British Society of Echocardiography

Accreditation in Adult Transoesophageal Echocardiography (TOE) Information Pack

This pack is for the use of all candidates undergoing the accreditation process and becomes effective as of 15 June 2023

This document supersedes all previous versions

This document is a guide to completing BSE TOE accreditation
Submission and assessment criteria are included

British Society of Echocardiography

Contents

Welcome message from Accreditation Chair

Dear Candidate,

Welcome to the British Society of Echocardiography (BSE). Transoesophageal echocardiography (TOE) accreditation process represents a joint venture between the BSE and the Association of Cardiothoracic Anaesthetists (ACTACC) with the ultimate aim of achieving and maintaining a high standard of transoesophageal echocardiography for the benefit of our patients.

The process is primarily offered as a service to the members of both these specialist societies. It is designed to accommodate the requirements of cardiologists, sonographers, anaesthetists, intensivists and cardiac surgeons. It is important that the candidate and their mentors read all the information carefully before commencing the accreditation process.

The accreditation process is regulated to ensure a high level of proficiency and professional standard. We aim to make it possible for as many members to achieve accreditation. A list of accredited members is maintained on the BSE website.

Please let us know if we can assist you in this process in any specific way, or if you have constructive feedback to offer the accreditation committee then please just get in touch.

Good luck with your accreditation process.

Best wishes,

Sadie Bennett

Chair, BSE Accreditation Committee

Introduction and Aims

- Accreditation is run as a service for members of the BSE and is not a compulsory or regulatory certificate of competence or excellence. Accredited echocardiographers are expected to be able to perform and report TOE studies unsupervised.
- The Accreditation process is predominantly based on TOE. However, an understanding of transthoracic echocardiography is also necessary because the two approaches are complementary.
- Accreditation is a minimum requirement and cannot be regarded as a guarantee of competence.
- TOE skills can only be maintained by continued education and practical involvement in echocardiography. The importance of this is underlined by limiting Accreditation to 5 years after which reaccreditation must be sought.

Summary of process requirements

- A candidate must be a member of the BSE.
- A candidate must have a designated mentor to assist them through the accreditation process.
- The accreditation process has two compulsory elements: A written theory examination and a practical assessment. Both elements need to be passed in order to become an accredited member.
- The written theory exam compromises two parts: A multiple choice question (MCQ) theory section and an image reporting section.
- The practical assessment compromises three parts: A logbook, a practical image acquisition assessment and a patient case studies viva assessment.
- The candidate must pass the written assessment before registering to attend the practical assessment.
- The logbook should be collected over a period of no more than 24 months from the written examination.
- There is no general (or 'grandfather') exemption for BSE TOE accreditation.
- Any queries regarding the accreditation process should be addressed to: BSE Accreditation Department, contact details and registrations are available on www.bsecho.org. Tel: 0208 065 5794 (lines open from 09:00-17:00 Mon-Fri), Email: accreditation@bsecho.org.

Exam fees:

- A fee of £275 is charged for the complete accreditation process. This fee is payable in advance upon registration for the written section of the examination and covers the practical assessment. There is a non-refundable booking fee of £25 to pay upon registering for a secured placement at the practical assessment.
- Candidates who are unsuccessful in the written theory examination will be charged a reduced fee of £137.50 to re-sit this section. This reduced fee only applies to candidates who re-sit the examination within two sittings of the unsuccessful attempt (i.e. within 12 months of an unsuccessful attempt).
- Candidates are entitled to one re-attempt at the practical assessment. A re-attempt at the practical assessment is subject to an additional fee of £137.50.

Extensions and appeals

- Extensions to the 24-month deadline may be granted in accordance with the extensions policy. Extension requests forms must be submitted **before the submission deadline.** Extension request forms (along with all other BSE applications forms) can be found via www.bsecho.org. Requests received after the case deadline may not be granted.
- Extensions are not guaranteed. A non-refundable charge of £100 will be made for each extension request regardless of the outcome.
- Appeals process can be accessed via www.bsecho.org. Candidates can appeal the decision on a practical assessment result and a reaccreditation result. There is no appeals process for the written section of the examination.

Mentor

- A mentor is an experienced TOE operator who can successfully guide a candidate through the BSE accreditation process. If the mentor is BSE accredited, this is an advantage but not essential.
- The mentor should have a clear understanding of the accreditation process including the training syllabus as seen in Appendix 1 and all relevant assessment criteria (see remainder of this accreditation pack for more details).
- The mentor must assess the candidate's ability to undertake a TOE to a proficient and safe level. Once a proficient level of ability is achieved the mentor must complete the curriculum-based competency tool and the mentor statements. These should be completed via the online logbook portal. The curriculum-based competency tool can be found in Appendix 2.

Details of the written theory assessment

- The full training syllabus for this accreditation process is available in Appendix 1. A recommended reading list is available in Appendix 3.
- The written exam is held once a year. The examinations are held at various Pearson VUE centers across the UK, Republic of Ireland, and some overseas locations. Dates and online registration are announced on the written assessment section of BSE website. Further information on registrations for the written examination can be found in Appendix 4.
- The written exam has two parts, an MCQ theory section and an image reporting section.
- The pass mark for the MCQ section is 70%, the image reporting section is 80%. These may vary slightly at the discretion of the Accreditation Chair following moderation.
- There is no bar to re-sitting the written examination any number of times. It is necessary to pass both parts at the same exam sitting.
- Accreditation is awarded once a candidate has also successfully completed the practical assessment. Satisfactory performance at the written assessment alone does not allow 'partial accreditation'.

Multiple choice section

- Consists of 50 questions which must be answered within 60 minutes.
- Questions are designed to test the knowledge of TOE echocardiographic findings with some additional questions on basic cardiology and ultrasound physics.
- Each MCQ comprises a main stem followed by 5 options related to the stem. The single best answer should be selected. Example questions are provided in Appendix 5.
- The Theory examination will be marked +1 for correct answers, and 0 for incorrect or unanswered questions. There is no negative marking.

- There are no 'trick' questions.
- The maximum possible mark is 50.

Image reporting section

- Consists of 50 questions which must be answered within 90 minutes.
- The candidate will be presented with 50 questions based on a range of echocardiographic images and pertinent patient data.
- Each MCQ comprises a main question followed by 5 possible answers. The single best answer should be selected. Example questions are provided in Appendix 6.
- The Reporting section will be marked +1 for correct answers, 0 for incorrect or unanswered questions. There is no negative marking.
- There are no 'trick' questions.
- The maximum possible mark is 50.

Details of the practical assessment

- All candidates will be required to attend a practical assessment within 26 months of beginning to collect their cases (i.e. within two months of their case collection deadline). **The written examination must have been passed before attending**. The Practical assessment will be held up to four times per year **depending on candidate demand**.
- Dates and locations will be announced on the Practical Registrations section of www.bsecho.org. Candidates will need to select an available date and register online. Registration will open approximately three months before the assessment date. Upon receiving confirmation of an exam placement, candidates will be given an assessment time.
- The practical assessment has three parts, a logbook, a practical scanning assessment and a viva assessment of five patient case studies.
- Registration should **ONLY** be sought after collecting the logbook and patient case studies.
- It is the candidate's responsibility to ensure they enter correct information on registration forms. Incorrect information will lead to a rejected registration.

Logbook

- The logbook should demonstrate the candidate's ability in meeting the competences shown in Appendix 2. The specific case mix for the logbook is shown below.
- It should consist of 125 reports personally **performed and reported** by the candidate during the specified period of 24 months. The logbook is reduced to 75 cases over the same time period if the candidate holds **BSE TTE**, **EACVI** TTE or EACVI TOE Accreditation. Evidence of this should be submitted under the "optional supporting information" section on the BSE logbook portal.
- It is not acceptable to include cases reported by the candidate that have been performed by someone else.
- The logbook format is copies of the actual clinical report. The reports are to be uploaded and submitted via the BSE logbook portal. Please see the portal user guide in Appendix 7.
- Studies performed before and after bypass i.e. during the same operation, count as one study. A study performed for the same patient on separate occasions counts as a two separate studies.
- More than one candidate from the same institution is permitted to study the same patient if the diagnosis is unusual but each candidate must independently scan and write their own report
- If a candidate encounters problems finding enough specific cases, this should be discussed with

the mentor who may explore ways for you to attend a nearby centre.
- Competencies and mentor statements are to be completed via the BSE logbook portal.
- For details on what is expected in reports see Appendix 8.
- For full details of the logbook marking criteria please see Appendix 9.
- Fully subscribed BSE members can request access to the portal before sitting the written examination by emailing accreditation@bsecho.org.

The logbook should reflect the normal case-load of a department and should include at least one example of the following case mix:

- Mitral repair
- Severe mitral valve regurgitation
- Infective endocarditis
- Basic adult congenital heart disease (e.g. ASD, VSD or pulmonary stenosis)
- Aortic pathology (e.g. dissection, aneurysm, intramural haematoma)
- Abnormal aortic valve
- Hypovolaemia/septic shock assessment
- Abnormal prosthetic valve
- Intracardiac mass including thrombus
- Pericardial effusion
- Left ventricular wall motion abnormality
- Right ventricular abnormality or pulmonary embolism assessment
- No more than 20 studies should be predominantly normal

Other information regarding the logbook:

- **All** patient identifiable data needs to be removed. This may require the manual removal of identifiable data. See Appendix 10.
  - All cases have been collected in accordance with local requirements for data protection, i.e. your trust policy.
  - Studies performed before and after bypass i.e. during the same operation, count as one study. A study performed for the same patient on separate occasions counts as a separate study.
- The **signature (or e-signature)** and full name of the candidate are included. At least the final 50 cases should be reported primarily by the candidate alone although they may be checked by another operator.
- The candidate's name must appear on the report as the performing and reporting echocardiographer/sonographer. Where local policy deviates from this, a supporting letter and current standard operating procedure from the departments echo lead stating local policy should be included. This should be submitted under the "optional supporting information" section on the BSE logbook portal.
- Final sign-off/validation of the logbook is undertaken by the departmental echo lead. Please see the portal user guide in Appendix 7.

Patient case study viva assessment

- Consists of a viva assessment of five separate patient case studies. See below for the required cases.
- The candidate will be expected to discuss their patient cases with the Assessor. All five cases may be reviewed.
- For full details of the viva case marking criteria please see Appendix 11.

- The cases must represent a complete study that is of good quality. Cases should be accompanied with a printed report. This should be complete, comprehensive and reflect the patient case study being presented. The report summary should be worded so that it can be understood by any non-echocardiographer.
- Candidates must bring and present their patient case studies on their own laptop. It is the candidate's responsibility to ensure these are anonymised and can be viewed in a manner to allow an assessment of the cases being presented.

The patient case studies should include one of each of the following:

1. Normal study

2. Moderate or severe aortic stenosis.

3. Moderate or severe mitral or aortic regurgitation.

4. The fourth case show an example of one of the following categories detailed below:
    a) Prosthetic valve with size and type noted and reference to normal values for that valve
    b) Mitral repair
    c) Infective endocarditis
    d) Intracardiac mass including thrombus with differential diagnoses
    e) Basic adult congenital heart disease (e.g. ASD, VSD or pulmonary stenosis)
    f) Aortic pathology (e.g. dissection, aneurysm, intramural haematoma)
    g) Hypovolaemia/septic shock assessment
    h) Pericardial effusion
    i) Right ventricular abnormality or pulmonary embolism assessment

5. The fifth case should show an example of a different category from those listed with case 4 above, and also must not replicate the categories for cases 1 to 3.

Other information regarding the patient case studies:

- The "normal study" should have no significant abnormality and must demonstrate appropriate use of machine settings for image optimisation as well as the correct use of standard 2-D views as per the BSE minimum dataset for a TOE study (mid-oesophageal, transgastric and upper oesophageal), M-mode, CW, PW and Colour Doppler to assess chambers and valves.
- It is essential to demonstrate accurate measurement of the LV dimensions in at least one case. This would normally be in the normal case but if this is not possible, it is acceptable to provide this in at least one of the other cases.
- Moderate or severe aortic stenosis (please include a good demonstration of the use of the CW and PW Doppler signals in the deep transgastric view/transgastric long axis view). You should also quantify the degree of stenosis to substantiate your conclusion of the grade of severity using the continuity equation as well as peak velocity, mean gradient, planimetry and other parameters as appropriate to the case
- Moderate or severe mitral or aortic regurgitation which demonstrates robust quantification of the degree of regurgitation as per BSE guidelines.
- It is essential to demonstrate accurate measurement of the LV dimensions in at least one case. These measurements must be made in diastole and systole in both mid-oesophageal 4 chamber and 2 chamber views. Ejection fraction and regional wall motion abnormalities (if present) must be described accurately.

Patient case studies may be used in subsequent BSE written exams, educational and training sessions

Image acquisition assessment

- Consists of a candidate acquiring 24 different TOE views within 20 minutes. A simulator will be used with which various different pathologies may be presented to test the candidate's knowledge and skill.
- This station assesses the haptic knowledge and image acquisition skills of the candidate.
- If there are concerns with any of the images, assessors may question the candidate - if they can demonstrate appropriate knowledge/competence when questioned this may be sufficient.
- For full details of the image acquisition marking criteria please see Appendix 12.

Outcomes and process for re-attempts

- In total a candidate will have two attempts at passing the practical assessment part of the accreditation process. A second attempt at the practical assessment is subject to a fee of £137.50.
- If a candidate is successful in all three parts of the practical assessment, the candidate will be awarded BSE TOE accreditation and will join the accredited member list.
- If a candidate is unsuccessful in any of the three parts of the practical assessment, the candidate will be deemed to have been unsuccessful at this first attempt. The candidate will be provided with constructive feedback to facilitate a re-attempt. See below for more details.
- In the event of an unsuccessful first attempt, the candidate may be requested to resubmit logbook reports and/or patient case studies. These must be new reports/patient case studies. A candidate is not permitted to resubmit previously assessed work under any circumstance.
- If a candidate is unsuccess at the second attempt of the practical assessment, the accreditation process must be started over with the candidate undertaking the written examination again.

In the event of an unsuccessful attempt, the candidate is required to:

- Attend another practical assessment and re-attempt **ONLY** the parts of the practical assessment that the candidate was unsuccessful at in the first attempt. The pass marks from the remaining practical assessment elements will be upheld.
- The timescale allowed for re-attempts will depend on which elements were unsuccessful and the candidate's current and future work commitments . This will be discussed with the candidate during the first attempt. Typical timeframes lie in the range 3 to 9 months.

Our feedback consistently demonstrates that non-face to face feedback does not adequately equip a candidate to pass at the next sitting. Therefore, all re-attempts at the practical

assessment, require the candidate's attendance in-person to facilitate adequate and helpful face-to-face feedback.

Appendix 1: Training syllabus for BSE accreditation

Topics that maybe included in the multiple-choice examination **General Concepts**

1. The place of echocardiography

Clinical role of echocardiography and Doppler
Information that echocardiography can and cannot provide
'Ruling out' pathology (sensitivity, specificity & Bayes theorem)
Likelihood of findings influencing patient management
Undesirable outcomes: inaction while waiting for results, clinical 'red herrings'
Indications for echocardiography
Competing and complementary technology
Cardiac catheterisation (ventriculography and coronary angiography)
CT imaging
Magnetic resonance imaging
Nuclear Cardiology

1.1 Service Provision

Provision and indication for specialised techniques, e.g. TOE, Contrast Echo.
Availability and access
Controlling workload
Training & motivation of staff
Audit, Quality Control & Clinical Governance
Infection control

1.2 Relationship with patients

Explaining the procedure in terms relevant to the particular patient
Respect for patient's dignity and cultural backgrounds
Relationships with colleagues
Handling requests for information about the study findings

1.3 Reporting and Documentation

Standard methods & terminology
Distinction between Technical and Clinical reports
Responsibility for reporting - Medico-legal considerations (Data Protection Act)

2. Imaging Physics & Instrumentation

2.1 Concepts and Terminology

Concept of compression waves
Definitions: frequency, wavelength, propagation velocity
Units of measurement: Hz and MHz
Decibel comparison of Ultrasound with audible sound.

2.2 Propagation of ultrasound through tissues

Speed of sound in different body tissues.
Frequency range used for diagnostic imaging

Distinction between specular reflection and backscatter
Principles of attenuation and scattering

2.3 Ultrasound Transducers

Piezo-electric effect
General concepts of 2D and 3D transducer construction
Characteristics of the ultrasound beam: Far (Fraunhofer) & Near (Fresnel) zones, side lobes
Beam steering methods: mechanical & electronic
Focusing methods, including dynamic receive focusing
Focus position
The role of intracardiac echocardiography

2.4 Imaging physics

Factors affecting choice of imaging frequency: typical practical values for adults & children
Broad-band imaging
Harmonic imaging
M-Mode imaging.
Scanning speed limitations, relationships between pulse repetition frequency, frame rate, lines per frame, field of view, depth to be imaged.
Temporal resolution.
Grey scale and dynamic range
Measurement and optimisation of Resolution: axial, lateral, azimuthal and temporal
Side lobe and grating artefacts
Reverberation artefacts
Limiting factors for detecting small targets

2.5 Echo Instrumentation

Function of machine controls:
Transmit power, overall gain, time gain compensation, lateral gain compensation, reject, compression, signal processing, dynamic range, pre-processing; post processing.
Optimisation of imaging parameters, including transducer frequency, scan angle, spatial and temporal smoothing.
Optimisation of 3D volume acquisitions including cropping and manipulation of viewing plane.
The advantages of 3D echocardiography over 2D echocardiography e.g. appreciation of mitral valve pathology, elimination of geometric assumptions in cardiac chamber volume estimations

2.6 Optimising Images

Use of gel (infection risk from transducer, operator)
Standard views: midoesophageal (4C, 5C, 30°, 60°, 90° & 120° views), bicaval, RV inflow-outflow, upper oesophageal and transgastric views
Use of non-standard views

2.7 Storage and Display of Images

Basic concept of digital acquisition and storage systems.
Scan converters and digital memories.
Display devices and controls, recording techniques

3. Doppler physics & fluid dynamics

3.1 Basic Fluid Dynamics

Fluid flow: significance of peak & mean velocities

Determination of volumetric flow by Continuity equation
Laminar & turbulent flow: Reynolds' equation (qualitative)
Transition from Laminar to turbulent flow: inlet jet Bernoulli equation

3.2 Principles of Doppler

Interaction of ultrasound waves with moving blood: the Doppler effect
The Doppler equation: factors influencing magnitude of Doppler shift
Spectral analysis: fast Fourier transform (qualitative)
The spectral Doppler display: determination of mean, modal and peak velocities
Limitation of CW Doppler caused by lack of depth discrimination
Audible range of Doppler shift frequencies
The effect of beam angle errors on Doppler velocities
Aliasing: how it is caused and how it manifests in practice: the Nyquist limit
Influence on aliasing of: transducer frequency; sample depth (range x velocity product); and beam angle
High pulse repetition frequency (extended range) PW Doppler and the phenomenon of range ambiguity
Relative advantages and disadvantages of CW, PW and HPRF modes
Concept of colour flow imaging as multi-sampled PW
Velocity estimation, by moving target indication and autocorrelation (qualitative)
Limitations of mean velocity: use of velocity variance to show high velocities/turbulence
Aliasing in colour Doppler
The principles of pulse wave tissue Doppler
Packet size, colour mode and sector size and their effect on frame rate and aliasing
Peak and Mean pressure gradient measurements by Doppler and their relationship to catheterisation data
Measurement of pulmonary pressures from tricuspid and pulmonary regurgitant flow velocities and assessment of inferior vena cava contraction during inspiration

4. Deformation Analysis

4.1 Principles of Myocardial Deformation

The definition of displacement, velocity, strain and strain rate
The cardiac ultrasound co-ordinate system for describing motion and deformation: longitudinal, radial, circumferential and rotational axes
Quantifying myocardial deformation as opposed to velocity or displacement
Concept of shear deformation; rotation of the base and apex of the left ventricle, and the resultant twisting deformation or torsion

4.2 Quantifying myocardial strain and strain rate by tissue Doppler

The concept of the myocardial velocity gradient
The concept of strain and strain rate to define deformation
Tissue Doppler imaging for deriving strain and strain rate: practical parameters in measuring strain and strain rate (e.g. sample size and shape, offset distance, drift compensation, spatial and temporal averaging, tracking of sample volume)
Reproducibility considerations

4.3 Speckle Tracking Echocardiography/2D strain

Familiarity with the concept of speckles and speckle tracking in greyscale 2D loops
Speckle tracking for angle-independent derivation of velocities, displacement, strain and strain rate, in 2 dimensions

The impact of frame rates on the quality of speckle tracking
Speckle tracking vs. tissue Doppler techniques for assessing myocardial motion and deformation
Speckle tracking for measuring left ventricular rotation and torsion
Kindred technologies
Methods of measuring diastolic dysfunction: E/A ratio, deceleration time, pulmonary venous flow patterns, the ratio of the peak early diastolic transmitral velocity and the peak early diastolic tissue velocity of the mitral valve annulus (the E/E' or E/Ea) ratio for estimating LV filling pressures, the mitral valve Flow propagation velocity

5. Doppler instrumentation

5.1 Spectral Doppler Instrumentation

Features of the spectral display: positive & negative velocities; scale & baseline controls.
Effect of high-and low-pass filter and intensity threshold ('reject') settings
Pulsed Doppler sample volume: influence of gate length and distance (beam width)
Representation of signal strength by image intensity
How aliasing manifests on the spectral display

5.2 Colour Flow Instrumentation

The colour display: BART convention
Colour maps to show velocity scales
Image domination and additive colour modes
Difference between velocity and power (signal amplitude) displays
Basic principles of Tissue Doppler Imaging (TDI), including optimisation of filters for detecting tissue versus blood velocities, sample volume and size, impact of interrogation angle on measured velocities, minimising aliasing, and maximising frame rates to detect short duration myocardial motion
Differences between colour Doppler TDI and pulsed wave TDI.
Minimisation of myocardial translational movements during acquisition.
The concept of tracking on colour Doppler TDI to ensure that sample volume remains in the region of interest
Parametric (curved M-mode) display of tissue Doppler images
The relevance of importing cardiac cycle time points, such as aortic valve closure, into tissue Doppler traces

5.3 TOE Instrumentation

Transducer types: single plane, biplane, omniplane
Optimising machine settings for TOE Patient monitoring for TOE and general safety considerations
Control of infection

5.4 Safety of ultrasound

Potential hazardous biological effects: heating, resonance and cavitation effects
Measurement of beam intensity (SPTA)
Practical precautions: power levels, use of colour and CW Doppler
Thermal Index, Mechanical Index

5.5 Recording methods

Advantages/disadvantages of recording on videotape and digitally
Basic understanding of digital image processing and recording methods: pixel density, volume of data, the DICOM standard, concept of data compression (JPEG, AVI, etc.), archiving of echocardiographic studies on magneto-optical discs, CD/DVD, portable solid-state memories, ECG-gated acquisitions vs. continuous recording, facility to review acquired loop prior to

storage, facility to choose the number and type of cardiac cycles to be recorded, facility for offline image properties adjustment and further quantitative analysis.

6. Cardiac Anatomy and Physiology

6.1 Anatomy of the thorax

Anatomy of oesophagus
Anatomy of the oesophagus with respect to the heart.
Anatomy of Lungs & pleura
Anatomy of heart, pericardium and mediastinum

6.2 Gross anatomy of the heart

Basic cardiac embryology
Nomenclature of chambers and valves
Major relationships of chambers, valves and blood vessels
Distinguishing features of valves and chambers as related to echocardiography
The pericardial sac

6.3 Cardiac anatomy and physiology as demonstrated by echocardiography

Detailed structural anatomy of the heart, great vessels and pericardium
Visualisation of normal cardiac anatomy and normal variants in standard echocardiographic planes
Normal valve function, normal Doppler parameters and normal variants
The phases of atrial function: reservoir, conduit and contractile phases
The LV remodelling process in response to disease: eccentric (chronically elevated preload) vs. concentric hypertrophy (chronically elevated afterload)

6.4 The Cardiac Cycle

Temporal relationships of the ECG, chamber pressures and valve movements
Typical values for intracardiac pressures
Relationship of valve movements to heart sounds
Identification of valve opening and closure signals on Doppler recordings
The timing of aortic valve closure as a marker of end-ejection, as derived from M-mode, blood flow Doppler or tissue Doppler

7. Cardiac functional parameters

7.1 Measurements and calculations

On-screen measurement of length, slope, area, volume and time interval, and their significance for 2-D, 3D images, M-mode and spectral Doppler displays
Standard M-mode measurements and calculations, both using machine software and manual methods
Derivation of Stroke Volume, Ejection Fraction and LV Mass
Methods of measuring LV volume, including biplane area, area-length, Simpson's rule methods and 3D.
Limitations of single plane estimations of LV ejection fraction e.g. Teichholtz formula method
Limitations of single plane measurements of LA size
Geometric assumptions used in estimation of cardiac chamber volumes with M mode and 2D imaging
The advantages of deriving volumes and ejection fraction by 3D echocardiography
Limitations of measurement and/or calculation validity in presence of poor quality and/or off- axis images

7.2 Doppler determination of cardiac output, ejection time and velocity acceleration

Methods of measuring diastolic dysfunction: E/A ratio, deceleration time, pulmonary venous flow patterns, the ratio of the peak early diastolic transmitral velocity and the peak early diastolic tissue velocity of the mitral valve annulus (the E/E‘ or E/Ea) ratio for estimating LV filling pressures, the mitral valve Flow propagation velocity
Peak and Mean pressure gradient measurements by Doppler and their relationship to catheterisation data
Measurement of pulmonary pressures from tricuspid and pulmonary regurgitant flow velocities and assessment of inferior vena cava contraction during inspiration

8. Contrast Studies

Significance of spontaneous echo contrast
Optimisation of machine control settings for detecting contrast
Main indications for a bubble contrast study: diagnosis of intracardiac shunts and PFO, diagnosis of left sided SVC
Manoeuvres to provoke right –to-left passage of bubbles during assessment for PFO
Relevance of injecting bubble contrast through upper arm vein vs. femoral vein for detecting PFO
Technique for performing a hand-agitated contrast study
Clinical precautions

8.1 Awareness of encapsulated contrast agents and techniques

Interaction of ultrasound with encapsulated agents
Generation of harmonic energy by bubble distortion and fracture
Doppler signals generated by bubbles (Power Mode)
Main indications for LV and RV opacification: enhancing endocardial definition for assessment of regional contractility and accurate cardiac volume estimations, detection of intracardiac masses, distinguishing thrombus from a vascular tumour, diagnosis of cardiomyopathies e.g. non- compaction, arrhythmogenic right ventricular dysplasia, Doppler enhancement
Use of contrast in stress echocardiography for improving detection of wall motion abnormalities and for assessment of myocardial perfusion

9. Pathology

9.1 Mitral Valve Disease, 2D, 3D, M-mode and Doppler features of the normal mitral valve

9.2 Mitral Stenosis

Mitral Stenosis
Recognition of rheumatic mitral stenosis
Qualitative description of valve and sub-valve calcification and fibrosis
Measurement of orifice area by planimetry
Factors favouring successful balloon valvuloplasty
Doppler assessment of mean and end-diastolic gradient
Doppler assessment of area by ‘pressure half-time‘: technique and limitations
Role of exercise echocardiography in assessing the change in transmitral gradient and pulmonary systolic pressures with exercise, as decision aid in the timing of surgery/balloon valvuloplasty

9.3 Mitral regurgitation

Aetiologies and typical echocardiographic features of
Rheumatic
Mitral annular calcification
Floppy /myxomatous mitral valve

Ischaemic
Functional
Infective endocarditis
Assessment of severity by
Chamber sizes and volume overload
CW Doppler – shape and density of contour of Doppler signal
Vena contracta, PISA and effective regurgitant orifice area
Size of colour jet relative to atrial size by colour flow Doppler, Regurgitant fraction, regurgitant volume
Pulmonary vein flow patterns
Indirect effects on LV and LA
Role of echocardiography in determining timing of surgery for primary mitral valve disease: ejection fraction, end-systolic LV diameter, EROA
Role of TOE in assessing mitral valve pathology and in determining likelihood of repair as opposed to replacement

10. Aortic Valve Disease

10.1 2D, 3D, M-mode and Doppler features of the normal aortic valve

10.2 Aortic Stenosis

Aetiologies and echocardiographic features:
Rheumatic
Bicuspid
Senile degenerative
Sub-and supra-valvular obstruction
Assessment by CW Doppler
Peak and Mean gradients
Apical, right parasternal and suprasternal positions
Continuity equation
Assessment of left ventricular hypertrophy and use of stress echocardiography for distinguishing fixed anatomical stenosis from pseudostenosis in low flow aortic stenosis and for assessing LV flow ("contractile") reserve
Difference between transaortic pressure gradients derived from echocardiography and from cardiac catheterisation
Low—flow, low gradient (LFLG) aortic stenosis with reduced LV ejection fraction
Low—flow, low gradient aortic stenosis with preserved LV ejection fraction
Role of DSE in distinguish between pseudosevere aortic stenosis and true severe AS in LFLG aortic stenosis
Considerations for the indexing of aortic valve area to body surface area

10.3 Aortic Regurgitation

Aetiologies and typical echocardiographic features of:
Rheumatic
Bicuspid valve
Aortic root disease
Infective endocarditis (including root abscesses)
Assessment of severity by:
Chamber sizes/volume overload (regurgitant volume, regurgitant fraction)

CW Doppler – shape and density of contour of Doppler signal, pressure half time
Colour Doppler – size of jet relative to left ventricular outflow tract diameter

Vena contracta
Effective regurgitant orifice area
Diastolic flow reversal in descending aorta
Indirect effects on LV
Role of echo in determining timing of surgery
Role of TOE in assessing aetiology and severity

11. Tricuspid Valve Disease

11.1 2D, M-mode and Doppler features of the normal tricuspid valve

11.2 Tricuspid valve stenosis

Echocardiographic features
Assessment of severity by imaging and Doppler

11.3 Tricuspid Regurgitation

Aetiologies and echocardiographic features of:
Rheumatic
Prolapse
Congenital
Endocarditis
Carcinoid
Functional
Assessment of severity by:
2D imaging and M-mode
CW Doppler – shape and density of contour of Doppler signal
Colour Doppler
Hepatic vein flow pattern
Indirect effects on RV and RA

12. Pulmonary Valve Disease

12.1 2D, M-mode and Doppler features of the normal pulmonary valve

12.2 Pulmonary Valve Stenosis

Echocardiographic feature
Assessment of severity by:
Spectral Doppler
Detection of infundibular obstruction by spectral Doppler

12.3 Pulmonary Regurgitation

Aetiologies and echocardiographic features
Assessment of severity

13. Endocarditis

Typical echocardiographic appearance of vegetations in bacterial and fungal infective endocarditis
Preferred locations for vegetations
'Jet', 'kissing' lesions
Endocarditis associated with congenital disease and HCM
Complications: abscess, fistula, perforation, valve regurgitation
Role of TOE in the diagnosis and assessment of suspected endocarditis
Non-infective (aseptic) endocarditis

Monitoring of endocarditis

14. Prosthetic valves

14.1 2D, M-Mode and Doppler features of the main types of replacement valves

Tilting Disc
Bi-leaflet
Ball & cage
Bioprostheses (stented and stentless)
Age-related deterioration of bioprostheses
Transcatheter valve implantation or intervention (TAVI, transcatheter edge-to-edge mitral repair)
Role of TOE in examining normal and malfunctioning prosthetic valves

14.2 Prosthetic valve stenosis

Assessment by 2D, M-mode and Doppler
Normal ranges
Use of Continuity Equation for aortic prostheses
The phenomenon of pressure recovery
The diagnosis of patient-prosthesis mismatch

14.3 Prosthetic valve regurgitation

Trans-versus para-valvular regurgitation
Normal versus abnormal regurgitation
Assessment by CW, PW and Colour
Doppler Colour artefacts from mechanical prostheses

15. Cardiomyopathies

15.1 Dilated Cardiomyopathy

2D, M-mode and Doppler features of dilated cardiomyopathy

Detection and assessment of associated lesions
Functional valve regurgitation
Thrombus in cardiac chambers
Pericardial effusions
Role of echocardiography in assessment and follow-up

15.2 Hypertrophic Cardiomyopathy

2D, M-mode and Doppler features of hypertrophic cardiomyopathy
Differentiation from other causes of hypertrophy, e.g. hypertension, “athletic heart”, amyloidosis, Fabry‘s disease, Friedreich‘s ataxia
Techniques for measurement of left ventricular wall thickness, detection of left ventricular outflow tract obstruction and intracavity gradient
Assessment of right ventricular involvement
Associated abnormalities, e.g. systolic anterior motion mitral valve

15.3 Restrictive Cardiomyopathy

Causes e.g. primary amyloidosis, sarcoidosis, idiopathic, endomyocardial fibrosis
2D, Doppler & TDI features of impaired ventricular filling – increased ventricular wall thickness, dilated atria, increased E/A ratio, reduced deceleration time, increased E/E‘ ratio, reduced S‘ wave.

15.4 Main features of LV non-compaction

15.5 Intracardiac Masses

Typical locations for formation of intracardiac thrombus

Echocardiographic features of typical LA myxoma
Differentiation of myxoma from other cardiac tumours
Features suggestive of malignancy
Role of TOE in assessment of intracardiac masses
Role of contrast in the assessment of intracardiac masses

16. Pericardial Disease

16.1 Anatomy of the normal pericardium

Relationships of serous pericardium to heart and great vessels
Transverse and oblique sinuses of the pericardium

16.2 Echocardiographic features of pericardial fluid

Location of fluid in relation to patient position and fluid volume
Differentiation from pleural effusion
Assessment of volume of pericardial fluid
Role of echocardiography in pericardiocentesis

16.3 Features of tamponade

Collapse of RA and/or RV walls
Effect on IVC and hepatic vein flow pattern
Effect on A-V valve flow velocities during respiratory cycle

16.4 Features of pericardial constriction

Pericardial thickening/appearance
Effect on A-V valve flow velocities
Effect of respiration
SVC/hepatic vein flow
Differentiation from restrictive cardiomyopathy including use of tissue Doppler

17. Coronary Artery Disease and Systolic LV function

17.1 Anatomy of the normal coronary arteries

Anatomy & nomenclature of the major branches of the coronary arteries
Relationship of coronary anatomy to standard echocardiographic imaging planes
Nomenclature for describing myocardial segments (16 & 17 segment models)

17.2 Analysis of segmental systolic myocardial function

Use of stress echo to assess for myocardial ischaemia
Diastolic dysfunction in coronary artery disease

17.3 Global measures of LV function:

Ejection fraction
Stroke distance
Stroke volume and cardiac output
Use of tissue Doppler and speckle tracking echocardiography for assessment of regional myocardial velocities and deformation in ischaemic heart disease, at rest and with stress
Longitudinal function of the left ventricle, as assessed by M-mode (MAPSE) and tissue Doppler of the mitral valve annulus
The concept of post-systolic contraction
The concept of isovolumic acceleration by tissue Doppler

Left ventricular torsion and its implications for systolic function of the LV

18. Diastolic function of the LV

18.1 Normal Diastology

The 4 stages of diastolic dysfunction as assessed by transmitral flow Doppler (including DT); impaired filling pattern and restrictive flow pattern
The limitations of transmitral flow

18.2 Doppler for assessing diastolic dysfunction:

Effect of LA pressures and pseudonormalisation
Effect of mitral regurgitation
The use of Valsalva manoeuvre in reducing LA pressures to differentiate normal from pseudonormalisation
Flow Doppler patterns
The use of left atrial size, IVRT, tissue Doppler (diastolic longitudinal velocities of the mitral valve annulus, the E/E' ratio), pulmonary vein flow pattern and mitral propagation velocity for assessing diastolic function
The importance of untwisting in left ventricular filling

19. LV dyssynchrony and assessment by echocardiography

Techniques for measuring interventricular and intraventricular dyssynchrony for predicting response to cardiac resynchronisation treatment
Tissue Doppler quantitation of intraventricular dyssynchrony and their limitations
Techniques for optimising settings of the cardiac resynchronisation device after implantation

20. Stress Echocardiography

Indications and basic knowledge of techniques for exercise, Dobutamine or vasodilator stress echocardiography
Exercise or pharmacological stress echocardiography for diagnosis of ischaemic heart disease and myocardial viability
The concept of viable and hibernating myocardium, and the relevance of the various responses of the myocardium to stress

The concept of flow/contractile reserve
The American Society of Echocardiography regional wall motion scoring system
Dobutamine stress echo in 'low flow' aortic stenosis
Exercise stress echo in valvular heart disease and pulmonary hypertension

21. Myocardial Infarction and its sequelae

2D, 3D, M-mode and Doppler features of:
post-infarction VSD
Mitral papillary muscle rupture
Cardiac tamponade
Mural thrombus
Myocardial scarring
Dressler's syndrome
Left ventricular aneurysm – true aneurysm vs. pseudoaneurysm
Main features of stress-induced (Takotsubo) cardiomyopathy as differential diagnosis of acute myocardial infarction

22. Pulmonary Hypertension (PH) and functional assessment of RV

2-D, M-mode and Doppler features of pulmonary hypertension
Aetiologies:
primary pulmonary hypertension
post pulmonary embolism
secondary to left-sided lesions
lung disease
Assessment of global RV systolic function: Tricuspid annular peak systolic excursion by M- mode (TAPSE), fractional area change, tissue Doppler imaging
Right ventricular dysfunction in pulmonary embolism, chronic pulmonary diseases, cardiomyopathy, Eisenmenger's syndrome, and systemic right ventricle

23. Diseases of the Aorta

Technique for examining the ascending and descending thoracic aorta
Echocardiographic features of the normal aortic root, ascending aorta, aortic arch and upper descending thoracic aorta
2-D, M-mode and Doppler features of:

- Marfan syndrome
- sinus of Valsalva aneurysm
- thoracic aortic aneurysm
- aortic dissection
- additional features related to aortic dissection:
- aortic cusp prolapse
- aortic regurgitation
- fluid in pericardium

Role of transoesophageal echocardiography in the diagnosis of aortic dissection
Assessment of aortic root for patients undergoing transcutaneous aortic valve replacement

24. Adult Congenital Heart Disease

Anatomy, pathophysiology and natural history of common congenital lesions present in adults
2-D, M-mode and Doppler features of the following, pre-operatively and post-operatively, as seen in the older child or adult.
Ostium Secundum Atrial septal defects
Perimembranous and muscular ventricular septal defects
Partial and complete atrio-ventricular septal defect
Persistent ductus arteriosus
Bicuspid aortic valve and associated aortopathy
Sub-and supra-valve aortic stenosis
Aortic coarctation
Pulmonary stenosis
Ebstein's anomaly
Tetralogy of Fallot
D-type transposition of the great arteries and congenitally corrected transposition
Role of contrast echocardiography in evaluating shunts in adults
Calculation of shunts
Role of TOE in adult congenital heart disease intervention

25. Likely echocardiographic findings for common clinical presentations:

Heart failure or breathlessness
Arrhythmia
Ejection systolic murmur
Hypertension
Collagen abnormalities (including systemic sclerosis)
Renal failure
Stroke

26. Emergency and ICU TOE

26.1 General

Constrained environment (multiple arterial/venous lines, ventilator, lighting issues etc.)

26.2 The hypotensive/shocked patient and post cardiac arrest

Role of focused peri-arrest study and appreciation of limited echo windows
Evaluation of LV (systolic and diastolic) and RV function.
Exclusion of severe valve disease (e.g. severe AS, endocarditis) and acute aortic dissection
Assessment for pericardial effusion and cardiac tamponade, hypovolaemia and underfilling, and high output cardiac failure
Septic shock – assess for LV systolic/diastolic dysfunction
Value of repeated echo studies to assess any deterioration/improvement in underlying state

26.3 Suspected acute pulmonary embolus

Echocardiographic evaluation of RV size and function, tricuspid regurgitation and pulmonary artery systolic pressure assessment, IVC size and respiratory variation, thrombus presence in IVC/RA

26.4 Blunt and penetrating cardiac trauma

Typical echocardiographic features including pericardial effusion, right and left ventricular contusion, acute valve lesions, aortic dilation and dissection/transection, VSD, pleural effusion

26.5 TOE in the ventilated patient

Awareness of echocardiographic findings in the presence of mechanical ventilation.
Value of echo in difficult to wean patients
Role in differentiating hydrostatic and inflammatory causes of pulmonary oedema

Assessment in persistent hypoxaemia despite pulmonary recruitment strategies (e.g. exclude PFO, proximal pulmonary embolus)
Acute arrhythmias such as fast AF (assessment for chamber abnormalities, valve disease, LV impairment, pericardial effusion)
Cardiac source of embolus – CVA/peripheral embolic event in ventilated patients, thrombus, endocarditis, myxoma)
Value of TOE in ventilated patients (if poor transthoracic echo window)

26.6 Post surgery patient

Appreciation of effects of general anaesthesia and cardio-pulmonary bypass on LV function

Assessment of post-surgical haemodynamic compromise/ acute deterioration e.g. cardiac surgery (tamponade, wall motion abnormalities, valvular dysfunction), general surgery (air/fat embolism, venous thromboembolism, acute MI, volume overload)

26.7 Assessment of filling status

Awareness of the role of TOE in assessing filling using left and right ventricular systolic and diastolic function, IVC, limitations of SVC and hepatic vein size and reactivity, atrial septal motion, chamber sizes and variation in Doppler velocities.
Role of repeated echo studies in assessing effects of fluid challenge and inotropes

26. Additional topics

The level of knowledge expected is that of a competent echocardiographer performing transesophageal echocardiographic studies and sustaining knowledge through the BSE and other educational resources, including issues relevant to clinical scanning and practice raised in the BSE Echo Journal.

Appendix 2: Curriculum Based Competency Assessment Tool

The following competency assessment tool should be used to ensure all knowledge and practical experience is covered during the candidates training period.

The competency tool is now required to be completed by the candidates mentor via the BSE online logbook portal.

Competency	Date achieved
1. BASIC ECHOCARDIOGRAPHY **Knowledge** Basic principles of ultrasound Basic principles of spectral Doppler Basic principles of colour flow Doppler Basic instrumentation Ethics and sensitivities of patient care Basic anatomy of the heart Basic echocardiographic scan planes: midoesophageal, upper oesophageal and transgastric views Indications for transthoracic and transoesophageal echocardiography Normal variants and artefacts **Practical competencies** Interacts appropriately with patients Understands basic instrumentation Cares for machine appropriately Can obtain standard views Can optimise gain setting, sector width, depth, harmonics, focus, sweep speed, Doppler baseline and scale, colour gain Can obtain standard measurements using 2D or M-mode Can recognise normal variants: Eustachian valve, Chiari network etc Can use Colour Flow Doppler for all valves optimising gain and box-size Can obtain pulsed wave Doppler at; left ventricular inflow (mitral valve) left ventricular outflow tract (LVOT) right ventricular inflow (tricuspid valve) right ventricular outflow tract, pulmonary valve & main pulmonary artery	
2. LEFT VENTRICLE **Knowledge** Coronary anatomy and correlation with 2D views of left ventricle. Segmentation of the left ventricle (16 and 17 segment models) Wall motion Measurements of global systolic function. (LVOT VTI, stroke volume, fractional shortening, ejection fraction using Simpson's rule) Doppler mitral valve filling patterns & normal range Appearance of complications after myocardial infarction Ventricular septal and papillary muscle rupture Ischaemic mitral regurgitation Features of dilated and hypertrophic cardiomyopathy Common differential diagnosis Athletic heart, hypertensive disease	

Practical competencies Can differentiate normal from abnormal LV systolic function Can recognise large wall motion abnormalities Can describe wall motion abnormalities and myocardial segments Can obtain basic measures of systolic function VTI, FS, LVEF Understands & can differentiate diastolic filling patterns Can detect and recognise complications after myocardial infarction Understands causes of a hypokinetic left ventricle Can recognise features associated with hypertrophic cardiomyopathy Can recognise hypertensive heart disease	
3. MITRAL VALVE DISEASE Knowledge Normal anatomy of the mitral valve, and the subvalvar apparatus and their relationship with LV function Causes of mitral stenosis and regurgitation Ischaemic, functional, prolapse, rheumatic, endocarditis Practical competencies Can recognise rheumatic disease Can recognise mitral prolapse Can recognise functional mitral regurgitation Can assess mitral stenosis 2D planimetry, pressure half-time, gradient Can assess severity of regurgitation, chamber size, signal density, proximal flow acceleration & vena contracta	
4. AORTIC VALVE DISEASE and AORTA Knowledge Causes of aortic valve disease Causes of aortic disease Methods of assessment of aortic stenosis and regurgitation Basic criteria for surgery to understand reasons for making measurements Practical competencies Can recognise bicuspid, rheumatic, and degenerative disease Can recognise a significantly stenotic aortic valve Can derive peak & mean gradients using continuous wave Doppler Can measure valve area using the continuity equation Can recognise severe aortic regurgitation Can recognise dilatation of the ascending aorta Knows the echocardiographic signs of dissection	
5. RIGHT HEART Knowledge Causes of tricuspid and pulmonary valve disease Causes of right ventricular dysfunction Causes of pulmonary hypertension The imaging features of pulmonary hypertension The estimation of pulmonary pressures Practical competencies Recognises right ventricular dilatation	

Can estimate PA systolic pressure Can estimate right atrial pressure from the appearance of the IVC	
6. REPLACEMENT HEART VALVES **Knowledge** Types of valve replacement Criteria of normality Signs of failure **Practical competencies** Can recognise broad types of replacement valve Can recognise para-prosthetic regurgitation Can recognise prosthetic obstruction	
7. INFECTIVE ENDOCARDITIS **Knowledge** Duke criteria for diagnosing endocarditis Echocardiographic features of endocarditis Criteria for TOE **Practical competencies** Can recognise typical vegetations Can recognise an abscess Can recognise complications just on valve regurgitation	
8. INTRACARDIAC MASSES **Knowledge** Types of mass found in the heart features of a mxyoma Differentiation of atrial mass Normal variants and artifacts **Practical competencies** Can recognise a LA myxoma Can differentiate LV thrombus and trabeculation	
9. PERICARDIAL DISEASE **Knowledge** Features of tamponade RV collapse, effect on IVC, A-V valve flow velocities and respiratory variation. Features of pericardial constriction Differentiation of pericardial constriction from restrictive myopathy **Practical competencies** Can differentiate a pleural and pericardial effusion Can recognise the features of tamponade Can judge the route for pericardiocentesis Can recognise restrictive physiology	
10. ADULT CONGENITAL HEART DISEASE **Knowledge** Anatomy and echo features of basic congenital disease: ASD, VSD, partial & complete atrio-ventricular defects Patent ductus arteriosus Sub and supravalvar aortic stenosis Sub valvar, valvar and supra-valvar pulmonary stenosis Ebstein's anomaly Fallot's tetralogy Role of contrast Shunt calculation Estimation of pulmonary artery pressure	

Practical competencies Can recognise a secundum ASD and identify pulmonary veins Can calculate a shunt	

Appendix 3: Reading list

The reading list is provided by the Accreditation committee of the British Society of Echocardiography and represents only a handful of text that are available for candidates to learn from.

- Practical Perioperative Transesophageal Echocardiography: With Critical Care Echocardiography by David Sidebotham, Alan Merry, Malcolm E. Legget · Elsevier/Saunders ISBN 0702034274.
- A Practical Approach to Transesophageal Echocardiography by Albert C. Perrino, Scott T. Reeves ISBN 1451175604
- Perioperative Two-Dimensional Transesophageal Echocardiography: A Practical Handbook by Annette Vegas. 1441999523
- Clinical Manual and Review of Transesophageal Echocardiography, Second Edition by Joseph Mathew, Madhav Swaminathan, Chakib Ayoub · Mcgraw-Hill. ISBN 0071638075
- Echocardiography: A Practical Guide for Reporting and Interpretation. 3rd Edition.Helen Rimington and John Chambers Taylor & Francis 2015 ISBN 1482231921
- Feigenbaum's Echocardiography William F. Armstrong, Thomas Ryan, Harvey Feigenbaum – 2010. ISBN 0781795575

Useful review articles:

- A minimum dataset for a standard transoesophageal echocardiogram: a guideline protocol from the British Society of Echocardiography. Richard Wheeler, Richard Steeds, Bushra Rana et al. Echo Res Pract. 2015 Dec 1; 2(4): G29–G45.
- ASE/SCA guidelines for performing a comprehensive intraoperative multiplane transesophageal echocardiography examination: recommendations of the ASE Council for Intraoperative Echocardiography and the SCA Task Force for Certification in Perioperative Transesophageal Echocardiography. Shanewise JS, Cheung AT, Aronson S et al. Anesth Analg. 1999 Oct;89(4):870-84.
- Guidelines for performing a comprehensive transesophageal echocardiographic examination: recommendations from the ASE and SCA. Hahn RT, Abraham T, Adams MS et al. Anesth Analg.2014 Jan;118(1):21-68
- Echocardiographic assessment of valve stenosis: EAE/ASE recommendations for clinical practice.
- Baumgartner H, Hung J, Bermejo J et al. Eur J Echocardiogr. 2009 Jan;10(1):1-25.
- Recommendations on the Echocardiographic Assessment of Aortic Valve Stenosis: A Focused Update from the European Association of Cardiovascular Imaging and the American Society of Echocardiography. Baumgartner H, Hung J, Bermejo J et al. J Am Soc Echocardiogr. 2017 Apr;30(4):372-392.
- European Association of Echocardiography recommendations for the assessment of valvular regurgitation. Part 2: mitral and tricuspid regurgitation (native valve disease). Lancellotti P, Moura L, Pierard LA et al. Eur J Echocardiogr. 2010 May;11(4):307-32.
- European Association of Echocardiography recommendations for the assessment of valvular regurgitation. Part 1: aortic and pulmonary regurgitation (native valve disease). Lancellotti P, Tribouilloy C, Hagendorff A et al. Eur J Echocardiogr. 2010 Apr;11(3):223-44.
- Recommendations for Noninvasive Evaluation of Native Valvular Regurgitation: A Report from the American Society of Echocardiography Developed in Collaboration with the Society for Cardiovascular Magnetic Resonance. Zoghbi WA, Adams D, Bonow RO. J Am Soc Echocardiogr. 2017 Apr;30(4):303-371Recommendations for cardiac chamber quantification by echocardiography in adults: an update from the ASE and the EACVI Lang RM, Badano LP, Mor-Avi V et al. J Am Soc Echocardiogr. 2015 Jan;28(1):1-39.

- Recommendations for quantification of Doppler echocardiography: a report from the Doppler Quantification Task Force of the Nomenclature and Standards Committee of the American Society of Echocardiography. Quiñones MA, Otto CM, Stoddard M et al. J Am Soc Echocardiogr.2002 Feb;15(2):167-84.
- Guidelines for the echocardiographic assessment of the right heart in adults: a report from the ASE endorsed by the EAE, a registered branch of the ESC, and the CSE. Rudski LG, Lai WW, Afilalo J et al. J Am Soc Echocardiogr. 2010 Jul;23(7):685-713
- Safe sedation during TOE. http://www.bsecho.org/recommendations-for-safe-practice-in-sedation.
- EAE/ASE Recommendations for the evaluation of left ventricular diastolic function by echocardiography. Nagueh SF, Appleton CP, Gillebert TC et al. J Am Soc Echocardiogr. 2009 Feb;22(2):107-33.

Protocols and guidelines are available under the Education tab of www.bsecho.org.

Please note that only fully subscribed BSE members are granted with full access to all education and exam content.

Appendix 4: Pearson VUE – Guidance Notes

BSE written exams are delivered in partnership with Pearson VUE. Candidates will be able to sit the exam at local centres throughout the UK, Republic of Ireland, and some overseas areas.

Pre-Registration (through BSE website)

- Candidates must register their interest to sit the written exam by completing an online pre-registration form via the accreditation section of www.bsecho.org. The pre-registration window is open for up to four weeks.
- Candidates registered names should appear the same as per their photo identification. Pearson Vue follows a strict admission policy.
- BSE will transfer your data and requirements to Pearson VUE, who will contact all pre-registered candidates with further information on confirming placements for the exam.
- **Delivery methods**: there are two ways candidates can take the exam- Test Centre or Online proctored exam (OnVUE), which allows candidates to sit the exam from home (subject to system requirement).

Special accommodations

- Pearson Vue can provide special accommodations to candidates who have official requirements, such as extra time, a reader, or the need for medication during the examination.
- Further information on accommodations is available on the website.
- All requests must be put in writing with supporting documents to support claims for special accommodations. Requests will be approved at the discretion of the BSE. Forward such requests to accreditation@bsecho.org.

Registration (through Pearson Vue)

- All registration and payments will be managed by Pearson VUE after the stage of pre-registration.
- Candidates with special requirements or conditions should notify the BSE during the pre-registration stage.
- Cancellations made in less than 7 days do not qualify for a refund. All cancellations must be processed through Pearson Vue.

On the day of the exam

- Instructions will be given on the day of the exam via a video tutorial at the test centre or onVUE online proctored. Candidates will complete the exam on a computer at the test centre.
- A basic calculator is already built into the online exam. An erasable sheet will be given to candidates by the examining centre. If sitting the exam from home using online proctoring- a calculator and whiteboard are built into the exam.
- **Candidates are not required to bring any stationery to the exam.**
- Candidates are required to bring a photo ID. Please ensure that the registration details match your photo ID exactly as otherwise you will be refused entry. If denied entry, candidates should contact BSE immediately.
- Any last-minute requests for special accommodations will not be facilitated by the test centre.

Results

- Results are typically released 5-6 weeks after sitting the exam. Scores will be uploaded to BSE personal profiles. Both sections must be passed to achieve a complete pass grade.
- **Pass:** candidates will be issued with login details to the portal to begin uploading cases. The submission deadline will appear at the 'Practical submission deadline' in the member profile.
- **Fail:** candidates can register interest to sit the next sitting of the exam.
- The reduced fee only applies to candidates who physically sat the exam and were unsuccessful; the next attempt must be taken at the next sitting (within 12 months).
- Results cannot be appealed or 'remarked' as the tests are computer-based.

Please watch the demo available via Pearson VUE; http://www.pearsonvue.com/demo/

Additional Information:

Candidates are advised to check the security procedures in the "What to expect section" of the Pearson VUE/BSE guide page; https://home.pearsonvue.com/test-taker/security.aspx

Pearson Vue operates a strict admissions policy. Candidates registered names should be exactly as they appear on their government photographic ID.

Appendix 5: Example of written exam multiple choice questions

Answer 'True' (T) or 'False' (F) to each of the following.

There is no negative marking - one mark added for a correct answer, no mark deducted for an incorrect answer.

1	When considering possible mitral valve repair there is no need to assess	
a.	the mechanism of the mitral regurgitation	
b.	left atrial size	
c.	mitral to tricuspid annular ratio	T
d.	anterior mitral valve leaflet length	
e.	the presence of annular calcification	

2	Doppler methods to quantify flow in clinical practice assume that	
a.	cross-sectional flow profiles are parabolic	
b.	turbulent flow profiles are being sampled	
c.	the intercept angle with flow is 15°	
d.	transmit power is kept constant	
e.	flow velocity and cross-sectional area are measured at the same point	T

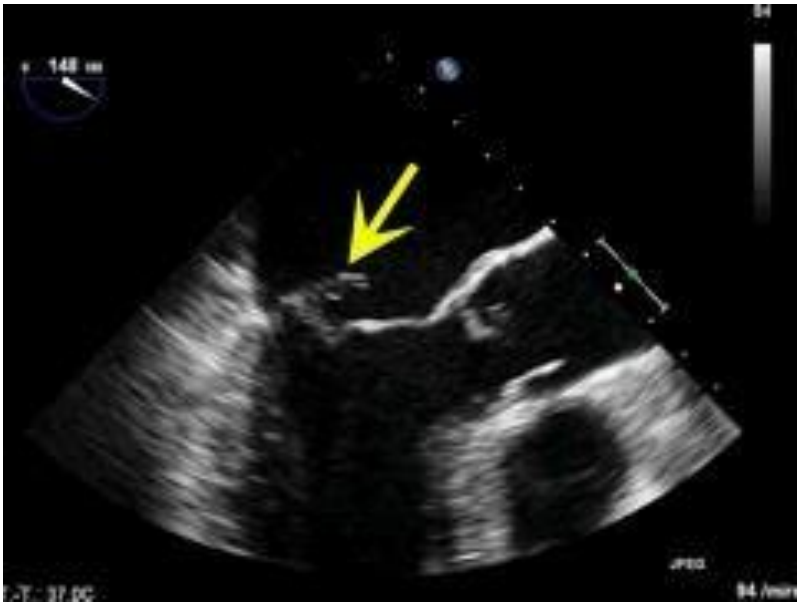
3	Left ventricular regional wall motion abnormalities resulting from occlusion of the circumflex coronary artery may commonly be seen in the following left ventricular segments	
a.	mid anteroseptal	
b.	basal inferolateral	T
c.	apical inferior	
d.	basal inferoseptal	
e.	apical anterior	

Appendix 6: Example of written exam image reporting questions

A number of moving clips and stills will be included in each question. Although these can be viewed and replayed as many times as the candidate wishes, the candidate should be mindful of the time spend on each question.

The SINGLE BEST ANSWER should be selected.

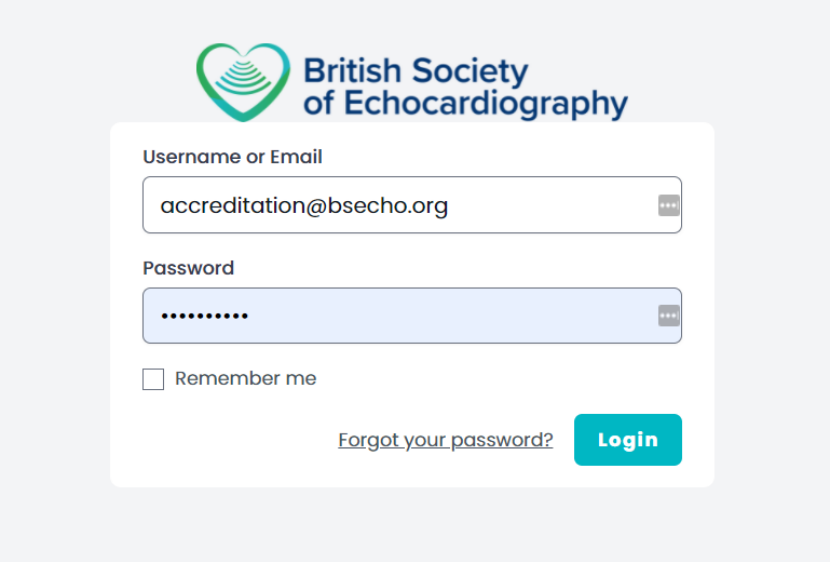
There is no negative marking - one mark added for a correct answer, no mark deducted for an incorrect answer.



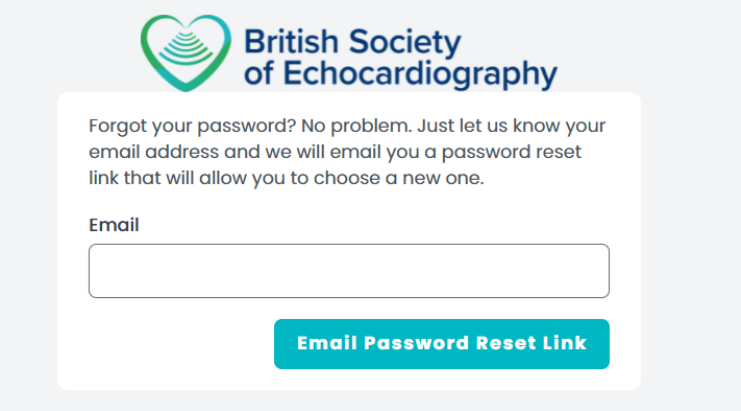
1	**The arrow indicates:**	**A**
a.	Anterior mitral valve leaflet	
b.	Posterior mitral valve leaflet	T
c.	Coronary sinus	
d.	Mitral valve annulus	
e.	Zone of coaptation	

Appendix 7: Logbook portal user guide

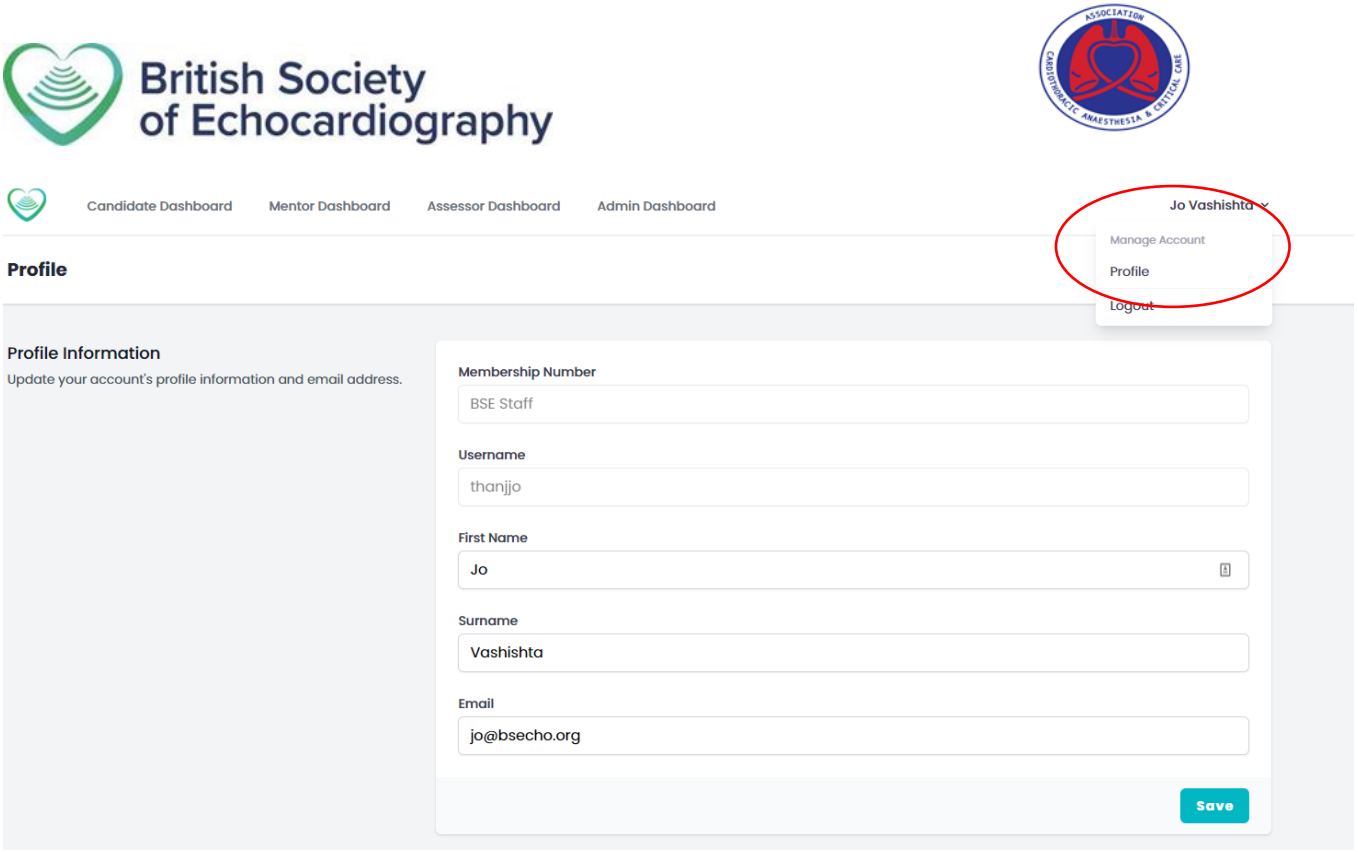
1. User Login Details:
   - Request login details by emailing the accreditation team- accreditation@bsecho.org. Provide your **BSE ID number**, the type of *accreditation you are pursuing.
     *TOE candidates, please specify if you require the reduced case template.
     Also, inform us of your mentor's name and email address- we will assign them to your logbook.
   - An automated message from the portal will be emailed to you with your login details.
   - Link to the portal: https://logbook-v2.bsecho.org/login



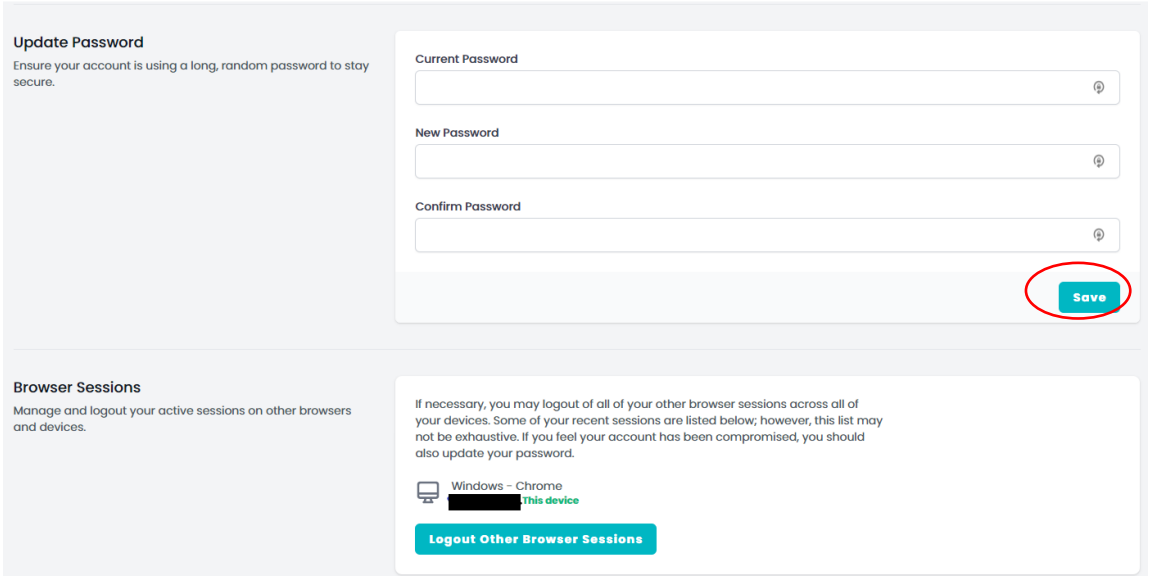
a. If you have forgotten your password, please click the link titled Forgot your password?



2. Update your profile
   - Click on your name, then **'Profile'** to update your name, email and password.

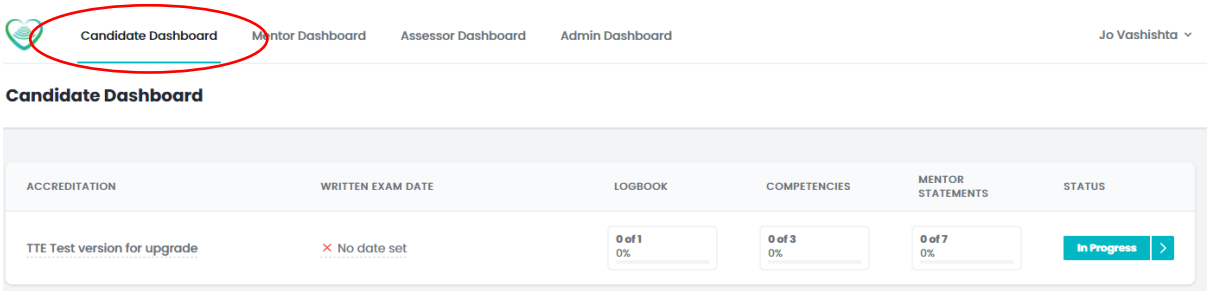


Enter new password and click 'save.'



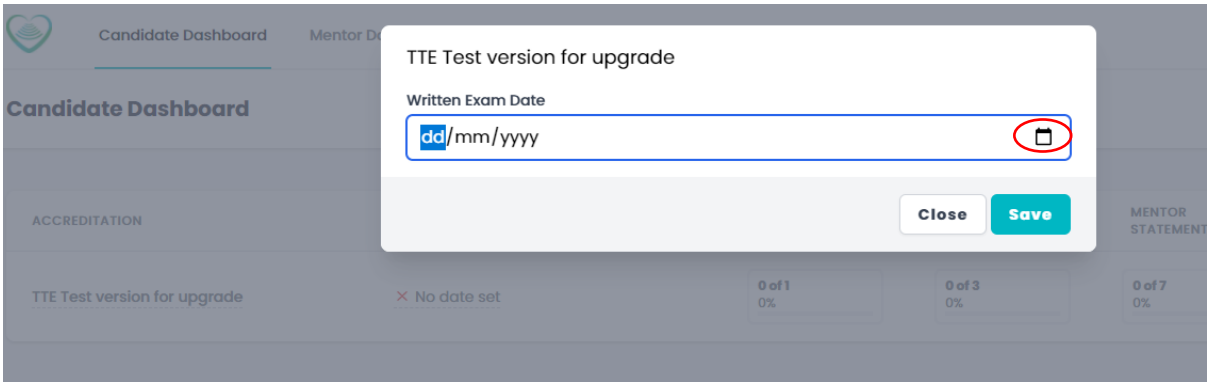
3. User dashboard (e.g. Candidate, Mentor or Assessor)

- Click on the visible heading to access your dashboard

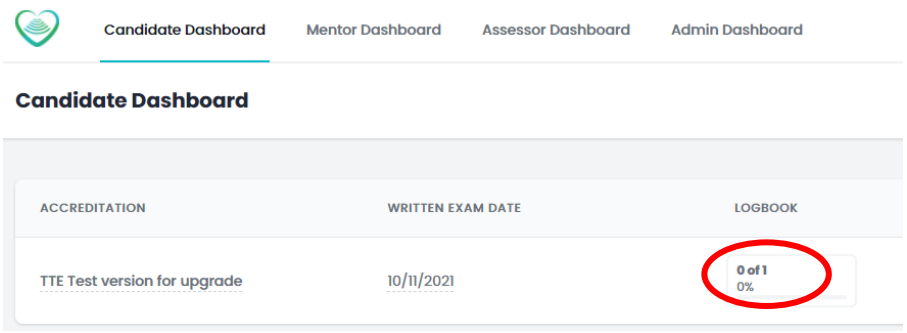


a. Enter Written Exam Date

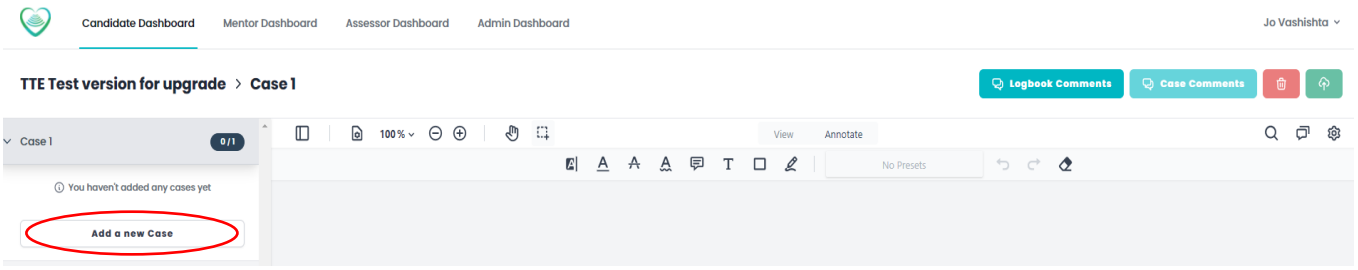
- Click on ✕ No date set to bring up the calendar and select the date you sat the written exam.

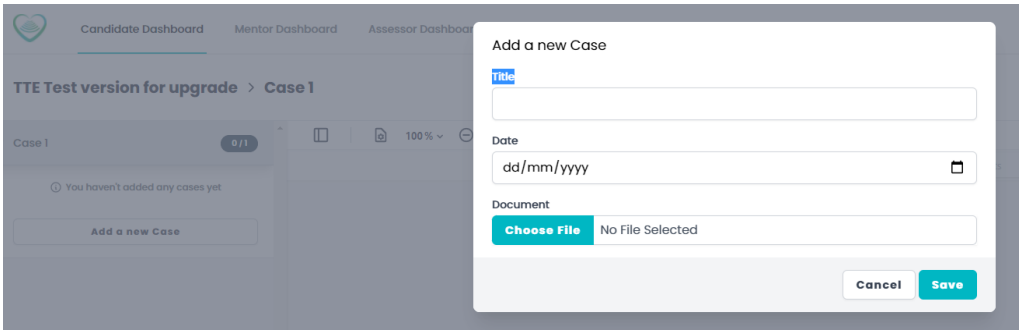


b. Click the box under the Logbook title to begin uploading PDF reports. The portal will take only PDF uploads.



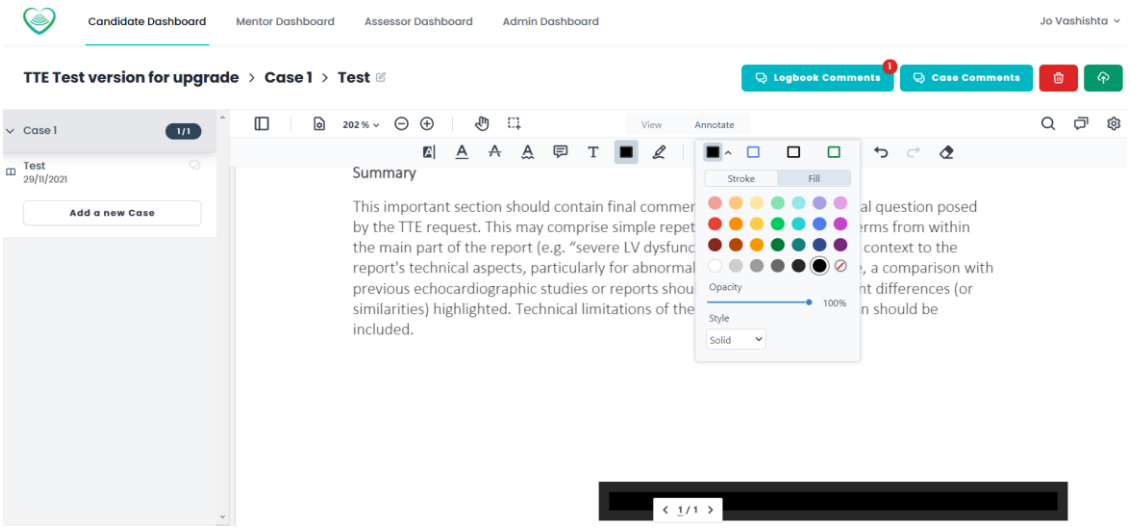
To add a new case, click on '**Add a new Case'**, give it a Title, enter the date of the case and Choose File.



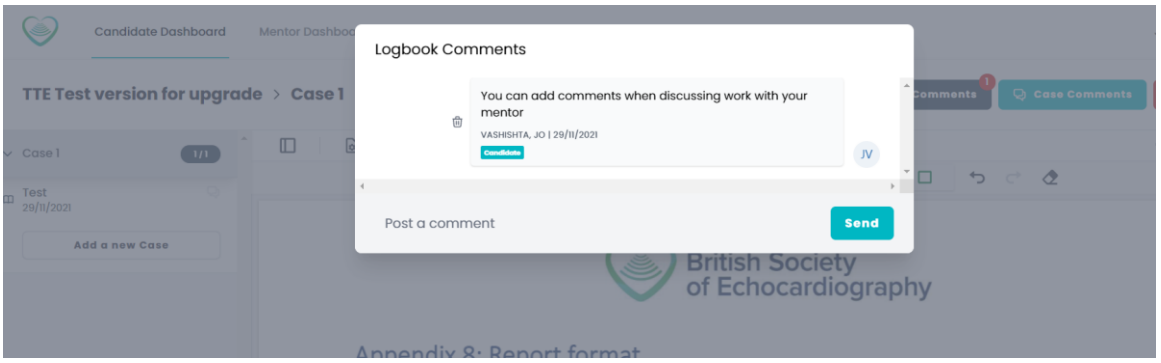


- Explore the features and tools by hovering over the icons to find what they can do.
- To **save** your work, click , to **delete** click

The 'Rectangle' tool allows masking over unwanted data. Click the Save button to keep the anonymise changes.

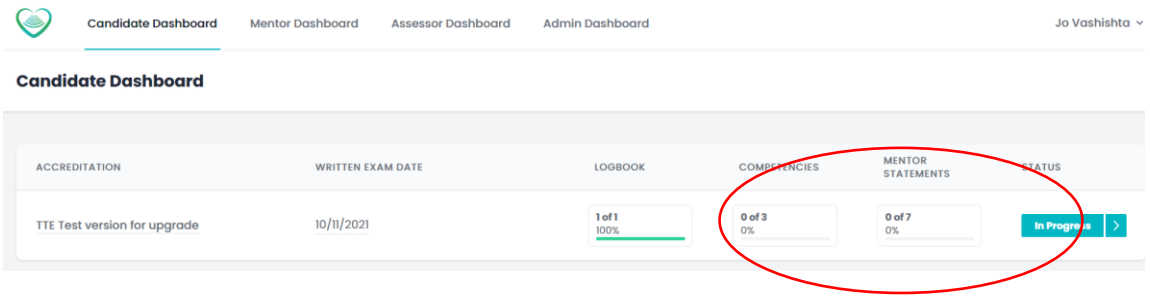


You can add logbook or case comments to share with your mentor only.



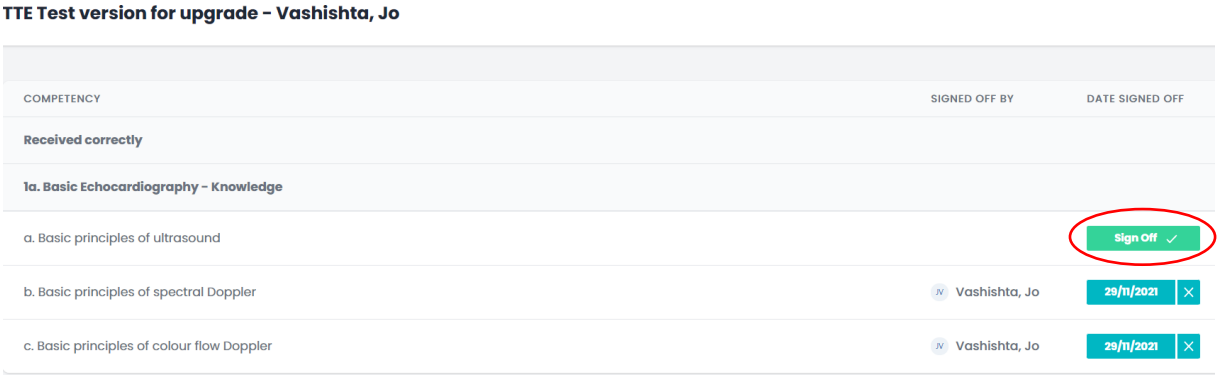
4. Competencies

Your mentor will access your portal via their login and sign off each of the competencies. Candidate can view the progress in the dashboard.

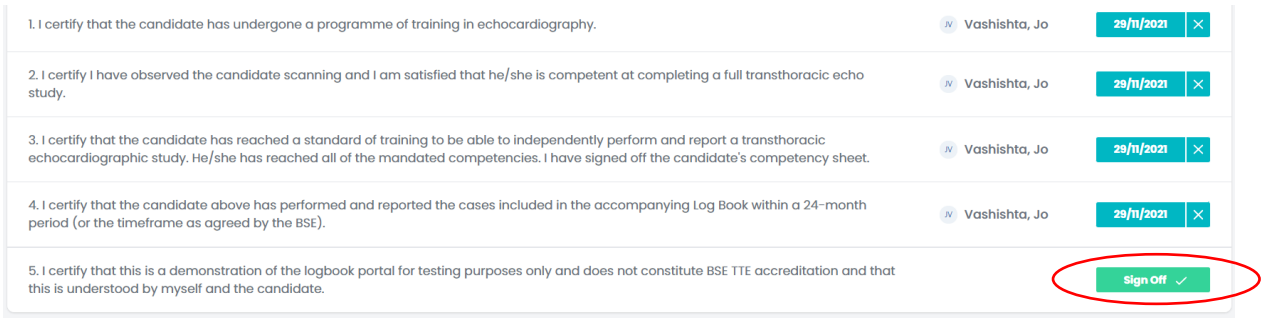


a. Mentor view:

The mentor clicks the sections below the 'DATE SIGNED OFF' header to sign off competencies by clicking on 'Sign off.'

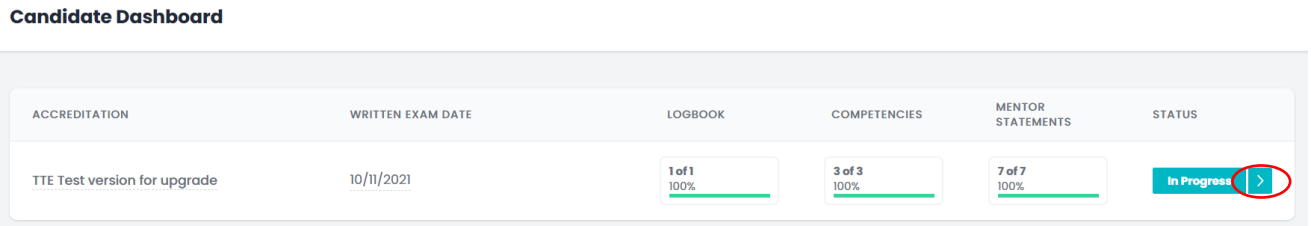


When mentor has completed competency sign off, they must do the same for the 'Mentor statement.'



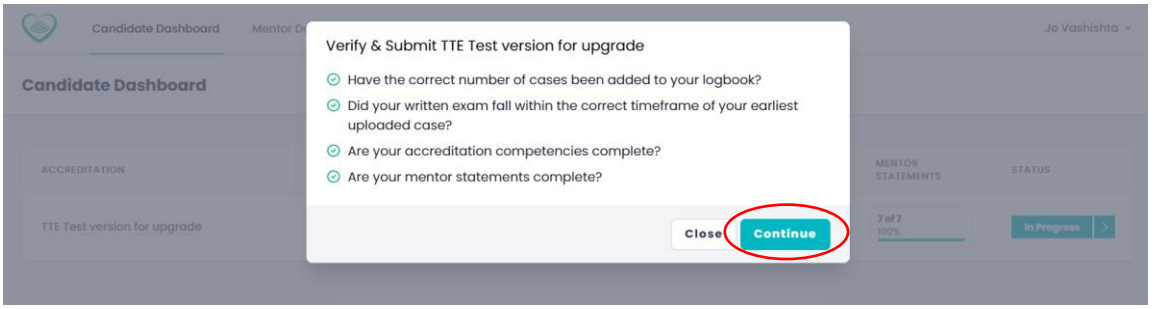
5. Candidate logbook submission

Candidate can check the progress of their logbook in the dashboard and click the arrow after 'In Progress'.

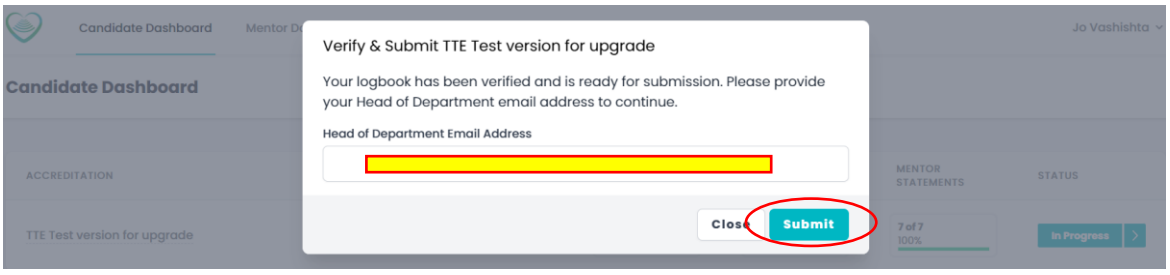


a. Verify and submit

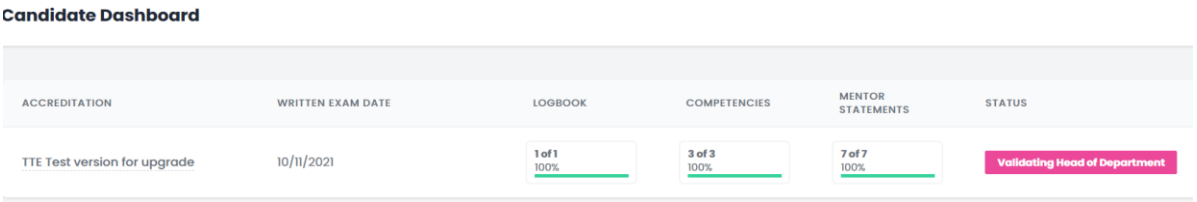
Check you have completed the requirement before clicking **'Continue.'**



b. Enter Head of Department Email Address and click submit:

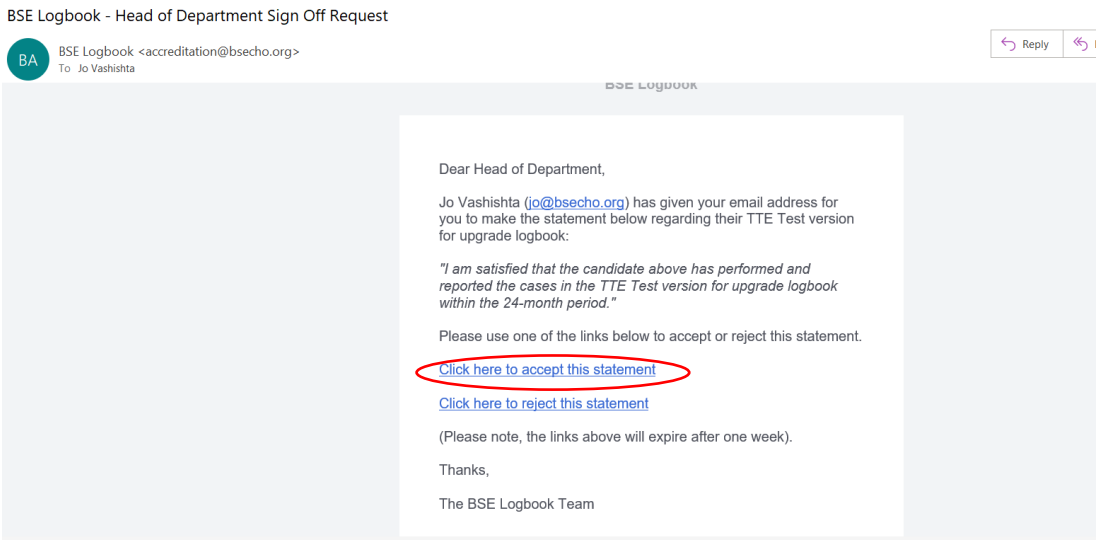


c. Contact accreditation@bsecho.org to inform you have entered your HOD's email address and clicked submit.



6. Validate logbook

Your Head of Department must click the link to accept the statement.



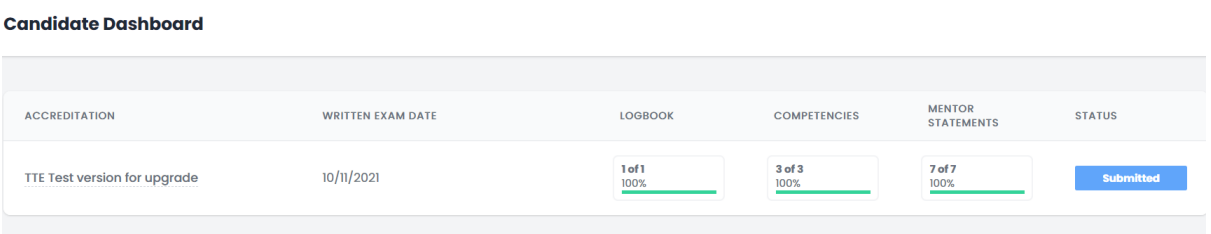
a. Head of Department varified

After clicking the statement, the Head of Department receives the message below.

Please note that some NHS emails may block messages from the logbook portal- accreditation@bsecho.org. In this case, candidates should consider providing an alternative email address, e.g. non-NHS email addresses.

7. Logbook submitted

Once the logbook has been validated, it is ready for an assessor to mark.



- No further action is required from this point.
- Candidates will be notified when marking is complete.

End of guide. *Updated: JV- 29/11/2021*

Appendix 8: Report Format

THIS IS A SUGGESTED FORMAT FOR A REPORT WITHIN THE WORKPLACE.
PLEASE NOTE ALL REPORTS SUBMITTED IN THE LOGBOOK AND ACCOMPANYING THE CASES MUST BE ANONYMISED

The report should comprise the following sections:

Demographic and other Identifying Information

Obligatory information
Patient's name
Medical record number, NHS number or other unique identifier
Age
Gender
Indications for test
Referring clinician identification
Interpreting echocardiographer identification
Date of study

Additional, optional information

Location of the patient (e.g. outpatient, inpatient, etc.)
Location where study was performed (e.g. Echo department, Cath lab, ITU, theatre, etc.)
Study classification (routine, urgent, emergency)
Date of study
Height and weight
Blood pressure
Medications administered

Echocardiographic study

This covers the main content of the report.
For each cardiac structure, the report is divided as follows:
Descriptive terms:
Phrases that are used to construct the text content of a report, describing morphology (e.g. mitral leaflet -thickened tips) and function (e.g. mitral leaflet –reduced mobility of the PMVL) of cardiac structures.
Measurements/analysis:
Examples to include: Vmax, peak gradient, mean gradient, valve area. LA / LV / RV /RA dimensions. Regurgitant jet quantification including; vena contracta, PISA, regurgitation volume, effective office area.
Diagnostic statements:
Phrases that add echocardiographic interpretation to descriptive terms (e.g. appearance of rheumatic mitral valve disease, suitable for commissurotomy).

Summary

This important section should contain final comments that address the clinical question posed by the TOE request. This may comprise simple repetition of key descriptive terms from within the main part of the report (e.g. "severe LV dysfunction"). It may add clinical context to the technical aspects of the report, particularly with respect to abnormal findings. Where possible, comparison with previous echocardiographic studies or reports should be made and important differences (or similarities) highlighted. Technical limitations of the study or its interpretation should be included.

Appendix 9: Logbook marking criteria

When marking a candidate's logbook, the Assessor will review a selection of reports in the candidate's logbook. The British Society of Echocardiography reserves the right to review all logbook reports if deemed appropriate.

The following marking criteria is used when assessing each logbook report.

Does the report meet the following criteria?	Yes / No (if no, state reasons why)
Indication for TOE present	
Appropriate 2D and m-mode (if relevant) measurements	
Appropriate Doppler measurements / calculations present	
Do measurements / Doppler calculations match descriptions	
All parts of heart described	
Descriptions complete	
Appropriate to request	
Conclusion appropriate to findings (No conclusion = automatic fail)	

Reporting marking comments:

- No conclusion = automatic fail for report being reviewed.
- More than two "no's" per report results in that report failing.
- 30% of cases deemed as being failed = Fail of entire logbook

Logbook outcomes include:

Satisfactory log-book for BSE accreditation

OR

Unsatisfactory at present and a resubmission is required.

Resubmission requirements will be discussed with the candidate and detailed feedback provided to assist the candidate with a resubmission.

Unsuccessful candidates will be informed by Assessor after discussion with the Senior Examiner.

Appendix 10: BSE Policy on the Non-anonymisation of Patient Data

The duty of confidentiality arises out of the common law of confidentiality, professional obligations and also staff employment contracts. Breach of confidence may lead to disciplinary measures, bring into question professional reputation and possibly result in legal proceedings.

Guidance is provided to Healthcare Professionals in the 'NHS Code of Practice on Confidentiality' (November 2003):
http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/@dh/@en/documents/digitalasset/ dh_4069254.pdf

Patient information that can identify individual patients is confidential and must not be used or disclosed in any part of the submission required for this accreditation process. In contrast, anonymised information is not confidential and may be used.

Key identifiable information includes:

- Patient's name
- Address
- Full post code
- Date of birth
- NHS number and local identifiable codes

Key identifiable information may also include information that may be used to identify a patient directly or indirectly. For example, rare diseases, drug treatment or statistical analyses which have very small numbers within a small population may allow individuals to be identified.

Guidance to candidates submitting Logbooks and Cases for Accreditation

The NHS Code of Practice on confidentiality means that evidence submitted for this accreditation process must have removed **ALL** patient identifiable information beyond that of gender and age/year of birth.

Reports – Please use the BSE online portal and electronically delete all patient information except age and gender.

We would advocate against the use of other electronical anonymisation as sometimes data is still present. If in doubt, manually remove patient identification information prior to use.

Video cases - We appreciate that the removal of patient ID may be difficult. Therefore, we advise that the video cases are specifically collected, and the data inputs are made relevant to your cases (E.g. Patient Name could be 'BSE Case 1', Patient Number could be your membership number followed by case number, '1111-1').

The final decision remains at the discretion of the Chair of the Accreditation Committee.

Appendix 11: Viva case marking criteria

The next few pages show the individual marking criteria for each of the patient video case studies.

All criteria must be met to a satisfactory standard for the patient case study to be passed.

A minimum of two patient case studies will be assessed. The British Society of Echocardiography reserves the right to assess all five patient viva cases.

Adult Transoesophageal Accreditation **Case 1 – Normal study** Practice must be satisfactory in all areas to pass			
Evidence of satisfactory practice	Tick	Evidence of unsatisfactory practice	Tick
ECG Largely present throughout without 2D image interference		**ECG** Unstable or frequently absent making timings inaccurate	
Optimisation Infrequent, non-repetitive optimisation errors which do not detract from the case conclusion		**Optimisation** Frequent, repetitive optimisation errors which detract from the case conclusion	
Complete study Images are complete enough to allow full assessment of the selected pathology, including Doppler study and measurements		**Incomplete study** Images are missing which are relevant to the accurate assessment of the selected pathology, including inadequate Doppler study or relevant measurements quoted in report but not demonstrated	
2D measurements/M-mode (if relevant) Accurate throughout with minor errors only		**2D measurements/M-mode (if relevant)** Frequent inaccuracies or isolated inaccuracies that change the categorisation of the chosen pathology	
Colour Doppler Accurate box size, gain, scale and baseline settings demonstrating anatomy clearly		**Colour Doppler** Frequent inaccuracies of box size, gain, scale and baseline settings which prevent clear demonstration of the anatomy	
Spectral Doppler Accurate use with good cursor alignment and optimised waveforms		**Spectral Doppler** Inaccurate use with poor cursor alignment or waveform optimisation altering pathology assessment	
Pathology assessment Good quality CWD. No images missing which are key to pathology assessment No measurements significantly inaccurate that are key to pathology assessment (LVOT diameter, LVOT $_{VTI}$ and AV $_{VTI}$)		**Pathology assessment** Missing, poor quality CWD signal. Images missing which are key to pathology assessment Measurements key to pathology assessment significantly inaccurate and change the categorisation of the pathology (LVOT diameter, LVOT $_{VTI}$ and AV $_{VTI}$)	
Report Complete, accurate and comprehensive description of all parts of the heart Correct categorisation of chosen pathology (NB trivial abnormalities may be included in this case) Correct interpretation of findings in the clinical context		**Report** Incomplete or inaccurate or partial and inaccurate description of parts of the heart Incorrect categorisation of chosen pathology Incorrect interpretation of findings in the clinical context	

Adult Transoesophageal Accreditation **Case 2 – Aortic stenosis** Practice must be satisfactory in all areas to pass			
Evidence of satisfactory practice	Tick	Evidence of unsatisfactory practice	Tick
ECG Largely present throughout without 2D image interference		**ECG** Unstable or frequently absent making timings inaccurate	
Optimisation Infrequent, non-repetitive optimisation errors which do not detract from the case conclusion		**Optimisation** Frequent, repetitive optimisation errors which detract from the case conclusion	
Complete study Images are complete enough to allow full assessment of the selected pathology, including Doppler study and measurements		**Incomplete study** Images are missing which are relevant to the accurate assessment of the selected pathology, including inadequate Doppler study or relevant measurements quoted in report but not demonstrated	
2D measurements/M-mode (if relevant) Accurate throughout with minor errors only		**2D measurements/M-mode (if relevant)** Frequent inaccuracies or isolated inaccuracies that change the categorisation of the chosen pathology	
Colour Doppler Accurate box size, gain, scale and baseline settings demonstrating anatomy clearly		**Colour Doppler** Frequent inaccuracies of box size, gain, scale and baseline settings which prevent clear demonstration of the anatomy	
Spectral Doppler Accurate use with good cursor alignment and optimised waveforms		**Spectral Doppler** Inaccurate use with poor cursor alignment or waveform optimisation altering pathology assessment	
Pathology assessment Good assessment of regurgitation. Understanding of the methods available to assess severity and accurate demonstration if appropriate (eg PISA/Vena contracta/PV flow) No images missing which are crucial to pathology assessment No measurements significantly inaccurate that are crucial to pathology assessment		**Pathology assessment** Poor or inadequate assessment of severity. Failure to return Doppler baseline to normal after PISA assessment Images missing which are crucial to pathology assessment Measurements key to pathology assessment significantly inaccurate and change the categorisation of the pathology	
Report Complete and accurate Comprehensive and accurate description of all parts of the heart Correct categorisation of chosen pathology Correct interpretation of findings in the clinical context.		**Report** Incomplete or inaccurate Partial and inaccurate description of parts of the heart Incorrect categorisation of chosen Pathology Incorrect interpretation of findings in the clinical context	

Adult Transoesophageal Accreditation **Case 3 – Mitral or aortic regurgitation** Practice must be satisfactory in all areas to pass			
Evidence of satisfactory practice	Tick	Evidence of unsatisfactory practice	Tick
ECG Largely present throughout without 2D image interference		**ECG** Unstable or frequently absent making timings inaccurate	
Optimisation Infrequent, non-repetitive optimisation errors which do not detract from the case conclusion		**Optimisation** Frequent, repetitive optimisation errors which detract from the case conclusion	
Complete study Images are complete enough to allow full assessment of the selected pathology, including Doppler study and measurements		**Incomplete study** Images are missing which are relevant to the accurate assessment of the selected pathology, including inadequate Doppler study or relevant measurements quoted in report but not demonstrated	
2D measurements/M-mode (if relevant) Accurate throughout with minor errors only		**2D measurements/M-mode (if relevant)** Frequent inaccuracies or isolated inaccuracies that change the categorisation of the chosen pathology	
Colour Doppler Accurate box size, gain, scale and baseline settings demonstrating anatomy clearly		**Colour Doppler** Frequent inaccuracies of box size, gain, scale and baseline settings which prevent clear demonstration of the anatomy	
Spectral Doppler Accurate use with good cursor alignment and optimised waveforms		**Spectral Doppler** Inaccurate use with poor cursor alignment or waveform optimisation altering pathology assessment	
Pathology assessment Appropriate measurement of Simpson's method, M-mode showing systolic and diastolic measurements in both 4C & 2C view. Correlates with visual impression and other methods No images missing which are crucial to pathology assessment No measurements significantly inaccurate which are crucial to pathology assessment.		**Pathology assessment** Incomplete assessment of Simpson's/M- mode or measured inaccurately and changes the categorisation of the reported EF Images missing which are crucial to pathology assessment Measurements key to pathology assessment significantly inaccurate and change the categorisation of the pathology	
Report Complete and accurate Comprehensive and accurate description of all parts of the heart Correct categorisation of chosen pathology (NB trivial abnormalities may be included in this case) Correct interpretation of findings in the clinical context.		**Report** Incomplete or inaccurate Partial and inaccurate description of parts of the heart Incorrect categorisation of chosen pathology Incorrect interpretation of findings in the clinical context	

Adult Transoesophageal Accreditation **Case 4 – Other pathology** Practice must be satisfactory in all areas to pass			
Evidence of satisfactory practice	Tick	Evidence of unsatisfactory practice	Tick
ECG Largely present throughout without 2D image interference		**ECG** Unstable or frequently absent making timings inaccurate	
Optimisation Infrequent, non-repetitive optimisation errors which do not detract from the case conclusion		**Optimisation** Frequent, repetitive optimisation errors which detract from the case conclusion	
Complete study Images are complete enough to allow full assessment of the selected pathology, including Doppler study and measurements		**Incomplete study** Images are missing which are relevant to the accurate assessment of the selected pathology, including inadequate Doppler study or relevant measurements quoted	
2D measurements/M-mode (if relevant) Accurate throughout with minor errors only		**2D measurements/M-mode (if relevant)** Frequent inaccuracies or isolated inaccuracies that change the categorisation of the chosen pathology	
Colour Doppler Accurate box size, gain, scale and baseline settings demonstrating anatomy clearly		**Colour Doppler** Frequent inaccuracies of box size, gain, scale and baseline settings which prevent clear demonstration of the anatomy	
Spectral Doppler Accurate use with good cursor alignment and optimised waveforms		**Spectral Doppler** Inaccurate use with poor cursor alignment or waveform optimisation altering pathology assessment	
Pathology assessment Appropriate measurement of Simpson's method, M-mode showing systolic and diastolic measurements in both 4C & 2C view. Correlates with visual impression and other methods No images missing which are crucial to pathology assessment No measurements significantly inaccurate which are crucial to pathology assessment.		**Pathology assessment** Incomplete assessment of Simpson's/M-mode or measured inaccurately and changes the categorisation of the reported EF Images missing which are crucial to pathology assessment Measurements key to pathology assessment significantly inaccurate and change the categorisation of the pathology.	
Report is complete and accurate Comprehensive and accurate description of all parts of the heart. Correct categorisation of chosen pathology (NB trivial abnormalities may be included in this case) Correct interpretation of findings in the clinical context.		**Report** is incomplete or inaccurate Partial and inaccurate description of parts of the heart Incorrect categorisation of chosen pathology Incorrect interpretation of findings in the clinical context	

Adult Transoesophageal Accreditation **Case 5 – Other pathology** Practice must be satisfactory in all areas to pass			
Evidence of satisfactory practice	Tick	Evidence of unsatisfactory practice	Tick
ECG Largely present throughout without 2D image interference		**ECG** Unstable or frequently absent making timings inaccurate	
Optimisation Infrequent, non-repetitive optimisation errors which do not detract from the case conclusion		**Optimisation** Frequent, repetitive optimisation errors which detract from the case conclusion	
Complete study Images are complete enough to allow full assessment of the selected pathology, including Doppler study and measurements		**Incomplete study** Images are missing which are relevant to the accurate assessment of the selected pathology, including inadequate Doppler study or relevant measurements quoted in report but not demonstrated	
2D measurements/M-mode (if relevant) Accurate throughout with minor errors only		**2D measurements/M- mode (if relevant)** Frequent inaccuracies or isolated inaccuracies that change the categorisation of the chosen pathology	
Colour Doppler Accurate box size, gain, scale and baseline settings demonstrating anatomy clearly		**Colour Doppler** Frequent inaccuracies of box size, gain, scale and baseline settings which prevent clear demonstration of the anatomy	
Spectral Doppler Accurate use with good cursor alignment and optimised waveforms		**Spectral Doppler** Inaccurate use with poor cursor alignment or waveform optimisation altering pathology assessment	
LV assessment Good quality M-mode of the LV and Ao/LA. No crucial images missing No measurements significantly inaccurate.		**LV assessment** Poor quality or missing M-mode of the LV and Ao/LA Images missing which are crucial to assessment Measurements crucial to assessment significantly inaccurate	
Report Complete and accurate Comprehensive and accurate description of all parts of the heart Correct categorisation of chosen pathology (NB trivial abnormalities may be included in this case) Correct interpretation of findings in the clinical context.		**Report** Incomplete or inaccurate Partial and inaccurate description of parts of the heart Incorrect categorisation of chosen pathology Incorrect interpretation of findings in the clinical context	

Appendix 12: Image acquisition marking criteria

The marking criteria used for the image acquisition assessment can be seen below.

The simulator maybe loaded will different pathologies.

The candidate will be asked to acquire a good quality image of a particular view.
N.B. No blind spot between upper oesophageal and mid oesophageal views.
Not all views may be possible in available time.
Image acquisition should take no more than 20 mins (10 images at 2 mins each).

If there are concerns, assessors should question the candidate - if they can demonstrate appropriate knowledge/competence when questioned this may be sufficient.
Candidates should not fail as a result of one poor image.
Pass mark = 80% of acquired images are of good quality.
Constructive feedback can be provided by the senior assessor in a separate room to enable direct comparison of candidate's image acquisition and the expected standards.

Image acquisition list

Spend 1-2 minutes on each acquisition	Image	Satisfactory	
		Yes	No
1.	2D MO 4 Chamber view		
2.	2D MO 5 Chamber view		
3.	2D MO mitral bicommissural view		
4.	2D MO 2 Chamber view		
5.	2D MO LAX view		
6.	2D MO AV SAX view		
7.	2D MO AV LAX view		
8.	2D MO LA appendage view		
9.	2D MO R/L Upper/lower pulm. veins		
10.	2D RV inflow/outflow view		
11.	MO Bicaval view		
12.	MO modified bicaval view		
13.	2D TG Basal SAX view		
14.	2D TG Mid Papillary view		
15.	2D TG 2 Chamber view		
16.	2D TG LAX with CWD across aortic valve		
17.	2D TG RV inflow view		
18.	2D Deep TG view		
19.	Desc Aorta SAX view		
20.	Desc Aorta LAX view		
21.	UO Aortic arch LAX view		
22.	UO Aortic arch SAX view		
23.	MO Asc Aorta LAX view		
24.	MO Asc Aorta SAX view		

Please circle the most appropriate score:

Body Position				
1 Looks awkward and uncomfortable.	2	3 Occasional awkward movement.	4	5 Appears at ease and moves comfortably.
Probe Handling				
1 Has difficulty moving the probe using excess force. Jerky.	2	3 Occasional difficulty or forceful use of probe.	4	5 Adjusts and moves the probe with ease. Smooth.
Recognition of anatomy				
1 Does not seem to be able to recognise obvious structures.	2	3 Some difficulty recognising structures.	4	5 Appears to recognise the anatomy without difficulty
Recognition of view				
1 Excess thinking time before attempting to find next view.	2	3 Some thinking time between moving on to find next view	4	5 Very little thinking time between each view.
Economy of movement				
1 Repetitive movements and non-purposeful movements.	2	3 Occasionally repetitions and non-purposeful movement.	4	5 No repetitive moves and purposeful movements.
Safety of movement				
1 Moves probe in oesophagus while tip in extremes of flexion; locks probe tip	2	3 Maintains some degree of probe tip flexion while moving probe in oesophagus	4	5 Releases all flexion while moving probe in oesophagus
Overall observed score				
1 Appeared at beginner level.	2	3 Appeared to have had some experience with TOE.	4	5 Appeared a skilled user.