



ECHOCARDIOGRAPHY

IAC Standards and Guidelines for Adult Echocardiography Accreditation

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Introduction

The Intersocietal Accreditation Commission (IAC) accredits imaging facilities specific to echocardiography. IAC accreditation is a means by which facilities can evaluate and demonstrate the level of patient care they provide.

An echocardiography facility is defined as an entity located at one postal address, composed of at least one ultrasound instrument and a Medical Director and a Technical Director performing and/or interpreting transthoracic echocardiography. There may be additional physicians and sonographers. The designation of the title of Medical Director and Technical Director are for IAC accreditation purposes only. The facility may also perform transesophageal, stress or **adult congenital transthoracic** echocardiography.

An accredited echocardiography facility requires the interpreting physicians and practicing sonographers to be adequately trained and experienced to interpret and perform echocardiograms. Published documents recognize that echocardiography requires considerable training and expertise ([see Bibliography](#)). Although published opinions vary with regard to the absolute numbers necessary for attaining and maintaining competence in echocardiography, all agree that numbers of studies performed or interpreted are helpful but not sufficient by themselves to assure clinical competence.

In order to achieve accreditation for transesophageal (TEE), stress or **adult congenital transthoracic* echocardiography**, all facilities are required to be accredited in adult transthoracic echocardiography. Facilities may submit completed applications for all testing areas at the same time or may first apply for transthoracic and add on TEE, stress or **adult congenital transthoracic** echocardiography at a later date. All areas granted accreditation will expire at the same time regardless of when they were submitted in the accreditation cycle.

The intent of the accreditation process is two-fold. It is designed to recognize facilities that provide quality echocardiographic services. It is also designed to be used as an educational tool to improve the overall quality of the facility.

The following are the specific areas of adult echocardiography for which accreditation may be obtained:

- adult transthoracic
- adult stress
- adult transesophageal
- **adult congenital transthoracic**

These accreditation Standards and Guidelines are the minimum standards for accreditation of echocardiography facilities. Standards are the minimum requirements to which an accredited facility is held accountable. *Guidelines are descriptions, examples, or recommendations that elaborate on the Standards. Guidelines are not required, but can assist with interpretation of the Standards.*

New or emerging technologies, protocols and other novel imaging or interventional approaches not included in guidelines published by professional societies must have supporting documentation that demonstrates adherence to manufacturer's training, safety specifications and quality control specifications as applicable.

Facilities are encouraged to [contact the IAC](#) for guidance related to utilization of new technology not currently addressed in the IAC Standards.

Standards are printed in regular typeface in outline form. *Guidelines are printed in italic typeface in narrative form.*

Standards that are highlighted are content changes that were made as part of the February 1, 2023 revision. Facilities applying for accreditation after February 1, 2023 must comply with these new highlighted Standards.

In addition to all Standards listed below, the facility, including all staff, must comply at all times with all federal, state and local laws and regulations, including but not limited to laws relating to licensed scope of practice, facility operations and billing requirements.

**It is recognized and accepted that adult patients with congenital heart disease are often imaged in pediatric echocardiography facilities. IAC accredited pediatric echocardiography facilities providing services to adult patients with congenital heart disease do not need to pursue adult congenital transthoracic echocardiography accreditation.*

Part A: Organization

Section 1A: Personnel and Supervision

STANDARD – Medical Director

1.1A The Medical Director must be a licensed physician.

1.1.1A Medical Director Required Training and Experience

The Medical Director must meet ONE of the following initial qualifications:

1.1.1.1A National Board of Echocardiography (NBE) active Testamur status
AND

Qualifying practice experience over previous 18 months:

- i. TTE - 450 examinations / 18 months
- ii. TEE - 75 examinations / 18 months
- iii. Stress - 75 examinations / 18 months

1.1.1.2A Level 2 or 3 COCATS echocardiography training
AND

Qualifying practice experience over previous 24 months:

- i. TTE - 600 examinations / 24 months
- ii. TEE - 100 examinations / 24 months
- iii. Stress - 100 examinations / 24 months

1.1.1.3A Cumulative practice experience of at least 1,800 echocardiography examinations
AND

Qualifying practice experience over previous 36 months:

- i. TTE - 900 examinations / 36 months
- ii. TEE - 150 examinations / 36 months
- iii. Stress - 150 examinations / 36 months

Comment: In addition to the initial qualifications, physicians must meet Ongoing Practice Experience and Continuing Medical Education Requirements as defined by the Standards outlined in this document.

1.1.2A Ongoing Practice Experience Requirements

Performance/interpretation of an average minimum number of echocardiography examinations per year in the specialties for which the staff member is listed:

1.1.2.1A TTE 300 examinations / year

1.1.2.2A TEE 50 examinations / year

1.1.2.3A Stress 50 examinations / year

1.1.3A Medical Director Responsibilities

The Medical Director responsibilities include but are not limited to:

- 1.1.3.1A all clinical services provided and for the determination of the quality and appropriateness of care provided;
- 1.1.3.2A supervising the entire operation of the facility or may delegate specific operations to associate directors and the Technical Director;
- 1.1.3.3A assuring compliance of the medical and technical staff to the Standards outlined in this document and the supervision of their work; and
- 1.1.3.4A must be an active participant in the interpretation of studies performed in the facility.

1.1.4A Continuing Medical Education (CME) Requirements

- 1.1.4.1A The Medical Director must document at least 30 hours of CME relevant to cardiac imaging over a period of three years. CME credits must be earned within the three-year period prior to application submission.
 - i. At least 15 hours must be echocardiography related.
- 1.1.4.2A Yearly accumulated CME must be kept on file and available for submission upon request.

(See Guidelines on Page 13 for further recommendations.)

Comment: If within the past three years the Medical Director has completed formal training or has acquired/renewed NBE Testamur status, the CME requirement will be considered fulfilled.

STANDARD – Technical Director

- 1.2A A qualified Technical Director(s) must be designated for the facility. The Technical Director is generally a full-time position. If the Technical Director is not on-site full time or serves as Technical Director in another facility, an appropriately credentialed sonographer who is a member of the technical staff must be present in the facility in the absence of the Technical Director and assume the duties of the Technical Director.

Comment: In a facility with no sonographers, the Medical Director serves as Technical Director and must assume the responsibilities of Technical Director.

1.2.1A Technical Director Required Training and Experience

The Technical Director must meet the following criteria:

- 1.2.1.1A The Technical Director must have an appropriate credential in echocardiography:
 - i. Registered Diagnostic Cardiac Sonographer (RDCS) from American Registry of Diagnostic Medical Sonography (ARDMS)
 - ii. Registered Cardiac Sonographer (RCS) or Registered Congenital Cardiac Sonographer (RCCS) from Cardiovascular Credentialing International (CCI)
 - iii. Canadian Registered Cardiac Sonographer (CRCS), Sonography Canada
 - iv. Advanced Cardiac Sonographer (ACS) from Cardiovascular Credentialing International (CCI)

1.2.2A Technical Director Responsibilities

The Technical Director reports directly to the Medical Director or his/her delegate. Responsibilities may include, but are not limited to:

- 1.2.2.1A performance of echocardiograms in the facility;
- 1.2.2.2A general supervision of the technical staff and/or ancillary staff (if applicable);
- 1.2.2.3A delegation, when warranted, of specific responsibilities to the technical staff and/or the ancillary staff;
- 1.2.2.4A daily technical operation of the facility (e.g., staff scheduling, patient scheduling, facility record keeping, etc.);
- 1.2.2.5A operation and maintenance of facility equipment;
- 1.2.2.6A compliance of the technical and/or ancillary staff to the Standards outlined within this document;
- 1.2.2.7A working with the Medical Director, medical staff and technical staff to ensure quality patient care; and
- 1.2.2.8A technical training.

1.2.3A Continuing Medical Education (CME) Requirements

- 1.2.3.1A The Technical Director must document at least 15 hours of cardiac imaging-related CME during their credentialing triennial cycle.
- 1.2.3.2A Yearly accumulated CME must be kept on file and available for submission upon request.

([See Guidelines on Page 13 for further recommendations.](#))

STANDARD – Medical Staff

1.3A All members of the medical staff must be licensed physicians.

1.3.1A Medical Staff Required Training and Experience

The medical staff members must meet ONE OR MORE of the following initial qualifications:

- 1.3.1.1A National Board of Echocardiography (NBE) active Testamur status
AND
Qualifying practice experience over previous 12 months:
 - i. TTE - 150 examinations / 12 months
 - ii. TEE - 25 examinations / 12 months
 - iii. Stress - 25 examinations / 12 months
- 1.3.1.2A Level 2 or 3 COCATS echocardiography training
- 1.3.1.3A Cumulative practice experience of at least 600 echocardiography examinations
AND

Qualifying practice experience over previous 12 months:

- i. TTE - 150 examinations / 12 months
- ii. TEE - 25 examinations / 12 months
- iii. Stress - 25 examinations / 12 months

Comment: In addition to the initial qualifications, physicians must meet Ongoing Practice Experience and Continuing Medical Education Requirements as defined by the Standards outlined within this document.

1.3.2A Ongoing Practice Experience Requirements

Performance/interpretation of an average minimum number of echocardiography examinations per year in the specialties for which the staff member is listed:

1.3.2.1A TTE 150 examinations / year

1.3.2.2A TEE 25 examinations / year

1.3.2.3A Stress 25 examinations / year

Comment: If there has been a lapse in the ongoing practice of echocardiography of more than two years, there must be documentation of:

- i. supervised review of interpretive and performance skills by the Medical Director; and
- ii. 30 hours of echocardiography-related CME prior to resuming independent interpretation as a staff member.

1.3.3A Medical Staff Responsibilities

Medical staff responsibilities include but are not limited to:

1.3.3.1A the medical staff interprets and/or performs clinical studies.

1.3.4A Continuing Medical Education (CME) Requirements

1.3.4.1A The medical staff must document at least 15 hours of CME relevant to cardiac imaging over a period of three years. CME credits must be earned within the three-year period prior to application submission.

- i. At least 5 hours must be echocardiography related.

1.3.4.2A Yearly accumulated CME must be kept on file and available to the IAC when requested.

(See Guidelines on Page 13 for further recommendations.)

Comment: If within the past three years the medical staff member has completed formal training or has acquired/renewed NBE Testamur status, the CME requirement will be considered fulfilled.

STANDARD – Technical Staff

1.4A Technical Staff Required Training and Experience

The technical staff members must meet one of the following criteria:

- 1.4.1A An appropriate credential in echocardiography:
 - 1.4.1.1A Registered Diagnostic Cardiac Sonographer (RDSCS) from American Registry of Diagnostic Medical Sonography (ARDMS)
 - 1.4.1.2A Registered Cardiac Sonographer (RCS) or Registered Congenital Cardiac Sonographer (RCCS) from Cardiovascular Credentialing International (CCI)
 - 1.4.1.3A Canadian Registered Cardiac Sonographer (CRCS), Sonography Canada
 - 1.4.1.4A Advanced Cardiac Sonographer (ACS) from Cardiovascular Credentialing International (CCI)
- 1.4.2A Provisional Staff
 - 1.4.2.1A New graduates of a cardiac ultrasound program who are employed in an accredited facility must obtain an appropriate credential within one year from the date of graduation. These individuals must be listed on the application as provisional technical staff who are eligible for credentialing, and must only work under appropriate supervision of a credentialed sonographer.
 - 1.4.2.2A Individuals employed in an accredited facility who are cross-training in echocardiography or working to fulfill clinical experience pre-requisites for a credentialing examination must obtain an appropriate credential within two years from the start date of training. These individuals must be listed on the application as provisional technical staff who are eligible for credentialing, and must only work under appropriate supervision of a credentialed sonographer.

1.5A Technical Staff Responsibilities

Technical staff responsibilities include but are not limited to:

- 1.5.1A reports to the Technical Director; and
- 1.5.2A assumes the responsibilities specified by the Technical Director and, in general, is responsible for the performance of clinical examinations and other tasks assigned.

1.6A Continuing Medical Education (CME) Requirements

- 1.6.1A The technical staff must document at least 15 hours of cardiac imaging-related CME during their credentialing triennial cycle.
- 1.6.2A Yearly accumulated CME must be kept on file and available for submission upon request.

(See Guidelines on Page 13 for further recommendations.)

STANDARD – Adult Congenital Staff

Facilities that seek accreditation in adult congenital transthoracic echocardiography, must ensure qualified personnel are appointed.

1.7A Lead Adult Congenital Echocardiographer

The facility must appoint a lead adult congenital echocardiographer who may be the Medical Director or a member of the medical staff, and they must meet the appropriate Standards for their role (1.1A or 1.3A).

1.7.1A Lead Adult Congenital Echocardiographer Training and Experience

In addition to the Standards outlined in 1.1A or 1.3A, the lead adult congenital echocardiographer must meet one of the following criteria:

- 1.7.1.1A American Board of Internal Medicine (ABIM) Adult Congenital Heart Disease (ACHD) Board Eligible or Certified
- 1.7.1.2A Advanced level of expertise: High level of expertise in all aspects of adult congenital echocardiography. Physicians with this level of training are expected to interpret echocardiograms in patients with all forms of congenital heart disease, and to supervise and train others. This should include cumulative practice experience of at least 300 adult congenital transthoracic echocardiography examinations.
- AND
- Qualifying practice experience of a minimum of 100 adult congenital transthoracic echocardiograms over the previous 24 months.
- Comment: This excludes patent foramen ovale, bicuspid aortic valve and secundum atrial septal defects.
- 1.7.1.3A If there is no physician who meets the above requirements (1.7.1.1A or 1.7.1.2A), there must be an affiliation with either an Adult Congenital Heart Association (ACHA) accredited Adult Congenital Heart Disease (ACHD) center;
- OR
- An IAC-accredited pediatric facility. The affiliation must have a well-defined, joint, Quality Improvement (QI) program that demonstrates regular education and quality initiatives.

1.7.2A Ongoing Practice Experience Requirements

- 1.7.2.1A Interpretation of an average minimum number of 50 congenital heart disease transthoracic echocardiography examinations per year over the previous three years.
- Comment: This excludes patent foramen ovale, bicuspid aortic valve and secundum atrial septal defects.

1.7.3A Lead Adult Congenital Echocardiographer Responsibilities

The lead adult congenital echocardiographer responsibilities include, but are not limited to:

- 1.7.3.1A assuring compliance to the ACHD Standards as outlined in this document and training and supervising the work of other adult congenital staff members;
- 1.7.3.2A overseeing the Quality Improvement (QI) activities related to ACHD; and
- 1.7.3.3A must be an active participant in the interpretation of the ACHD studies performed in the facility.

1.7.4A Continuing Medical Education (CME) Requirements

- 1.7.4.1A The lead adult congenital echocardiographer is required to obtain at minimum five hours of CME over a period of three years relevant to congenital echocardiography. These CME hours may be included in the overall minimum number of echocardiography-related CME hours required within the three-year period prior to application submission.

1.8A Lead Congenital Sonographer

A qualified lead congenital sonographer must be designated for the facility. The lead congenital sonographer may be the Technical Director or a member of the technical staff, and they must meet the appropriate Standards for their role (1.2A or 1.4A).

1.8.1A Lead Congenital Sonographer Training and Experience

In addition to the Standards outlined in 1.2A or 1.4A, the lead congenital sonographer must meet the following criteria:

- 1.8.1.1A Hold an active credential in pediatric or congenital heart disease:
- i. Registered Diagnostic Cardiac Sonographer (RDCS) in Pediatric Echocardiography (PE) from American Registry of Diagnostic Medical Sonography (ARDMS)
 - ii. Registered Congenital Cardiac Sonographer (RCCS) from Cardiovascular Credentialing International (CCI)

1.8.2A Lead Congenital Sonographer Responsibilities

The lead congenital sonographer works with the lead adult congenital echocardiographer to:

- 1.8.2.1A oversee the training and education of sonographers in congenital heart disease;
- 1.8.2.2A oversee ACHD Standard protocol development and adherence; and
- 1.8.2.3A oversee Quality Improvement (QI) activities related to ACHD.

1.8.3A Continuing Medical Education (CME) Requirements

- 1.8.3.1A The lead congenital sonographer must obtain at least five hours of CME relevant to congenital echocardiography over a period of three years. These CME hours may be included in the overall minimum number of echocardiography-related CME hours required during their credentialing triennial cycle.

1.9A Adult Congenital Medical Staff

Medical staff who participate in the interpretation of ACHD examinations must meet the Standards outlined for either the adult echocardiography Medical Director or medical staff (1.1A or 1.3A).

1.9.1A Adult Congenital Medical Staff Training and Experience

In addition to the Standards outlined in 1.1A or 1.3A, adult congenital medical staff must meet one of the following criteria:

- 1.9.1.1A American Board of Internal Medicine (ABIM) Adult Congenital Heart Disease Board eligible or certified or American Board of Pediatrics (ABP) Pediatric Cardiology Board certified.

OR

- 1.9.1.2A Advanced level of expertise: High level of expertise in all aspects of adult congenital echocardiography. Physicians with this level of training are expected to interpret echocardiograms in patients with all forms of congenital heart disease. This should include cumulative practice experience of at least 150 adult congenital echocardiography transthoracic examinations.

AND

Qualifying practice experience of a minimum of 50 adult congenital echocardiography transthoracic examinations over the last 24 months.

Comment: This excludes patent foramen ovale, bicuspid aortic valve and secundum atrial septal defects.

1.9.2A **Ongoing Practice Experience Requirements**

1.9.2.1A Interpretation of an average minimum number of 25 adult congenital transthoracic echocardiography examinations per year over the previous three years.

Comment: This excludes patent foramen ovale, bicuspid aortic valve and secundum atrial septal defects.

1.9.3A **Adult Congenital Medical Staff Responsibilities**

The adult congenital medical staff responsibilities include, but are not limited to:

1.9.3.1A Interpretation of adult congenital clinical studies.

1.9.4A **Continuing Medical Education (CME) Requirements**

1.9.4.1A Adult congenital medical staff are required to obtain at minimum three hours of CME over a period of three years relevant to congenital echocardiography. These CME hours may be included in the overall minimum number of echocardiography-related CME hours required within the three-year period prior to application submission.

1.10A **Congenital Technical Staff**

Congenital technical staff may be either the Technical Director or a member of the Technical Staff and must meet the appropriate Standards for their role (1.2A or 1.4A).

1.10.1A **Congenital Technical Staff Training and Experience**

In addition to the Standards outlined in 1.2A or 1.4A, congenital technical staff must meet the following criteria:

1.10.1.1A Hold an active credential in pediatric or congenital heart disease:

- i. Registered Diagnostic Cardiac Sonographer (RDCS) in Pediatric Echocardiography (PE) from American Registry of Diagnostic Medical Sonography (ARDMS)
- ii. Registered Congenital Cardiac Sonographer (RCCS) from Cardiovascular Credentialing International (CCI)

1.10.2A **Provisional Congenital Technical Staff**

Provisional congenital technical staff are technical staff who hold the appropriate credential in adult echocardiography and are cross-training in congenital echocardiography or working to fulfill clinical experience pre-requisites for a credentialing examination.

1.10.2.1A **Provisional Congenital Technical Staff Training and Experience**

- i. Provisional congenital technical staff must obtain an appropriate credential within two years from the start date of training. These individuals must be listed on the IAC application as provisional congenital technical staff who

are eligible for credentialing and must only work under appropriate supervision by a credentialed congenital sonographer.

1.10.3A Congenital Technical Staff Responsibilities

The congenital technical staff responsibilities include but are not limited to:

1.10.3.1A Performance of adult congenital clinical examinations.

1.10.4A Continuing Medical Education (CME) Requirements

1.10.4.1A The congenital technical staff must obtain at least three hours of CME relevant to congenital echocardiography over a period of three years. These CME hours may be included in the overall minimum number of echocardiography-related CME hours required during their credentialing triennial cycle.

STANDARD – Support Services

- 1.11A Ancillary personnel (clerical, nursing, transport, etc.) necessary for safe and efficient patient care are provided.

 - 1.11.1A Clerical and administrative support must be sufficient to ensure efficient operation and record keeping.
 - 1.11.2A Nursing and ancillary services sufficient to ensure quality patient care are available when necessary.
 - 1.11.3A Supervision: The Medical Director must ensure that appropriate support services are provided in the best interest of patient care.

Section 1A: Personnel and Supervision *Guidelines*

1.1.4A, 1.2.3A, 1.3.4A and 1.6A One hour of CME or non-CME work-related musculoskeletal disorder (WRMSD) training is recommended for all staff. This can be fulfilled through CME, in-service training or IAC webcast.

Section 2A: Facility

STANDARD – Examination and Interpretation Areas

- 2.1A Examinations must be performed in a setting providing patient and technical staff safety, comfort and privacy.
 - 2.1.1A The adequate performance of an echocardiogram requires the proper positioning of the patient, the echocardiographic system and the sonographer. For this reason, adequate spacing is required for inclusion of a patient bed, which allows for position changes, an echocardiographic imaging system and patient privacy.
 - 2.1.1.1A It is understood that many echocardiographic studies are performed on a portable basis, requiring performance of the studies in less than optimal conditions. All studies, regardless of the location, must be performed with adequate room for patient positioning and equipment use.
 - 2.1.1.2A Patient privacy must be assured with the use of either appropriate curtains or doors.
 - 2.1.1.3A A sink and antiseptic soap must be readily available and used for hand washing in accordance with the infection control policy of the facility.
 - 2.1.1.4A Establishment of and/or adherence to an infection control policy.
 - 2.1.1.5A Adequate designated space must be provided for the interpretation of the echocardiogram and the preparation of reports.

(See Guidelines on Page 15 for further recommendations.)

STANDARD – Storage

- 2.2A Space permitted for storage of records and supplies must be sufficient for the patient volume of the facility.

(See Guidelines on Page 15 for further recommendations.)

STANDARD – Instrument Maintenance

- 2.3A Instrumentation used for diagnostic testing must be maintained in good operating condition. The accuracy of the data collected by ultrasound instruments is paramount in the interpretation and diagnostic utilization of the information collected. Equipment maintenance include, but are not limited to, the following:
 - 2.3.1A Recording of the method and frequency of maintenance of ultrasound instrumentation and digitizing equipment.
 - 2.3.2A Establishment of and adherence to a policy regarding routine safety inspections and testing of all facility electrical equipment.
 - 2.3.3A Establishment of and adherence to an instrument cleaning schedule that includes routine cleaning of equipment parts, including filters and transducers, according to the specifications of the manufacturer. The cleaning schedule must be frequent enough to allow for accurate collection of data.

Section 2A: Facility Guidelines

- 2.1.1A *Approximately 150 square feet is recommended for a transthoracic echocardiography examination room.*
- Approximately 200-250 square feet is recommended for an exercise stress or transesophageal echocardiography examination area.*
- 2.2A *Space should be provided for data evaluation, interpretation and discussion of the study with the sonographer and/or referring physician as needed.*

Section 3A: Examination Reports and Records

STANDARD – Records

- 3.1A Provisions must exist for the generation and retention of examination data for all echocardiograms performed. Measures for HIPAA compliance and IT security must be in place.
- 3.1.1A A system for recording and archiving echocardiographic data (images, measurements and final reports) obtained for diagnostic purposes must be in place.
- 3.1.2A A permanent record of the images and interpretation must be made and retained in accordance with applicable state or federal guidelines for medical records, generally five to seven years. Images and interpretation must be retrievable for comparison with new studies
- 3.1.3A Acceptable archiving media includes videotape and digital storage (including PACS, CD/DVD or other digital archiving media). Digital storage will be required by January 1, 2024.

(See Guidelines on Page 20 for further recommendations.)

STANDARD – Examination Interpretation and Reports

- 3.2A Provisions must exist for the timely reporting of examination data.
- 3.2.1A There must be a policy in place for communicating critical results.
- 3.2.2A The findings of a STAT echocardiogram must be made available immediately by the interpreting physician. Comment: Sonographer worksheets, comments (verbal or written) or electronic summary of findings must not be provided to anyone other than the interpreting physician.
- 3.2.3A Preliminary reports can only be issued by a physician. There must be a policy in place for communicating any significant changes between the preliminary and final reports.
- 3.2.4A Routine inpatient echocardiographic studies must be interpreted by a qualified physician within 24 hours of completion of the examination. Outpatient studies must be interpreted by the end of the next business day. The final verified (by the interpreting physician) signed report must be completed within 48 hours after interpretation.

(See Guidelines on Page 20 for further recommendations.)

- 3.3A Echocardiography reporting must be standardized in the facility. All physicians interpreting echocardiograms in the facility must agree on uniform diagnostic criteria and a standardized report format.⁵
- 3.3.1A The report must accurately reflect the content and results of the study. The report must include, but may not be limited to:
- 3.3.1.1A Demographics:
- i. date of the study;
 - ii. name and/or identifier of the facility
 - iii. name and/or identifier of the patient;
 - iv. date of birth and/or age of the patient;
 - v. indication for the study;

- vi. name or initials of the performing sonographer;
- vii. name of the ordering physician and/or identifier;
- viii. height;
- ix. weight;
- x. gender; and
- xi. blood pressure – systolic and diastolic blood pressure must be obtained on or around the time of the study and displayed on the report.

3.3.1.2A A summary of the results of the examination. Summary comments must include any pertinent or positive and negative findings particularly those relative to the indication for the examination, and communication of critical findings.

(See Guidelines on Page 20 for further recommendations.)

3.3.1.3A The final report must be completely typewritten, including the printed name of the interpreting physician. The final report must be reviewed, signed and dated manually or electronically by the interpreting physician. Electronic signatures must be password protected and indicate they are electronically recorded. Stamped signatures or signing by non-physician staff is unacceptable.

3.4A Adult Transthoracic Echocardiogram Report Components

3.4.1A The report must accurately reflect the content and results of the study. The report must include, but may not be limited to:

3.4.1.1A quantitative data which must include:

- i. the measurements performed in the course of the examination and/or interpretation; and
- ii. 2-D, 3-D and/or M-Mode numerical data for transthoracic echocardiograms, must include, but not be limited to (except where technically unobtainable):
- iii. left ventricular internal dimension and/or volume at end-diastole;
- iv. left ventricular internal dimension and/or volume at end-systole;
- v. left ventricular posterobasal free wall thickness at end-diastole;
- vi. ventricular septal thickness at end-diastole;
- vii. left atrial dimension at end-systole or indexed LA volume; and
- viii. aortic root dimension at end-diastole or ascending aorta.

Comment: Normal ranges may be included in the report per the facility's standards. The report must comment on whether a given dimension is normal or abnormal.

(See Guidelines on Page 20 for further recommendations.)

3.4.1.2A A report of the Doppler evaluation must include, but not be limited to:

- i. evaluation of peak velocities, and peak and mean gradients, as appropriate for each valve (if stenotic or prosthetic);
- ii. valve area (if stenotic);
- iii. degree of pathologic regurgitation (and quantification data if performed);
- iv. right ventricular systolic pressure value reported when tricuspid regurgitation is present; and
- v. other pathology.

3.4.1.3A Report text must include comments on:

- i. left ventricle (LV size; ejection fraction; presence or absence of regional wall motion abnormalities; diastolic function; and strain, if performed);
- ii. right ventricle (size and function);
- iii. right atrium;
- iv. left atrium;
- v. mitral valve;
- vi. aortic valve;
- vii. tricuspid valve;
- viii. pulmonic valve;
- ix. pericardium; and
- x. aorta.

Comment: If any structure is not well visualized this must be noted. The report text must be consistent with the quantitative data. Where appropriate, this must include localization and quantification of abnormal findings.

3.5A Adult Transesophageal Echocardiogram Report Components

3.5.1A The report must accurately reflect the content and results of the study. The report must include, but may not be limited to:

3.5.1.1A Report text (including procedure comments) must include:

- i. medication used for the procedure (If sedation was provided by the anesthesiology service, this must be referenced.);
- ii. ease of transducer insertion;
- iii. complications (yes or no); and
- iv. components of procedure (i.e., color flow Doppler, PW/CW Doppler, contrast administration).

3.5.1.2A Report text must include comments on:

- i. left ventricle;
- ii. right ventricle;
- iii. right atrium;
- iv. left atrium;
- v. left atrial appendage;
- vi. interatrial septum;
- vii. mitral valve;
- viii. aortic valve;
- ix. tricuspid valve;
- x. pulmonic valve;
- xi. pericardium; and
- xii. aorta.

Comment: If any structure is not well visualized or was not imaged due to the need for a targeted examination this must be noted.

3.5.1.3A Measurements and Doppler (if obtained):

- i. Linear and/or volume/area measurements;

- ii. Color and spectral Doppler interpretation statements regarding antegrade and retrograde flow abnormalities for each valve, along with any other Doppler velocity, gradient and/or volume measurements generally accepted as needed for documentation of pathology.

3.6A Stress Echocardiogram Report Components

3.6.1A The report must accurately reflect the content and results of the study. The report must include, but may not be limited to:

3.6.1.1A Report text must include the following non-imaging data:

- i. exercise time, or maximum dose of pharmacologic agent (if used);
- ii. target heart rate;
- iii. maximum heart rate achieved;
- iv. whether or not target HR was achieved and/or stress adequate;
- v. resting blood pressure and blood pressure response to exercise stress (For pharmacologic stress, resting and peak BP should be recorded.);
- vi. reason for termination;
- vii. patient's cardiac symptoms, if any, during the examination;
- viii. if complete image acquisition of the left ventricle exceeds 90 seconds post stress; and
- ix. summary of stress ECG findings.

Comment: If the electrocardiographic portion of the stress test is reported separately, the imaging report must include the items listed in 3.6.1.1A. Image description must include:

- pre-exercise segmental wall motion and global systolic function;
- post-exercise wall motion comparison and global systolic function;
- for Doppler stress testing, the report must contain the relevant baseline and peak / immediate post stress Doppler data.

Comment: If imaging data is delayed in order to obtain Doppler data, this must be noted in the report.

3.6.1.2A A summary of the results of the examination, including any pertinent positive (e.g., ischemia, viability and coronary distribution, LV cavity size and EF response) and negative findings.

Comment: An accurate, succinct impression (e.g., normal, abnormal, stable). This must clearly communicate the result of the study and, when possible, answer the clinical question that was the cause for the examination. This final conclusion must resolve any inconsistencies or discrepancies (e.g., abnormal stress test with normal images) or provide guidance for further studies to do so.

3.6.1.3A Any need for additional studies based on the results of the procedure being reported.

(See Guidelines on Page 20 for further recommendations.)

3.7A Adult Congenital Transthoracic Echocardiogram Report Components

3.7.1A The report must accurately reflect the content and result of the study.

The report must include everything referenced in Section 3.4.1A of the Adult TTE Standards, except where technically or anatomically unobtainable or not applicable in the clinical setting.

- 3.7.1.1A In addition, the following must be commented on, except where technically or anatomically unobtainable or not applicable in the clinical setting:
- i. previous surgical/transcatheter interventions (when available);
 - ii. aortic arch anatomy;
 - iii. measurement of the aorta at the level of the sinuses of Valsalva;
 - iv. measurements of sinotubular junction and mid-ascending when clinically indicated;
 - v. presence or absence of shunt;
 - vi. pulmonary artery anatomy; and
 - vii. pulmonary venous drainage.

Comment: The report elements may be different in congenitally malformed and/or surgically repaired complex malformations and cases with abnormalities of cardiac position.

Section 3A: Examination Reports and Records

Guidelines

- 3.1.3A *Digital storage: The number of images acquired post stress must be sufficient to allow for adequate review, generally 2 or more images are recommended for each view obtained.*
- 3.2.2A *Suggested method for reporting life-threatening findings: The interpreting physician or physician designee in the facility will notify the appropriate provider.*
- 3.2.4A *Comment: An interpretation can be in the form of paper, digital storage or an accessible voice system.*
- 3.3.1.2A *When available and relevant, comparison with a prior echocardiographic study and/or report should be done and noted in the final report.*
- 3.4.1.1A *Additional measurements may be indicated and when performed, should be included.*
- 3.6.1A *Comment: Stress echocardiography interpretation includes at a minimum an assessment of regional and global LV function at rest and stress. Depending on the reason for the study, the stress echocardiogram may require quantitation of valvular regurgitation, stenosis and RV systolic pressure. The electrocardiographic portion of the stress test may be interpreted as part of the stress echocardiogram or separately.*

Section 4A: Facility Safety

STANDARD – Patient and Facility Safety

- 4.1A Patient and employee safety is ensured by written policies and procedures approved by the Medical Director.
- 4.1.1A Personnel Safety Policy (Ergonomics) – A policy must be in place to address technical staff safety, comfort and avoidance of work-related musculoskeletal disorders (MSD).
(See Guidelines below for further recommendations).
- 4.1.2A When in the presence of ionizing radiation, all staff must observe proper radiation safety techniques as prescribed by the facility’s policies.
- 4.1.3A Standard echocardiograms are considered to be safe to both patients and sonographers. However, special echocardiographic procedures, such as transesophageal echocardiograms and stress echocardiograms, pose potential risks to the safety of the patient due to either their semi-invasive nature, or the physiologic stress placed on the cardiovascular system of the patient. For this reason, an echocardiography facility providing special echocardiographic procedures must have an emergency procedure plan, and the following emergency supplies must be readily available for transesophageal echocardiograms and stress echocardiograms:
- 4.1.3.1A a fully equipped cardiac arrest cart (crash cart);
 - 4.1.3.2A a defibrillator;
 - 4.1.3.3A equipment for starting and maintaining intravenous access;
 - 4.1.3.4A oxygen tanks or wall mounted oxygen sources with appropriate cannulae and/or masks; and
 - 4.1.3.5A suction equipment.
- 4.1.4A The facility must meet the standards set forth by the Occupational Safety and Health Administration (OSHA) and by the Joint Commission (JC), where applicable.
- 4.1.5A The facility must have a written procedure in place for handling acute medical emergencies.

Section 4A: Facility Safety Guidelines

- 4.1.1A *Comment: For additional information regarding MSD, please visit:*
www.cdc.gov/niosh/docs/wp-solutions/2006-148/
www.sdms.org/pdf/wrmsd2003.pdf

Section 5A: Administrative

STANDARD – Patient Confidentiality

- 5.1A All facility personnel must ascribe to professional principles of patient-physician confidentiality as legally required by federal, state, local or institutional policy or regulation.

STANDARD – Patient or Other Customer Complaints

- 5.2A There must be a policy in place outlining the process for patients or other customers to issue a complaint/grievance in reference to the care/services they received at the facility/facility and how the facility handles complaints/grievances.

STANDARD – Primary Source Verification

- 5.3A There must be a policy in place identifying how the facility verifies the medical education, training, appropriate licenses and certifications of all physicians as well as, the certification and training of all technical staff members and any other direct patient care providers.

Section 5A: Administrative *Guidelines*

Sample documents are available for each of the required policies listed in Section 5A on the IAC Echocardiography website at intersocietal.org/helpful-resources/sample-documents-repository.

Section 6A: Multiple Sites (Fixed and/or Mobile)

STANDARD – Multiple Sites

- 6.1A When testing is performed at more than one physical facility, the facility may be eligible to apply for a single accreditation as a multiple site facility.
 - 6.1.1A All facilities have the same Medical Director.
 - 6.1.2A All facilities have the same Technical Director.
 - 6.1.3A Identical testing protocols are used at all sites.
 - 6.1.4A Identical diagnostic criteria are used at all sites.
 - 6.1.5A For multi-site facilities, each site must be represented in the Quality Improvement (QI) process at least annually, whether done locally or centrally. All areas of testing (Adult Transthoracic, Adult Transesophageal and Stress) at each site must be represented in this annual evaluation.
 - 6.1.6A Equipment of similar quality and capability must be used at all sites.

Section 6A: Multiple Sites (Fixed and/or Mobile) *Guidelines*

Facilities needing complete details on adding a multiple site should review the current IAC Policies and Procedures available on the IAC website at intersocietal.org/legal/policies-procedures.

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Section 1B: Adult Transthoracic Echocardiography Testing

STANDARD – Instrumentation

1.1B Cardiac Ultrasound Systems

1.1.1B Ultrasound instruments utilized for diagnostic studies must include, at a minimum, hardware and software to perform:

1.1.1.1B M-Mode imaging;

1.1.1.2B 2-D imaging (the system must include harmonic capabilities);

1.1.1.3B spectral display for pulsed (PW) and continuous wave (CW) Doppler and tissue Doppler imaging;

1.1.1.4B color flow Doppler;

1.1.1.5B monitor or other display method of suitable size and quality for observation and interpretation of all modalities;

Comment: The display or DICOM header must identify the parent institution, the name of the patient, second patient identifier (such as MRN or DOB), the date and time of the study. The ECG must also be displayed.

1.1.1.6B Instrument settings to enable optimization of ultrasound enhancing agents (UEAs).

1.1.1.7B Instrument settings to enable optimization of tissue Doppler imaging.

1.1.1.8B range or depth markers must be available on all displays;

1.1.1.9B capabilities to measure the distance between two points, an area on a 2-D image, blood flow velocities, time intervals and peak and mean gradients from spectral Doppler studies;

1.1.1.10B at least two imaging transducers, one of low frequency (2-2.5 MHz) and one of high frequency (3.5 MHz or higher); or a multi-frequency transducer which includes a range of frequencies specific to the clinical needs in adult echo.

Comment: A transducer dedicated to the performance of non-imaging continuous wave Doppler must be available at each site.

1.1.1.11B an audible output must be present at the time of acquisition;

1.1.1.12B machines with some, but not all of the above, equipment may be used for limited or directed echocardiographic examinations. However, machines utilized for complete diagnostic procedures must include all of the above listed capabilities.

STANDARD – Procedure Volumes

1.2B The annual procedure volume must be sufficient to maintain proficiency in examination performance and interpretation.

STANDARD – Indications, Ordering Process and Scheduling

- 1.3B Transthoracic echocardiography testing is performed for appropriate indications.¹
- 1.3.1B Verification of the Indication – A process must be in place in the facility for obtaining and recording the indication. Before a study is performed, the indication must be verified and any additional information needed to direct the examination must be obtained.
- 1.4B Transthoracic echocardiography testing is appropriately ordered and scheduled. Appropriate Use Criteria (AUC) documents pertaining to echocardiography must be available for review in the facility.
- 1.4.1B Ordering Process – The echocardiogram order and requisition must clearly indicate the type of study to be performed, the reason(s) for the study and the clinical question(s) to be answered. The signed (electronic or handwritten) order/requisition must be present in the medical record of the patient.
- 1.4.2B Definition of Procedure Types and Protocols
- 1.4.2.1B Complete Studies:
- i. A complete imaging study is one that examines all of the cardiac chambers and valves and the great vessels from multiple views, then uses the available information to completely define any recognized abnormalities.
 - ii. A complete Doppler study is one that examines every cardiac valve, and the atrial and ventricular septa for antegrade and/or retrograde flow. In addition, a complete Doppler study provides functional hemodynamic data.
- 1.4.2.2B Limited Study: A limited study is generally only performed when the patient has undergone a complete recent examination and there is no clinical reason to suspect any changes outside the specific area of interest. A limited study generally examines a single area of the heart or answers a single clinical question.
- 1.4.3B Scheduling – Sufficient time must be allotted for each study according to the procedure type. The performance time allotted for a complete (imaging and Doppler) transthoracic examination is 45 to 60 minutes from patient encounter to departure. An additional 15 to 30 minutes may be required for complicated studies.
- 1.4.3.1B An urgent study must be performed in the next available time period.
- 1.4.3.2B A stat study must be performed as soon as possible, preempting routine studies.
- (See Guidelines on Page 30 for further recommendations.)*
- 1.4.3.3B Availability for Emergencies: Qualified personnel and equipment must be available for urgent or stat studies outside normal working hours in inpatient facilities or where appropriate.
- (See Guidelines on Page 30 for further recommendations.)*

STANDARD – Techniques

- 1.5B Examination performance must include proper technique.
- 1.5.1B All procedures must be explained to the patient and/or parents or guardian. The patient's height, weight and blood pressure must be measured and recorded prior to or during the examination.

- 1.5.2B Echocardiography examinations of the heart must examine all cardiac chambers and structures. The course and extent of disease must be documented.
- 1.5.3B Elements of study performance include, but are not limited to:
 - 1.5.3.1B proper patient positioning;
 - 1.5.3.2B transducer selection and placement;
 - 1.5.3.3B optimization of equipment gain and display settings;
 - 1.5.3.4B utilization of appropriate Doppler technique (including proper Doppler alignment) and measurements;
 - 1.5.3.5B representative image storage of all images and data;
 - 1.5.3.6B timely report generation and communication of results; and
 - 1.5.3.7B performance of a 2-D/M-Mode/Doppler examination according to the facility specific and appropriate protocol that incorporate all views and imaging planes mandated by Standards (1.6.1B, 1.6.2B).
- 1.5.4B Elements of study quality include, but are not limited to:
 - 1.5.4.1B definition of endocardium;
 - 1.5.4.2B display of standard (on axis) imaging planes (e.g., avoidance of foreshortening);
 - 1.5.4.3B delineation of the details of valvular anatomy;
 - 1.5.4.4B measurements of left heart chamber dimensions and volumes (indexed when appropriate) from standard imaging planes;
 - 1.5.4.5B optimal recording and evaluation of Doppler flows (which are aligned to the Doppler beam and parallel to flow);
 - 1.5.4.6B accurate spectral Doppler recording and recording of abnormal Doppler flow signals in multiple views; and
 - 1.5.4.7B adherence to the facility specific protocol including sequence with allowances for additional views.

STANDARD – Components of the Transthoracic Echocardiogram

- 1.6B Transthoracic echocardiograms must be comprehensive and include standard components.
 - 1.6.1B Components of the Examination – A protocol must be in place that defines the components of the standard examination. Indications for performance of a complete and/or limited exam must be included.
 - 1.6.1.1B Complete Examination: Includes standard views from multiple planes including views of all cardiac structures and selected extracardiac structures. These include, but are not limited to:
 - i. left ventricle;
 - ii. right ventricle;
 - iii. left atrium;

- iv. right atrium;
- v. aortic valve;
- vi. pulmonic valve;
- vii. mitral valve;
- viii. tricuspid valve;
- ix. proximal ascending aorta;
- x. aortic arch;
- xi. inferior vena cava; and
- xii. pericardium.

1.6.1.2B Complete Doppler Study: Includes spectral Doppler and/or color flow interrogation of all normal and abnormal flows within the heart including the valves, the great vessels and the atrial and ventricular septa.

1.6.1.3B Limited Examination: A limited study is generally only performed when the patient has undergone a complete recent examination and there is no clinical reason to suspect any changes outside the specific area of interest. A limited study generally examines a single area of the heart or answers a single clinical question.

(See Guidelines on Page 30 for further recommendations.)

1.6.2B The complete examination must include (except where technically unobtainable), but not be limited to:

(See Guidelines on Page 30 for further recommendations.)

1.6.2.1B The following standard 2-D views:

- i. parasternal long axis view;
- ii. right ventricular outflow tract view;
- iii. right ventricular inflow view;
- iv. parasternal short axis views (at the level of the aortic valve, left ventricle at the basal, mid and apical levels);
- v. apical four-chamber view;
- vi. focused view of the right ventricle;
- vii. apical five-chamber view;
- viii. apical two-chamber view;
- ix. apical long axis view (three-chamber);
- x. subcostal four-chamber view;
- xi. subcostal short axis view (when indicated);
- xii. subcostal IVC/hepatic vein view; and
- xiii. suprasternal notch view.

(See Guidelines on Page 30 for further recommendations.)

1.6.2.2B The following 2-D, 3-D or M-Mode measurements of the left heart:

- i. left ventricular internal dimension and/or volume at end-diastole
- ii. left ventricular internal dimension and/or volume at end-systole
- iii. left ventricular posterobasal free wall thickness at end-diastole;
- iv. ventricular septal thickness at end-diastole;
- v. left atrial dimension at end-systole or left atrial volume index; and

- vi. aorta at the level of the sinuses of Valsalva; measurements of sinotubular junction and mid-ascending, as clinically indicated;
 - vii. left ventricular ejection fraction.
- Comment: Quantitated ejection fraction by 3-D volumes or 2-D biplane method of discs is preferred over visual estimate.

(See Guidelines on Page 30 for further recommendations.)

1.6.2.3B The following standard Doppler flow evaluations:

- i. four cardiac valves – forward flow spectra for each valve, and any regurgitation, shown in at least two imaging planes with color Doppler;
- ii. also use of non-imaging Doppler Transducer to assess stenotic valves, valvular regurgitation or whenever indicated;
- iii. tricuspid regurgitation spectrum must always be sought with CW Doppler from multiple views for estimation of systolic right ventricular pressure when tricuspid regurgitation is present;
- iv. atrial and ventricular septa – color Doppler screening for defects;
- v. left ventricular outflow tract velocity;
- vi. velocity-time integrals of the left ventricular outflow tract and the aortic valve, when clinically indicated;
- vii. hepatic and pulmonary vein flow spectra, when clinically indicated;
- viii. For aortic stenosis, the systolic velocity must be evaluated from multiple transducer positions (e.g., apical, suprasternal and right parasternal). This must include interrogation from multiple views with a dedicated non-imaging continuous wave Doppler transducer (at least one clear envelope must be obtained); and
- ix. Diastolic Function Evaluation – LV diastolic function must be evaluated through a combination of PW and tissue Doppler techniques.

(See Guidelines on Page 30 for further recommendations.)

1.6.2.4B Use of Ultrasound Enhancing Agents (UEAs) for Suboptimal Image Quality –UEAs are indicated for use when two or more LV segments cannot be visualized adequately for the assessment of LV function (LVEF and regional wall motion assessment) and/or in settings in which the study indication requires accurate analysis of regional wall motion.^{14,15}

- i. If UEAs are used, there must be a written policy for the use of UEAs. Although hypersensitivity reactions are rare, laboratories that use UEAs must have policies in place for emergent resuscitation of patients who may experience serious side effects.
- ii. Cardiopulmonary resuscitation personnel and equipment must be readily available prior to ultrasound enhancing agent administration.
- iii. If a UEA is not able to be used, or if UEAs do not provide adequate visualization, a policy must be available for recommended alternative imaging.

Comment: Poor endocardial border definition is defined as the inability to detect two or more segments.

(See Guidelines on Page 30 for further recommendations.)

Section 1B: Adult Transthoracic Echocardiography Testing Guidelines

1.4.3B *Additional time should be allocated for technical staff to complete analysis and documentation for each study.*

A routine study on an inpatient should be performed on the same working day as ordered, unless otherwise specified. Outpatient studies should be assigned priority as defined by the referring physician and/or the indication of the study.

1.4.3.2B *The facility should have a policy defining STAT echocardiogram indications.*

1.6.1B *For all imaging protocols, if any required view or Doppler signal cannot be adequately obtained, it should be recorded and labeled in order to demonstrate that it was attempted.*

1.6.2B *Strain imaging should be considered when clinically indicated. If strain is performed it should be reported. 3D imaging should be performed when clinically indicated, and should be reported*

1.6.2.1B *Additional views that should be considered include:*

- *Parasternal short axis view of the aorta and branch pulmonary arteries*
- *Apical four-chamber view focused on atria*
- *Apical two-chamber view focused on the left atrium*

1.6.2.2B *Additional measurements that should be considered include:*

- *Linear measurement of the right ventricle, when clinically indicated*
- *Measurement and description of the response of the IVC to respiration, when clinically indicated*

1.6.2.3B *Velocity-time intergrals of hepatic and pulmonary vein flow spectra, when clinically indicated*

1.6.2.4B *UEAs should be used in the presence of poor endocardial border definition for quantification of chamber dimensions, volumes, ejection fraction and assessment of regional wall motion.*

UEAs should also be used to assess conditions such as hypertrophic cardiomyopathy or when left ventricular thrombus is suspected.

Allergy kits should be available and easily accessible in all areas where UEAs are in use and expiration dates should be checked on a regular basis in accordance with local institutional or lab policies.

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Section 2B: Adult Transesophageal Echocardiography Testing

STANDARD – Instrumentation

2.1B Cardiac Ultrasound Systems

- 2.1.1B Ultrasound instruments utilized for transesophageal echocardiographic studies (TEEs) must include the echocardiographic imaging system requirements, as outlined in the [Section 1B: Adult Transthoracic Echocardiography Testing, STANDARD – Instrumentation](#) and be maintained as outlined in the [Section 2.4A: Adult Transthoracic Echocardiography STANDARD – Instrument Maintenance](#).

2.2B Transesophageal Ultrasound Transducer

- 2.2.1B Transesophageal ultrasound transducers must be those manufactured for the ultrasound system of the facility.
- 2.2.2B Transesophageal ultrasound transducers must incorporate multiplane imaging capabilities.
- 2.2.3B A written policy must be established for cleaning/decontaminating the TEE transducer, ultrasound system, cables, etc., between patient use in accordance with local infection control policies/procedures.
- 2.2.4B The manufacturer’s guidelines must be followed for the appropriate care and cleansing of the TEE transducer and adhere to the appropriate infectious disease standards to prevent the transmission of disease. The structural and electrical integrity of the transducer must be checked between each use, using an ultrasound transducer leakage tester. “Passed” or “Failed” must be documented in the routine TEE probe cleaning / maintenance log along with action taken if “Failed.”

STANDARD – Procedure Volumes

- 2.3B The annual procedure volume must be sufficient to maintain proficiency in examination performance and interpretation.

STANDARD – Indications, Ordering Process and Scheduling

- 2.4B Transesophageal echocardiographic testing is performed for appropriate indications.¹

- 2.4.1B Verification of the Indication – A process must be in place in the facility for obtaining and recording the indication. Before a study is performed, the indication must be verified and any additional information, including pertinent clinical history, needed to direct the examination must be obtained.¹ If the indication for the examination and/or clinical history are not clear, the physician performing the TEE must verify the clinical history and an appropriate indication before proceeding with the examination.

- 2.5B Transesophageal echocardiographic studies are appropriately ordered and scheduled.

(See Guidelines on Page 36 for further recommendations.)

- 2.5.1B Ordering Process – The TEE order and/or requisition must clearly indicate the type of study to be performed, reason(s) for the study and the clinical question(s) to be answered. The order/requisition must be present in the medical record of the patient.

- 2.5.2B Definition of Procedure Types and Protocols

2.5.2.1B A TEE examination is one that examines all of the cardiac chambers, valves and great vessels from multiple imaging planes and then uses the information to completely define any recognized abnormalities. This study must include appropriate Doppler interrogation of all cardiac valves and structures (e.g., pulmonary veins and atrial appendage) and provide any hemodynamic data felt to be of importance for patient care. It is recognized that in some instances “limited” TEEs are performed (i.e., in the OR with time constraints or when a follow up examination is performed to evaluate specific pathology) that may limit or prevent a complete evaluation.

(See Guidelines on Page 36 for further recommendations.)

2.5.2.2B The TEE is a semi-invasive examination and usually is performed using conscious sedation. The facility must demonstrate that all medical and technical staff routinely adhere to the global conscious sedation policies in place for the medical facility as required by the Joint Commission or other appropriate accrediting organizations.

2.5.3B **Scheduling** – Sufficient time must be allotted for each study according to the procedure type. The performance time allotted for an uncomplicated, complete study (outside of the OR or interventional lab) is estimated to be 60 minutes, with an additional 15 to 30 minutes for complicated studies from patient encounter to departure. Sufficient time must be included in the scheduling process for adequate post-sedation monitoring.

2.5.3.1B An urgent or stat TEE study must be performed as soon as possible and may preempt other clinical facility activities.

2.5.3.2B Availability for emergencies: Qualified personnel and equipment must be available for urgent or stat studies outside normal working hours in inpatient facilities or where appropriate.

STANDARD – Training

2.6B Transesophageal echocardiography is a semi-invasive examination, which, if performed incorrectly, can lead to serious harm to patients and therefore, must be performed by appropriately trained physicians.

2.6.1B All performing physicians must be adequately trained and experienced to perform and interpret the study.²

2.6.2B All assisting sonographers and nurses must be adequately trained and validated as competent in procedures and policies for assisting in invasive procedures using conscious sedation.

STANDARD – Techniques

2.7B Examination performance must include proper technique.

2.7.1B Elements of study performance include, but are not limited to:

2.7.1.1B transducer insertion;

2.7.1.2B optimization of equipment gain and display settings;

2.7.1.3B utilization of appropriate Doppler technique and measurements;

2.7.1.4B optimization of image orientation to enhance Doppler display; and

2.7.1.5B performance of a 2-D/3-D/Doppler transesophageal examination according to the facility specific and appropriate protocol that incorporates all views and imaging planes mandated by Standard 2.8.6B (in any sequence).

- 2.7.2B Elements of study quality include, but are not limited to:
 - 2.7.2.1B demonstration of cardiac structure and function;
 - 2.7.2.2B evaluation of atrial and ventricular septal integrity;
 - 2.7.2.3B evaluation of left atrium and left atrial appendage;
 - 2.7.2.4B evaluation of ascending aorta, descending aorta and aortic arch;
 - 2.7.2.5B delineation of the details of valvular anatomy;
 - 2.7.2.6B optimal recording and evaluation of spectral and color flow Doppler;
 - 2.7.2.7B adherence to the facility specific and appropriate protocol (except for sequence); and
 - 2.7.2.8B imaging of at least one right and one left pulmonary vein, with Doppler when appropriate.

STANDARD – Components of Transesophageal Echocardiograms

- 2.8B Transesophageal echocardiograms must be comprehensive and include standard components.
 - 2.8.1B Technical Personnel – Due to the complexity of the TEE study, appropriate technical personnel must be available to assist the performing physician. These personnel may include a sonographer and a nurse. The duties of these individuals include, but are not limited to:
 - 2.8.1.1B preparing the patient for the test;
 - 2.8.1.2B assisting the physician with the ultrasound equipment;
 - 2.8.1.3B monitoring the patient during and after the examination; and
 - 2.8.1.4B administration of anesthetic medication and airway management.
 - 2.8.2B Preparation of the Patient – To perform TEE studies safely, appropriate safety guidelines must be in place. Patients must have a functioning intravenous access in place. Cardiac monitoring with standard telemetry leads must be utilized. Instrumentation to monitor the blood pressure and oxygen saturation of the patient before, during and after the examination must be available, as well as oxygen with appropriate delivery devices if needed.
 - 2.8.3B Procedural Sedation – The facility must recognize the potential need for patient sedation in order to obtain an adequate examination. This may be provided by the anesthesia service or by a licensed provider. If moderate sedation is utilized, there must be methods in place to assess the patient’s level of consciousness pre-procedure and throughout the procedure. All procedures must be explained to the patient and/or the parents or guardians of those unable to give informed consent. Consent must be obtained in a manner consistent with the rules and regulations required by the hospital or facility. Written policies must exist for the use of moderate sedation including, but not limited to:
 - 2.8.3.1B training requirements for personnel providing moderate sedation;
 - 2.8.3.2B monitoring of vital signs and level of consciousness during and after the examination; and
 - 2.8.3.3B type of sedatives and appropriate dosing.

2.8.4B Monitoring the Patient – During the procedure, the vital signs and physiologic status of the patient must be continuously evaluated and recorded per the institutional policy. The development of instability in either the vital signs or comfort of the patient must be addressed by the performing physician. Facility guidelines for the monitoring of patients who receive intravenous anesthetic agents are required. These written guidelines must be in place and available for all facilities where TEEs are performed. A list of peri-procedural complications must be maintained.

2.8.5B Recovery of the Patient – Prior to discharge from the TEE facility, the patient must be monitored for a sufficient amount of time to assure that no complications have arisen either from the procedure or the medication administered. The patient and/or the family must be instructed on any post-procedure care that the physician feels is necessary. Information must be given to outpatients that will allow them to recognize potential complications or side effects and contact the performing physician or physician on call after discharge. A method to track procedural complications must be maintained.

(See Guidelines on Page 36 for further recommendations.)

2.8.6B Components of the Examination – A protocol must be in place that defines the standard views and components of a comprehensive TEE examination. Indications for performance of a TEE examination must be included. A complete TEE and TEE-Doppler examination includes standard views from multiple planes including views of all cardiac structures and selected extracardiac structures.

(See Guidelines on Page 36 for further recommendations.)

2.8.7B The complete examination must include the following standard views while allowing for patient tolerance and safety:

2.8.7.1B gastric short axis and long axis views;

2.8.7.2B standard two- and four-chamber views;

2.8.7.3B short and long axis views of the aortic valve with appropriate Doppler;

2.8.7.4B multiple imaging planes of the mitral valve with appropriate Doppler;

2.8.7.5B multiple imaging planes of the tricuspid valve with appropriate Doppler;

2.8.7.6B longitudinal view of the pulmonic valve with appropriate Doppler;

2.8.7.7B multiple imaging planes of the right atrium, left atrium and left atrial appendage with appropriate Doppler;

2.8.7.8B Multiple imaging planes of the atrial septum and foramen ovale with appropriate Doppler. In cases of suspected cardiac source of emboli, when no obvious intracardiac shunt is identified with color Doppler, injection of agitated saline is required unless contraindicated.

2.8.7.9B imaging of the pulmonary veins with appropriate Doppler, when mitral regurgitation is present;

2.8.7.10B multiple imaging planes of the ascending, descending and transverse arch of the aorta;

2.8.7.11B long axis views of the main pulmonary artery and proximal portions of the right and left pulmonary arteries;

2.8.7.12B images of the proximal inferior and superior vena cava; and

2.8.7.13B imaging of the pericardial space and pericardium.

(See Guidelines on Page 36 for further recommendations.)

Section 2B: Adult Transesophageal Echocardiography Testing Guidelines

2.5B *The facility should have a policy defining STAT echocardiogram indications.*

2.5.2.1B *Definition of Procedure Types and Protocols*

In general, a TEE should be performed to answer clinical questions that cannot be answered by transthoracic imaging. However, the routine practice of a facility should be the performance of a comprehensive evaluation.

2.8.5B *Recovery of the Patient*

Provider performing the procedure or designee should consider follow up phone call or secure communication with the patient to ensure that there weren't any late developing complications or have any further questions related to the procedure.

2.8.6B *Components of TEE Examination*

The examination should be performed in a methodical fashion although the order of imaging plane acquisitions and Doppler may vary so as to answer the question at hand in an expeditious fashion. Although limited TEE examinations may have a role in specific clinical situations, a facility should generally perform comprehensive examinations routinely, due to the high yield of unexpected findings.

2.8.7B *A complete TEE should include injection of agitated saline to evaluate intracardiac shunting, unless contraindicated.*

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Section 3B: Adult Stress Echocardiography Testing

STANDARD – Instrumentation

3.1B Cardiac Ultrasound Systems

3.1.1B Ultrasound instruments utilized for stress echocardiographic studies must include, at a minimum, hardware and software to perform:

3.1.1.1B M-Mode imaging;

3.1.1.2B 2-D imaging (the system must include harmonic capabilities);

3.1.1.3B spectral display for pulsed (PW) and continuous wave (CW) Doppler studies and tissue Doppler imaging;

3.1.1.4B color flow Doppler;

3.1.1.5B monitor or other display method of suitable size and quality for observation and interpretation of all modalities;

Comment: The display or DICOM header must identify the parent institution, the name of the patient, second patient identifier (such as MRN or DOB), the date and time of the study. The ECG must also be displayed.

3.1.1.6B range or depth markers must be available on all displays;

3.1.1.7B capabilities to measure the distance between two points, an area on a 2-D image, blood flow velocities, time intervals, and peak and mean gradients from spectral Doppler studies;

3.1.1.8B at least two imaging transducers, one of low frequency (2-2.5 MHz) and one of high frequency (3.5 MHz or higher); or a multi-frequency transducer which includes a range of frequencies specific to the clinical needs in adult echo.

Comment: A transducer dedicated to the performance of non-imaging continuous wave Doppler must be available at each site.

3.1.1.9B an audible output must be present at the time of acquisition;

3.1.1.10B Instrument settings to enable optimization of ultrasound enhancing agents.

3.2B Stress Echocardiography Acquisition Systems

3.2.1B Acquisition of the stress echocardiographic images must be available and utilized for the performance and interpretation of stress echocardiography.

3.2.1.1B The system must allow for accurate “triggered” acquisition of images and side-by-side image display. An image acquisition timer must be displayed.

3.2.1.2B The acquisition system must have adequate memory to allow performance of multi-stage stress echocardiogram studies.

- 3.2.1.3B The capability of side-by-side comparison of images from baseline and different stages of stress. Side-by-side review may be accomplished within the ultrasound stress package or on a dedicated offline workstation.

(See Guidelines on Page 43 for further recommendations.)

STANDARD – Procedure Volumes

- 3.3B The annual procedure volume must be sufficient to maintain proficiency in examination performance and interpretation.

STANDARD – Indications, Ordering Process and Scheduling

- 3.4B Stress echocardiography is performed for appropriate indications.¹
- 3.4.1B Verification of the Indication – A process must be in place for obtaining and recording the indication. Before a study is performed, the indication must be verified and any additional information needed to direct the examination must be obtained.
- 3.5B Stress echocardiographic studies are appropriately ordered and scheduled.
- 3.5.1B Ordering Process – The stress echocardiogram order and/or requisition must indicate the type of study to be performed, the reason(s) for the study and the clinical question(s) to be answered. The signed order/requisition must be retained in the medical record of the patient.
- 3.5.1.1B Immediately prior to performing the test, the facility staff must assess the patient for the ability to exercise safely or undergo a pharmacologic stress test. Staff must confirm that the type of stress (exercise or pharmacologic) requested is most appropriate. If indicated, the type of stress may be changed with input from the supervising physician. The ordering provider must subsequently be notified if the test is cancelled or if an alternative stress modality (e.g., nuclear perfusion imaging) is more appropriate.
- 3.5.2B Definition of Procedure Types
- 3.5.2.1B Two-phase stress echocardiography examines and compares left ventricular wall segments before stress and after stress and is usually accomplished using treadmill exercise.
- 3.5.2.2B Three-phase stress echocardiography examines and compares left ventricular wall segments before, during, and after stress, and is usually accomplished using treadmill exercise or bicycle exercise ergometry.
- 3.5.2.3B Four-phase stress echocardiography examines and compares left ventricular wall segments before, during and/or after stress, and is usually accomplished using pharmacological stress agents or supine bicycle ergometry.
- 3.5.2.4B Doppler stress echocardiography (in addition to left ventricular and/or right ventricular imaging) may be employed to assess valvular heart disease, hypertrophic cardiomyopathy, diastolic function or pulmonary hypertension and may be performed with treadmill, bicycle or pharmacological stress.
- 3.5.2.5B Ultrasound enhancing agents may be used in conjunction with treadmill, bicycle or pharmacological stress to optimize endocardial border definition or enhance Doppler signals.
- 3.5.3B Scheduling – Sufficient time is allotted for each study according to the procedure type. The

performance time allotted for a stress echocardiogram is 45 to 60 minutes from patient encounter to departure. An additional 15 to 30 minutes per study may be needed for the performance of a pharmacologic stress echocardiogram since these procedures require that intravenous access be obtained. Additional time will also be required when adding Doppler to any standard stress echocardiogram.

STANDARD – Training

- 3.6B Stress echocardiography is a diagnostic test which, if performed and/or interpreted incorrectly, can lead to serious consequences for the patient.
- 3.6.1B Accurate performance of stress echocardiography requires that the performing sonographer and interpreting physician are adequately trained and experienced to perform and interpret stress echocardiograms and must meet current training recommendations.
- 3.6.2B All personnel directly supervising stress procedures must have appropriate training/experience. While physician presence during stress testing is not required, the facility must assure that appropriate staff is present based upon the types of procedures being performed and the patients' risks of adverse events.
- 3.6.3B If a non-physician (e.g., properly trained nurse, physician assistant, nurse practitioner, exercise physiologist) practicing under the physician's license is supervising the stress test, the Medical Director or physician director of the stress facility must provide written attestation of appropriate training and competence as outlined in the American College of Cardiology/American Heart Association Clinical Competence Statement on Stress Testing.
- Comment: For specific training and competence requirements, see [Bibliography](#).
- 3.6.4B At a minimum, at least two qualified people are required to be in attendance during stress testing.
- 3.6.5B Basic Life Support – All personnel, including physicians, directly supervising stress procedures must have appropriate training/experience and must be certified in basic life support (BLS) and/or Advanced Cardiac Life Support (ACLS).
- 3.6.6B Advanced Cardiac Life Support – There must be ACLS certified personnel on-site and immediately available during cardiac stress procedures.

(See Guidelines on Page 43 for further recommendations.)

STANDARD – Techniques

- 3.7B Examination performance must include proper technique.
- 3.7.1B Elements of study performance include, but are not limited to:
- 3.7.1.1B proper patient positioning during image acquisition (beds with imaging drop sections are strongly recommended);
- 3.7.1.2B appropriate transducer selection and placement;
- 3.7.1.3B achievement of optimal heart rate;
- 3.7.1.4B optimization of the ultrasound equipment gain and display settings;
- 3.7.1.5B Use of Ultrasound Enhancing Agents (UEAs) for Suboptimal Image Quality – UEAs should be used when two or more LV segments or any coronary territory cannot be adequately visualized for the assessment of LV function or regional wall motion.^{10,11}

- i. If UEAs are used, there must be a written policy for the use of UEAs. Although hypersensitivity reactions are rare, laboratories that use UEAs must have policies in place for emergent resuscitation of patients who may experience serious side effects.
- ii. Cardiopulmonary resuscitation personnel and equipment must be readily available prior to ultrasound enhancing agent administration.
- iii. If a UEA is not able to be used, or if UEAs do not provide adequate visualization, a policy must be available for recommending alternative imaging.

(See Guidelines on Page 43 for further recommendations.)

- 3.7.1.6B depth settings and view orientation must be the same at all stages for the purpose of side by side comparisons;
- 3.7.1.7B for treadmill stress, post stress images must be obtained within 60-90 seconds of peak stress. Timer must be started at the time peak exercise is terminated (if images are obtained beyond 90 seconds it must be noted in the report).
- 3.7.1.8B for pharmacologic echo, images must be obtained within the last 60 seconds of each stage;
- 3.7.1.9B optimization of digitized images for side by side comparison;
- 3.7.1.10B appropriate ECG preparation and lead placement to ensure accurate interpretation and digital triggering purposes;
- 3.7.1.11B utilization of appropriate Doppler technique (including proper alignment) and measurements; and
- 3.7.1.12B performance of a stress echocardiogram according to the facility specific and appropriate protocol that incorporates all views and imaging planes mandated by Standard 3.9B.
- 3.7.2B Elements of study quality include, but are not limited to:
 - 3.7.2.1B definition of endocardium;
 - 3.7.2.2B display of standard, on axis, imaging planes (e.g., avoidance of foreshortening);
 - 3.7.2.3B measurements of left ventricular dimensions (when performed) obtained from standard orthogonal imaging planes;
 - 3.7.2.4B accurate digital triggering (from ECG R wave);
 - 3.7.2.5B appropriate side by side image display;
 - 3.7.2.6B adherence to the facility specific and appropriate protocol; and
 - 3.7.2.7B avoidance of artifacts when using ultrasound enhancing agents.

STANDARD – Stress Echocardiography Facility Arrangement

- 3.8B Stress echocardiograms must be performed in a facility designed to assure patient safety.
 - 3.8.1B Elements of the stress echocardiography facility arrangement include, but are not limited to ([Section 2A: Facility, 2.1A, 2.12A](#) and [Section 4A: Facility Safety, 4.1A and 4.1.1A](#)):

- 3.8.1.1B Proper placement of emergency equipment (crash cart and oxygen) such that they are easily accessible.

STANDARD – Stress Echocardiogram Components

3.9B Stress echocardiograms must be comprehensive and include standard components.

- 3.9.1B Components of the Examination – Separate protocols must be in place that define the components of each type of stress echocardiogram-performed in the facility (i.e., diastolic function, hypertrophic cardiomyopathy, valve and pulmonary hypertension assessment). Prioritization of image acquisition sequence (left ventricular assessment vs. Doppler assessment) should be made based on the primary indication for the test. Indications for the performance of a pharmacologic stress echocardiogram and/or a standard exercise stress echocardiogram must be included.

Comment: Alternate views may be obtained if contrast is used.

- 3.9.1.1B Treadmill Stress Echo: Images must be obtained at baseline and immediately post exercise. All LV segments need to be visualized and compared side by side (baseline vs. peak exercise). The standard views are parasternal long axis view, parasternal short axis view, apical four-chamber view and apical two-chamber view, or apical long axis, apical four-chamber view, apical two-chamber view and apical short-axis view. Alternative windows may be substituted if standard views are not adequate.
- 3.9.1.2B Bicycle Stress Echo Protocols: At a minimum, images must be obtained at baseline and immediately post exercise. All LV segments need to be visualized and compared side by side. The standard views are parasternal long axis view, parasternal short axis view, apical four-chamber view and apical two-chamber view or apical long axis, apical four-chamber view, apical two-chamber view and apical short-axis view. Alternative windows may be substituted if standard views are not adequate.
- 3.9.1.3B Pharmacologic Stress Echo: Images must be obtained at baseline and three other phases. Common protocols include digitizing rest, low-dose, pre-peak and peak, or rest, low-dose, peak and recovery. All LV segments need to be visualized and compared side by side. The standard views are parasternal long axis view, parasternal short axis view, apical four-chamber view and apical two-chamber view, or apical long axis, apical four-chamber view, apical two-chamber view and apical short-axis view. Alternative windows may be substituted if standard views are not adequate.
- 3.9.1.4B A Doppler stress echocardiogram includes interrogations of flow velocities (from the same site) before, during and/or immediately following stress. Doppler stress echocardiography may be utilized to document gradient changes that occur with stress, or to evaluate diastolic filling pattern changes that occur with stress.
- 3.9.2B Patient Preparation – To adequately perform stress echocardiogram studies, appropriate safety guidelines must be in place.
 - 3.9.2.1B All stress echocardiogram procedures must be explained to the patient and/or the guardian of those unable to give informed consent. Consent must be obtained in a manner consistent with the rules and regulations outlined by the hospital or facility.
 - 3.9.2.2B Patients undergoing pharmacologic or ultrasound enhancing agent stress echocardiography must have a functioning intravenous access in place.
 - 3.9.2.3B A fully-equipped cardiac arrest cart (crash cart) as outlined in [Section 4A: Facility Safety, 4.1.2A](#) of the Standards with additional medications utilized for reversing the effect of the pharmacologic stress agent(s) must be available at all times.

3.9.3B Patient Monitoring

- 3.9.3.1B During the image acquisition phase and during the recovery phase of the examination, the vital signs of the patient must be periodically evaluated in accordance with the stress testing protocol.
- 3.9.3.2B Cardiac monitoring with standard stress testing leads must be utilized.
- 3.9.3.3B A method to track procedural complications must be maintained.

(See Guidelines below for further recommendations.)

Section 3B: Adult Stress Echocardiography Testing Guidelines

- 3.2B *An alternative protocol should be in place when triggered acquisition/timing malfunctions.*
- 3.6B *Stress Training - It is recommended that sonographers who perform stress echocardiography should have independently performed 1,000 complete transthoracic echocardiograms with a minimum of one-year experience (preferably two years) in the field of echocardiography. Sonographers should perform at least 100 stress echocardiograms annually for maintenance of competency.*

Physicians interpreting stress echocardiograms should follow COCATS level II training requirements. Level III training is recommended for interpretation of advanced stress echo (i.e., stress in valvular heart disease, hypertrophic cardiomyopathy, pulmonary hypertension, etc.).
- 3.7.1.5B *Allergy kits should be available and easily accessible in all areas where UEAs are in use and expiration dates should be checked on a regular basis in accordance with local institutional or lab policies.*
- 3.9B *Stress Echocardiogram Components - Consideration should be given to moving to a five-view protocol (rather than a four-view protocol) for stress and pharmacologic stress echo studies to include the parasternal long axis view, parasternal short axis view, apical four-chamber view, apical two-chamber view and apical long axis view.*

Labs should also consider adopting a three-stage protocol (for exercise stress studies) or four stage protocol (for pharmacologic stress studies) to incorporate a recovery stage. This would include baseline, impost and recovery imaging on exercise echo studies and baseline, low dose, peak dose and recovery for dobutamine stress tests.

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Section 4B: Adult Congenital Transthoracic Echocardiography Testing

STANDARD – Instrumentation, Indications, Ordering Process and Scheduling.

4.1B Adult congenital echocardiography facilities must adhere to the Standards listed in Section 1B: Adult Transthoracic Echocardiography Testing regarding the instrumentation, indications, ordering process and scheduling.

STANDARD – Techniques

4.2B Examination performance must include proper technique. All procedures must be explained to the patient.

4.2.1B Elements of study performance and quality include, but are not limited to:

4.2.1.1B optimizing patient position with careful attention to comfort and safety;

4.2.1.2B correct transducer selection for patient size;

4.2.1.3B optimization of equipment settings and display of ECG;

4.2.1.4B if UEAs are utilized in the adult congenital population, there must be a protocol in place;

4.2.1.5B performance of a complete 2-D/M-Mode/Doppler imaging and hemodynamic examination according to the facility specific protocols that incorporate all views and imaging planes mandated by Standards outlined in the Components section below; and

4.2.1.6B consistency in image display.

STANDARD – Components of the Adult Congenital Transthoracic Echocardiogram

4.3B Adult congenital transthoracic echocardiograms must be comprehensive and include standard components.

4.3.1B Components of the Examination – A protocol must be in place that defines the components of the standard examination.

4.3.1.1B The complete examination, when applicable or available, must include the following standard views when cardiac anatomy allows:

- i. inferior and superior vena cava;
- ii. hepatic veins;
- iii. pulmonary veins;
- iv. right, left or single atrial morphology;
- v. atrial septum;
- vi. mitral, tricuspid or single atrioventricular valve morphology and function;
- vii. right, left or single ventricular morphology;
- viii. ventricular septum;
- ix. semilunar valve morphology and function;
- x. coronary arteries when visible;
- xi. ascending, transverse and descending aorta, and arch sidedness when visible;

- xii. main pulmonary artery and proximal branch pulmonary arteries;
- xiii. pericardium; and
- xiv. measurements of the cardiac chambers and ventricular function where standard measurements are available.

4.3.1.2B The complete Doppler study: Includes spectral Doppler and/or color flow interrogation of all normal and abnormal flows within the heart including:

- i. atrioventricular valves;
- ii. semilunar valves;
- iii. atrial septum;
- iv. ventricular septum; and
- v. great vessels.

4.3.1.3B Standard views for the complete examination of the adult congenital heart (where anatomically appropriate and technically obtainable) must include, but are not limited to the following standard 2-D views:

- i. parasternal long axis view (including evaluation of the right ventricular inflow and right ventricular outflow);
- ii. parasternal short axis views (including evaluation at the level of the aortic and pulmonary valves, mitral, mid-papillary muscle level and apex);
- iii. apical four-chamber view;
- iv. focused view of the right ventricle;
- v. apical two-chamber view;
- vi. apical five-chamber view;
- vii. apical long axis view;
- viii. subcostal long axis view;
- ix. subcostal short axis view including evaluation of the SVC, IVC, hepatic veins and descending aorta;
- x. suprasternal long axis view;
- xi. suprasternal short axis view; and
- xii. right parasternal view (when clinically indicated).

Comment: Complex anatomy and repair often require use of non-standard views.

4.3.1.4B The following 2-D, 3D or M-Mode measurements of the left heart (where appropriate):

- i. left ventricular internal dimension or volume at end-diastole;
- ii. left ventricular internal dimension or volume at end-systole;
- iii. left ventricular posterobasal free wall thickness and ventricular septal thickness at end-diastole or left ventricular mass;
- iv. aorta at the level of the sinuses of Valsalva; measurements of sinotubular junction and mid-ascending, as clinically indicated;
- v. left ventricular ejection fraction; and
- vi. left atrial dimension or left atrial volume index at end-systole (when clinically indicated).

Comment: Quantitated ejection fraction by 3-D volumes or 2-D biplane method of discs is preferred over visual estimate.

4.3.1.5B The following standard Doppler evaluations:

- i. spectral Doppler interrogation and/or color mapping in at least two imaging planes for all four valves (when available);
- ii. tricuspid regurgitation velocity when available to estimate the systolic right ventricular pressure in patients with anatomically normal hearts;
- iii. color mapping of the atrial and ventricular septa to exclude defects;
- iv. spectral Doppler interrogation and color mapping for the ventricular outflow tracts, pulmonary arteries, and aortic arch;
- v. spectral Doppler interrogation of the abdominal aorta;
- vi. spectral Doppler interrogation and color mapping of the systemic and pulmonary veins may be helpful in some cases; and
- vii. use of a dedicated non-imaging CW Doppler transducer to assess stenotic valves or valvular regurgitation may be helpful in some cases.

Comment: These must be customized based on congenital malformations and/or previous palliations or repairs. Labs are encouraged to develop lesion specific protocols.

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Part C:

Quality Improvement

Section 1C: Quality Improvement Program

STANDARD – QI Program

1.1C The facility must have a written Quality Improvement (QI) program for all imaging procedures. The QI program must include the QI measures outlined below but may not be limited to the evaluation and review of:

1.1.1C test appropriateness;

1.1.2C technical quality and, if applicable, safety of the imaging;

1.1.3C interpretive quality review;

1.1.4C report completeness and timeliness.

STANDARD – QI Oversight

1.2C The Medical Director, staff and/or an appointed QI Committee must provide oversight to the QI program including but not limited to review of the reports of QI evaluations and any corrective actions taken to address any deficiencies.

Section 1C: Quality Improvement Program *Guidelines*

The IAC Quality Improvement (QI) Self-Assessment Tool may be utilized that includes all Quality Improvement measures. Learn more at www.intersocietal.org/QITool.

Section 2C: Quality Improvement Measures

STANDARD – QI Measures

2.1C Facilities must have a process in place to evaluate the QI measures outlined in sections 2.1.1C through 2.1.5C. A minimum of two cases per modality (TTE, TEE, SE, **ACTE**) per quarter must be evaluated and the same cases may be used for all the measures.

2.1.1C Test Appropriateness

2.1.1.1C A minimum of two cases per modality (TTE, TEE, SE, **ACTE**) per quarter must be evaluated for the appropriateness of the test performed and categorized as:

- i. appropriate/usually appropriate;
- ii. may be appropriate; or
- iii. rarely appropriate/usually not appropriate.

2.1.2C Technical Quality Review (Sonographer Performance Variability)

2.1.2.1C The facility must evaluate the technical quality of the images and, if applicable, the safety of the procedure. The review must include but is not limited to the evaluation of:

- i. the clinical images for clarity of images and/or evaluation for suboptimal images or artifact;
- ii. completeness of the study; and
- iii. adherence to the facility imaging acquisition protocols.

2.1.2.2C Two cases per modality (TTE, TEE, SE, **ACTE**) per quarter must be reviewed for image quality, completeness of the study and adherence to the facility protocol to be reviewed in QI meetings. The cases must represent as many sonographers as possible. Discrepancies in acquisition quality and variability must be reconciled to achieve uniform examination quality.

2.1.3C Interpretive Quality Review (Physician Interpretation Variability)

2.1.3.1C The facility must evaluate the quality and accuracy of the interpretation based on the acquired images.

- i. A minimum of two cases per modality (TTE, TEE, SE, **ACTE**) per quarter must be evaluated for the quality and accuracy of the interpretation based on the acquired images. The cases must represent as many physicians as possible. Differences in interpretation must be reconciled to achieve uniform examination interpretation.

2.1.4C Final Report Completeness and Timeliness

2.1.4.1C The facility must evaluate the final report for completeness and timeliness as required in the Standards.

- i. A minimum of two cases per modality (TTE, TEE, SE, **ACTE**) per quarter must be evaluated for completeness and timeliness of the final report as required in the Standards (refer to Standards [3.2A](#), [3.2.4A](#) for report completeness and Standards [3.3A through 3.6A](#) for report timeliness). The reports must represent as many physicians as possible.

(See Guidelines on Page 51 for further recommendations.)

Section 2C: Quality Improvement Measures

Guidelines

2.1C Correlation and Confirmation of Results

Transthoracic, Transesophageal, and Stress Echocardiograms should be routinely compared with other imaging or diagnostic modalities (another echocardiographic modality, cardiac CT or MRI, cardiac catheterization, nuclear perfusion studies, etc.) or surgical findings. Correlation data for each physician responsible for the interpretation of transthoracic echocardiograms in the facility should be accumulated by the facility and distributed to the interpreting physician. A process for addressing discrepancies between echocardiogram examination results and results of other procedures should be in place.

Appropriate areas for correlation of transthoracic echocardiograms may include, but are not limited to:

- *left ventricular function, regional wall motion abnormalities and ejection fraction;*
- *aortic stenosis;*
- *aortic regurgitation;*
- *mitral valve regurgitation;*
- *mitral stenosis; and*
- *pulmonary artery pressure.*

Appropriate areas for correlation of transesophageal echocardiograms may include, but are not limited to:

- *left ventricular function and regional wall motion analysis;*
- *mechanism and severity of valvular dysfunction;*
- *presence or absence of thrombi or vegetations; and*
- *presence or absence of aortic dissection, atheromas, hematomas or ruptures.*

Appropriate areas for correlation of stress echocardiograms may include, but are not limited to:

- *left ventricular function, regional wall motion abnormalities and ejection fraction;*
- *myocardial viability*
- *myocardial perfusion*
- *valvular disease; and*
- *pulmonary artery pressure.*

Section 3C: Quality Improvement Meetings

STANDARD – QI Meetings

3.1C Quality Improvement (QI) Meetings

- 3.1.1C The facility must have a minimum of two QI meetings per year, one of which is to review the results of the QI analyses and any additional QI-related topics.
- 3.1.2C All staff must participate in at least one meeting per year.

Section 4C: Quality Improvement Documentation

STANDARD – QI Documentation

4.1C QI Documentation and Record Retention

4.1.1C The facility QI documentation must include but is not limited to:

4.1.1.1C the data for all of the QI meetings;

4.1.1.2C minutes from the QI meetings; and

4.1.1.3C participant list (may include remote participation and/or review of minutes).

4.1.2C The QI documentation must be maintained and available for all appropriate personnel to review.

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Appendix A

Stress test supervision by non-physician training and competency requirements:

- 1.5.1A If a non-physician (e.g., properly trained nurse, physician assistant, nurse practitioner, exercise physiologist) practicing under the physician's license is supervising the stress test, the facility or Medical Director must document appropriate training and competence as outlined in the American College of Cardiology/American Heart Association Clinical Competence Statement on Stress Testing. (See Bibliography)

Supervision of Exercise Stress Testing:

- a. knowledge of appropriate indications for exercise testing;
- b. knowledge of alternative physiological cardiovascular tests;
- c. knowledge of appropriate contraindications, risks and risk assessment of testing (not limited to Bayes' theorem and sensitivity/specificity, including concepts of absolute and relative risk);
- d. knowledge to promptly recognize and treat complications of exercise testing;
- e. competence in cardiopulmonary resuscitation and successful completion of an AHA-sponsored course in advanced cardiovascular life support and renewal on a regular basis;
- f. knowledge of various exercise protocols and indications for each;
- g. knowledge of basic cardiovascular and exercise physiology, including hemodynamic response to exercise;
- h. knowledge of cardiac arrhythmias and the ability to recognize and treat serious arrhythmias;
- i. knowledge of cardiovascular drugs and how they can affect exercise performance, hemodynamics and the ECG;
- j. knowledge of the effects of age and disease on hemodynamic and ECG responses to exercise;
- k. knowledge of principles and details of exercise testing, including proper lead placement and skin preparation;
- l. knowledge of end points of exercise testing and indications to terminate exercise testing.

Supervision of Pharmacologic Stress Agents:

- a. knowledge of appropriate indications;
- b. knowledge of appropriate contraindications;
- c. knowledge of advantages and disadvantages of different exercise and pharmacological stress for echocardiography;
- d. knowledge of complications and ability to recognize and appropriately treat complications, including use of adenosine/dobutamine antagonists such as theophylline and aminophylline;
- e. competence in cardiopulmonary resuscitation and successful completion of an AHA-sponsored course in advanced cardiovascular life support and renewal on a regular basis;
- f. knowledge of various vasodilator, adrenergic stress protocols;
- g. knowledge of the pharmacokinetics of vasodilator and adrenergic drugs;
- h. knowledge of basic cardiovascular physiology, including heart rate and blood pressure response to vasodilators and adrenergic-stimulating agents;
- i. knowledge of electrocardiography and changes that may occur in response to vasodilators or adrenergic-stimulating agents;
- j. knowledge of cardiac arrhythmias and their treatment, including high-grade ventricular arrhythmia and heart block;
- k. knowledge of cardiovascular drugs (and other agents, e.g., caffeine) and their effects on vasodilator and adrenergic drugs.