

EXERCISE TESTING GUIDELINE

This guidance does not override the individual responsibility of health professionals to make appropriate decision according to the circumstances of the individual patient in consultation with the patient and /or carer. Health care professionals must be prepared to justify any deviation from this guidance.

Introduction

Exercise Testing is a widely used tool for risk assessment in patients with coronary artery disease and strong clinical suspicion of coronary artery disease. It is not a substitute for a good clinical history and is not a reliable diagnostic test in patients with a low probability of coronary artery disease as the cause of their symptoms.

This guideline is for use by the following staff groups :

Physicians, Cardiac Physiologists, Rapid Access Chest Pain Clinic Specialist Nurses, Cardiac Rehabilitation Nurses and Chest Pain Specialist Nurses

Lead Clinician(s)

Mr Matthew Manners

Countywide cardiopulmonary Service manager

Approved by Cardiology Directorate meeting
(Chairs' approval) on:

7th December 2022

Review Date:

7th December 2025

This is the most current document and should be used until a revised version is in place

Key amendments to this guideline

Date	Amendment	Approved by:
09/09/2003	Guideline approved by Clinical Effectiveness Committee	
30/08/2007	Guideline reviewed with minor amendments made	Julie Caulfield
30/11/2009	Guideline reviewed with minor amendments made	Julie Caulfield
02/09/2011	Reviewed on 2nd September, no changes required	Julie Caulfield
27/08/2013	Guideline reviewed with minor amendments made	Julie Caulfield
July 2016	Document extended for 12 months as per TMC paper agreed on 22nd July 2015	TMC
August 2017	Further extension as per TMC paper agreed on 22nd July 2015	TMC
September 2017	Document extended for two years as per email from Julie Caulfield, no changes made	Julie Caulfield
December 2017	Sentence added in at the request of the Coroner	
October 2022	Document reviewed and approved for 3 years	Cardiology Directorate Meeting (Chair's approval)

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EXERCISE TESTING GUIDELINE

Introduction

Exercise Testing is a widely used tool for risk assessment in patients with coronary artery disease and strong clinical suspicion of coronary artery disease. It is not a substitute for a good clinical history and is not a reliable diagnostic test in patients with a low probability of coronary artery disease as the cause of their symptoms.

Exercise tests are frequently supervised by Specialised Cardiac Clinical Physiologists (CCP) without direct involvement of Medical Staff. Only CCPs who have been assessed as competent may supervise these tests. Assessment of competency must be carried out annually.

There are strict guidelines (Society for Cardiological Science & Technology) to ensure patient safety and appropriate supervision. High-risk patients must always have Medically Supervised exercise tests.

The patient's dignity must be respected at all times and adequate covering should be available and offered to all patients.

Competencies Required

Request forms must be signed by referring physician, or after receiving formal training and assessment i.e. auscultation skills, RACPC Specialist Nurse, Chest Pain Assessment Nurse and Cardiac Rehabilitation Nurse Specialist, to indicate that:

'The patient has been clinically examined to confirm that none of the contraindications exist and it is safe to proceed with an exercise tolerance test'

<http://www.scst.org.uk> - Recommendations for clinical Exercise Tolerance Testing Pts 4.0

Supervision

Medically supervised tests (Doctor present throughout)

All high-risk exercise tests should be medically supervised. Any patient being exercised with aortic stenosis, hypertrophic cardiomyopathy, unstable angina, recent myocardial infarction, and all others with a recognised potential for developing malignant arrhythmias should be supervised by a Doctor. If there are any doubts over the suitability of a patient for a CCP supervised test, the test should be medically supervised.

CCP supervised tests (low risk)

Low risk ETT is classified as an ETT that excludes the contraindications listed on page 5. There should be a minimum of a Specialised or Highly Specialised CCP who is fully trained in exercise testing and CPR and is aware that they are responsible for the safe conduct of the test, **and** one trained CCP or ATO present throughout the test and recovery period. (A Rapid Access Chest Pain Clinic (RACPC) or Chest Pain Assessment (CPAN) Nurse may be the second person in attendance).

The type of supervision required for exercise testing in each patient should be decided by the Consultant responsible for the patient, but if a CCP is unhappy to supervise a test (because

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of apparent high risk) they should request medical supervision or seek advice from a Consultant Cardiologist.

Protocols for Exercise Testing

a) Standard Bruce

- Appropriate for most outpatient exercise tests including risk assessment in stable coronary disease, risk assessment after discharge following myocardial infarction and “diagnostic” tests where these are considered worthwhile.
- The Bruce protocol may also be appropriate for low-risk in-patients who initially presented with chest pain and are now pain free for a minimum of 8 hours, have normal ECGs and normal Troponin levels.

b) Modified Bruce

- Use for high-risk tests at Clinician discretion: e.g. all in-patients after acute coronary syndromes – allows safe detection of a high-risk result at a low workload.
- Use for patients up to 4 weeks after MI – with medical supervision.
- Use for all patients who have limited mobility.

c) DVLA

Standard Bruce to Stage 3 (9 minutes). Do not continue the test beyond this time.

http://www.dvla.gov.uk/at_a_glance/ch2_cardiovascular.htm

d) Cardiac Physiologist Managed

<http://www.scst.org.uk> - Reference documents/Stress Testing

Maximum predicted heart rate = 220 – patient’s age

(Target heart rate is at least 85% of maximum predicted to allow reasonable interpretation of a test as low-risk or negative.)

THE TREADMILL CAN BE ADJUSTED MANUALLY IF THERE IS DOUBT ABOUT A PATIENT'S ABILITY TO MANAGE ANY OF THE ABOVE PROTOCOLS.

Indications for Exercise Testing

- Risk assessment in stable angina due to coronary artery disease
- Risk assessment after acute coronary syndromes
- Assessment of exercise capacity (e.g. after CABG / PCI)
- Assessment of the effectiveness of drug therapy (e.g. beta blockade)
- Risk assessment on behalf of the DVLA, RAC, CAA
- Detection or assessment of exercise-induced arrhythmia
- Risk assessment in asymptomatic valve disease (e.g. aortic stenosis)
- Risk assessment in younger patients with hypertrophic cardiomyopathy
- Detection of coronary artery disease in asymptomatic patients in certain specific circumstances
- Pre-operative assessment for Abdominal Aortic Aneurysm (The SHO of the referring Consultant MUST either supervise or be in attendance for this test.)

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Contraindications to Exercise Testing**Absolute contraindications**

- Less than 5 days after myocardial infarction
- During known unstable angina, crescendo angina or angina <1month post PCI, CABG, MI
- Uncontrolled cardiac arrhythmia
- Active acute myocarditis / pericarditis
- Infective endocarditis
- Severe Aortic stenosis / HOCM are contra indicated BCS Guidelines for CCP supervised Exercise testing
- Uncontrolled heart failure
- Physical handicap sufficient to prevent safe use of the treadmill
- Non-cardiac illness such as:
 - active infection
 - uncontrolled bronchial asthma
 - advanced renal failure
 - severe pulmonary arterial hypertension
 - significant anaemia (e.g Hb 10.0 g/dl or less)
- Uncontrolled severe systemic hypertension (>180/110)
- Acquired complete heart block or Mobitz II AV block
- Known left main stem stenosis of more than mild degree
- Patient Weight limits on treadmills: 203 kg / 32 stone

Relative contraindications (should be medically supervised)

- Cardiac arrhythmia – assess in individual patients
- Cardiomyopathy (dilated or hypertrophic) – assess in individual patients and discuss with Cardiologist before proceeding.
- History of recent unexplained syncope
- When the test may be difficult to interpret or of limited value and is unlikely to influence the patient's management, e.g. bundle branch block, permanent pacemaker, digoxin therapy, hypokalaemia
- Hypotension SBP <90mmHg

Preparation for Exercise Testing

a) Medication

Beta Blockers:

Effective beta blockade will blunt the heart rate and blood pressure response to exercise and may not allow target heart rate responses to be achieved. **However, withdrawal of b-blockers may result in rebound tachycardia, angina and possibly myocardial infarction.** Any decision to stop beta blocker therapy prior to an exercise test must be made by the Consultant in charge of the patient who will evaluate in the individual clinical context. In the majority of patients beta blockade does not prevent adequate risk assessment and exercise testing can provide useful information about the degree of beta blockade achieved.

Digoxin:

Digoxin may cause ST-segment depression on exercise, making interpretation of the ECG during the test difficult. However an exercise test may still allow useful risk assessment if it provokes angina or a fall in BP during exercise.

DVLA requirements:

Some patients undertaking exercise testing for the DVLA and other regulatory authorities will be required to stop anti-angina drugs, usually for at least 48 hours, before the test. The Cardiologist supervising the test is responsible for assessing in advance the need for and safety of withdrawal of any drug therapy in each individual patient. For example some “anti-angina” drugs may be needed for control of hypertension and their withdrawal before exercise testing may be hazardous.

b) ECG changes during exercise

The **normal** exercise electrocardiogram.

Normally during exercise the PR interval shortens, the P wave becomes taller and there is downward displacement of the junction between P wave and PR segment. For the purpose of determining ST segment abnormalities, the PR(PQ) segment is used as the isoelectric line. During exercise it is common for the J-point (junction between QRS complex and ST segment) to be depressed but the ST segment is upsloping and returns to isoelectric within 0.04 - 0.06 secs. R wave amplitudes tend to decrease on exercise. T wave amplitude may increase in some patients

Abnormal

ST segment depression

ST segment depression is a non-specific abnormality that may occur in a variety of circumstances:

- reversible myocardial ischaemia due to coronary disease
- acute myocardial infarction
- chronic myocardial ischaemia
- Left ventricular hypertrophy due to aortic stenosis
- hypertensive heart disease
- hypertrophic cardiomyopathy
- dilated cardiomyopathy
- myocarditis and pericarditis

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- pulmonary embolism
- drugs, e.g. digoxin
- hypokalaemia
- bundle branch block
- pre-excitation (WPW syndrome)
- changes in posture
- hyperventilation
- mitral valve prolapse
- females

However, in some circumstances myocardial ischaemia may develop in the absence of coronary artery disease and, conversely, coronary artery disease may be present without inducing myocardial ischaemia. Thus, the ST segment provides no more than an indirect indication of the presence or absence of coronary artery disease. A “negative” ECG during exercise testing **does not exclude** coronary disease and ST segment depression on exercise may not indicate the presence of coronary disease.

ST segment depression criteria

Horizontal or downsloping ST-segment depression of 1 mm (0.1 mv) measured 80msec after the J point provides high sensitivity for the detection of myocardial ischaemia on exercise. However the specificity of this finding is relatively low. Using greater degrees of ST depression increases the specificity for myocardial ischaemia but reduces the sensitivity for its detection. Thus, the more severe the ST segment depression, the greater is the likelihood that myocardial ischaemia is present.

Typically, ST-segment depression due to reversible ischaemia starts during exercise and becomes deeper as exercise progresses. The ST-segment usually returns to normal during the recovery phase. The time taken for ST segment depression to resolve after exercise may be a further indication of severity of coronary disease. Horizontal ST segment depression during exercise may start to resolve during recovery and is then followed by downsloping ST segments and biphasic T waves (post-ischaemic change). Occasionally post-ischaemic changes occur during the recovery phase when little or no ST segment depression has been seen during exercise.

Some patients have ST-segment depression at rest, which becomes normal during exercise and reverts to ST-segment depression late in the recovery period. This is a non-specific finding.

ST-segment elevation during an exercise test

This usually occurs in association with regional left ventricular dyskinesia, usually in leads with Q waves from a previous myocardial infarction. When it occurs in leads which do not show evidence of previous myocardial infarction, it usually indicates myocardial ischaemia.

Ventricular arrhythmia

It is not uncommon to observe ventricular ectopic beats during an exercise test even in normal individuals. Often as the heart rate increases, the ectopic beats become less frequent, and they increase in frequency again during the recovery phase. Ventricular extrasystoles which increase in frequency during exercise or which are multifocal, or salvoes of non-sustained VT should be regarded as high-risk features, likely to indicate important myocardial disease or coronary artery disease.

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c) Indications for terminating the exercise test

(Refer to Society of Cardiological Science and Technology – Sample Operational Policy and British Cardiac Society Guidelines for Non-medically Supervised Exercise Tests March 2003)

Absolute indications:

- Patient collapses / Cardiac arrest - commence Basic Life Support. Call cardiac arrest team (2222).
- Limiting angina:
 - At least as severe as that which would normally cause the patient to stop
 - Especially if associated with significant ST-segment depression.
- Ventricular fibrillation or sustained ventricular tachycardia.
- Fall in systolic blood pressure or heart rate:
 - A fall of 20 mm Hg systolic or more from the previous value. However remember that very tense individuals may show a fall in systolic BP from the resting value as they start to exercise and in these circumstances it is reasonable to continue and to make repeated measurements of BP to check that it is increasing normally with exercise thereafter.
 - A fall in heart rate during exercise is most likely to indicate the development of exercise-induced second or third degree AV block and the test should be terminated and continuous multi-lead ECG recordings made to document the rhythm and its behaviour.
- ST Elevation >1mm in leads without Q wave
- Dyspnoea
 - At least as severe as that which would normally cause the patient to stop or clearly inappropriately severe for the level of exercise.
- Disabling feelings of faintness or dizziness.
- Limiting chest pain, regardless of the presence or absence of ST segment changes
- Inability to continue walking safely on the treadmill for any reason.
- HR doesn't increase more than 10% from baseline value, which may indicate chronotropic incompetence

Relative indications:

- Fatigue
- Unsteadiness or mild sensations of dizziness
- Marked ST-segment depression 3mm even in the absence of chest pain, or 2mm with associated chest pain
- Atrial arrhythmia (e.g. exercise-induced AF or other tachyarrhythmia)
- Attainment of 85% Maximum Predicted Heart Rate – if able patient should be encouraged to continue
- B Blocked patients attaining 73% Maximum Predicted Heart Rate
- Increase in VE burden or frequent couplets/triplets/salvos
- Non-sustained ventricular tachycardia
- Marked elevation of blood pressure >230 systolic.
- Development of exercise-induced LBBB
- Inability to record ECG/BP due to technical problems

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IF IN DOUBT ABOUT A SITUATION, FOR PATIENT SAFETY, CHECK WITH THE DOCTOR IN CLINIC. CPR SHOULD BE TO CURRENT RESUSCITATION COUNCIL (UK) GUIDELINES.

Exercise Test Report

Report exercise test results to Consultant on generated Report form, to include symptoms, reason for termination, baseline and maximum heart rate, BP response to exercise, exercise duration, stage attained*, and any significant ECG change. Report to be signed, dated and timed by Lead CCP or clinician in charge of test.

Remember that Bruce stage II is achieved only after completion of the second stage (i.e. 6 minutes of standard Bruce, 12 minutes of modified Bruce, stage III after 9 minutes and 15 minutes respectively).

Monitoring

MONITORING TOOL

How will monitoring be carried out? Continuous audit
 When will monitoring be carried out? Continuous
 Who will monitor compliance with the guideline? CCPs

Page/ Section of Key Document	Key control:	Checks to be carried out to confirm compliance with the Policy:	How often the check will be carried out:	Responsible for carrying out the check:	Results of check reported to: <i>(Responsible for also ensuring actions are developed to address any areas of non-compliance)</i>	Frequency of reporting:
	WHAT?	HOW?	WHEN?	WHO?	WHERE?	WHEN?
	These are the 'key' parts of the process that we are relying on to manage risk. We may not be able to monitor every part of the process, but we MUST monitor the key elements, otherwise we won't know whether we are keeping patients, visitors and/or staff safe.	What are we going to do to make sure the key parts of the process we have identified are being followed? (Some techniques to consider are; audits, spot-checks, analysis of incident trends, monitoring of attendance at training.)	Be realistic. Set achievable frequencies. Use terms such as '10 times a year' instead of 'monthly'.	Who is responsible for the check? Is it listed in the 'duties' section of the Policy? Is it in the job description?	Who will receive the monitoring results? Where this is a committee the committee's specific responsibility for monitoring the process must be described within its terms of reference.	Use terms such as '10 times a year' instead of 'monthly'.

STANDARDS

Item	%	Exceptions
Referrals should meet the appropriate criteria	100%	None
All adverse outcomes to be monitored	100%	None

References

- Chung, E K. Exercise Electrocardiography Practical Approach 2nd Ed Williams & Wilkins Baltimore / London
- Cleland, J G F ; Findlay, I N; Gilligan, D; Pennell, D J, The Essentials of Exercise Electrocardiography Bayer Current Medical Literature Ltd.
- Gordon, C A Dataset for Chest Pain Clinics developed by the Prestige project Royal Brompton & Harefield NHS Trust
- Resuscitation Council (UK) Basic Life Support Resuscitation guidelines 2000 <http://www.resus.org.uk/pages/blsalgo.pdf>
- Resuscitation Council (UK) Adult Advanced Life Support Resuscitation guidelines 2000 <http://www.resus.org.uk/pages/als.htm>
- DVLA Guidance on Cardiovascular Disorders January 2003 http://www.dvla.gov.uk/at_a_glance/ch2_cardiovascular.htm
- British Cardiac Society/The Society of Cardiological Science and Technology, Reference documents - Protocol for Cardiac Physiologist managed exercise stress testing 2006 <http://www.scst.org.uk>
- The Society of Cardiological Science and Technology, Reference Documents - Cardiology Department Sample Operational Policy CCP Managed Exercise Tolerance Tests <http://www.scst.org.uk>

Contribution List

Contribution List

This key document has been circulated to the following individuals for consultation;

Designation

This key document has been circulated to the chair(s) of the following committee's / groups for comments;

Committee
Cardiology Directorate meeting

Supporting Document 1 - Equality Impact Assessment Tool

To be completed by the key document author and included as an appendix to key document when submitted to the appropriate committee for consideration and approval.



Herefordshire & Worcestershire STP - Equality Impact Assessment (EIA) Form
Please read EIA guidelines when completing this form

Section 1 - Name of Organisation (please tick)

Herefordshire & Worcestershire STP		Herefordshire Council		Herefordshire CCG	
Worcestershire Acute Hospitals NHS Trust	x	Worcestershire County Council		Worcestershire CCGs	
Worcestershire Health and Care NHS Trust		Wye Valley NHS Trust		Other (please state)	

Name of Lead for Activity	
----------------------------------	--

Details of individuals completing this assessment	Name	Job title	e-mail contact
Date assessment completed	December 2022		

Section 2

Activity being assessed (e.g. policy/procedure, document, service redesign, policy, strategy etc.)	Title: Exercise Testing Guideline			
What is the aim, purpose and/or intended outcomes of this Activity?	See body of document			
Who will be affected by the development & implementation of this activity?	<input type="checkbox"/> Service User	<input type="checkbox"/> Staff	Communities	
	<input type="checkbox"/> Patient	<input type="checkbox"/>	Other _____	
	<input type="checkbox"/> Carers	<input type="checkbox"/>		
	<input type="checkbox"/> Visitors	<input type="checkbox"/>		
Is this:	x <input type="checkbox"/> Review of an existing activity			

	<input type="checkbox"/> New activity <input type="checkbox"/> Planning to withdraw or reduce a service, activity or presence?
What information and evidence have you reviewed to help inform this assessment? (Please name sources, eg demographic information for patients / services / staff groups affected, complaints etc.)	See body of document
Summary of engagement or consultation undertaken (e.g. who and how have you engaged with, or why do you believe this is not required)	See body of document
Summary of relevant findings	

Section 3

Please consider the potential impact of this activity (during development & implementation) on each of the equality groups outlined below. **Please tick one or more impact box below for each Equality Group and explain your rationale.**

Please note it is possible for the potential impact to be both positive and negative within the same equality group and this should be recorded. Remember to consider the impact on e.g. staff, public, patients, carers etc. in these equality groups.

Equality Group	Potential positive impact	Potential neutral impact	Potential negative impact	Please explain your reasons for any potential positive, neutral or negative impact identified
Age				See body of document
Disability				See body of document
Gender Reassignment				See body of document
Marriage & Civil Partnerships				See body of document
Pregnancy & Maternity				See body of document
Race including Traveling Communities				See body of document
Religion & Belief				See body of document
Sex				See body of document
Sexual Orientation				See body of document
Other Vulnerable and Disadvantaged				See body of document

Equality Group	Potential <u>positive</u> impact	Potential <u>neutral</u> impact	Potential <u>negative</u> impact	Please explain your reasons for any potential positive, neutral or negative impact identified
Groups (e.g. carers; care leavers; homeless; Social/Economic deprivation, travelling communities etc.)				
Health Inequalities (any preventable, unfair & unjust differences in health status between groups, populations or individuals that arise from the unequal distribution of social, environmental & economic conditions within societies)				See body of document

Section 4

What actions will you take to mitigate any potential negative impacts?	Risk identified	Actions required to reduce / eliminate negative impact	Who will lead on the action?	Timeframe
	N/A			
How will you monitor these actions?				
When will you review this EIA? (e.g in a service redesign, this EIA should be revisited regularly throughout the design & implementation)				

Section 5 - Please read and agree to the following Equality Statement

1. Equality Statement

1.1. All public bodies have a statutory duty under the Equality Act 2010 to set out arrangements to assess and consult on how their policies and functions impact on the 9 protected characteristics: Age; Disability; Gender Reassignment; Marriage & Civil Partnership; Pregnancy & Maternity; Race; Religion & Belief; Sex; Sexual Orientation

1.2. Our Organisations will challenge discrimination, promote equality, respect human rights, and aims to design and implement services, policies and measures that meet the diverse needs of our service, and population, ensuring that none are placed at a disadvantage over others.

1.3. All staff are expected to deliver services and provide services and care in a manner which respects the individuality of service users, patients, carer's etc, and as such treat them and members of the workforce respectfully, paying due regard to the 9 protected characteristics.

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Signature of person completing EIA	Completed on behalf of owner
Date signed	December 2022
Comments:	
Signature of person the Leader Person for this activity	
Date signed	
Comments:	



Supporting Document 2 – Financial Impact Assessment

To be completed by the key document author and attached to key document when submitted to the appropriate committee for consideration and approval.

	Title of document:	Yes/No
1.	Does the implementation of this document require any additional Capital resources	N
2.	Does the implementation of this document require additional revenue	N
3.	Does the implementation of this document require additional manpower	N
4.	Does the implementation of this document release any manpower costs through a change in practice	N
5.	Are there additional staff training costs associated with implementing this document which cannot be delivered through current training programmes or allocated training times for staff	N
	Other comments:	

If the response to any of the above is yes, please complete a business case and which is signed by your Finance Manager and Directorate Manager for consideration by the Accountable Director before progressing to the relevant committee for approval.

Appendix 1

Pre ETT checklist:

- Have you checked the patient details checked against request?
- Is the patient able to comfortably walk on the treadmill?
- Are any of the contra-indications to ETT met?
- If so, is a Doctor going to be present for the test?
- Has the patient had chest pain at rest during the last 4 weeks? (Undiagnosed unstable angina)
- Has the patient taken GTN spray within 2 hours of test?
- Has adequate skin prep taken place and a clear ECG tracing obtained
- Have you explained the procedure to the patient including the BRUCE protocol and are they happy to proceed?
- If necessary is an interpreter present?