Guidelines for the Provision of Echocardiography in Canada

Recommendations of a Joint
Canadian Cardiovascular Society and
Canadian Society of Echocardiography
Consensus Panel
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Preamble
Echocardiographic examinations have become integral to the assessment of virtually all patients presenting with cardiac disease. They provide reliable and comprehensive assessment of heart function in a timely, economical and non-toxic manner. This has led to widespread and expanding use of this technology which has advanced the care of cardiac patients, but also imposes increasing financial and personnel demands on an already stressed health care system. The Canadian public's need for accurate and appropriately applied echocardiographic services must be safeguarded. It is incumbent on those familiar with the techniques and utility of these services to guide their application. Recognizing this responsibility, the Canadian Cardiovascular Society and Canadian Society of Echocardiography have jointly undertaken this review.

The Current Environment
Health care in Canada is a predominantly provincial jurisdiction. Because they do not cause direct toxic effects, ultrasound based diagnostic services have not always fallen under the same regulatory rigour as have, for example, radiation and nuclear based technologies. This has resulted in a marked disparity across the country with respect to how echocardiographic services are provided and regulated. Current practices are summarized in Appendix 1. In some provinces, such as British Columbia and Alberta, echocardiography is provided only within limited, usually hospital based settings, and only specifically designated physicians receive financial compensation for interpretation of echocardiographic examinations. In contrast other provinces, such as Ontario, have no limitation as to where or by which physicians echocardiography can be provided. Currently no nationally accepted standards exist.

Purpose of this Document and Guiding Principles
This document is intended to provide an objective reference for current standards of practice in echocardiography in Canada. It is hoped it will be of interest to a number of parties and agencies involved in echocardiography, including the general public, physicians, sonographers, hospital administrations and governmental agencies. The guiding principle used to develop and test the recommendations contained in this document has been to ensure the utility, reliability and safety of echocardiographic examinations.

Recognizing the diversity of individuals involved in echocardiography and the potentially far-reaching impact of this document, it was felt important to involve as many perspectives and regional viewpoints as possible. Accordingly, membership of the panels was structured to involve all regions of Canada, as well as individuals drawn from all groups involved in the practice of echocardiography, including academic as well as non-academically based physicians, non-cardiologists involved in echocardiography and sonographers.

The intent in developing this document was not to produce a comprehensive review of the available literature. Such excellent reviews exist and will be cited. Rather, the intent was to produce a comprehensive, practical, "single source" guide to the use of echocardiography. Recommendations will reflect a synthesis of currently available trial evidence, practice guidelines, and the consensus view of panel members guided by the principles noted above.

Echocardiography requires a number of components, each of which is critical to producing an optimal outcome. The organizing committee felt it therefore important that this document address all aspects of the provision of services including:

1. The Echocardiographic examination
2. The Echocardiographic facility (commonly referred to as the Laboratory)
3. The Echocardiographic report
4. The physician
5. The sonographer
6. Indications for echocardiographic examinations

Scope of this Document
This document is limited to adult echocardiography, including both transthoracic and transesophageal applications. Pediatric and intraoperative echocardiography are excluded from this document, because it was felt their importance and complexity merit complete and separate reviews. With respect to stress echocardiography, laboratory and training recommendations overlap with those for adult echocardiography and are therefore included. Comprehensive recommendations regarding stress echocardiography require separate review.

SECTION 1. THE ECHOCARDIOGRAPHIC EXAMINATION

Echocardiography refers to the application of ultrasound technology to the assessment of cardiac structure and function. Both the technology and understanding have increased steadily since its inception fifty years ago. The modern transthoracic examination now involves an integrated combination of numerous images, Doppler tracings and measurements. The transesophageal examination differs in being directed at acquisition of high quality images that complement the transthoracic examination and provide incremental diagnostic information in specific clinical settings. In this section the constituent components of comprehensive transthoracic and transesophageal examinations will be described.

1.1 General Principles

1. Although the sequence in which information is acquired may vary according to local practices and preferences, there is a minimum set of information that is required of the complete echocardiographic examination. This arises from the fact that the component images, Doppler tracings and measurements are interdependent and all are required to develop a comprehensive assessment.

2. It is recognized that in some instances clinical circumstances may not allow for acquisition of full data, either because of clinical urgency or technical limitations. Even with such limited examinations, useful information may be obtained that could contribute to management of the patient. Such useful information should not be discarded. In such instances, a partial or limited study should be carried out and findings reported as such. In such reports, the limitations of the study should be clarified.

3. In most Canadian centers, the examination is carried out and recorded by a specifically trained individual (the Sonographer). However, physician training in echocardiography (see Section 3) includes the performance of examinations. Qualified physicians therefore can and should carry out examinations. However, the components of a full study do not vary according to the status of the individual carrying out the examination.

4. Physician responsibilities in the echocardiographic examination include all of the following:
    a. interpretation of all acquired images and measurements
    b. generation of a report of those findings
    c. transmission of critical findings to attending physicians
    d. assistance and supervision with the acquisition of information as required.

    It is recognized that in order to carry out these roles, physicians engaged in echocardiography require specific training (see Section 5) and must be physically available during the performance of the examination, such that they can be called upon to advise and, as necessary, participate in the acquisition of imaging and Doppler information.

5. The constituent images, Doppler recordings and measurements must all be recorded on appropriate dynamic medium, either videotape or digitally. The full patient record includes the recorded study as well as the interpreted report (which will be discussed in Section 2).

6. It is emphasized that the components described constitute the minimum examination. Specific pathologies that are identified in the course of an examination require additional imaging and/or measurements to achieve optimal definition. These are well described in standard texts and their complete description is beyond the scope of this document. It is necessary that the sonographers recognize these pathologies and provide the appropriate information. However, it is the ultimate responsibility of the interpreting physician to ensure that all relevant information is provided before the final report is issued.

7. Technological advances have provided smaller, easily portable, and even hand-held imaging systems. Such systems represent a significant advance, potentially providing opportunities to carry out echocardiographic examinations more widely and easily, thus expanding the benefits of the technology. However, it is important to ensure that as such advances occur, the quality of echocardiographic examinations is not compromised. It is important to note, therefore, that the principles noted above and throughout this document do not vary with different imaging systems.

1.2 The Transthoracic Examination

The complete echocardiographic examination involves an integration of multiple and disparate types of data. Chamber measurements, images, and hemodynamic assessment (the latter largely derived using Doppler based techniques), are obtained in a continuous and integrated fashion. The sequence of data acquisition, which is intended to maximize efficiency and patient convenience, varies between laboratories according to individual preferences, and also from examination to examination, depending on the particular patient situation, indications and pathology that is uncovered. This flexibility and adaptability to varying requirements is, in fact, a major strength of the technology. Although, it is therefore somewhat artificial to separate the examination into its constituent components, this is done in order to ensure completeness.

1.2.1
The imaging components include the following:

1. Parasternal long axis (PLA) of left ventricle (LV), left atrium (LA) and aorta (AO),
2. Parasternal short axis (PSA) consisting of 3 short axis cuts of LV, pulmonary artery view and aortic valve view

3. Right ventricle (RV) inflow view
4. Apical 4 chamber view
5. Apical 2 chamber view
6. Apical 3 chamber view (long axis view)
7. Apical 5 chamber view
8. Apical imaging of left ventricular apex
9. Subcostal long axis view
10. Subcostal short axis view
11. Subcostal IVC view
12. Suprasternal views of aorta

1.2.2
The Doppler components include the following:

1. PLA 2-D with colour screening for aortic insufficiency (AI) and mitral regurgitation (MR)
2. PSA 2-D with pulmonary artery colour and pulsed wave (PW) Doppler
3. RV inflow view 2-D with colour for tricuspid regurgitation (TR)
4. Apical 4 chamber view 2-D with colour for MR and TR; pulsed and continuous wave if indicated
5. Apical 5 chamber view with colour and aortic flow velocity
6. Apical 3 chamber (long axis) view 2-D with colour and aortic flow velocity
7. Apical 2 chamber with colour flow Doppler of mitral valve (MV)
8. Subcostal view with colour Doppler of interatrial septum
9. Suprasternal view with colour and PW/CW Doppler of aorta

1.2.3
The following standard measurements should be obtained and recorded for all studies:
Because of its established standards and reproducibility, M-Mode based measurements should be utilized whenever possible. Measurements obtained from still frame two dimensional images are to be reserved for circumstances where M-modes cannot be reliably recorded because of technical limitations.

1. Left ventricular (LV) systolic and diastolic dimensions
2. LV wall thickness (septum and posterior wall)
3. Ejection fraction – This should be quantitated whenever practical by any of the numerous well validated methods that have been described.
4. Transvalvular aortic flow velocity
5. Pulmonary valve velocity
6. Diastolic parameters – Diastolic function should be assessed according to the accepted categories of Normal, Mild Dysfunction (Impaired Relaxation), Moderate Dysfunction (Pseudonormalization) and Severe Dysfunction (Restriction). This assessment is based on consideration of the numerous parameters available from the echocardiographic examination (mitral inflow velocities, mitral deceleration time, isovolumic relaxation time, pulmonary venous systolic and diastolic velocities, Tissue Doppler assessment of mitral annular motion).
7. Tricuspid regurgitation velocity in order to calculate right ventricular systolic pressure.
8. Measurements of the aortic root and ascending aorta, to include the annulus, Sinuses of Valsalva and proximal ascending aorta.
9. Left atrial dimensions.

1.2.4
The following additional information should be obtained in selective studies where clinical indications or findings warrant:

1. Transvalvular mean and maximal gradients with CW Doppler for stenotic valves and valvular prostheses, including views from multiple planes such as suprasternal and right sternal border.
2. PISA (proximal isovelocity surface area) calculation or other quantitative methods (e.g. for Mitral regurgitation)
3. Respiratory variation of mitral and tricuspid inflow Doppler (eg. Pericardial disease)
4. Saline contrast examination
5. Hepatic venous flow pattern and Inferior Vena Cava collapse
6. Shunt calculation

7. Descending aortic velocity and presence of flow reversal, for assessment of aortic coarctation and regurgitation.

1.3 The Transesophageal Examination

Transesophageal echocardiography has proven to be an effective and accurate means of assessing patients with factors that limit precordial examination or in circumstances where more detailed evaluation of cardiac structures is essential as in the area of intracardiac shunts or endocarditis, to assess the aorta in the setting of aortic dissection, and in the search for potential source of embolus. Transesophageal echocardiography is also valuable in the assessment of prosthetic valve function because of the limitations of obtaining sufficient data from the transthoracic studies related to interference by the prosthetic device.

Because of its inherent focused nature, transesophageal echocardiography is generally complementary to the information from a recent complete transthoracic examination. In some emergency situations, however, a transesophageal examination may be the initial investigation, and should be followed by appropriate transthoracic imaging if additional or confirmatory clinical information is required.

Contraindications to transesophageal echocardiography include the following:

- Inability of patient to cooperate with the examination and/or protect airway (unless intubated)
- History of active esophageal or gastric pathology
- Severe respiratory distress
- Cervical spine immobility or instability
- Severe coagulopathy or thrombocytopenia
- If the patient has taken food or drink within 4-6 hours (the exact time frame should be assessed in view of the clinical situation and urgency of the study)

Transesophageal echocardiography requires informed consent, to be obtained in a manner compatible with hospital policies. Potential complications of the transesophageal echocardiography should be explained to the patient, including approximately 1% risk of minor complications and 0.01% major complications. Current guidelines do not require standard antibiotic prophylaxis prior to transesophageal echocardiography. A comprehensive examination should include all standard views noted below. In dealing with specific clinical situations, additional non-standard views may be required. In critically ill patients, a targeted transesophageal echocardiography examination is appropriate and should be structured to initially obtain the data which is essential to answer the specific questions of the referring physicians.

Because of the small risk of complications and need for sedation, transesophageal echocardiography imposes a greater responsibility on the echo laboratory for patient monitoring and recovery. This includes patient screening prior to the procedure, as well as monitoring throughout and during recovery. Appropriately qualified personnel and equipment must be available. These aspects will be discussed in greater detail in Section 2.

A complete transesophageal study should include standard views from multiple planes including views of all cardiac structures as well as appropriate use of Doppler.

1. Standard 4 chamber (0°-20°), 2 chamber (80°-100°) and long axis (120°-160°) views
2. Aortic valve short (30°-60°) and long axis (120°-160°) views
3. Bicaval view of atrial septum (80°-110°)
4. Images of the mitral valve from multiple planes
    a. 4 chamber (0°-20°)
    b. commissural (60°-70°)
    c. 2 chamber (80°-100°)
    d. Long axis (120°-160°)
5. Images of the tricuspid valve from multiple planes
    a. 4 chamber (0°-20°)
    b. RV inflow-outflow (60°-90°)
    c. Modified bicaval (110°-160°)
6. Longitudinal views of ascending aorta and pulmonary valves
7. Imaging of atrial appendices
8. Identification of pulmonary veins
9. Appropriate use of saline or other contrast agents in the setting of evaluation for interatrial shunt or abnormal venous drainage
10. Transgastric short and long axis view for left ventricular function as well as appropriate angulated views for assessment of valves and prostheses. Specifically:
    a. Basal short (0°-20°)
    b. Mid short (0°-20°)

c. 2 chamber (80°-100°)
d. Long axis (90°-120°)
e. RV inflow (100-120°)
f. Deep transgastric (0°-20° with anteflexion)

11. Aorta (including ascending, arch and descending thoracic portions).

Section 2: The Echocardiography Laboratory

2.1 General Principles

In order to generate a comprehensive and reliable echocardiographic examination, appropriately trained individuals require a workplace that is adequately equipped and configured. This section will detail the requirements of such a facility. The echocardiographic facility is commonly referred to as a laboratory, and that term will be used in this document.

In general, the echocardiographic laboratory must fulfill the following **objectives**:

1. It must provide and maintain equipment capable of producing a comprehensive study.
2. It must ensure safety of patients and staff
3. It must provide adequate space and facilities to provide for the above
4. It must operate in a fashion that allows for the efficient provision of comprehensive examinations

2.2 Recommendations with respect to Equipment:

Fully equipped, highly functioning and well maintained equipment is essential if optimal examinations are to be produced. Because echocardiography has been and continues to be the subject of rapid technological advances, the definition of "state of the art" has become a moving target. In addition, although multiple manufacturers are known to produce excellent equipment, there is considerable variation as to configuration and specific analysis packages available. In this document, no attempt will be made to recommend any specific system, or any specific package of options. Rather, the minimal attributes of a currently acceptable and adequately configured system will be described.

1. High quality imaging capability, featuring excellent resolution and grey scale and including the availability to do harmonic imaging.
2. Full Doppler capability, including pulsed wave, continuous wave, colour and tissue Doppler.
3. Systems must be configured specifically to cardiac application.
4. Systems must be equipped with probes capable of 2-6 MHz frequencies for adults, 5-7 MHz for children and 7-10 MHz for neonates. In addition, a Pedhoff stand-alone continuous wave probe should be available.
5. Labs should have the capability to perform respirometry monitoring for selected indications.
6. Appropriate equipment must be available for either videotape or digital recording of studies.
7. Multiplane probes are now the standard for transesophageal echocardiography.

2.3 Recommendations with respect to Maintenance and Safety of Equipment:

Regular equipment maintenance by appropriately trained individuals is essential. This can be carried out either through maintenance and service agreements with manufacturers, or by training of on-site personnel. In the case of the latter, training specific to the equipment being used is required, which has to be provided through the manufacturer. Regular maintenance by qualified personnel should be carried out at least twice a year.

To ensure that the ultrasound system(s) are safe:

- System filters should be cleaned periodically
- Systems should be checked for electrical current leaks and interference whenever new equipment is brought into the lab and at least annually thereafter
- All probes should be wiped and cleaned between usages. Imaging systems should be wiped down daily
- Echo-Doppler studies should be performed only on fully operational echo systems with all capabilities functioning correctly.

2.4 Recommendations with respect to Health and Safety of Personnel:

Echocardiographic facilities should take measures to ensure the safety and health of all personnel. The examination requires close physical contact between operator and patient for up to an hour. The equipment generates heat and therefore requires an appropriate space and ventilation. The examination can be physically demanding on the part of the operator, sometimes resulting in musculoskeletal strain. In view of these issues, it is important that the facility be appropriately structured and have processes in place to minimize risk to personnel:

2.4.1 Workplace considerations

The room in which the examinations are carried out should be separate, self contained, and used only for that purpose. Patient processing and waiting areas should be carried out in separate rooms. Within the examining

rooms, adequate space, light, ventilation and seating will minimize the risk of injury to personnel. Specific recommendations in this respect are outlined in section 2.5.

2.4.2 Infectious precautions

The prolonged close proximity of operator to patient raises a risk of infectious spread to staff and between patients. This risk and the appropriate preventative measures varies between patients and also with respect to the current conditions. Echocardiographic facilities within hospital settings should maintain links with their local Infection Control departments and follow standard recommendations. It would also be advisable to ensure that staff are updated on a regular basis with respect to current recommendations. This could take the form of posted bulletins or periodic educational conferences. For facilities operating independently, it is recommended that they maintain contact with the Infection Control department of a nearby hospital, or their local department of Public Health in order to ensure the appropriate recommendations are understood and followed. Transesophageal probes require specific disinfection procedures which are described in Section 2.6.

2.4.3 Repetitive stress injury

This is an increasing problem for echo facilities of all types. This problem can be substantially reduced by raising awareness and instituting preventative programs. The following measures are recommended to all echo facilities:

- That prevention of repetitive stress injury be integrated into the facilities educational program
- That links be established with the departments of occupation or physical health which will provide education and preventative physiotherapy
- That personnel be encouraged to learn about this issue and participate in preventative physiotherapy

2.5 Recommendations with respect to Space and Facilities (Transthoracic Echocardiography):

In order to produce optimal studies, ensure cleanliness and sonographer health, echocardiography rooms should meet the following specifications:

- An adequate space (minimum 15 meter^2) for regular studies, larger for stress and TEE studies
- Adequate ventilation, temperature control
- A dedicated plug for the echocardiographic system
- An adjustable echocardiography bed with firm mattress with a cut-out for optimal probe access for apical views
- An adjustable chair (five point) with back support and foot rest
- Sphygmomanometer
- Sink for hand washing
- Sterile gel (ideally warmed) should be available for use when indicated

2.6 Special considerations for Labs providing Transesophageal Echocardiography:

In addition to the standard features noted above, labs providing transesophageal echo require the following additional facilities:

- EKG monitoring
- Blood pressure monitoring
- suction
- oxygen
- pulse oxymetry
- resuscitation equipment
- IV equipment
- lockable cabinet for drugs
- a means of rapidly calling for help with an unstable patient (e.g. telephone, intercom, arrest buzzer)
- a large sink for washing probes

Appropriately trained and qualified personnel are required to provide monitoring of the patient through the procedure and recovery. The individual carrying out the examination should not be expected to provide this monitoring function.

Larger rooms are required to perform transesophageal echo, in order to accommodate extra equipment, personnel and potential resuscitation procedures. It is recommended that these rooms be at least 200 square feet.

Laboratories carrying out transesophageal studies with sedation, stress studies or studies on critically ill patients must have facilities available for observation and recovery of these patients by appropriately trained and qualified personnel prior to discharge home or back to their referring location.

Transesophageal probes should be checked for current leak twice a year

The echocardiography laboratory must follow proper cleaning and disinfection procedures as stipulated by manufacturer and hospital standards. TEE probes should be disinfected at least 20 minutes (time compatible with

hospital standards) between studies in an appropriate solution (e.g. gluteraldehyde). Laboratories performing TEE studies should have appropriate equipment available to properly clean and disinfect TEE probes.

2.7 Recommendations with respect to Operating Procedures:

2.7.1 Scheduling of studies.

To allow for recording of all necessary information, adequate time must be provided for each study. In order to provide adequate time for patient preparation, acquisition and recording of information and processing, the following scheduling is generally required:

- Transthoracic studies should be scheduled at 45 minute intervals
- Transesophageal studies at 60 minute intervals
- Combined transthoracic and transesophageal studies should be scheduled at 90 minute intervals
- Exercise stress studies at 45 minute intervals
- Pharmacologic stress studies at 60 minute intervals

2.7.2 Portable studies.

For optimal study quality, studies should be carried out in the laboratory whenever patient condition allows. The decision as to whether a patient should be imaged portably or within the echocardiography lab is determined by the clinical stability of the patient as assessed by the referring physician in consultation with the echocardiography lab attending physician. Portable studies must meet the same level of completeness and quality as studies carried out within the laboratory.

2.7.3 Stress Studies – Personnel considerations

Pharmacologic and exercise stress echo require special personnel considerations. The sonographer's responsibility is to acquire the echocardiographic images. The tasks of treadmill operation, EKG monitoring, medication infusion and patient monitoring cannot be carried out by the sonographer and require the presence and active participation of an appropriately qualified and trained individual. This can be the supervising physician if available. If not, supplementary personnel are required

2.7.4 Transesophageal and Stress Studies – Recovery

Labs performing exercise stress, pharmacologic and transesophageal echocardiogrpahy must have facilities, processes and personnel in place to monitor, assess and support patients until they have fully recovered from those procedures. This can vary considerably between sites depending on the patient population, echo lab location and what facilities or local arrangements are in place. The key components are; 1) that patients have opportunity to recover in an appropriate setting, 2) patients not be released until fully recovered as assessed by appropriately qualified and trained personnel and 3) that processes are in place to deal with patients slow to recover or experiencing complications of the procedure. In addition, it is recommended that patients be given both verbal and written instruction as to potential late complications and how to seek help if they occur.

2.7.5 Reporting Time

Echocardiographic examinations provide information important to patient management. In some cases, the findings are unexpected and can be critical to patient care. It is therefore essential that reports be provided in a timely fashion. It is recommended that the results of routine studies be available to referring physicians within five working days of the examination. In the case of studies that were ordered on an urgent basis, or any study on hospital inpatients, the report should be available by the end of the day on which the examination was carried out. If unexpected high risk findings are uncovered, these should be communicated immediately by the interpreting physician to the referring physician.

2.7.6 Storage of studies and reports.

Information should be recorded and stored in a format that facilitates retrieval, communication and patient confidentiality. Storage policies should meet or exceed provincial medical imaging storage regulations.

Section 3: The Echocardiographic Report

3.1 Objectives

In order to achieve clinical utility, the findings of the examination have to be transmitted to referring physicians in an effective manner. The purpose of the report is as follows:

- To provide clinically relevant, useful and timely information to the referring physician
- To promote quality by providing the basic core statements and measurements of an echocardiography report
- To include all relevant demographic, qualitative as well as quantitative Doppler information in the report

- To compare with previous reports if available
- To openly acknowledge to the referring physician any study limitations (equipment, technical, image quality, pathology complexity etc) in the report.
- To improve communication and patient care by providing an immediate preliminary report for inpatients or outpatients transferred from other institutions.

3.2 Components of an echo report

Basic components of an echo report (i.e. those that should form a minimal component of every transthoracic echo report) include the following:

1. Patient identification and demographics
2. Patient location (inpatient vs outpatient, hospital location)
3. Height, weight, body surface area and heart rate
4. The indication for the study
5. General study information including:
    - 5.1 Study date
    - 5.2 Referring physician identification
    - 5.3 Interpreting physician identification
    - 5.4 Media location (e.g. disk or tape number etc)
    - 5.5 Location where study was performed (e.g. portable, lab)
    - 5.6 Sonographer ID
    - 5.7 Type of study (e.g. adult TTE, neonatal TTE, TEE, stress echo etc)
    - 5.8 Study technical quality (e.g. teaching quality, good, fair, poor, incomplete)
6. Cardiac Dimensions. As a minimum, these should include:
    - 6.1. Left ventricular systolic and diastolic dimensions
    - 6.2. Left ventricular septal and posterior wall thickness
    - 6.3. Left atrial size
    - 6.4. Aortic root dimensions, including diameters of the annulus, sinus of Valsalva, sinotubular junction and ascending aorta
7. Assessment of Left ventricular Ejection Fraction (and method used)
8. Right Ventricular Systolic Pressure (assuming tricuspid regurgitation jet available)
9. Evaluation of the structure and function of the anatomic components of the examination, include the following: (The minimum evaluation for each, and the implied meaning of a “normal” report is detailed in the next section)
    - 9.1. Left Ventricle
    - 9.2. Right Ventricle
    - 9.3. Left atrium
    - 9.4. Right atrium
    - 9.5. Aortic Valve
    - 9.6. Mitral Valve
    - 9.7. Tricuspid Valve
    - 9.8. Pulmonic Valve
    - 9.9. Aorta
    - 9.10. Pulmonary artery
    - 9.11. Interventricular septum
    - 9.12. Interatrial septum
    - 9.13. Pulmonary veins
    - 9.14. Pericardium
10. Specific evaluation directed at the presenting problem and detected significant pathology
11. Conclusions and summary. To include:
    - 11.1. overall interpretation/summary of findings
    - 11.2. assessment of presenting issue
    - 11.3. relevant comparisons to prior studies or reports as available
    - 11.4. study limitations
    - 11.5. recommendations regarding alternative or additional investigations where appropriate.

The above constitutes a basic examination. Specific indications or pathology require further targeted imaging and/or hemodynamic assessment. A full review of the specific data required for evaluation of all possible pathologies is beyond the scope of this review and the reader is referred to one of the many excellent comprehensive texts available.

3.3 The meaning of “Normal”

For each of the anatomic and functional components of the report, a minimum of information is expected and should be implied in the designation of “normal”. These include the following:

1. Left Ventricle
    a. Chamber size
    b. Wall thickness
    c. Systolic function
    d. Diastolic function
2. Right Ventricle
    a. Chamber size
    b. Wall thickness
    c. Systolic function
3. Left atrium
    a. Normal size
    b. Absence of masses
4. Right atrium
    a. Normal size
    b. Absence of masses
    c. Normal caval connections
5. Aortic Valve
    a. Normal morphology
    b. No significant stenosis
    c. No significant regurgitation
6. Mitral Valve
    a. Normal leaflet morphology
    b. Normal chordal morphology
    c. Normal leaflet coaptation
    d. No significant stenosis
    e. No significant regurgitation
7. Tricuspid Valve
    a. Normal leaflet morphology
    b. Normal leaflet coaptation
    c. No significant stenosis
    d. No significant regurgitation
8. Pulmonic Valve
    a. Normal leaflet morphology
    b. No significant stenosis
    c. No significant regurgitation
9. Aorta
    a. Normal annular dimension
    b. Normal sinus of Valsalva structure and size
    c. Normal ascending aortic dimension
    d. Normal arch dimensions
    e. Normal proximal descending aorta
10. Pulmonary artery
    a. Normal main pulmonary artery dimension
11. Interventricular septum
    a. Normal thickness
    b. No defect
12. Interatrial septum
    a. Normal structure
    b. No defects or shunt flow
13. Pericardium
    a. Absence of significant effusion

It is recognized that echocardiography is sensitive to various technologic limitations and the acquisition of a full set of interpretable data may not be possible for all patients. It is therefore important that such limitations be clearly stated within the report, in order to avoid the assumption of normality by the referring physician. Statements such as “imaging was suboptimal or impossible” or “reliable interpretation not possible” should be used where appropriate.

3.4 The Preliminary Report

A major strength of echocardiography is its ability to quickly derive very valuable information regarding the status of critically ill patients. Sonographers are highly trained and capable of recognizing a wide range of pathology. In order to avoid delays in transmitting valuable information to attending physicians, it is imperative that a mechanism exists for the immediate communication of preliminary findings. Such mechanisms should be developed within each laboratory and hospital setting, in accordance with local practices. In doing so, it must be recognized that it is not the responsibility of the sonographer to generate reports, nor should they be compelled to report findings if they are not

confident or comfortable in doing so for any reason. In addition, such a mechanism should in no way be interpreted as a substitute for urgent access to physician backup and interpretation

Section 4: The Physician

Physician roles with respect to echocardiography include:

- Interpretation of examinations
- Supervision of procedures and policies of the laboratory
- Support, training and continuing education of sonographers and medical trainees
- Ability to perform a complete transthoracic examination
- Performance of transesophageal studies

The ability to carry out these roles requires a level of knowledge and training beyond that provided by basic physician training or specialty certification. It is therefore mandatory that additional training and ongoing education take place. Physician involvement in echocardiography can vary according to specific needs and circumstances. Consequently not all of the above roles may be required of all physicians involved in this field. For this reason, a variety of levels of training are described:

Level 1: Basic training involving familiarity with image acquisition, indications and recognition of basic pathology. This is currently provided as a component of basic cardiology specialty training, recognizing the importance of echocardiography in the practice of cardiology and the advanced level of understanding therefore required. It does not imply the ability to independently interpret studies.

Level 2: Training sufficient to independently perform and interpret adult transthoracic echocardiograms, and supervise sonographers. At this level, the physician must be familiar with the physical principles of ultrasound, the operation of diagnostic instruments, and the bioeffects of ultrasound. Specific training for transesophageal and stress studies is required as an additional, independent component.

Level 3: An advanced level of training that builds on that required for Level 2 training and enables interpretation and performance of all adult studies (including transesophageal and stress echocardiography), training and supervision of physician trainees and sonographers, and supervision of all aspects of echocardiographic laboratory.

4.1 Adult Transthoracic Echocardiography

4.1.1 Training requirements

Level 1: Four months of full time echocardiography with performance of 75 complete echocardiograms and interpretation of an additional 150 echocardiograms as part of core training within cardiology. These are minimum standards and the time, performance and interpretation criteria must all be fulfilled.

Level 2: Level 2 responsibilities require a greater depth of experience in the science, technology and practical applications of echocardiography. Completion of both an adequate volume of studies and participation in the day to day activities of a fully functioning echocardiography laboratory is required. Specifically, trainees must complete the equivalent of 6 months of dedicated, full-time attendance, during which they personally complete at least 150 complete transthoracic echocardiograms and interpret an additional 300 echocardiograms. Level 1 training can be counted towards this total if completed within 4 years. It is recognized that when such training is interrupted or carried out concurrently with other training activities, an extended training period will be required. For non-cardiology specialty trainees, two months exposure to clinical cardiology is a necessary prerequisite. This may occur during their training program, or as an extension of the Level 2 requirements.

Level 3: Requires a further 12 months of training which must include an additional 150 studies performed (300 total) and 450 interpretations (750 total). During this time it is expected that the Level 3 trainee will participate in transesophageal and stress echocardiography sufficient to achieve the training requirements noted below (Sections 4.2 and 4.3).

4.1.2 Documentation of Training:
The training required to reach Level 1 or 2 competence in echocardiography should be carried out over the course of no more than 36 months in a laboratory which provides a high volume (at least 3000 adult studies per year) and broad spectrum of clinical problems, with supervision by a Level 3 physician. It is recommended that this training be performed in blocks of time no less than one month in duration, during which the trainee is exclusively engaged in echocardiography. A logbook of all echocardiograms interpreted (including identifying data, date, extent of scanning and pathology) should be signed off by the supervising sonographer or physician. A final record should be maintained and written assessment of echocardiography training should be provided by the director of the echocardiography laboratory. Performance of echocardiograms implies that all imaging planes are obtained and the study is signed off in the logbook by the supervisor. A preliminary report should be written by the trainee prior to

interpretation by the echocardiographer. Written assessment by the director of the echocardiography laboratory should include the number of studies performed and interpreted, technical competency and interpretive ability.

4.1.3. Guidelines for physicians with interruption of active practice in echocardiography
If the physician has completed prior level II training for echocardiography, but has not met minimal requirements for maintenance of competency in echocardiography in the past two years, they should undertake one additional month of training in echocardiography. If maintenance of competency has not been achieved for the past five years, they are required to take three additional months of training in echocardiography and to interpret at least 300 studies during that time.

4.1.4. Maintenance of competence
Maintenance of competency in transthoracic echocardiography requires interpretation of a minimum of 300 echocardiograms per year. At least 12 hours of accredited CME in echocardiography (Canadian Society of Echocardiography, American Society of Echocardiography, American College of Cardiology, etc) should be obtained every two years. Self-assessment of competency in echocardiography through the National Board of Echocardiography examination is encouraged.

4.2 Transesophageal echocardiography

4.2.1
Competence in transesophageal echocardiography requires facility in the technique of esophageal intubation as well as acquisition of appropriate imaging and Doppler information. This requires performance of 25 esophageal intubations, as well as performance and interpretation of at least 50 transesophageal echocardiograms under supervision. This can be carried out either in conjunction with a course of training for Level 2 competence, or as a separate training period dedicated to transesophageal echocardiography, assuming that Level 2 competence has been achieved. In either case, the performance targets are identical.

4.2.2
Maintenance of competence for active practice of transesophageal echocardiography should include a minimum performance and interpretation of 25 transesophageal echocardiograms per year.

4.3 Stress echocardiography

4.3.1
Performance and interpretation of stress echocardiography requires a minimum of level II training in echocardiography and at least 100 stress echocardiograms, including both treadmill and pharmacologic stress. This can be carried out either in conjunction with a course of training for Level 2 competence, or as a separate training period dedicated to stress echocardiography. In either case, the performance targets are identical.

4.3.2
Maintenance of active practice in stress echocardiography requires performance and interpretation of at least 100 stress echocardiograms per year.

Summary: Echocardiography Training Requirements

	Duration of Training (cumulative)	TTE studies performed (cumulative)	TTE Studies interpreted (cumulative)	TEE Studies	Stress Echo Studies
Level 1	4 months	75	150	0	0
Level 2 (Basic)	6 months	150	300	0	0
Level 2 (with TEE)	6 months	150	300	50	0
Level 2 (with Stress)	6 months	150	300	0	100
Level 3	18 months	300	750	50	100

Section 5: The Sonographer

5.1 Sonographers role and responsibilities
Cardiac sonographers are allied health practitioners who have obtained both comprehensive education and practical training in theoretical and technical aspects of echocardiography that allows them to perform examinations that meet the goals noted in section 1 of this document.

In addition to recording the appropriate images and measurement, an optimal echocardiographic examination requires the operator to continuously integrate the relevant clinical information with the information being recorded. Consequently, the technique is highly operator dependent, requiring a high degree of knowledge, skill and independent judgment from the individual performing the examination.

The cardiac sonographer operates under the supervision of Level 2 or Level 3 trained physicians. The supervising physician should be available for assistance in the performance of the examination when it is technically difficult, confusing, nondiagnostic or when ancillary techniques or interventions are needed. The cardiac sonographer should participate with the supervising physician in the interpretation of the examination to provide input in the evaluation of data and to contribute relevant technical information. This collaborative, cooperative effort is not only desirable but necessary to ensure that the diagnostic information obtained and reported will be as complete as possible.

Specific responsibilities of the sonographer include the following:

1. Obtaining the images, measurements and hemodynamic data that constitute the full echocardiographic examination as outlined in Section 1 of this document.
2. Recording that information in either video or digital format in a manner that allows full review by the physician interpreter and long term storage.
3. Notifying the physician interpreter of any deficiencies or inconsistencies in the data that require his/her involvement.
4. Where clinical circumstances require, providing a preliminary interpretation, as outlined in Section 3.4 of this report

It is specifically noted and emphasized that the cardiac sonographer is not responsible for the final interpretation of the examination or the generation of the final report to referring physicians.

5.2 Skills and Knowledge Required
The cardiac sonographer requires the following specific knowledge and skills.

5.2.1
The cardiac sonographer is required to have a detailed understanding of cardiac and thoracic anatomy, physiology, hemodynamics, embryology, tomographic anatomy, and pathophysiology. This knowledge base is a prerequisite to the understanding of echocardiographic data and quantitation of derived parameters.

5.2.2
The cardiac sonographer must be able to recognize abnormalities, form a preliminary set of differential diagnoses, and extend the scope of the examination to explore these possible pathologic conditions.

5.2.3
The cardiac sonographer should be able to obtain pertinent clinical information from the patient, referring physician, and patient's record, including cardiac related physical findings and pertinent laboratory data, and to apply the necessary sonographic techniques to obtain comprehensive and diagnostic echocardiographic information. Failure to obtain and integrate such data may lead to an incomplete examination, erroneous clinical interpretation of the echocardiogram, or both.

5.2.4
A cardiac sonographer must be skilled in interacting with patients, which involves explaining the procedure to the patient but not discussing the clinical findings of the examination.

5.2.5
The cardiac sonographer must be skilled in selecting relevant echocardiographic data, making quantitative calculations from these data, and communicating his or her impressions to the physician interpreting the study.

5.2.6
The cardiac sonographer must have a complete understanding of the physical principles of ultrasound, the operation of diagnostic instruments, and the bioeffects of ultrasound. He or she should be responsible for obtaining routine periodic quality assurance and safety checks on the ultrasonography equipment. The sonographer must also be cognizant of patient exposure to ultrasonic energy and its effects on human tissue systems to ensure patient safety without sacrificing examination quality.

5.2.7
The nature of the patient population mandates that the cardiac sonographer be qualified to perform cardiopulmonary resuscitation.

5.3 Training

Formal Training Programs
Programs in echocardiography are currently available through a number of established educational institutions in Canada. There are also a number of independent programs that provide echocardiography training. All such programs in echocardiography are independent and quite diverse. They have different admission requirements, include variable degrees of practical training, and have individual evaluation criteria by which their certification is

granted. None have adequate and integrated facilities for practical training and are therefore highly dependent on relationships with hospital and clinic based labs to provide placements for their students.

For all these reasons, although successful completion of a recognized training program is highly valuable and desirable, there is no globally accepted standard by which any program can be measured and regarded as an independent and sole demonstration of competence.

Informal Training
Because of the lack of a standardized and accepted training program, Canadian echocardiography laboratories have provided informal training of sonographers for many years. In fact, the majority of sonographers currently operating in Canada were trained in this way. The quality of training provided is obviously highly dependent on the experience, focus and spectrum of practice of the lab and its personnel.

Practical Experience
Because of the paucity of training opportunities that has existed in Canada, many very competent sonographers have acquired their training in a piecemeal fashion and provided a consistent and high standard of work for many years. Such skill, talent and practical experience should not be ignored or wasted by the development of overly restrictive training requirements. Rather, criteria for evaluating and recognizing such training should be developed. It is suggested that minimum criteria for acceptance of practical training in echocardiography be defined as follows:

> At least two continuous years of full time work resulting in personal production of at least 300 studies per year in a full service adult echocardiography facility under the direction of a Level 2 or Level 3 qualified physician. Such experience must have occurred within the last 3 years and is to be documented by the supervising physician.

5.4 Registration
The American Registry of Diagnostic Medical Sonographers (ARDMS) provides a qualifying examination in cardiac ultrasound that tests the knowledge component required. It leads to registration and is currently the most widely accepted form of credentialing in the field. It also provided ongoing registration which requires demonstration of ongoing Maintenance of Competence activities. Notable deficiencies are that the examination does not test the practical component of sonography, and is not available in the French language.

New examinations and registration processes are under development within Canada. It is anticipated that such examinations, once developed, will provide an alternative to the above for Canadian sonographers, and will be available in both official languages.

5.5 Demonstrating Overall Competence
Assessment of the competence of sonographers requires assessment of both knowledge and practical components. Given the current realities as noted above, multiple avenues are required if all qualified individuals are to be recognized. A practical problem is that after January 2005 it is anticipated that the ARDMS will no longer be available to those with practical experience only. Sonographers in this situation will therefore have no means to demonstrate their competence. It is anticipated that a Canadian examination will be available to these individuals within 2 years. Recognizing these varied realities and with the intention of providing a means of recognizing all genuinely qualified individuals, the following are recommended as adequate demonstrations of competence:

1. Completion of recognized echocardiography training program and registration. This is currently only available through ARDMS. It is anticipated that a Canadian equivalent examination is under development and should provide an alternative when available and fully recognized. **This is the optimal and preferred qualification and should be achieved by all sonographers entering the workplace after January 2005**.

2. Demonstration of practical experience as noted above, with qualifying examination and registration, with the ARDMS or Canadian equivalent when available.

3. For those with recognized practical experience as noted above who have not yet completed a registration examination, it is recommended that they be recognized but required to participate in the Maintenance of Competence activities as noted below, and be required to complete a recognized Canadian or American qualifying examination once such examinations are available to them.

5.6 Maintenance of Competence
The sub-committee suggests 30 “credit hours” over 3 years. Credit hours could be courses offered by recognized bodies, specifically the ARDMS, the Canadian Society of Echocardiography, the Canadian Cardiovascular Society, the American Society of Echocardiography, the American College of Cardiology, the American Heart Association.

The committee feels maintenance of skill also requires that a minimum volume of studies should be carried out, specifically at least 300 studies per year. After more than a one year absence from the field, it is recommended that the sonographer spend at least one week with updating/refreshing skills in a high volume (> 20 studies per day) full

service (offering TTE, TEE, stress) laboratory with a qualified sonographer colleague and Level 3 supervising physicians.

For each additional year of absence the update/refresher period should be extended by 1 week for each year of absence.

Section 6: INDICATIONS FOR ECHOCARDIOGRAPHIC EXAMINATION

6.01 Overview and Definitions

Because of its widespread availability, non-toxic nature and application to a wide variety of clinical problems, echocardiography procedures have become highly utilized. In addition, potential applications are increasing as technological advances are developed. Consequently it is important to define appropriate indications, which can be broadly defined as clinical applications in which echocardiography provides demonstrable or widely accepted incremental value to patient management, not available through other less costly methods.

In this section, clinical applications of echocardiography will be reviewed. Three levels of indications will be utilized, with definitions as follows:

1. **Class 1 (Definite) Indication:** Indication supported by results of clinical studies and/or general agreement and accepted clinical practice. The latter is based on the principle that the echocardiographic examination is known to have a positive impact on clinical practice.
2. **Class 2 (Selective) Indication:** Clinical study evidence not available. Impact of echocardiographic examination in these situations generally but not universally established or limited to specific clinical situations.
3. **Non Indications:** Clinical situations in which there is no established or generally accepted role for echocardiographic examinations.

6.02 Indications for Echocardiography in the Evaluation of Heart Murmurs

Class 1 Indications
1. A murmur in a patient with cardiorespiratory symptoms
2. A murmur in an asymptomatic patient if the clinical features suggests underlying structural heart disease.

Class 2 Indications
1. A murmur in an asymptomatic patient where structural heart disease cannot totally be excluded by clinical assessment.

Non Indications
1. In an asymptomatic patient in whom the murmur is identified as functional or "innocent" by an experienced clinician
2. In an asymptomatic patient with a previous normal echocardiogram whose murmur is unchanged.

6.03 Indications for Echocardiography in Valvular Stenosis

Class 1 Indications
1. Initial assessment of etiology, severity, chamber dimensions, ventricular systolic function and overall hemodynamic impact
2. Reassessment of patients with known valvular stenosis of any severity and changing clinical status

Class 2 Indications
1. Periodic reassessment of asymptomatic patients with significant valvular stenosis (usually annual, but may be shortened to 6 months in some individual clinical situations).

Non Indications
1. Reassessment of asymptomatic adult patients with hemodynamically insignificant lesions (eg. aortic sclerosis, mitral annular calcification)

6.04 Indications for Echocardiography in Native Valvular Regurgitation

Class 1 Indications
1. Initial assessment of etiology, severity, chamber dimensions, ventricular systolic function and overall hemodynamic impact
2. Reassessment of patients with known valvular regurgitation and changing symptoms, or LV dilatation/systolic dysfunction
3. Periodic reassessment of patients with asymptomatic severe valvular regurgitation (usually annual, but may be shortened to 6 months in some individual clinical situations)

Class 2 Indications

1. Periodic (normally annual) reassessment of asymptomatic, clinically stable patients with moderate mitral regurgitation without chamber dilatation/dysfunction
2. Periodic (normally annual) reassessment of asymptomatic, clinically stable patients with moderate aortic regurgitation without chamber dilatation/dysfunction

Non Indications

1. Reevaluation of asymptomatic, clinically stable patients with trivial or mild valvular regurgitation having normal left ventricular size and function

6.05 Indications for Echocardiography in Known or Suspected Mitral Valve Prolapse

Class 1 Indications

1. Diagnosis and assessment of hemodynamic severity, leaflet morphology and ventricular cavity size and function in patients with physical findings of mitral valve prolapse

2. Patients with previous diagnosis of mitral valve prolapse and changing clinical status or physical findings suggestive of progressive valvular dysfunction.

3. To re-evaluate patients with prior echocardiographic diagnosis but no supporting physical findings.

4. Periodic reassessment as required by clinical findings and severity of regurgitation (see Section 6.04)

Class 2 Indications

None

Non Indications

1. Non-specific symptoms (i.e. atypical chest pain) with no clinical evidence of mitral valve prolapse

2. Reevaluation of asymptomatic patients with stable clinical findings known to have mitral valve prolapse on echocardiography with trivial or mild mitral regurgitation

6.06 Indications for Echocardiography in Patients with Prosthetic Heart Valves

Class 1 Indications

1. Assessment of a newly implanted prosthetic heart valve (baseline assessment)
2. Assessment of a prosthetic heart valve in patients with symptoms, clinical findings or prior echocardiogram suggestive of prosthetic valve dysfunction

Class 2 Indications

1. Annual assessment in asymptomatic, hemodynamically stable patients with a prosthetic valve

Non Indications

1. An asymptomatic patient without symptoms or findings suggestive of dysfunction and a prior echocardiogram carried out within the past year showing normal function.

6.07 Indications for Echocardiography in Infective Endocarditis: Native and Prosthetic Valves

NOTE: Transesophageal echo may provide incremental diagnostic value in addition to transthoracic in patients with both native and prosthetic valves. In patients with high clinical suspicion of infective endocarditis, a negative transthoracic study does not necessarily exclude the diagnosis and a transesophageal examination should be performed.

Class 1 Indications

1. To support the diagnosis in patients in whom endocarditis is suspected clinically.
2. In a patient with clinically proven or suspected endocarditis to assess the severity and hemodynamic impact of valvular lesions, and to detect other high risk lesions (e.g. fistulae, abscesses)

Class 2 Indications

1. Evaluation of bacteremia with a known source.
2. Reassessment in a clinically stable patient with prior echocardiographic evaluation to assess response to therapy or detect clinically silent disease progression

Non Indications

1. Evaluation of patients with no clinical criteria for diagnosis of endocarditis other than fever

6.08 Indications for Echocardiography in Pre and Post Interventional Evaluation for Valvular Heart Disease

Class 1 Indications

1. To assist pre and peri-procedural decision making for valve surgery or percutaneous intervention (e.g. mitral valve repair, replacement and valvuloplasty)*
2. Post-intervention baseline studies for valve function and ventricular remodelling (e.g. within 3 months)
3. Reevaluation of patients with valve replacement with suspected surgical complication (e.g. prosthetic dysfunction)*

Class 2 Indications

1. Annual reassessment of patients with valve surgery/intervention without clinical suspicion of valve dysfunction.

* TEE may provide incremental value in addition to TTE.

6.09 Indications for Echo in Patients with Chest Pain or Suspected or Established Coronary Artery Disease

Class 1 Indications

1. Evaluation for suspected aortic dissection (strongly consider addition of TEE)
2. Evaluation of chest pain with hemodynamic instability
3. Evaluation of murmur associated with acute or recent myocardial infarction
4. Assessment of infarct size and baseline LV systolic function post myocardial infarction. (Stress echo or Pharmacologic echocardiography may add incremental value in the detection of CAD or risk stratification post infarction)
5. Evaluation for suspected LV thrombus
6. Unexplained hypotension in Intensive Care or emergency settings
7. Patients requiring an evaluation of cardiac function as part of assessment for Driving License qualification.

Class 2 Indications

1. Evaluation of chest pain suspicious for underlying coronary artery disease
2. Assessment of LV function post revascularization
3. Reassessment of LV function to guide or modify therapy in patients with known LV systolic dysfunction
4. Atypical chest pain
5. Patients scheduled to undergo coronary artery bypass surgery
6. Stress echo or Pharmacologic echocardiography for risk stratification post myocardial infarction

Non Indications

1. Evaluation of chest pain which is noncardiac
2. Assessment of LV function when a recent reliable alternate evaluation (i.e. wall motion scan, ventriculogram) is available
3. The asymptomatic patient with remote infarction and previously demonstrated normal LV systolic function

6.10 Indications for Echocardiography in Patients with Dyspnea, Edema or Cardiomyopathy

Class 1 Indications

1. Assessment of patients with suspected:
    a) heart failure
    b) peripheral edema with elevated jugular venous pressure
    c) unexplained dyspnea
    d) clinical or radiographic heart failure
2. Clinically suspected cardiomyopathy
3. Patients with clinically unexplained hypotension
4. Assessment of baseline LV function and periodic review when using cardiotoxic drugs
5. Reevaluation of LV function in patients with documented cardiomyopathy and change in clinical status or undergoing procedures that could potentially affect function such as alcohol septal ablation or surgical myomectomy.
6. Screening of first degree relatives with suspected inherited cardiomyopathy

Class 2 Indications

1. Reevaluation of patients with known cardiomyopathy without clinical change in status

Non Indications

1. Patients with dyspnea or edema in whom an alternative diagnosis is established

6.11 Indications for Echocardiography in Pericardial Disease

Class 1 Indications
1. Patients with suspected pericarditis, pericardial effusion, tamponade, or constriction
2. Follow up of moderate or large pericardial effusion
3. Follow up of small pericardial effusion with clinical change
4. Echo guided pericardiocentesis (i.e. diagnostic and/or therapeutic for pericardial effusion/tamponade)

Class 2 Indications
Follow up of small pericardial effusion with no change in symptoms

6.12 Indications for Echocardiography in Patients with Cardiac Masses

Class 1 Indications
1. Evaluation of patients with clinical syndromes suspicious for an underlying cardiac mass
2. Follow up or surveillance study following surgical removal of masses/tumours
3. Patients with malignancies when echocardiographic assessment for cardiac involvement is part of the standard disease staging process

Non Indications
1. Patients for whom the results of an echocardiographic examination will not alter clinical decision making or management

6.13 Indications for Echocardiography in Pulmonary Disease

Class 1 Indications
1. Patients with suspected or established pulmonary hypertension
2. Suspected or established pulmonary embolism
3. Patients being considered for lung transplantation or other surgical procedure for advanced lung disease to exclude possible cardiac disease

Class 2 Indications
1. Follow-up of pulmonary artery pressures in patients with pulmonary hypertension to evaluate response to treatment
2. Routine reevaluation of right ventricular function in patients with cor pulmonale
3. Patients with known chronic lung disease and unexplained desaturation

Non Indications
1. Lung disease without clinical suspicion of cardiac involvement

6.14 Indications for Echocardiography in Hypertension

Class 1 Indications
1. Suspected left ventricular dysfunction

Class 2 Indications
1. Suspicion or evaluation of left ventricular hypertrophy that may influence management

Non Indications
1. Routine evaluation
2. Reevaluation to guide antihypertensive therapy based on LV mass regression
3. Reevaluation in asymptomatic patients to assess LV function

6.15 Indications for Echocardiography in Suspected Thoracic Aortic Disease

Class 1 Indications
1. Suspected aortic dissection (TEE)
2. Suspected aortic rupture/trauma (TEE)
3. Suspected dilatation of aortic root or ascending aorta for any cause.
4. Evaluation patient with known aortic pathology and change in symptoms or clinical findings suggestive of progression (TEE may be required).
5. Suspected or proven Marfan Syndrome or other connective tissue disorder in which aortic pathology is a potential feature.

Class 2 Indications

1. Annual evaluation of patients with known aortic dilatation but no change in findings or symptoms status
2. Reevaluation of patients with prior surgical repair of aorta

6.16 Indications for Echocardiography in Patients with Neurological Events or Other Vascular Occlusive Events

Class 1 Indications
1. Patient of any age with abrupt occlusion of a major peripheral or visceral artery
2. Unexplained stroke or TIA without evidence of cerebrovascular disease and in whom a clinical therapeutic decision (eg. anticoagulation) will depend on the results of echocardiography

Class 2 Indications
1. Patients with suspicion of embolic disease and with cerebral vascular disease of borderline significance

Non Indications
1. Patients for whom the results of echocardiography will not impact a decision to institute anticoagulant therapy

6.17 Indications for Echocardiography in Patients with Arrhythmia and Palpitations

Class 1 Indications
1. Arrhythmias with clinical suspicion of structural heart disease
2. Atrial fibrillation, atrial flutter, ventricular tachycardia or ventricular fibrillation remote from an acute ischemic event

Class 2 Indications
1. TEE guidance of transseptal catheterization and catheter placement during ablative procedures
2. Evaluation of patients as a component of an electrophysiological ablative procedure work up
3. Evaluation of patients without clinical suspicion of cardiac abnormality, but with arrhythmias that are associated with cardiac structural abnormalities

Non Indications
1. Palpitations without corresponding arrhythmia or other signs or symptoms of cardiac disease
2. Isolated premature ventricular contractions for which there is no clinical suspicion of heart disease

6.18 Indications for Echocardiography (TEE) before Cardioversion

Class 1 Indications
1. Patients with atrial fibrillation of more than 48 hours duration requiring cardioversion and not chronically or adequately anticoagulated
2. Patients for whom atrial thrombus has been demonstrated in previous TEE
3. Evaluation of patients for whom a decision concerning cardioversion will be impacted by knowledge of prognostic factors (i.e. LV function or coexistent mitral valve disease) [TTE usually adequate for this purpose]

Class 2 Indications
1. Patients with atrial fibrillation of less than 48 hours' duration and other heart disease present
2. Precardioversion evaluation of patients who have previous echocardiographic evidence of structural heart disease

Non Indications
1. Patients requiring emergency cardioversion
2. Patients who have been on long-term anticoagulation therapy at therapeutic levels and no structural heart disease

6.19 Indications for Echocardiography to Screen for the Presence of Cardiovascular Disease Including Patients with Syncope

Class 1 Indications
1. Patients with a family history of genetically transmitted cardiovascular disease.
2. Potential donors for cardiac transplantation
3. Patients with phenotypic features of Marfan’s Syndrome or related connective tissue diseases
4. Syncope in a patient with clinically suspected heart disease or periexertional syncope
5. Syncope in patients with high risk occupations (e.g. pilot, school-bus driver)

Class 2 Indications

1. Patients with systemic disease that may affect the heart
2. Syncope of unknown etiology and no clinical evidence of heart disease

Non Indications

1. Routine screening of asymptomatic patients without clinical evidence of cardiac disease
2. Recurrent syncope in patients with a recent previously normal echocardiogram and no clinical findings suggestive of cardiac disease
3. Syncope in patients with no clinical suspicion of heart disease
4. Classic neurocardiogenic syncope

Appendix 1

Current Canadian Provinical Policies with Respect to Echocardiography
This information was obtained through the Colleges of Physicians and Surgeons of each Canadian province in August 2002.

British Columbia
Cardiologists and radiologists are required to complete **six months** of full-time training and complete personally **300 transthoracic echocardiograms** during that period of time. Supervisor must provide written assessment including number of studies performed technical competence and interpretative ability. If the cardiologist or radiologist has completed six months of training in echocardiography, but has not practiced for the past two years, they are required to undertake one additional month of training. If the physician has not practiced for the past five years, they are required to take three additional months of training and to complete at least 300 studies during this time.
Specialists in Internal Medicine must have a minimum of six months of training in cardiology and then undertake an additional six months of full-time training in an echocardiography laboratory. They must complete 300 echocardiograms during that period time and have written assessment from the supervisor.
Active practice of echocardiography means a minimum of one day of echocardiography interpretation per week on a full-time basis or eight cases per week.
Minimum training for transesophageal echocardiography includes **six months of training in echocardiography with a minimum performance of 300 transthoracic echocardiograms**. The physician must have performed 25 **esophageal intubations** and should have been exposed to at least **50 transesophageal echocardiograms.** Maintenance of expertise in transesophageal echocardiography requires a minimum of one study per week or **50 studies per year on an ongoing basis**.

Alberta
Cardiologists must complete six months of training in echocardiography and have completed 300 echocardiograms. Radiologists must complete three months of training in echocardiography and have completed 300 echocardiograms. Physicians in active practice must interpret echocardiograms one day per week or eight cases per week. **Transesophageal echocardiography may be performed by Anesthetists who have six months of training and who have performed 240 echocardiograms including 80 transesophageal echocardiograms. Physicians in active practice must perform a minimum of 60 transesophageal echocardiograms per year to maintain competency.**

Saskatchewan
Complete set of guidelines for ultrasound facilities, records of examination and training standards, equipment. Performance and interpretation of echocardiograms requires **six months of training for cardiologists** and one year of training for directors of an echocardiography laboratory. There is a note added that any specialist physician wishing to perform a specialized area of ultrasound not included in the bylaws must apply to the advisory committee on medical imaging of the College of Physicians and Surgeons of Saskatchewan for training standards. There are no specific requirements with regards to transesophageal echocardiography

Manitoba
Those individuals who possess certification in an appropriate specialty from the Royal College of Physicians and Surgeons of Canada or equivalent specialist recognition may be approved to perform echocardiography provided that they have completed **six months of approved training in the field of echocardiography.**

Ontario
There are no guidelines for echocardiography interpretation. Any physician may practice in any area of medicine for which they have training. Physicians may bill for echocardiograms which are performed in hospitals if their hospital privileges include echocardiography and they may also bill for echocardiograms which are performed in out of hospital laboratories.

Quebec
The Quebec College of Physicians and Surgeons follows the recommendations of an expert committee chaired by Dr. George Honos.
Interpretation of transthoracic echocardiograms requires eight months of training with total performance and interpretation of 450 cases. Maintenance of competency requires specialization in cardiology and interpretation of at least 300 transthoracic echocardiograms on a yearly basis, interpretation of 50 transesophageal echocardiograms on a yearly basis.

New Brunswick
According to the College there are no specific requirements for transthoracic echocardiogram or transesophageal echocardiogram interpretation. These may be performed by any licensed physician.

Nova Scotia
The College has no guidelines for interpretation of echocardiograms.

Prince Edward Island
There are no cardiologists in the province and there are six radiologists. There are no specific guidelines for physician training required for interpretation of echocardiograms.

Newfoundland
Any radiologist or cardiologist may bill for echocardiograms. Echocardiograms are only performed in hospitals and hospitals make the decisions regarding the physicians who can perform echocardiograms.

Summary Table

	Transthoracic Echo			Transesophageal	
Duration of Training	**Number of TTEs**	**Maintenance of Competency**	**Duration of Training**	**Number of TEEs**	**Maintenance of Competency**
British Columbia					
Cardiologists 6 months Radiologists 6 months Internists 6 months + 6 months of cardiology	300 300 300	8 TTE/week	6 months	50	50/year
Alberta					
Cardiologists 6 months Radiologists 3 months Anesthetists	300 300	8 TTE/week	6 months	TEEs 80 + 240 TTEs	60/year
Saskatchewan					
Cardiologists 6 months					
Manitoba					
Specialists 6 months					
Ontario					
Quebec					
Cardiologist 8 months	450	350/year			50/year
New Brunswick					
Nova Scotia					
Prince Edward Island					
Newfoundland					

Appendix 2

Guideline Documents Reviewed

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