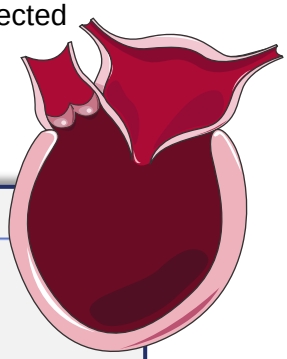
ASI = aortic size index; EF = ejection fraction; HTAD = heritable thoracic aortic disease; mWHO = modified World Health Organization classification; NYHA = New York Heart Association; WHO = World Health Organization.

Reference

2018 ESC Guidelines for the management of cardiovascular diseases during pregnancy. European Heart Journal 2018; 39, 3165-3241

ECHOCARDIOGRAM IN HEART FAILURE AND CARDIOMYOPATHY

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



INITIAL EXAMINATION – GENERAL ECHOCARDIOGRAM CRITERIA

Prioritised
Heart failure that is:

Associated with **clinical symptoms and signs** -(e.g peripheral oedema, bilateral pleural effusions)

or

Symptoms consistent with HF and elevated NT- pro BNP/BNP

≥125pg/mL / 35pg/mL refer for HF specialist assessment (with echocardiography) as per international guidelines.

Routine
Heart failure that is:

Suspected heart failure and NT- pro BNP / BNP ≥125pg/mL / 35pg/mL where reduced EF is less likely

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, HFPEF) in 30 - 50% of patients and NT- pro BNP is less sensitive in this cohort We propose that in resource limited areas where routine echocardiograms are not offered to those who would otherwise be suitable (see key principles for echocardiogram referral) this should be placed on the ‘At Risk’ register.

ECHOCARDIOGRAM IN SURVEILLANCE OF HEART FAILURE

Heart failure with reduced ejection fraction

TTE for initial diagnosis: symptoms, elevated NT- pro BNP / BNP

TTE surveillance after three to six months following optimization of medical therapy

TTE surveillance to assess improvement post CRT implant

Routine TTE every two years in stable patients where a change in function is likely to result in a change in management. If there is unlikely to be a change in management and patient is >65 years or has unmodifiable contra-indications to cardiac transplantation, consider discharge to GP.

TTE if HF symptoms re-occur

Repeat TTE is recommended if there is a change or deterioration in the patient's clinical status, or following optimisation of guideline directed medical therapy in heart failure with reduced ejection fraction to decide on further therapies (e.g. Cardiac resynchronisation therapy [CRT] or an implantable cardioverter–defibrillator [ICD]). If further therapies are unlikely to be offered, a goals of care conversation is required to determine clinical utility of further echocardiography.

TTE surveillance in stable heart failure to detect subclinical changes prior to overt clinical deterioration may be considered every two years, if the patient is a candidate for further escalation of therapy.

In clinical situations where there are no findings on clinical examination and BNP is normal, although routine echocardiography is recommended it should be put into clinical context and a decision based upon likelihood of an abnormal study, likelihood of an alternative diagnosis and likelihood of a change in clinical management considered before wait-listing, particularly where resources are limited.

HYPERTROPHIC OR OTHER CARDIOMYOPATHIES

INITIAL EXAMINATION – GENERAL ECHOCARDIOGRAM CRITERIA

Prioritised
Cardiomyopathy or **suspected cardiomyopathy** that is:

Associated with **clinical symptoms, pre-syncope** / **syncope**

Associated with **abnormal test results** (e.g BNP[3], ECG) or other relevant abnormal test results.

Routine
First degree relative of cardiomyopathy or **suspected cardiomyopathy**:

Note if proband is gene positive and the family has been genetically tested there is no need for echocardiogram in gene negative relatives.

FOLLOW UP EXAMINATION – GENERAL ECHOCARDIOGRAM CRITERIA

Follow up for clinical screening of hereditary cardiomyopathies

Age (years)	Frequency of screening*
0-11	Optional unless clinical suspicion, symptoms, malignant FHx
12-20	12 - 18 months
21-40	2 - 3 years
40+	3-5 years

As age advances a discussion will be required as to the appropriate time to discontinue screening. This is likely to be when an abnormal finding is no longer likely to result in a change in management for that patient and will have no potential impact on their family.

Follow up echocardiogram of a confirmed case of hypertrophic /hereditary cardiomyopathy:

• Annually

*Consider earlier follow up if peak resting LVOTO (LVOT obstruction) ≥ 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.

CANCER THERAPY RELATED CARDIAC DYSFUNCTION (CTRTD)

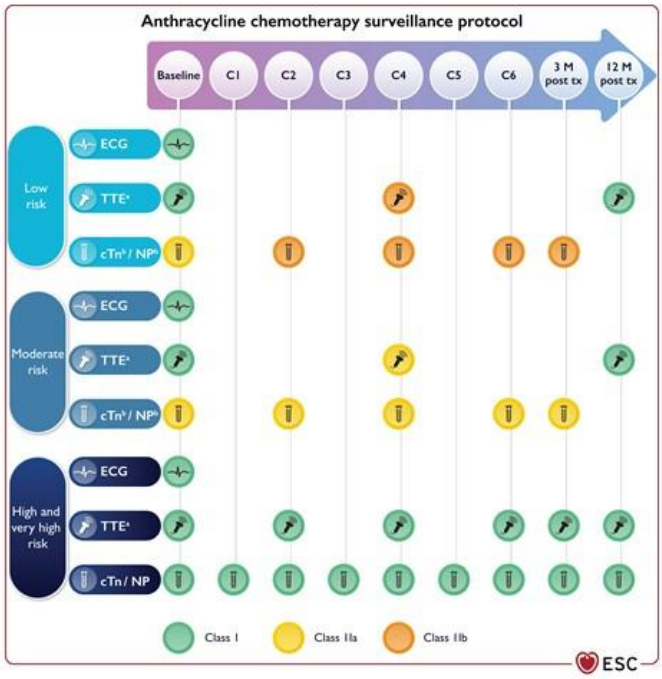
Inequities in cancer outcomes continue to exist for Māori, with higher prevalence of risk factors that are shared for both CVD and cancer. [1-3] Furthermore, echocardiography is a limited resource in Aotearoa with regional variations in care that are specific to echocardiogram surveillance for CTRCD: access to echocardiogram, access to imaging cardiologists, support for ultrasound enhancing agents and access to MRI in the case of poor echocardiogram views.

Therefore, the utility of echocardiogram as a screening tool for CTRCD must be supported with baseline risk assessment and adequate management of baseline CVD, [4 – 6] cardiac biomarkers, [5,7] and collaboration between oncology and cardiology to consider the use of primary and secondary prevention. [5,6] As cancer survivor numbers continue to grow, attention to long-term cardiac risk management/surveillance is required. [5,6]

A baseline echocardiogram is recommended prior to initiation of cancer therapy to assess baseline risk and develop a personalised surveillance approach. A full scanning protocol should be used. [6,8] This initial scan is also a reference point to compare for change during treatment.

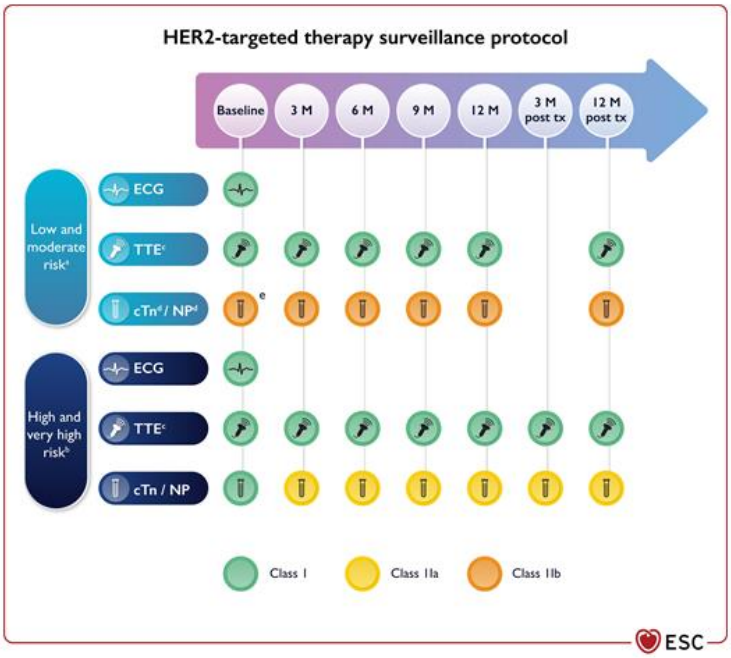
Surveillance protocols for anthracycline and HER2-targeted therapies should be adopted as per ESC guidelines. [5] A targeted follow up scanning protocol can be adopted as per the 2024 CSANZ Position Statement. [6]

Figure 10 Cardiovascular toxicity monitoring in patients receiving anthracycline chemotherapy.
cTn, cardiac troponin; ...



Eur Heart J, Volume 43, Issue 41, 1 November 2022, Pages 4229–4361, https://doi.org/10.1093/eurheartj/ehac244

Figure 11 Cardiovascular toxicity monitoring in patients receiving human epidermal receptor 2-targeted therapies.
cTn, ...



Eur Heart J, Volume 43, Issue 41, 1 November 2022, Pages 4229–4361, https://doi.org/10.1093/eurheartj/ehac244

CTRCD is defined as:

- > 10% reduction in LVEF to < 50%
- > 15% relative decrease in LV Global Longitudinal Strain (GLS)compared to baseline

  - 3D EF is superior to 2D EF and should be performed wherever possible
  - Same vendor GLS should be used wherever possible
  - In the case of poor 2D views, consider Ultrasound Enhancing Agents or CMR, particularly for high risk patients
  - Blood pressure should be recorded at each scan
  - Changes in LV systolic function should be highlighted to the referrer in the report

If at any point, an echocardiogram result is unlikely to change treatment management, removal from echocardiogram surveillance should be considered.

PULMONARY HYPERTENSION

Post-capillary PHTN is a common consequence of left heart disease. Pre-capillary PHTN is far less common but it's differentiation from post-capillary PHTN is important due to the availability of specific pulmonary vasodilator therapies.

INITIAL EXAMINATION – GENERAL ECHOCARDIOGRAM CRITERIA

Prioritised
Suspected Pulmonary Hypertension due to:

Presence of associated underlying conditions.

Associated with **abnormal test results** (e.g BNP, ECG, CT) or other relevant abnormal test results.

Associated with progressive clinical symptoms

Routine
Suspected Pulmonary Hypertension:

Not associated with **clinical symptoms** or a change in clinical symptoms/findings and with normal investigation

Unexplained breathlessness

- TTE should also be considered in cases of unexplained breathlessness after other common causes have been excluded.

FOLLOW UP ECHOCARDIOGRAM:

- Consider 6 - 12 month TTE follow up in patients on active treatment for pulmonary hypertension
- Consider TTE follow up with a change in clinical status
- Consider TTE follow up three months after pulmonary embolism.

ATRIAL FIBRILLATION (AF) AND ARRHYTHMIAS

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 echocardiogram is generally felt to be useful although not all guidelines are explicit. In advanced age, comorbidity and frailty, an echocardiogram might not contribute to clinical management and therefore may not be required.

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

INITIAL EXAMINATION – GENERAL ECHOCARDIOGRAM CRITERIA

Prioritised

New diagnosis of AF/Flutter.
New LBBB
NSVT (<30secs) or sustained VT (>30secs)
Frequent VPBs/exercise induced VPBs (no firm guide but ≥ ~15%)
Syncope with signs of CVD

And

Change in clinical status.
Suspected underlying structural heart disease and LV dysfunction with abnormal clinical findings or investigation

And

Will influence clinical management

Or:

Sustained ventricular arrhythmia

Routine

Not associated with **clinical symptoms** or a change in clinical symptoms/findings and with normal investigation

OTHER INDICATIONS

In select patients on Class 1A anti-arrhythmic drugs. Consider a stress echocardiogram depending on cardiovascular risk profile.

Echocardiogram maybe required for LA assessment for planning of cardioversion (DC) or pulmonary vein isolation (PVI) in AF/AFlutter.

ECHOCARDIOGRAM MAYBE APPROPRIATE FOR:

- New RBBB if other adverse symptoms / signs
- Supraventricular tachycardia as directed by electrophysiology specialist

ECHOCARDIOGRAM GENERALLY NOT APPROPRIATE FOR:

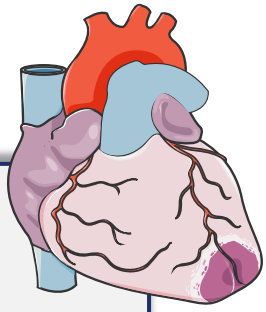
- Infrequent and asymptomatic Atrial or Ventricular ectopics.
    - Consider a follow up echocardiogram when VPB's >10%
- Isolated sinus bradycardia
- Presyncope without other features of CVD

ACUTE CORONARY SYNDROME AND MYOCARDIAL INFARCTION.

All patients should routinely have an initial evaluation of ventricular function following a myocardial infarction/acute coronary syndrome during the index admission. This is primarily to assess for infarct size and ventricular function.

The evaluation of ventricular function should ideally be with an echocardiogram rather than an invasive ventriculogram or other modality.

INITIAL EXAMINATION – GENERAL ECHOCARDIOGRAM CRITERIA



Prioritised - URGENT
ACS that is associated with a:

Suspected complication of a myocardial infarction including:

A new murmur (Ventricular septal defect, Ischaemic MR)

LV thrombus

Pericardial tamponade

Ventricular rupture

Or

Associated with haemodynamic instability

Arrhythmia or new murmur

Routine (in-patient)
ACS that is:

Associated with a typical rise and fall in troponin

Not associated with any of the above findings

Patients with stable angina and no rise and fall in troponin maybe considered for a prioritised scan as an outpatient

High Risk Features for requesting Echocardiogram
Heart Failure / hypotension / instability (tamponade, ventricular rupture)
Arrhythmia
New murmur (Ischaemic mitral regurgitation, ventricular septal defect)
Large territory of infarction (LV thrombus)

FOLLOW UP ECECHOCARDIOGRAM

Routine repeat TTE surveillance is not indicated post-ACS if LV function was normal on the original echocardiogram and there is no clinical indication of deterioration in cardiac function.

In patients with LV impairment at the time of MI (LV EF <50% i.e including those with mildly reduced ejection fractions), a repeat evaluation of LV function should be considered once stable on heart failure medications and more than six weeks post coronary revascularization (CABG or PCI), where this is likely to lead to a change in clinical management.

Note that if LV function is mildly impaired (LV EF 45-50%) and patient is stable, a routine echocardiogram follow up may not be required.

Post CABG. If echocardiogram is normal pre-operatively no follow up echocardiogram is routinely required unless there are new clinical concerns (heart failure or suspected complications such as pericardial tamponade).

STROKE OR CARDIAC SOURCE OF EMBOLISM (CSOE)

Cardio-embolic events account for about 30% of strokes, with a tendency to cause more severe strokes. However, despite comprehensive evaluation around 30% of ischaemic strokes remain ‘cryptogenic’ or of undetermined cause.

The role of echocardiography in investigating a cardiac source of embolism (CSOE) is limited by uncertainties in diagnosis of embolic events and ambiguity of echocardiogram findings. The aim of echocardiogram investigations is to influence a change in clinical management, such as initiation of a form of anticoagulation or other treatment to lower the future risk of CSOE (e.g. PFO or LAA closure).

INITIAL EXAMINATION – GENERAL ECHOCARDIOGRAM CRITERIA

Prioritised
CSOE with high/moderate risk (see next section for more information):

Left atrial thrombi

Left ventricular thrombus

Cardiac masses

Valvular changes

Patent Foramen Ovale (PFO) - Saline contrast +/- Valsalva technique should be considered if investigating for a PFO. This may be more relevant in younger patients (generally <65 years), with minimal or no cardiovascular risk factors with concerns for an embolic event.

TOE generally indicated if:

Prosthetic cardiac valves in situ

Intra-cardiac device in situ

High probability of endocarditis

Atrial fibrillation requiring cardioversion

Young (<65 years) without evidence of PFO to exclude fibro-elastoma or other cardiac mass

INDICATION

Individualized decision based on:

(1) **Risk:** Probability of the event being embolic and having a cardiac source of embolism.
(2) **Management:** Probability of the investigation changing management.
(3) **Method:** Probability of the investigation being able to detect a CSOE.

Clinical events and conditions associated with **high (moderate) risk** of embolism:

Left atrial thrombi
- Atrial fibrillation
- Mitral valve stenosis

Left ventricular thrombus
- Recent myocardial infarction
- Cardiomyopathy

Cardiac Masses
- Cardiac Tumors

Valvular Changes
- Endocarditis/Valvular Vegetations
- Prosthetic cardiac valves
- Mitral Valve Prolapse
- Mitral annulus calcification
- Aortic Valve calcification and stenosis

Patent Foramen Ovale
- Atrial Septum Aneurysm
- Atrial Septal Defect

METHOD

Transthoracic echocardiogram is, outside of specifically directed clinical or technical questions, the preferred investigation for CSOE.

Saline contrast (+/- Valsalva technique) should be considered if investigating for a PFO.

Left heart echocardiogram with UEA should be considered if investigating for left heart thrombus.

TOE can be a reasonable first step in investigation for particular clinical questions, but is generally reserved for specific questions following an initial TTE.

Consider a TOE to investigate for CSOE in:

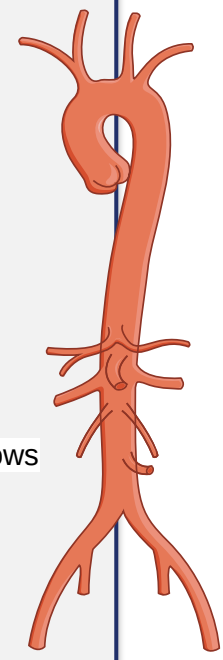
- Prosthetic cardiac valves
- Intracardiac devices
- High probability of endocarditis.
- Atrial fibrillation requiring cardioversion.
- Young (<65 years) without evidence of PFO to exclude fibro-elastoma or other cardiac mass

Alternative methods such as cardiac CT and cardiac MRI have very high, and in some areas even superior sensitivity and specificity when compared to TOE and can be considered where available.

AORTIC DIMENSION

INITIAL INVESTIGATION

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



Prioritised:

- 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

The recommended normal ranges by the EACVI for standardized reporting are as follows

	Male	Female
Annulus	≤14mm/m^2	≤14mm/m^2
Sinus of Valsalva	≤19mm/m ^{2}	≤20mm/m ^{2}
Sinotubular junction	≤17mm/m ^{2}	≤17mm/m ^{2}
Proximal ascending aorta	≤17mm/m ^{2}	≤19mm/m ^{2}

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 m^2. Use BSA correction factor for

Men: Add 0.5 mm per 0.1 m^2 BSA above 2.0 m^2 OR subtract 0.5 mm per 0.1 m^2 below 2.0 m^2.

Women: Add 0.5 mm per 0.1 m^2 BSA above 1.7 m^2 OR subtract 0.5 mm per 0.1 m^2 below 1.7 m^2.

FOLLOW UP INVESTIGATION

Please refer to CSANZ position statement.

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. Routine surveillance that will not influence management is not indicated.

- Echocardiogram 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 (12).

Diameter	Aetiology	Surveillance Recommendation
Within ULN	No aortopathy*	Discharge to GP
40- 44 mm	No aortopathy*	5 years
45 -49 mm	No aortopathy*	Annual follow up for first echocardiogram and then 2 yearly if no rapid progression
Post aortic dissection		Echocardiogram at 1, 3, 6 and 12 months, then annually**.

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

* Where there is a known aortopathy, Bicupsid AV consider more frequent surveillance.

** Where stability is demonstrated, the post surgery surveillance period may be increased.

Consider MRI or CT for the assessment of aorta dimensions and configuration, in particular when aortic dimensions are within 5mm of surgical threshold. Direct comparisons using the same imaging modality should be undertaken (Class I C).

Aortic follow up for congenital aortic anomalies should be guided by congenital guidelines.

Note should be made as per CSANZ position statement that “the relevance of ethnicity was demonstrated in a large New Zealand cohort study where Pasifika patients accounted for 28% of acute aortic dissections, who in turn only represent 7% the total population”. Therefore consideration must be given to lower thresholds for surveillance and more frequent surveillance.

EVALULATION OF INTRACARDIAC AND EXTRACARDIC STRUCTURES AND CHAMBERS

Echocardiography is a vital tool in the evaluation of intra- and extra-cardiac structures and for chamber quantification.

The appropriate use for echocardiography in assessing valvular heart disease, arrhythmias, and cardiomyopathy are described in separate chapters in this guideline.

INITIAL EXAMINATION – GENERAL ECHOCARDIOGRAM CRITERIA

The following situations may not be covered elsewhere in this document, and are scenarios whereby echocardiography would generally be considered appropriate:

Prioritised disease	Evaluation of suspected and surveillance of known congenital heart disease
	Suspected pericardial disease Suspected cardiac masses including tumour, thrombi (*see cardiac source of embolus)*
	Acute aortic pathology
	Cardiac structure and function evaluation in a potential heart donor
	Cardiac structure and function evaluation and surveillance in planned cardio-toxic treatments (e.g. oncological – see section on cancer therapy related cardiac dysfunction).
	Pre-participation screening in athlete's with one of either: an abnormal ECG, examination or family history of heritable heart disease
	Haemodynamic instability of unknown or suspected cardiac cause

This is not intended to be a comprehensive overview of all possible indications for trans-thoracic echocardiogram. Most indications and appropriate use are well-described in the reference documents from the ASE and BSE[19, 21].

GENERAL CONSIDERATION IN PROVISION AND REQUEST OF ECHOCARDIOGRAM

TIMING AND TRIAGE OF ECHOCARDIOGRAM

Appropriateness of an echocardiogram will prompt the question of timing. Recommendations are established based on international existing guidelines and on consensus decision. Attempts to control timing and access to medical investigations can lead to inappropriate treatment delays. Triage processes need regular review and auditing in view of extended waiting times to ensure appropriateness of those waiting.

URGENCY TRIAGE CRITERIA

	Timeframe
Emergency	Immediate Response
Urgent	ASAP, imminent risk
Semi-Urgent	clinical decision near future
Routine	influence on general clinical course
Routine arranged	At a planned interval for follow up of specific conditions

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

Urgency Criteria Triage (Time to finalisation of clinical report)		
	In Patient -	**Out Patient**
Emergency	Immediate	N/A
Urgent – P1	Within 24 hours	Within 14 days.
Semi-Urgent – P2	Within 48 hours	Within 6 weeks.
Routine – P3	Within 5 days	Within 12 weeks.
Routine arranged	N/A	Planned date

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

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

The minimum standard for this time period is less than three months for routine priority.

Patients that cannot be accommodated within that approximate time frame should be reassessed and if appropriate the referrer, GP and patient advised so that alternative arrangements can be made if required or triage category amended.

Long waiting lists for echocardiogram investigations should be avoided and the relevant service manager should be involved in monitoring and responding to the clinical demand for this investigation. We propose that if patients are routinely waiting for urgent or semi-urgent echocardiograms for more than double the suggested time (i.e. four weeks for urgent or 12 weeks for semi-urgent), then the echocardiography service is placed on the local clinical risk register.

Given that Māori and Pacific peoples are more likely to be hospitalised and die from cardiovascular disease with a significant reduction in life expectancy compared with New Zealand/European populations, consideration should be given to prioritization to the top of the respective triage category.

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 echocardiogram studies as well as point of care cardiac ultrasound (POCUS).

Note should be made that point of care ultrasound should not be considered an alternative to a transthoracic echocardiogram, nor a means of managing resources. Those meeting referral criteria should be referred for transthoracic echocardiography, however in centres with appropriate POCUS governance structures, image storage and auditing processes, this may be taken into consideration when determining clinical priority.

In alignment with international standards and the NZ minimum dataset for a standard transthoracic echocardiogram, all transthoracic echocardiograms should be considered a clinical assessment which requires clinical interpretation and therefore reported by a credentialed physician with clinical recommendations.

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