British Society of Echocardiography

Accreditation in Adult Transthoracic Echocardiography (TTE) Information Pack

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

25 April 2023

This document supersedes all previous versions

This document is a guide to completing BSE TTE accreditation

Submission and assessment criteria are included

British Society of Echocardiography

Contents

Welcome message from Chair of Accreditation

Dear Candidate,

Welcome to the British Society of Echocardiography (BSE). The process underlying accreditation is set up to assist the echocardiographer in training with the ultimate aim of achieving and maintaining a high standard of clinical echocardiography for the benefit of our patients.

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 or if you have constructive feedback to offer the accreditation committee; please just get in touch.

Good luck with your accreditation process.

Best wishes,

Sadie Bennett

Chair, BSE Accreditation Committee

Introduction & 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 members are expected to be able to perform and report echocardiographic studies unsupervised.
- The Accreditation process comprises two parts: a written theory examination and a practical assessment. Further information for both is available within this pack.
- Accreditation is a minimum requirement and cannot be regarded as a guarantee of competence.
- Echocardiography skills can only be maintained by continued education and practical involvement in echocardiography. The importance of this is underlined by limiting accreditation to five years, after which reaccreditation must be sought. Further details surrounding reaccreditation can be found on the BSE website.

Summary of process requirements

- The 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 a "best answer" image reporting section.
- The practical assessment compromises three parts: A logbook, a practical scanning assessment and a viva assessment of five patient case studies.
- 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.
- 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 (operating hours **09:00 -17:00 Monday-Friday**, excluding UK public holidays), **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 section of the 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 per the extensions policy. Extension requests forms must be submitted **before the submission deadline.** Extension request information and forms (along with all other BSE application forms) can be found at www.bsecho.org. Requests received after the case deadline may not be granted.
- Candidates can appeal the decision on a practical assessment. There is no appeals process for the written section of the examination. Further information can be accessed via www.bsecho.org.

Mentor

- A mentor is an experienced echocardiographer who can successfully guide a candidate through the BSE accreditation process. If the echocardiographer 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 (see 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 an echocardiogram to a proficient level. Once a proficient level of ability is achieved the mentor must complete the curriculum-based competency tool and the mentor statements. These can be accessed and completed via the online logbook portal. The curriculum-based competency tool can also be found in Appendix 2.
- Candidates who cannot find a mentor should contact us; we will try our best to help source a suitable mentor. Alternatively, candidates can reach out to local BSE representatives, please visit the Governance, committees section of www.bsecho.org.

Details of the written theory examination

- The full training syllabus for this accreditation process is available in Appendix 1. A recommended reading list is available in Appendix 3.
- The written theory examination is held twice a year, usually in the Spring and Autumn. The examinations are held at various Pearson VUE centres 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 examination has two parts, an MCQ theory section and an image reporting section. In order to pass the written examination overall, it is necessary to pass both parts at the same exam sitting.
- The pass mark for the MCQ is 70%, the image reporting section is 60%. 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.
- 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 25 questions that must be answered within 60 minutes.
- Questions are designed to test the knowledge of echocardiographic findings, basic cardiology and the physics of ultrasound.
- Each question comprises a brief statement followed by five questions. Candidates are required to answer 'true' or 'false' to each question. Example questions are provided in Appendix 5.
- This part of the examination will be marked +1 for correct answers, 0 for incorrect, or unanswered questions (no negative marking).
- There are no 'trick' questions.
- There are no fixed number of correct answers, i.e. for each question, it is possible for every answer to be false or every answer to be true or any combination of true or false.
- The maximum possible mark is 125.

Image reporting section

- Consists of 50 questions centred around 10 patient case studies that must be answered within 90 minutes.
- The candidate will be presented with 10 patient case studies. Each case study will compromise of relevant patient details and a variety of echocardiographic images.
- For each case study, the candidate will be required to answer five questions. Each question will have four possible answers, the candidate must select the best single answer. An example case study and questions are provided in Appendix 6
- The maximum possible mark is 50.

Details of the practical assessment

- The practical assessment is held up to five times per year. Dates, locations and online registration instructions are announced on the practical assessment section of BSE website.
- The practical assessment has three parts, a 250 case logbook, a practical scanning assessment and a viva assessment of five patient case studies.
- All candidates will be required to attend a within 26 months of starting the accreditation process (i.e. within two months of their case collection deadline). A two months of grace period has is designed to give the candidate time to review, prepare and submit the logbook and 5 viva cases.
- Registration should ONLY be sought after collecting the logbook and patient case studies.
- It is the Candidates responsibility to ensure they enter correct information on registration forms. Incorrect information will lead to a rejected registration.
- Logbooks are to be submitted in advance, a logbook submission deadline is displayed on the online booking page, please read carefully before booking a space. If there are any concerns, please email accreditation@bsecho.org.

Logbook submission

- The logbook should demonstrate the candidate's ability in meeting the competencies as shown Appendix 2. The specific case mix of the logbook is shown below.
- It should consist of 250 reports personally **performed and reported** by the candidate during the specified period of 24 months. The logbook is reduced to 150 reports if the candidates holds BSE or EACVI TOE Accreditation. There is no reduction in the logbook numbers for candidates holding EAVCI TTE accreditation.
- 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 . **Non-portal logbooks will not be accepted.**
- For full details of what is expected in reports and how the logbook is marked, please see Appendix 8.
- Duplicate reports are not acceptable.
- If you have problems finding enough specific cases, discuss this with your mentor who may consider arranging for you to attend a nearby centre.
- The logbook should reflect the candidate's best clinical practice, and as such targeted scans, unless showing a significant and rare pathology, should not be included.
- Competencies and mentor statements are to be completed via the BSE logbook portal.
- 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 general adult department with the following constraints:

- At least 25 cases should be for left ventricular abnormality assessment*
- At least 50 cases should be for valve disease assessment**
- At least 10 cases should be for replacement/repaired valves
- At least 10 cases should be for right ventricular abnormality assessment***
- At least 5 cases should be for pericardial disease/effusion assessment
- At least 5 cases should be for abnormalities of the aorta
- At least 2 cases should be for confirmed endocarditis, mass or thrombus
- At least 5 cases should be for left ventricular hypertrophy assessment, at least 2 should be for hypertrophic (-/+ obstructive) cardiomyopathy
- At least 3 cases should be for simple congenital disease (e.g. ASD, VSD, PDA, BAV)
- A maximum of 15 cases should be for specialised studies (i.e. bubble echo and contrast studies). This section is not compulsory
- A maximum of 30 cases should be for no significant abnormality

* This section should demonstrate a candidate's ability to assess for left ventricular abnormalities (normal / dilated cavity size, systolic impairment with global or regional wall motion abnormalities or diastolic impairment). At least half of the reports in this section should include a biplane Simpson's ejection fraction measurement.

** This section should demonstrate a candidate's ability to assess for all severities of valve pathology and not primarily mild disease. The majority of these studies should consist of moderate to severe pathology.

*** This section should demonstrate a candidate's ability to assess for right ventricular abnormalities (normal / dilated cavity size, systolic impairment with global or regional wall motion abnormalities).

Other information regarding the logbook:

- **All** patient identifiable data needs to be removed. This may require the manual removal of identifiable data. See Appendix 9.
- **At least the final 150** cases should be reported primarily by the candidate, although they may be checked by another operator.
- Logbook reports should reflect the latest BSE guidance. Where local policy deviates from this, a supporting letter (and current standing 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.
- **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 departments echo lead. Please see the portal user guide in Appendix 7.
- **Logbooks must be submitted in advance**, usually up to eight weeks before a practical assessment date. Please check the online registration information before booking a space. Candidates may request an extension by contacting accreditation@bsecho.org.

Practical scanning assessment

- Consists of a candidate acquiring up to 10 different echocardiographic imaging views within 20 minutes. A real-life model or simulator may be used.
- This part of the assessment is designed to assess a candidates practical scanning ability along with their ability to perform basic image optimisation.
- All imaging views used in this assessment are taken from the from the minimum BSE transthoracic echocardiography dataset.
- A pass mark / trigger score of 66% is used. Once obtained, the candidate will be deemed successful at this part of the assessment process.
- The candidate is not expected to be familiar with the equipment. The Assessor will alter equipment setting as directed by the candidate.
- For full details of the practical scanning marking criteria please see Appendix 10.

Viva case submission

- 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 case studies should be assessed using the most up to date BSE guidance**. Candidates will be

expected to know the most up to date BSE guidance and local deviations in practice **will not** be accepted.

- 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 candidate must ensure that at least one full cardiac cycle is recorded. The cases must play automatically / continuously within a PowerPoint presentation (or equivalent). Cases that do not play appropriately may be classified as an unsuccessful attempt.

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 viva case studies should include one of each of the following:

1. A study showing no significant abnormality.
2. Moderate or severe aortic stenosis.
3. Moderate or severe mitral or aortic regurgitation.
4. Previous or recent myocardial infarction.
5. The fifth case should show an example of one of the following (and which has not previously been shown in the cases above):

    a) Valve repair / replacement.
    b) Mass or thrombus.
    c) Simple congenital heart disease.
    d) Significant left ventricular hypertrophy.
    e) Significant pericardial effusion, mitral stenosis or right heart disease.

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

Practical assessment- 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 TTE 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 / 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 candidates current and future work commitments . This will be discussed with the candidate during the first attempt. Typical timeframes may include: 3-9months.

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*.

**Subject to government guidance we may authorise virtual submissions.*

Appendix 1: Training syllabus

The following sections form the minimum suggested training syllabus for this accreditation process. Candidates should use as a guide to prepare for the written and practical assessments of this accreditation process.

1 General Concepts

1.0 The place of echocardiography

- Information that echocardiography can, and cannot provide
- 'Ruling out' pathology (sensitivity, specificity & Baye's 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)
- C-T imaging
- Magnetic resonance imaging
- Nuclear Cardiology

1.1 Service Provision

- Considerations of Physiologist-led versus physician-led service
- Costs: fixed and variable
- Provision and indication for specialised techniques, e.g. TOE. Stress echo, 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 patients' 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 Clinical role of echocardiography

2.0 Imaging Physics & Instrumentation

- Concepts and terminology
- Concepts of compression waves
- Definitions: frequency, wavelength, propagation velocity, amplitude?
- Units of measurement: Hz and MHz
- Decibel Comparison of Ultrasound with audible sound.

2.1 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

2.2 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 and use of dual focus
• The role of intracardiac echocardiography

2.3 Imaging physics

• Factors affecting choice of imaging frequency: typical practical values for adults & children
• Broad-band imaging
• Harmonic imaging
• and M Mode methods.
• Curved Anatomical M Mode
• Scanning speed limitations, relationships between pulse repetition frequency, frame rate, scan-lines per frame, field of view, depth to be imaged.
• Concept of Parallel Processing and its influence on frame rate and image quality
• Effect on evaluation of rapid motion
• Temporal resolution.
• Grey scale and dynamic range
• Measurement and optimisation of Resolution: axial, azimuthal and elevation
• Lateral resolution and side-lobe/grating artefacts
• Reverberation artefacts
• Limiting factors for detecting small targets

2.4 Echo Instrumentation

• Function of machine controls: Transmit power; overall gain; time gain compensation; reject, logarithmic compression, signal processing, dynamic range, pre-processing; post-processing
• Optimisation of imaging parameters, including transducer frequency, scan angle, gamma correction, spatial and temporal smoothing
• Optimisation of 3D volume acquisitions including frame/volume rate, 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

2.5 Optimising Images

• Use of gel (infection risk from transducer, operator)
• Positioning of the subject
• Standard views: Parasternal, apical (4, 5 and 2-chamber, long axis), subcostal, suprasternal, right parasternal, long and short axis.
• Use of non-standard views
• Adapting for subjects with difficult echo windows, ventilated patients, ward-based studies, emergency room studies

2.6 Storage and Display of Images

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

3 Doppler Physics & Fluid Dynamics

3.0 Basic Fluid Dynamics

• Fluid flow: significance of peak & mean velocities
• Determination of volumetric flow, Continuity equation
• Laminar & turbulent flow: Reynolds' equation (qualitative)
• Transition from Laminar to turbulent flow: inlet jet Bernoulli equation
•Bernoulli principle for fluid dynamics – relationship of fluid speed and statics pressure/potential energy
•Coanda effect

3.1 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 and the effect of scan frequency on the Nyquist limit
• The principles of pulse wave tissue Doppler
• Packet size, colour mode and sector size and their effect on frame rate and aliasing

4 Deformation Analysis

4.0 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

4.1 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 issues

4.2 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

• 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

5 Doppler instrumentation

5.0 Spectral Doppler Instrumentation

• Duplex Doppler using imaging transducers
• The 'Stand-alone' Doppler probe
• 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.

5.1 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, 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 tissue Doppler Imaging and pulsed wave tissue Doppler imaging
• Minimisation of myocardial translational movements during acquisition.
• The concept of tracking on colour Doppler tissue Doppler imaging 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

6 TOE Instrumentation

6.0 General concepts

• Transducer types: single plane, biplane, multiplane
• Optimising machine settings for TOE Patient monitoring for TOE and general safety considerations
• Control of infection
• General indications and recognition of the limitations of TTE.

7 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

8 Cardiac Anatomy and Physiology

8.0 Anatomy of the thorax

• Thorax contained by rib cage & diaphragm
• Lungs & pleura; heart & pericardium; mediastinum
• Blood vessels within the thorax

8.1 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

8.2 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
• 2D/3D, M-mode and Doppler features of normal valve anatomy (aortic, mitral, tricuspid and pulmonary), function 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)

8.3 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

9 Cardiac functional parameters

9.0 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
• Knowledge, appreciation and limitations of M-mode measurements (including MAPSE and TAPSE, Ao / LA dimensions)
• Derivation of stroke volume, ejection fraction, relative wall thickness, LV Mass and indexed LV mass
• 2D / 3D methods of measuring LV volume
• Limitations of single plane estimations of LV ejection fraction e.g. Teicholtz 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 the presence of poor quality and/or off-axis images

9.1 Doppler determination of cardiac output, ejection time, valve function and velocity acceleration

• Methods for assessing normal valve function (aortic, mitral, tricuspid and pulmonary) to include: peak and mean velocities, peak and mean gradients, pressure half time and flow rate assessments (where appropriate)
• Methods of measuring diastolic function: 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 methods for estimating LV filling pressures, mitral valve 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

10 Contrast and bubble contrast studies

10.0 Bubble contrast studies

• Main indications for a bubble contrast study: Diagnosis of intracardiac shunts, diagnosis of intra-pulmonary shunts, improved assessment of tricuspid regurgitation velocities.
• Technique for performing a hand-agitated contrast bubble study
• Acoustic views required and optimisation of machine control settings for bubble contrast studies
• Patient manoeuvres to provoke right –to-left passage of bubbles during assessment for PFO
• Knowledge of findings consistent with a positive and negative intra-cardiac and intra-pulmonary shunt.
• Relevance of injecting bubble contrast through upper arm vein vs. femoral vein
• Technique for performing a hand-agitated contrast study
• Contra-indications and clinical precautions

10.1 Awareness of encapsulated contrast agents and techniques

• Knowledge of available contrast agents
• Knowledge of contrast agent's characteristics including interaction of ultrasound
• Generation of harmonic energy by bubble distortion and fracture
• Optimisation of machine control settings for contrast agents
• Indications for administration of contrast agents to include: 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, myocardial perfusion assessment.
• Use of contrast in stress echocardiography for improving detection of wall motion abnormalities and for assessment of myocardial perfusion
• Appreciation of contrast administration – bolus vs infusion
• Contra-indications and clinical precautions

Valve pathology

11 Mitral valve disease

11.0 Mitral Stenosis

• Aetiologies and typical 2D/3D echocardiographic features: rheumatic, calcific, myxoma / tumours, cor-triatriatum, congenital
• Qualitative description of valve and sub-valve calcification and fibrosis
• Assessment of mitral stenosis severity to include: mean gradient, planimetry (2D and 3D), pressure half time method, continuity equation, PISA method: techniques and limitations
• Factors favouring successful balloon valvuloplasty: Wilkins score

• Role of exercise stress echocardiography to evaluate for changes in mean trans-mitral gradient, PA systolic pressures, exercise tolerance and symptomatic status with exercise to aid in the timing of surgery/balloon valvuloplasty
•Role of echocardiography in assessment and follow-up

11.1 Mitral regurgitation

• Aetiologies and typical 2D / 3D echocardiographic features of primary mitral regurgitation: mitral valve prolapse (fibro-elastic deficiency, myxomatous mitral valve, flail leaflet, Barlow's disease), ruptured chordae, infective endocarditis, mitral annular calcification, rheumatic, congenital causes, drug and / or radiotherapy induced
• Aetiologies and typical 2D / 3D echocardiographic features of secondary mitral regurgitation: Ischemia and impairment / dysfunction of sub-valvular apparatus (i.e. papillary muscle dysfunction or rupture), LV dilatation, leaflet tethering, LA dilatation, annular dilatation
•Chronis vs acute mitral regurgitation and differential diagnosis
•Awareness of Carpentier classification
• Consequences of mitral regurgitation on left and right heart chamber sizes and right heart pressure
• Assessment of mitral regurgitation severity to include: vena contracta, PISA (2D and 3D), effective regurgitant orifice area, regurgitation volume, regurgitation fraction, MV VTI/AV VTI, increased antegrade E wave velocity and shape and density of contour of Doppler signal: techniques and limitations
• Pulmonary vein flow patterns seen in all mitral regurgitation severity ranges: techniques and limitations
• Role of echocardiography in determining timing of surgery for primary mitral valve disease: ejection fraction, end-systolic LV diameter, EROA, resting PA pressure.
• Role of TOE in assessing mitral valve pathology and in determining likelihood of repair as opposed to replacement
• Role of exercise stress echo to evaluate for MR severity changes, LV function assessment, PA systolic pressures, symptomatic status and exercise tolerance during exercise to aid in the timing of surgical intervention.
•Role of echocardiography in assessment and follow-up

12 Aortic valve disease

12.0 Aortic stenosis

• Aetiologies and typical 2D / 3D echocardiographic features of aortic stenosis: rheumatic, bicuspid (and classification of type), senile degenerative, sub-and supra-valve obstruction
• Assessment of aortic stenosis severity to include: maximum velocity, mean gradient, aortic valve area by continuity equation (including indexed values), valve planimetry, dimensionless index: techniques and limitations.
• Consequences of aortic stenosis on cardiac chamber size and function
• Appreciation of the causes of discordant parameters when assessing aortic stenosis and potential remedies.
• Use of apical, right parasternal and suprasternal positions to obtain optimal AV Doppler parameters.
• Definition of low flow low gradient severe aortic stenosis
Concept of flow-rate and effect on transvalvular velocities
• Use of stress echocardiography for distinguishing pseudo severe stenosis vs truly severe stenosis in low flow aortic stenosis
• Use of stress echocardiography in patients with low flow low gradient severe AS and assessing for LV contractile reserve

• Difference between transaortic pressure gradients derived from echocardiography and from cardiac catheterisation
•Role of echocardiography in assessment and follow-up

12.1 Aortic Regurgitation

• Aetiologies and typical 2D / 3D echocardiographic features of aortic regurgitation: rheumatic, bicuspid, aortic root disease, infective endocarditis (including root abscesses).
• Assessment of aortic regurgitation severity to include: Colour Doppler – size of jet relative to left ventricular outflow tract diameter, vena contracta, effective regurgitant orifice area, regurgitant volume, diastolic flow reversal in descending aorta, diastolic flow reversal in the abdominal aorta (including BP pulse pressure width), indirect effects on LV size and function: techniques and limitations.
•Consequences of aortic regurgitation on cardiac chamber size and function
•Role of echo in determining timing of surgery
•Role of TOE in assessing aetiology and severity
•Role of echocardiography in assessment and follow-up

13 Tricuspid valve disease

13.0 Tricuspid stenosis

• Aetiologies and typical 2D / 3D echocardiographic features of tricuspid stenosis: rheumatic, prolapse, congenital, infective endocarditis, carcinoid, functional.
• Assessment of tricuspid stenosis severity to include: Mean pressure gradient, inflow velocity-time integral, pressure half time and valve area by continuity equation: techniques and limitations.
•Consequences of tricuspid stenosis on cardiac chamber size and function
•Role of echocardiography in assessment and follow-up

13.1 Tricuspid regurgitation

• Aetiologies and typical 2D / 3D echocardiographic features of tricuspid regurgitation: rheumatic, prolapse, congenital, infective endocarditis, carcinoid, functional /secondary (RA, RV, annular dilatation), trauma and device leads.
• Assessment of tricuspid regurgitation severity to include: Colour Doppler – shape and density of continuous Doppler signal, effective orifice area, regurgitation volume (by PISA), colour flow area, PISA, vena contracta, tricuspid inflow, colour Doppler signal, hepatic vein flow pattern, indirect effects on RA, RV, IVC and intraventricular septal motion: techniques and limitations
•Consequences of tricuspid regurgitation on cardiac chamber size and function
•Role of echocardiography in assessment and follow-up

14 Pulmonary valve disease

14.0 Pulmonary stenosis.

• Aetiologies and typical 2D / 3D echocardiographic features of pulmonary stenosis: rheumatic, congenital, infective endocarditis, carcinoid, sub-valvular and supra-valvular obstruction, infundibular obstruction
• Assessment of pulmonary stenosis severity to include: peak velocity, peak gradient: techniques and limitations
•Consequences of pulmonary stenosis on cardiac chamber size and function
•Role of echocardiography in assessment and follow-up

14.1 Pulmonary regurgitation

•Aetiologies and typical 2D / 3D echocardiographic features of pulmonary regurgitation: congenital, endocarditis, carcinoid, rheumatic, secondary (post valvuloplasty, post TOF repair)

•Assessment of pulmonary regurgitation severity to include: jet width percentage of RVOT, vena contracta percentage of pulmonary valve annulus, deceleration time, pressure half time, 3D vena contracta, Doppler pulmonary regurgitation index, origin of PR jet in relation to pulmonary artery bifurcation: techniques and limitations
•Consequences of pulmonary regurgitation on cardiac chamber size and function
•Role of echocardiography in assessment and follow-up

15 Infective endocarditis

•Typical bacteraemia / fungal causes of infective and non-infective endocarditis
•Use of Duke criteria for infective endocarditis
•Typical 2D / 3D echocardiographic features of vegetations for bacteraemia / fungal causes of infective and non-infective endocarditis
• Typical and atypical locations of vegetations
•Complications of endocarditis to include: abscess, fistula, perforation, valve destruction and regurgitation, prosthetic valve dehiscence, new paravalvular regurgitation, healed/ chronic vegetations
• Infective and non-infective endocarditis associated with congenital heart disease and hypertrophic cardiomyopathy
•Role of TOE in suspected endocarditis
•Role of echocardiography in assessment and follow-up

16 Prosthetic heart valves

•Typical 2D/3D, M-mode and Doppler features of the main types of replacement / repaired valves to include: Mechanical (tilting disc, bilealfet and ball and cage), bio-prosthese (stented and stentless), leaflet repair ± annuloplasty rings, percutaneous valve intervention (mitral clip and TAVI).
•Assessment of age related deterioration of bioprostheses
•Assessment of artefacts, pannus, thrombus and vegetations (and associated complications) on prosthetic valves
•Role of TOE in examining normal and malfunctioning prosthetic valves
• Assessment of prosthetic valve stenosis to include: 2D, M-mode and Doppler assessment, use of continuity equation and indexed values, the phenomenon of pressure recovery
• The assessment of normal and abnormal aortic prosthetic valve function and differentiation between high flow states, patient-prosthesis mismatch and insignificant / significant stenosis. To include the use of maximum velocity, acceleration time: techniques and limitations.
• The assessment of normal and abnormal mitral prosthetic valve function and differentiation between normal, possible and significant prosthetic stenosis. To include: peak velocity, mean gradient, VTi, effective orifice area and pressure half time: techniques and limitations.
• The assessment of normal and abnormal tricuspid prosthetic valve function. To include: mean gradient, pressure half time, tricuspid valve E velocity, VTi: techniques and limitations
• The assessment of normal and abnormal pulmonary prosthetic valve function. To include: mean gradient, peak velocity: techniques and limitations: techniques and limitations
•Assessment of consequences of prosthetic valve dysfunction, to include: chamber dilatation, progression to pulmonary hypertension
•Assessment of prosthetic valve regurgitation to include: trans-versus para-valvar regurgitation, normal versus abnormal prosthetic valve regurgitation, assessment by CW, PW and Colour Doppler: techniques and limitations.
•Role of echocardiography in assessment and follow-up

17. Cardiomyopathies

17.0 Dilated cardiomyopathy

•Aetiologies and typical 2D/3D echocardiographic features of dilated cardiomyopathies
•Detection and assessment of associated lesions to include: functional valve regurgitation, thrombus in cardiac chambers, pericardial effusions, pulmonary hypertension
•Role of echocardiography in assessment and follow-up

17.1 Hypertrophic cardiomyopathies

•Aetiologies and typical 2D/3D echocardiographic features of hypertrophic cardiomyopathies
•Techniques for measurement of left ventricular wall thickness, detection of left ventricular outflow tract obstruction and intracavity gradient (including the use of breath hold and provocative manoeuvres to assist in the detection of inducible gradients)
•Assessment of right ventricular involvement
•Associated abnormalities to include: systolic anterior motion mitral valve and associated mitral regurgitation, apical aneurysms and associated thrombus, abnormal papillary muscle location
•Differentiation from other causes of hypertrophy, e.g. hypertension, athletic heart', amyloidosis, Fabry's disease, Friedreich's ataxia cardiomyopathy
•Role of echocardiography in assessment and follow-up

17.2 Restrictive cardiomyopathy

•Aetiologies and typical 2D/3D echocardiographic features of restrictive cardiomyopathies: storage / infiltrative disorders (e.g. Fabry's, Danon disease and Friedrich ataxia), amyloidosis, sarcoidosis, idiopathic, endomyocardial fibrosis, carcinoid heart disease, radiation or drug induced
•Assessment of restrictive cardiomyopathies to include: 2D findings, Doppler & TDI features (small to normal LV cavity size, normal wall thickness, normal or near normal LVEF, reduced GLS, associated GLS patterns, dilated atria, increased E/A ratio, reduced deceleration time, reduced early diastolic velocities, increased E/E' ratio, reduced S velocities)

18 LV non-compaction

•Aetiology and typical 2D/3D echocardiographic features of LV non-compaction
•Assessment of LV non-compaction to include: Visual assessment of prominent LV trabeculation and deep recesses. Non-compacted: compacted wall ratio of >2:1, colour Doppler flow within deep recesses, global LV systolic function assessment, thrombus assessment, abnormal papillary muscle structure
•Role of contrast agents

19 Intra-cardiac masses

•Aetiology and typical 2D/3D echocardiographic features and locations of masses to include: thrombus, cardiac tumours (primary and secondary) and myxoma's.
•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

20 Pericardium and pericardial pathology

20.0 Pericardium

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

20.1 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

20.2 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

20.3 Features of pericardial constriction

- Pericardial thickening/appearance
- Effect on A-V valve flow velocities
- Effect of respiration

21 Coronary artery disease and LV systolic function

•Assessment of global LV systolic function to include: 2D/3D, M-mode and Doppler indices, Simpson's biplane ejection fraction, stroke distance, stroke volume, stroke volume index 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), tissue Doppler of the mitral valve annulus and global longitudinal strain analysis
•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
•Appreciation of assessing for cardiotoxic effects of cancer therapy and the impact of LV systolic function

22 Diastolic function of the left ventricle.

• The 4 stages of diastolic function as assessed by transmitral flow Doppler, deceleration time, E': techniques and limitations
Doppler for assessing diastolic dysfunction:
•Effect of LA size
•Pressures and pseudo-normalisation, effect of mitral regurgitation
•The use of Valsalva manoeuvre in reducing LA pressures to differentiate normal from pseudonormal transmitral 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
• Assessment and knowledge of LA strain (reservoir)

23 Left ventricular 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

24 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 contractile reserve and flow reserve (for AS)

• 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

25 Myocardial Infarction and its sequelae

• Ability to assess for regional wall motion abnormalities (hypokinesia, akinesia and dyskinesia) and global LV systolic function/impairment

• Knowledge of 2D, M-mode and Doppler features of MI complications to include: post-infarction VSD, mitral papillary muscle rupture, cardiac tamponade, mural thrombus, myocardial scarring, Dressler's syndrome, left ventricular aneurysm (true aneurysm vs. pseudoaneurysm)

• Assessment of the main features of stress-induced (takotsubo) cardiomyopathy as a deferential diagnosis to acute myocardial infraction

26 Pulmonary Hypertension and functional assessment of right ventricle

• Aetiologies of pulmonary hypertension to include: primary, post pulmonary embolism, lung disease, connective tissue disease and secondary to left-sided lesions

• Assessment of pulmonary hypertension by 2-D, M-mode and Doppler features of pulmonary hypertension

• Assessment of regional and global RV systolic function to include: TAPSE, RV S velocity, fractional area change of the RV, RV free wall 2D global longitudinal strain.

• Assessment of right ventricular dysfunction in acute pulmonary embolism (McConnell's sign and 60/60 sign) and chronic pulmonary embolism

27 Diseases of the Aorta

•Assessment of the aortic root (sinuses of valsalva and ST junction), proximal ascending, aortic arch, descending thoracic aorta and abdominal aorta by 2-D, M-mode and Doppler.
•Assessment of Marfan syndrome, sinus of Valsalva aneurysm, thoracic aortic aneurysm, aortic dissection (to include aortic cusp prolapse, aortic regurgitation, pericardial fluid) by 2D,M-mode and Doppler.

28 Adult Congenital Heart Disease

• Anatomy, pathophysiology and natural history of common congenital lesions present in adults to include; 2-D, M-mode and Doppler features of the following (pre-operatively and post- operatively, as seen in the older child or adult):

• Atrial septal defects (primum, secundum and sinus venous)

• Perimembranous and muscular ventricular septal defects

• Partial and complete atrio-ventricular septal defects

• Persistent ductus arteriosus

• Bicuspid aortic valve and associated aortopathy

- Sub-and supra-valve aortic stenosis
- Aortic coarctation
- Pulmonary stenosis
- Ebstein's anomaly
- Fallot's tetralogy
- Transposition and corrected transposition of the great arteries
- Role of contrast echocardiography in evaluating shunts in adults
- Calculation of shunts
- Role of TOE in adult congenital disease

29 Echocardiographic assessment of common clinical presentation of patients

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

30 Emergency and ICU Echo

30.0 General

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

31 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 systolic function.
- Exclusion of severe valve disease (e.g. severe AS, endocarditis) and acute aortic dissection
- Assessment for pericardial effusion and cardiac tamponade, hypovolaemia and under-filling, and high output cardiac failure
- Septic shock – assessment of for LV systolic and diastolic function
- Value of repeated echo studies to assess any deterioration/improvement in underlying state

32 Suspected acute pulmonary embolus

- Assessment of acute pulmonary embolus to include 2D, M-mode and Doppler assessment of RV size and function, tricuspid regurgitation and pulmonary artery systolic pressure assessment, IVC size and respiratory variation, thrombus presence in IVC/RA

33 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

34 Echo in the ventilated patient

- Echocardiographic assessment for common clinical presentations to include 2D, M-mode and Doppler of acute arrhythmias such as fast AF, cardiac source of embolus – CVA/peripheral embolic event in ventilated patients
- Value of TOE in ventilated patients (if poor transthoracic echo window)

35 Post surgery patient

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

• Assessment of post-surgery haemodynamic compromise/ acute deterioration to include: common findings post cardiac surgery (tamponade, wall motion abnormalities and valvular dysfunction) and general surgery (air/fat embolism, venous thromboembolism, acute MI, volume overload)

36 Assessment of filling status

• Awareness of the role of echocardiography in assessing filling using LV and RV systolic and diastolic function, IVC, 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

37 Additional topics

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

Appendix 2: Curriculum based competency 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 Parasternal long axis standard, RV inflow, RV outflow Parasternal short axis including aortic valve, mitral valve and papillary muscles Apical views, 4- and 5-chamber, 2-chamber and long-axis. Subcostal and suprasternal 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 appropriate images and undertake accurate measurements Can recognise normal variants – Eustachian valve, chiari work, LV tendon Can use colour examination in at least two planes for all valves optimising gain and box-size Can obtain pulsed wave Doppler at: a. left ventricular inflow (mitral valve) b. left ventricular outflow tract (LVOT) c. right ventricular inflow (tricuspid valve) d. 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 for regional wall motion assessment Measurements of global systolic function. (LVOT VTI, stroke volume, fractional shortening, ejection fraction using Simpson's rule, S velocities) Doppler mitral valve filling patterns & normal range Appearance of complications after myocardial infarction: a. Aneurysm, pseudoaneurysm b. Ventricular septal rupture and papillary muscle rupture c. 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, S velocities Understands & can differentiate diastolic filling patterns Can detect and recognise complications after myocardial infarction Can recognise features associated with dilated cardiomyopathy Can recognise features associated with hypertrophic cardiomyopathy Can recognise hypertensive heart disease Can recognise athletic heart	
3. MITRAL VALVE DISEASE **Knowledge** Normal anatomy of the mitral valve and sub-valvular 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 / probability of pulmonary hypertension **Practical competencies** Recognises right ventricular dilatation Can estimate PA systolic pressure / probability of pulmonary hypertension	

Can estimate right atrial pressure from the appearance of the IVC	
6. REPLACEMENT / REPAIRED HEART VALVES Knowledge Types of valve replacement / repair Criteria of normality Signs of failure Practical competencies Can recognise broad types of replacement valve Can recognise repaired valves Can recognise para-prosthetic regurgitation Can recognise prosthetic / repaired 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 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 Differentiation of pericardial constriction from restrictive myopathy	

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 Estimation of pulmonary artery pressure **Practical competencies** Can recognise a secundum ASD Can recognise a patent ductus arteriosus Can recognise sub and supravalvar aortic stenosis Can recognise sub valvar, valvar and supra-valvar pulmonary stenosis Can recognise Ebstein's anomaly Can recognise Fallot;s tetralogy Can estimated pulmonary artery pressure	

Appendix 3: Reading list

The reading list is provided by the Accreditation Committee of the British Society of Echocardiography and represent only a handful textbooks that are available for candidate to learn from.

- Textbook of Clinical Echocardiography (5th edition, June 2013), (6th edition, May 2018) - Catherine Otto
- Echocardiography Review Guide: Companion to the Textbook of Clinical Echocardiography (3rd edition) – Catherine Otto et al.(2015)
- Feigenbaum's Echocardiography (7th edition) - William Armstrong and Thomas Ryan - (2010)
- Echocardiography: A Practical Guide for Reporting and Interpretation (3rd edition) – Helen Rimington and John Chambers (Nov 2015)
- Echocardiography (Oxford Specialist Handbooks in Cardiology (2nd edition) – Paul Leeson et al. (2012)
- Making Sense of Echocardiography: A Hands-on Guide (2nd edition) –Andrew Houghton (2013)

Protocols and the most up to date BSE guidelines are available under the Education tab of www.bsecho.org.

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

Appendix 4: Written examination registration guidance

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 data and requirements to Pearson VUE, who will contact all pre-registered candidates with further information on booking an paying for the exam.
- **Delivery methods:** there are two ways candidates can take the exam- **Test Centre (recommended)** 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 www.bsecho.org.
- 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. 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 released 5-6 weeks after sitting the exam. Scores will be uploaded to BSE personal profiles. Both sections must be passed to achieve an overall 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: Examples 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.

Q1	In an ultrasound imaging system:	
a)	Sector width, sector depth and frame rate can all be controlled independently	F
b)	Frame rate falls as sector width increases	T
c)	Using a lower frequency transducer improves the frame rate	F
d)	Frame rate increases as sector depth increases	F
e)	Using Colour Flow Doppler reduces the frame rate	T

Q2	On a spectral Doppler display:	
a)	The velocity at which aliasing occurs increases at higher ultrasound frequencies	F
b)	The velocity at which aliasing occurs increases at greater depths	F
c)	The velocity at which aliasing occurs increases at greater sector angles	F
d)	At 2MHz the aliasing velocity at 10cm is approximately 1.5m/s	T
e)	The aliasing velocity can be increased by increasing the pulse rate (high PRF)	T

Q3	An Atrial Septal Defect (ASD) may be associated with:	
a)	Paradoxical interventricular septal motion	T
b)	No obvious defect of the atrial septum on imaging	T
c)	Right ventricular dilatation	T
d)	Left ventricular dilatation	F
e)	Flow of blood from left atrium to right atrium	T

Q4	Regarding assessing aortic stenosis:	
a)	Aortic valve maximum velocity of 5.2m/s is consistent with severe AS	F
b)	A mean gradient of 30mmHg and a valve ratio of 0.20 is consistent with severe AS	F
c)	In severe AS there is rapid acceleration and early peaking of the Doppler waveform	F
d)	A rate of change of >0.9m/s/year is associated with poor patient prognosis	F
e)	An aortic valve velocity ratio of 0.34 and a maximum velocity of 3.8m/s is consistent with moderate AS	T

Appendix 6: Examples of the written exam image reporting questions

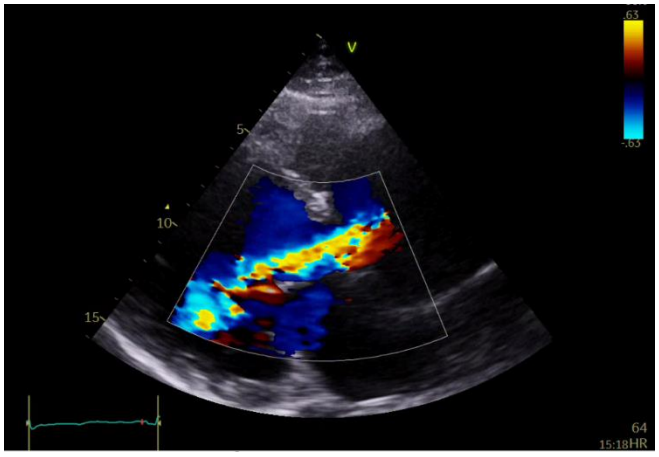
A number of moving clips and stills will be included in each question. Although these can be viewed and replayed as many times as the candidate wishes, the candidate should be mindful of the time spend on each question.

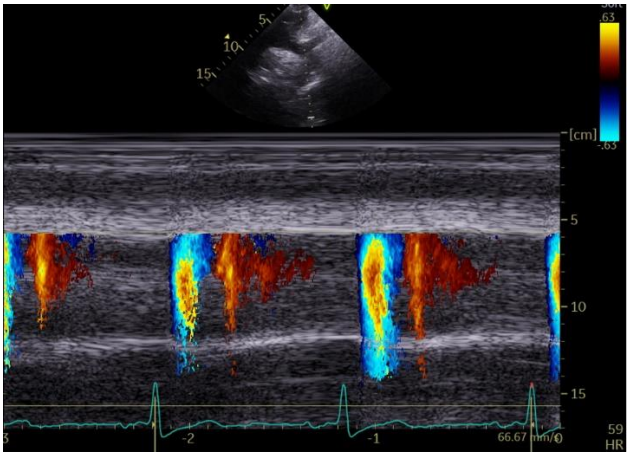
The **SINGLE BEST ANSWER** should be selected.

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

Case 1
Request: male, 42 year old, admitted with chest pain radiating into back, SOBOE.

Data: LVIDd: 7.4cm, SoV dimension: 7.0cm, STJ: 6.9cm, proximal ascending aorta: 7.4cm, TAPSE: 1.4cm. proximal RVOT dimension: 4.2cm. Descending aorta end diastolic velocity: 0.30m/s. TR Vmax: 3.2m/s, right atrial area: 26cmsq, pulmonary valve acceleration time: 100ms, AR Pressure half time: 149msec.





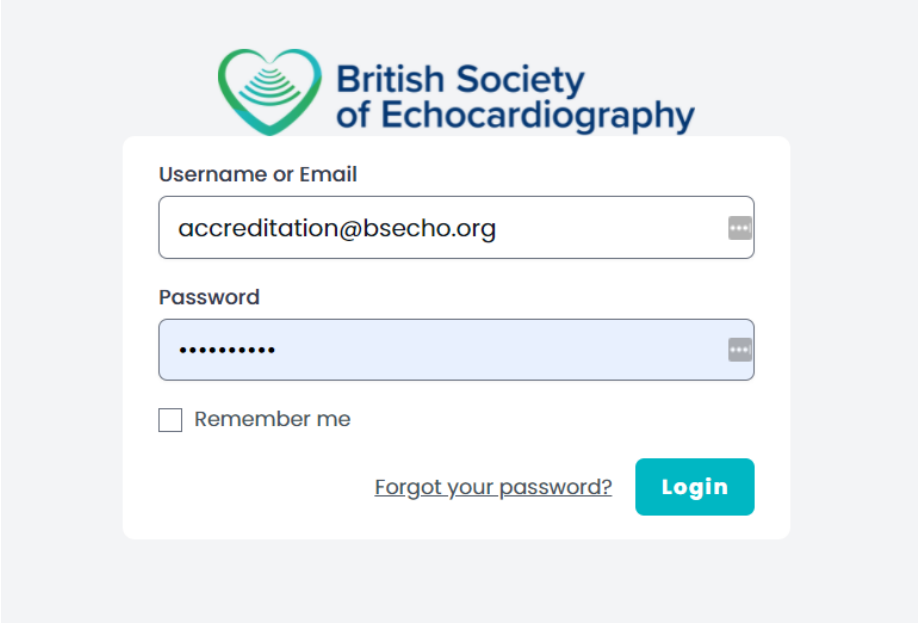
1.1	Regarding the severity of the aortic regurgitation	Answer
a	There is moderate central aortic regurgitation	
b	There is moderate eccentric aortic regurgitation	
c	There is severe central aortic regurgitation	T
d	There is severe eccentric aortic regurgitation	

1.2	Regarding the echo probability of pulmonary hypertension	
a	There is no echo probability of pulmonary hypertension	
b	There is low echo probability of pulmonary hypertension	
c	There is intermediate echo probability of pulmonary hypertension	
d	There is high echo probability of pulmonary hypertension	T

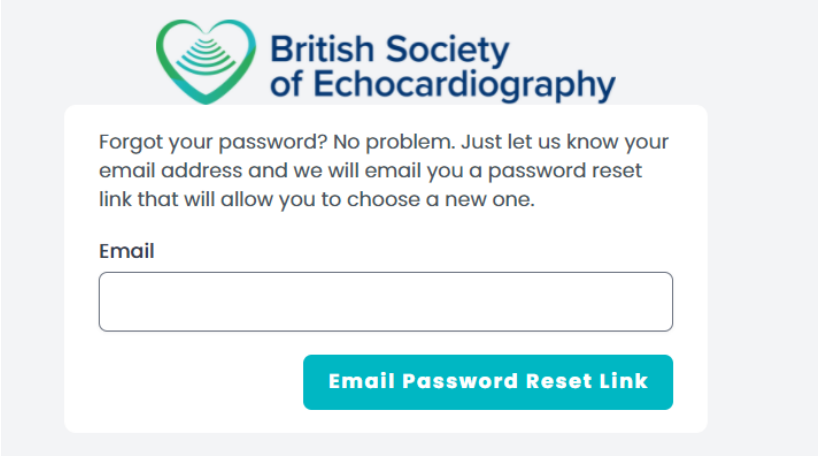
Appendix 7: BSE logbook portal user guidance

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.
  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.bsecho.org/

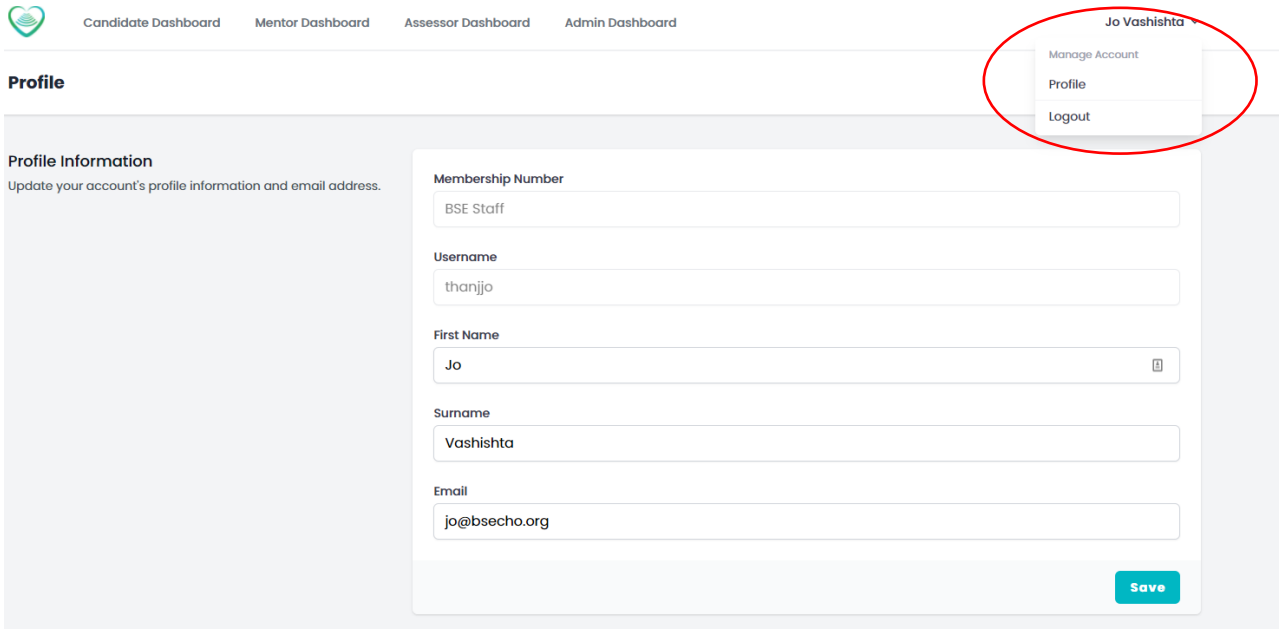


a. If you have forgotten your password, please click the link titled Forgot your password?

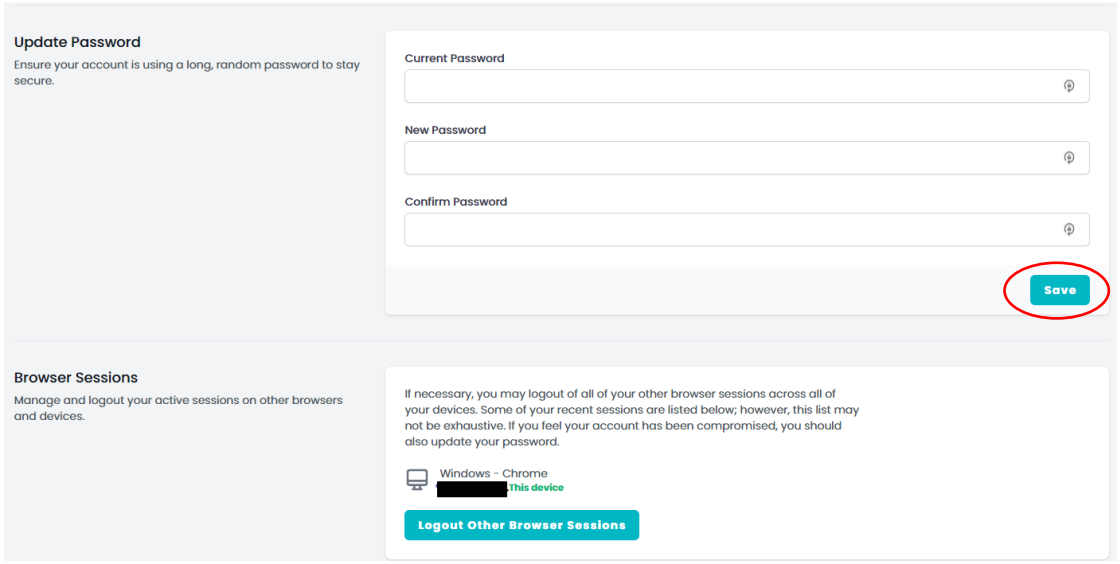


2. Update your profile

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

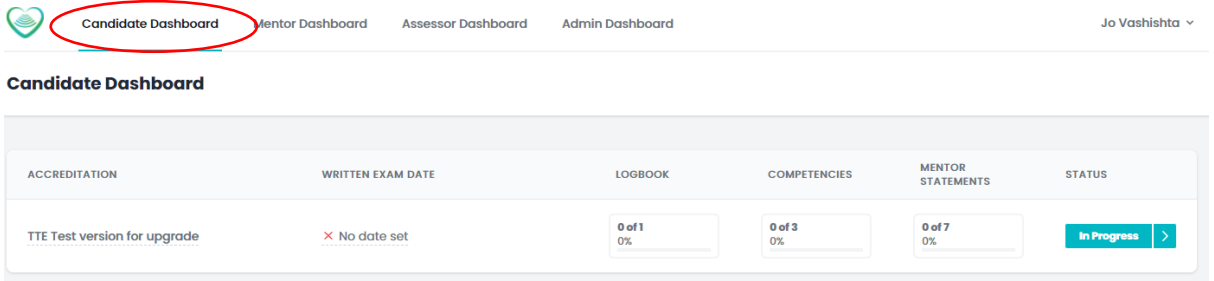


Enter new password and click 'save.'



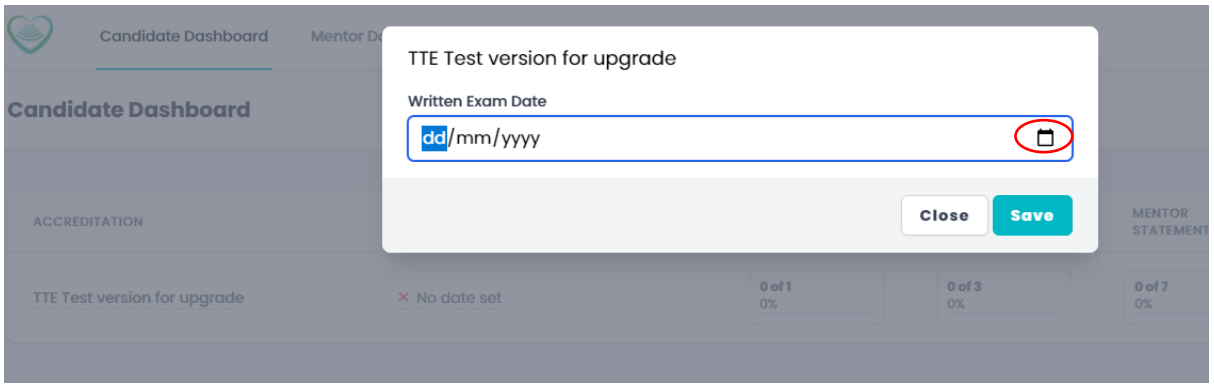
3. User dashboard (e.g. Candidate, Mentor or Assessor)

- Click on the visible heading to access your dashboard

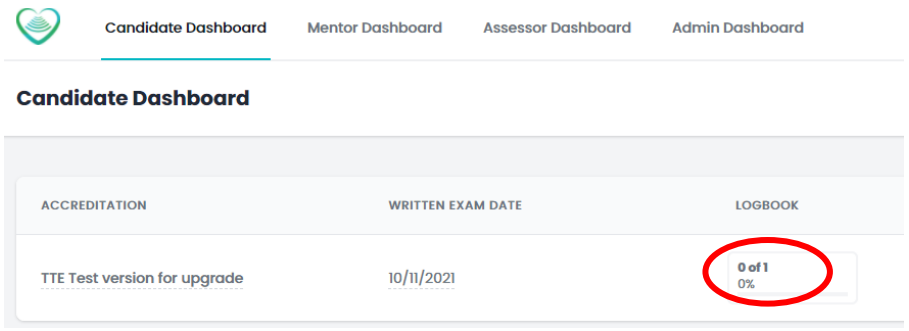


a. Enter Written Exam Date

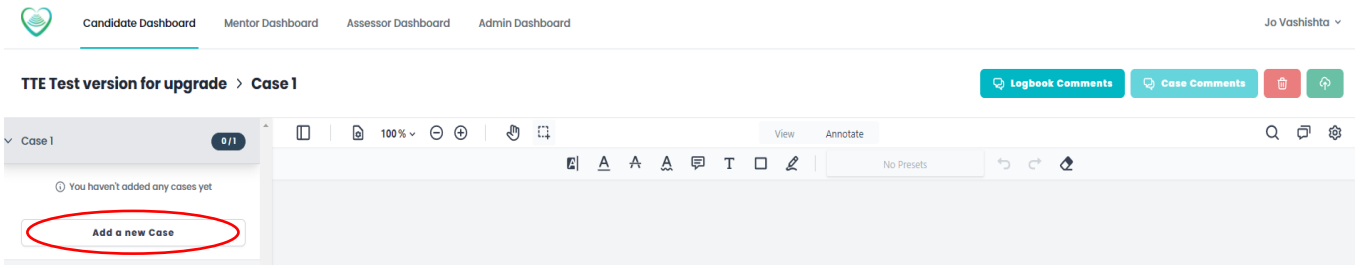
- Click on ✕ No date set to bring up the calendar and select the date you sat the written exam.

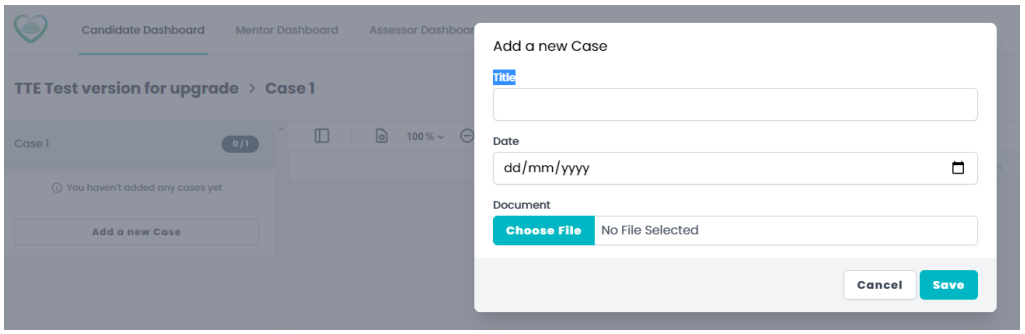


b. Click the box under the Logbook title to begin uploading PDF reports. The portal will take only PDF uploads.



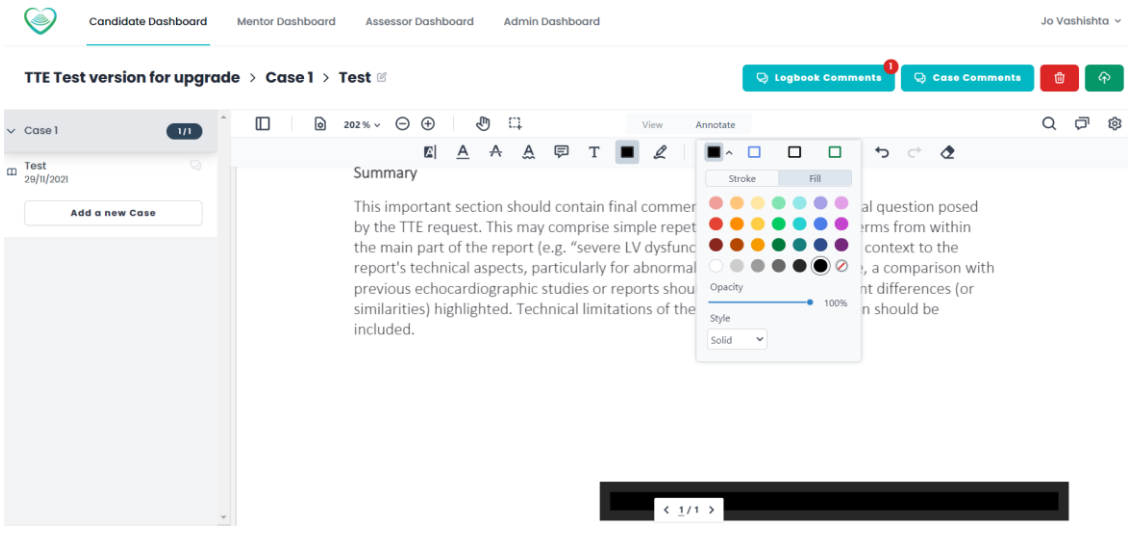
To add a new case, click on '**Add a new Case**', give it a Title, enter the date of the case and Choose File.



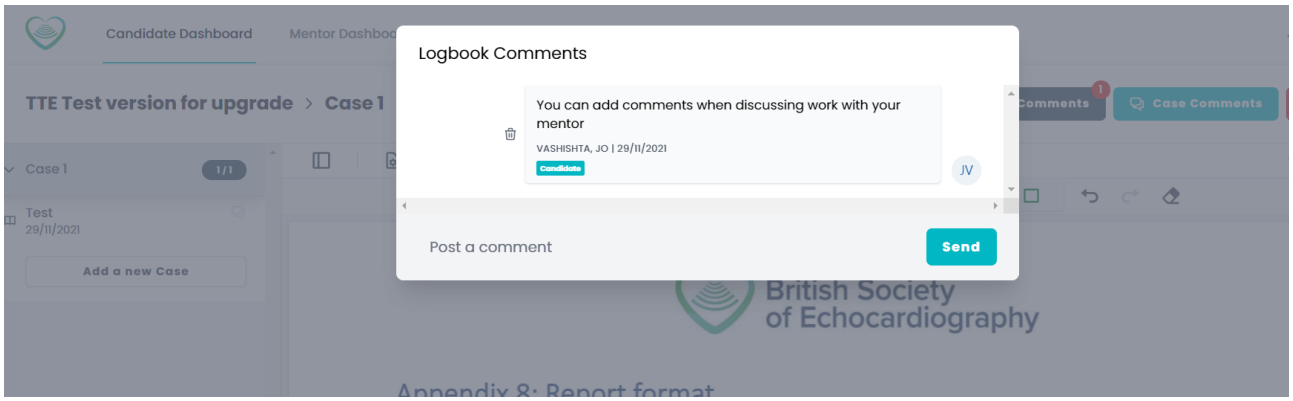


- Explore the features and tools by hovering over the icons to find what they can do.
- To **save** your work, click , to **delete** click

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



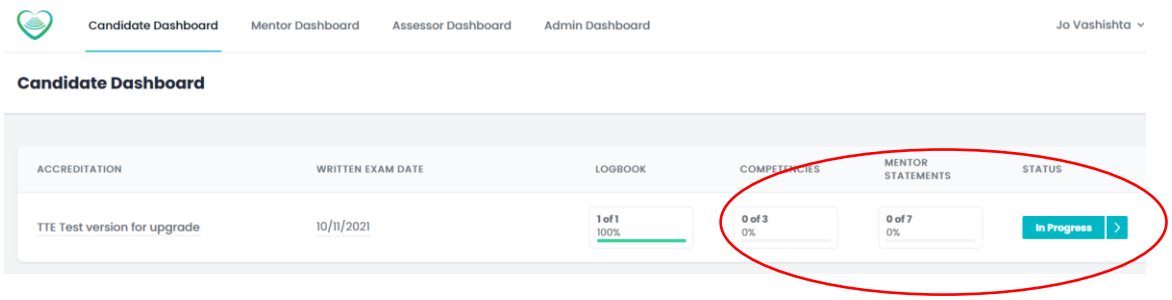
You can add logbook or case comments to share with your mentor only.



4. Competencies

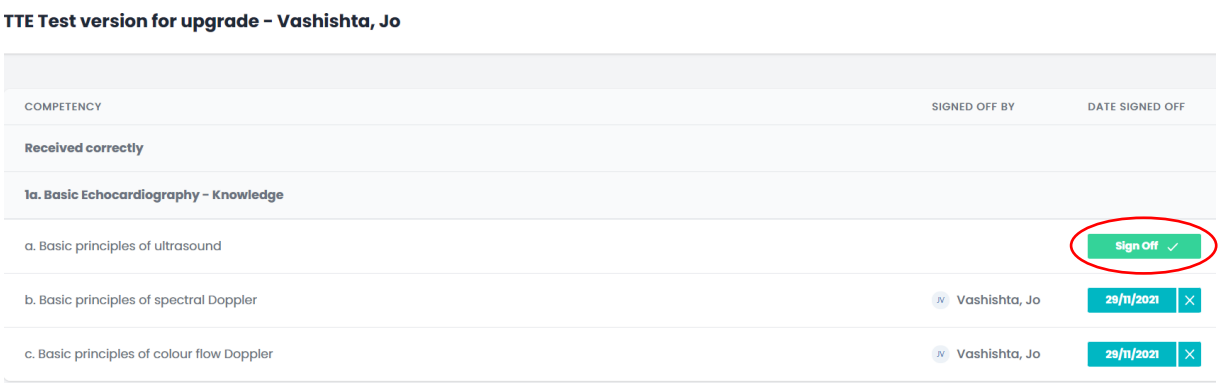
Your mentor will access your portal via their login and sign off each of the competencies.

Candidate can view the progress in the dashboard.

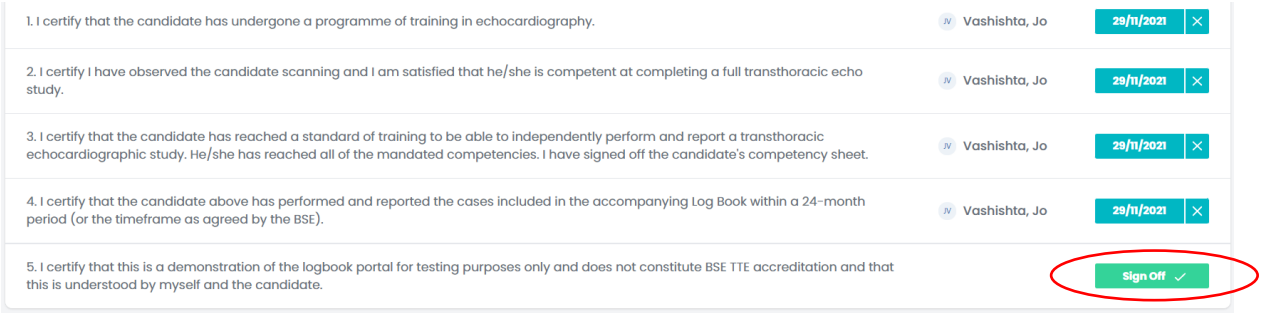


a. Mentor view:

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

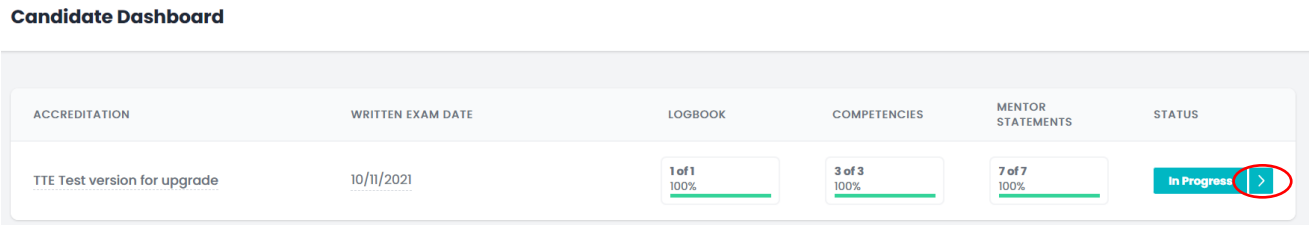


When mentor has completed competency sign off, they must do the same for the 'Mentor statement.'



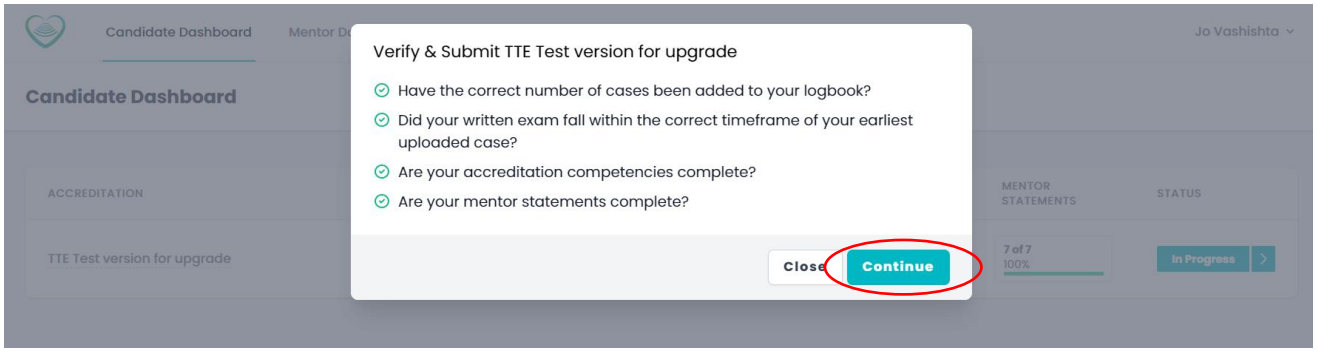
5. Candidate logbook submission

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

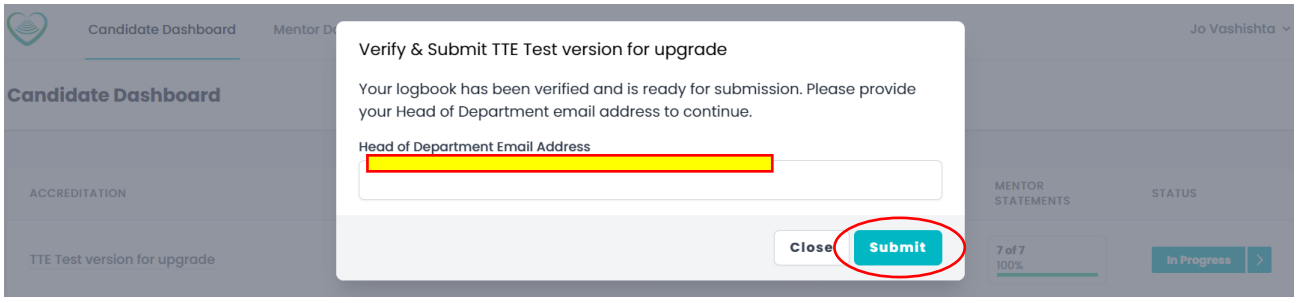


a. Verify and submit

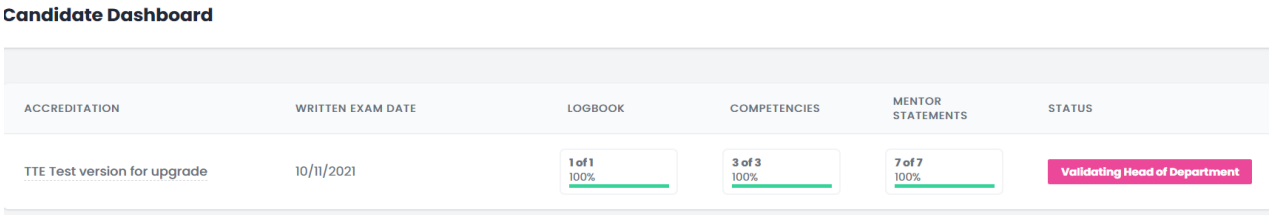
Check you have completed the requirement before clicking **'Continue.'**



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

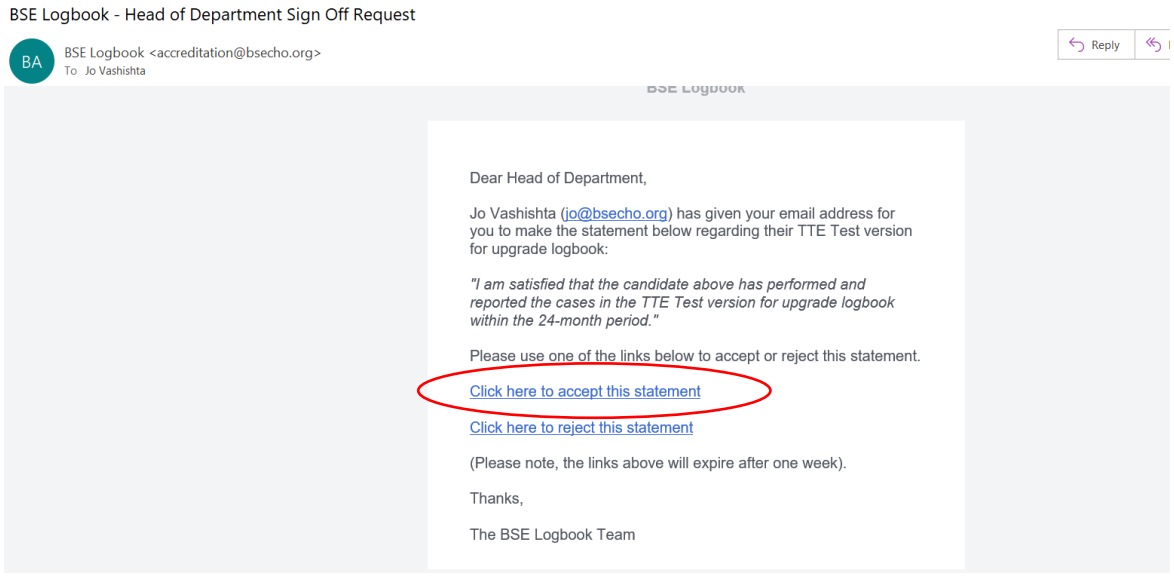


c. Contact accreditation@bsecho.org to inform you have entered your HOD's email address and clicked submit.



6. Validate logbook

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



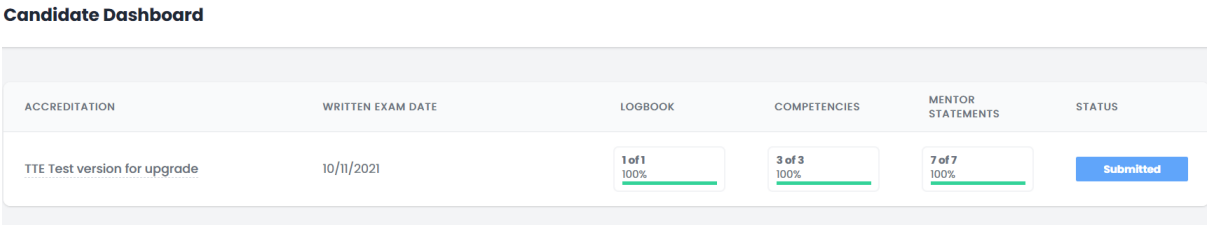
a. Head of Department varified

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.

Updated: JV- 29/11/2021

End of guide.

Appendix 8: Logbook guidance and marking criteria

In order to meet all competencies of this accreditation process the logbook should represent good/excellent examples of a candidate's daily workload. Ideally, it should reflect the most up to date BSE guidance (see page 7 if your department has different locally agreed working practices).

Whilst we encourage the use of good / excellent work to be included in the logbook, it is acknowledged that not every report in the logbook will meet this standard. Therefore, when considering whether to include a report, please refer to the following as an absolute minimum.

*****If a report does not meet the below, it should not be included as a logbook report*****

Clinical question: Must be stated.

Patient Ht, Wt and BSA: should be given unless it is not possible to obtain these measurement (reasons for this should be stated e.g. patient in bed)

BP: Should be included particularly where clinically relevant (i.e. aortic stenosis, LVH).

Left ventricle:

Descriptive section:

Comment on left ventricular cavity size, absence / presence (and degree) of hypertrophy.

Comment on global left systolic function, including regional wall motion abnormalities if present.

Comment on left ventricular diastolic function.

Measurements / analysis section:

LV diastolic and systolic dimensions, LV wall thicknesses.

Visually estimated ejection fraction.

E wave velocity, A wave velocity, E wave deceleration time, e' velocities, E/e' (can be reported under mitral valve section), mitral annular S'.

Mitral valve:

Descriptive section:

Comment on mitral valve structure, leaflet thickness and mobility.

Comment on absence / presence of mitral stenosis.

Comment on absence / presence of mitral regurgitation.

Measurements / analysis section:

E wave velocity, A wave velocity, E wave deceleration time (can be reported under LV section).

If stenosis is present:

A range of measurements taken from BSE guidelines.

If more than mild regurgitation is present:

A range of measurements taken from BSE guidelines.

Left atrium:

Descriptive section:

Visually comment on left atrial size.

Measurements / analysis section:

If seen, monoplane volume (A4C or A2C).

Aortic valve:

Descriptive section:

Comment on aortic valve structure, leaflet thickness and mobility.

Comment on absence / presence of aortic stenosis.

Comment on absence / presence of aortic regurgitation.

Measurements / analysis section:

Aortic Vmax, maximum and mean gradient, aortic VTI.

Left ventricular outflow tract Vmax, left ventricular outflow tract max and gradient, left ventricular outflow tract VTI.

If stenosis is present:

Measurements as above plus: aortic valve area or dimensionless index

If more than mild regurgitation is present:

A range of measurements taken from BSE guidelines.

Aorta:

Descriptive section:

Comment on aortic root, proximal ascending aorta and aortic arch size or, “not well seen to assess” if more appropriate.

Measurements / analysis section:

If seen; sinuses of valsalva dimension, sino-tubular junction dimension, proximal ascending aorta dimension.

Right ventricle:

Descriptive section:

Comment on right ventricular size

Comment on global right ventricular systolic function.

Measurements / analysis section:

RVD1

TAPSE

Right atrium:

Descriptive section:

Visually comment on right atrial size.

Measurements / analysis section:

If seen, RA area.

Tricuspid valve:

Descriptive section:

Comment on tricuspid valve structure, leaflet thickness and mobility or, “not well seen” if more appropriate.

Comment on absence / presence of tricuspid stenosis.

Comment on absence / presence of tricuspid regurgitation.

Measurements / analysis section: Tricuspid regurgitation Vmax (if tricuspid regurgitation present) or “no measurable tricuspid regurgitation Vmax ” if more appropriate.

If stenosis is present - A range of measurements taken from BSE guidelines.

If more than mild regurgitation is present - A range of measurements as per BSE guidelines.

Pulmonary valve:

Descriptive section:

Comment on pulmonary valve leaflet thickness and mobility or, “not well seen” if more appropriate.

Measurements / analysis section: If seen, pulmonary valve Vmax.

If stenosis is present - A range of measurements taken from BSE guidelines.

If more than mild regurgitation is present - A range of measurements taken from BSE guidelines.

Pulmonary hypertension:

Descriptive section:

Comment on echocardiography probability of pulmonary hypertension or “unable to comment” if more appropriate.

Measurements / analysis section:

Tricuspid regurgitation Vmax (if present), at least one further echocardiography parameter to help quantify the descriptive statement.

Inferior Vena Cava:

Descriptive section:

Comment size and collapsibility or, “not well seen” if more appropriate.

Measurements / analysis section:

If seen, IVC max dimension.

Pericardium:

Descriptive section:

Comment on absence / presence of pericardial fluid. If present: A comment location, size and hemodynamic effects.

Measurements / analysis section:

If no pericardial fluid – N/A

If pericardial effusion present: Effusion dimensions and assessment of haemodynamic effects which may include: MV, TV, LVOT inflow variation with respiration, presence or absence of cardiac chamber collapse, IVC size and collapsibility assessment.

If a valve replacement is present:

Descriptive section:

Replacement valve location, type and size (if known, or stipulate not known if more appropriate) and stability of replacement valve.

Comment on absence / presence of prosthetic stenosis.

Comment on absence / presence of prosthetic regurgitation. Including likely origin of the regurgitant jet.

Comparison to previous study where possible.

Measurements / analysis section:

A range of hemodynamic parameters assessing forward flow that is relevant to the replacement valve position.

A range of parameters to assess regurgitation severity as per valve native disease.

If a valve repair is present:

Descriptive section:

Location and type of valve repair (if known, or stipulate not known if more appropriate) and stability of repaired valve.

Comment on absence / presence of repaired valve stenosis.

Comment on absence / presence of repaired regurgitation. Including likely origin of the regurgitant jet.

Measurements / analysis section:

A range of hemodynamic parameters assessing forward flow that is relevant to the position of the repaired valve.

A range of parameters to assess regurgitation severity as per valve native disease.

Conclusion:

Must summarise main findings.

A comparison to previous studies should made where possible.

Logbook marking criteria:

When marking a candidate's logbook, the Assessor will review a selection of reports in the candidate's logbook.

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)
Fully Anonymised	
Indication for echo present	
Appropriate measurements present	
Appropriate Doppler calculations present	
Do measurements / Doppler calculations match descriptions	
All parts of heart described	
Descriptions complete	
Appropriate to request	
Conclusion present	

Logbook outcomes include:

Satisfactory logbook for BSE accreditation OR Unsatisfactory at present and a resubmission is required.

If a logbook is unsatisfactory, the candidate will be asked for one of the following resubmissions.

- 10-20 further specified reports: To address persistent inaccuracies in certain measurements or observations (e.g. lack of diastolic function assessment).
- 25-75 further specified reports: To address repeated inaccuracies, lack of correct conclusion or lack of sequential systematic comments on all parts of the heart. (e.g. lack of RWMA description + lack of quantitative valve pathology measurements).
- 250 reports: To address significant errors, inaccurate or lack of systematic comments. The presence of Patient ID on any report will require a complete resubmission of the logbook.

To ensure consistency across logbook marking, all logbooks are discussed with the national logbook leads and chief assessor prior to a resubmission being requested.

Appendix 9: Guidance for the removal of patient identifiable 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 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 10: Practical scanning mark scheme

The marking criteria used for the practical scanning assessment can be seen below.

2 minutes:	• Familiarisation of echo machine / equipment. • Assessor will be on hand if assistance is required.
20 minutes:	• Candidate to have 2 minutes to obtain and acquire each image. • The Assessor will instruct the candidate on the images to acquire. • The Assessor can alter echo machine / equipment setting to optimise images at the direction of the candidate.

The pass mark is set at 66%. Once this mark is achieved the candidate will be deemed as being successful at this station.

Each image the candidate acquires is scored as per the marking scheme below.

Appendix Four - Practical Scanning Mark Scheme

F = Fail = 0 points:	unable to demonstrate appropriate skill set
BF = Borderline Fail = 1 point:	unable to demonstrate appropriate skill set, is able to describe reasons how improvement could be achieved
BP = Borderline Pass = 2 points: quality	able to acquire/demonstrate skill set although fails to optimize image acquisition
P = Pass = 3 points: optimization of images	able to fully demonstrate high quality image acquisition with appropriate

All images used in the practical scanning assessment are taken from the BSE minimum dataset. An example of the imaging list used in this assessment can be seen below.

Image List One

2 minutes per acquisition Encourage candidates to move on if necessary	Image (Score Weighting)
1	**2D Parasternal Long Axis (5)**
2	**2D Parasternal Short Axis Left Ventricle (5)**
3	**2D modified Short Axis demonstrating Main Pulmonary Artery (3)**
4	**PW Doppler RVOT (1)**
5	**2D Apical 4 Chamber (5)**
6	**PW Doppler Mitral Valve (1)**
7	**2D Apical 2 Chamber (5)**
8	**2D A4C modified to show RV, with Colour Doppler, demonstrating TR if present (3)**
9	**2D Subcostal 4 Chamber (3)**
10	**Blind CW Doppler Descending Aorta (3)**
	Modification of Patient Position to Optimise Image Quality (5)
	Image Optimisation (3)

Appendix 11: Patient case studies viva 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 in order 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 Transthoracic Accreditation. **Case 1 – No significant 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	
Optimization Infrequent, non-repetitive optimization errors which do not detract from the case conclusion		**Optimization** Frequent, repetitive optimization 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 Accurate throughout with minor errors that do not change the categorisation of the chosen pathology		**2D measurements** 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 optimization altering pathology assessment	
Pathology assessment No images missing which are key to pathology assessment No measurements significantly inaccurate that are key to pathology assessment		**Pathology assessment** Poor quality or missing images missing which are key to pathology assessment Measurements key to pathology assessment significantly inaccurate and change the categorisation of the pathology	
Report is complete and accurate Comprehensive/accurate description of all parts of the heart Correct categorisation of chosen pathology (NB none significant abnormalities may be included in this case) Correct interpretation of findings in the clinical context		**Report is incomplete or inaccurate** Partial/inaccurate description of parts of the heart Incorrect categorisation of chosen pathology Incorrect interpretation of findings in the clinical context	

Adult Transthoracic 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	
Optimization Infrequent, non-repetitive optimisation errors which do not detract from the case conclusion		**Optimization** 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 Accurate throughout with minor errors that do not change the categorisation of the chosen pathology		**2D measurements** 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 optimization altering pathology assessment	
Pathology assessment Good quality CW from the A5C and stand-alone CW from at least one other window. No images missing which are key to pathology assessment No measurements significantly inaccurate that are key to pathology assessment (LVOT diameter, LVOT VTi and aortic VTi)		**Pathology assessment** Missing, poor quality or significantly lower stand-alone CW 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 aortic VTi)	
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 Transthoracic Accreditation. **Case 3 – 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	
Optimization Infrequent, non-repetitive optimisation errors which do not detract from the case conclusion		**Optimization** 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 Accurate throughout with minor errors that do not change the categorisation of the chosen pathology		**2D measurements** 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/RV/ERO/PV flow) No images missing which are key to pathology assessment No measurements significantly inaccurate that are key 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 key 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 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 Transthoracic Accreditation. **Case 4 – RWMA.** 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	
Optimization Infrequent, non-repetitive optimisation errors which do not detract from the case conclusion		**Optimization** 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 Accurate throughout with minor errors that do not change the categorisation of the chosen pathology		**2D measurements** 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 biplane showing systolic and diastolic measurements in both A4C and A2C which correlates with visual impression No images missing which are key to pathology assessment No measurements significantly inaccurate that are key to pathology assessment		**Pathology assessment** Incomplete assessment of Simpson's or measured inaccurately which leads to a change the categorisation of the reported LVEF Images missing which are key to pathology assessment Measurements key to pathology assessment significantly inaccurate that change the categorisation of the pathology	
Report is complete and accurate Comprehensive and accurate description of all parts of the heart including RWMAs Correct categorisation of chosen pathology Correct interpretation of findings in the clinical context		**Report is incomplete or inaccurate** Partial and inaccurate description of parts of the heart including RWMAs Incorrect categorisation of chosen pathology Incorrect interpretation of findings in the clinical context	

Adult Transthoracic 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	
Optimization Infrequent, non-repetitive optimisation errors which do not detract from the case conclusion		**Optimization** 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 Accurate throughout with minor errors that do not change the categorisation of the chosen pathology		**2D measurements** 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 No images missing which are key to pathology assessment No measurements significantly inaccurate that are key to pathology assessment		**Pathology assessment** Images missing which are key 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 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	