Guidelines for the Standardization of Adult Echocardiography Reporting: Recommendations From the American Society of Echocardiography

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The American Society of Echocardiography (ASE) plays a vital role in establishing practice standards and guidelines within the echocardiography field. Its influence is comprehensive, covering training, image acquisition, nomenclature, measurements, diagnosis, and quality improvement. This report focuses on the final phases of the diagnostic imaging process, specifically reporting and communicating exam results. It provides updates to previously published guidelines on the required components of a comprehensive echocardiography report. Standardization within echocardiography reports is essential to uphold quality, consistency, and interoperability across various echocardiography (echo) labs, institutions, and healthcare systems, as well as over different time points. Additionally, standardized reporting is crucial for facilitating big data analysis, aligning with the current emphasis on machine learning and artificial intelligence. This document delineates core measurements and statements applicable to transthoracic, transesophageal, and stress echocardiography. It also elucidates abbreviations, acronyms, terminology, and definitions to enhance communication. The path from preliminary report to final submission is clarified, alongside examples of critical, urgent, and significant findings. Recommendations include comparison of serial echocardiograms and, when clinically relevant, comparisons with other imaging modalities. The document addresses the integration of simple congenital heart disease (CHD) findings appropriate for an adult echo lab. Standardization facilitates clinical and research endeavors by ensuring clear and consistent data reporting, thereby enabling seamless data sharing and reusability. (J Am Soc Echocardiogr 2025;38:735-74.)

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INTRODUCTION

The ASE has published guidelines and standards "for training (and certification); performance; nomenclature and measurement; and quality improvement related to echocardiography" for more than 40 years.[1,2] In 1998, Dr. Richard Kerber, then president of the ASE, convened a task force "to develop recommendations for a standardized report for adult echocardiography" to improve the quality of echocardiography practice. The specific goals of their 2002 report remain valid.[1] Standardized reporting should 1) promote quality by defining the core of measurements and statements that constitute the report, 2) encourage the comparison of serial echocardiograms performed in patients at the same site or different sites, 3) improve communication by expediting the development of structured report form software, and 4) facilitate multicenter research and analyses of cost-effectiveness.

The 1998 task force developed its recommendations in response to an emergent computing and information age explosion, heralding the end of an era in which echocardiography reports were typed or even hand-written. Their recommendations laid the groundwork for acceptable structured reporting methods that were readily adopted by clinical and academic practitioners, industry, and accreditation agencies. In 2008, ASE President Dr. William Zoghbi commissioned a task force to explore quality aspects of echocardiography laboratory operations using a multi-faceted approach, including facility, equipment, personnel, various aspects of the imaging process, interpretation and reporting, and the presence of a continuous quality improvement process. The resultant publication, the ASE's Recommendations for Quality Echocardiography Laboratory Operations, remains an important reference, establishing a framework for quality standards that are readily achievable by most clinical echocardiography labs performing adult transthoracic (TTE), transesophageal (TEE), and stress echocardiography (SE) examinations.[3] Some 23 years after the ASE's initial 2002 reporting standards recommendations, many laboratories continue to use reporting methods and software solutions developed for the dawn of the information age. We now practice in an advanced information age with pervasive digital image processing, near-universal adoption of electronic health records, automated data exchanges, and the potential for big data analysis using machine learning and large language models (LLMs).[4] A high-quality echo report should meet four criteria, as proposed by Chao *et al.*, completeness, conciseness, correctness, and clinical utility.[5]

In recent years, there has been an increasing recognition that clinically relevant reporting should integrate more comprehensive demographic information and normative and abnormal data metrics derived from up-to-date societal guidelines to better define, categorize, and communicate both normal and pathological findings.[6-8] A

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Abbreviations

2D = Two-dimensional

3D = Three-dimensional

ACHD = Adult congenital heart disease

AK = Akinesis

AoV = Aortic valve

AR = Aortic regurgitation

AS = Aortic stenosis

ASD = Atrial septal defect

ASE = American Society of Echocardiography

BP = Blood pressure

BSA = Body Surface Area

CFD = Color flow Doppler

CHD = Congenital heart disease

CMR = Cardiovascular magnetic resonance

CWD = Continuous wave Doppler

DICOM = Digital Imaging and Communications in Medicine

DK = Dyskinesis

EACVI = European Association of Cardiovascular Imaging

ECG = Electrocardiogram

Echo = Echocardiography/ echocardiogram/ echocardiographic

ECL = Echocardiography core laboratory

EROA = Effective regurgitant orifice area

FAC = Fractional area change

GLS = Global longitudinal strain

HK = Hypokinesis

IABP = Intra-aortic balloon pump

IAC = Intersocietal Accreditation Commission

IAS = Interatrial septum

IVC = Inferior vena cava

IVS = Interventricular septum

LA = Left atrium/atrial

LAA = Left atrial appendage

LLM = Large Language Model

LV = Left ventricle/ventricular

LVAD = Left ventricular assist device

LVEDD = Left ventricular end-diastolic dimension

LVEF = Left ventricular ejection fraction

LVESD = Left ventricular end-systolic dimension

LVOT = Left ventricular outflow tract

MAC = Mitral annular calcification

MCS = Mechanical circulatory support

MR = Mitral regurgitation

MS = Mitral stenosis

MV = Mitral valve

NK = Normokinesis

PA = Pulmonary artery

PACS = Picture archiving and communication system

PDA = Patent ductus arteriosus

PFO = Patent foramen ovale

PHT = Pressure half-time

POCUS = Point-of-care ultrasound

PV = Pulmonic valve

PWD = Pulsed wave Doppler

QI = Quality improvement

RA = Right atrium/atrial

RAP = Right atrial pressure

RPP = Rate pressure product

RV = Right ventricle/ ventricular

SAM = Systolic anterior motion

SCMR = Society for Cardiovascular Magnetic Resonance

SE = Stress echocardiogram/ echocardiography

TAPSE = Tricuspid annular plane systolic excursion

more consistent reporting language is increasingly achievable because of the maturation of the field, including an increasingly large portfolio of updated science and consensus-driven echocardiography guidelines. With this history and new developments in mind, the ASE commissioned a new task force to examine and provide guidance upon standards for adult echocardiography reporting.

Scope

Consistent with the ASE's 2002 reporting standards recommendations, the focus of this document is to update the reporting component of the greater echo lab quality framework established by Picard *et al.*, rather than addressing performance or interpretation of echocardiograms.[3] This document will 1) provide recommendations for which demographic elements, descriptive items, and measurements should be included in a report, 2) provide recommendations on how reports should be presented stylistically to improve communication and translation of findings into patient care, and 3) facilitate research. Although many elements of this guideline may be useful for laboratories performing comprehensive adult congenital and pediatric echocardiography, recommendations are limited to consultative adult echocardiography laboratories performing TTE, TEE, and SE examinations. A recent ASE guideline distinguishes consultative echocardiography from the various forms of cardiac point-of-care ultrasound (POCUS).[9] Although this document may provide guidance for those performing POCUS examinations, recommendations herein are intended for individuals practicing in laboratories performing consultative echocardiography examinations in adults. New to this reporting standards guideline are tables for reporting SE for coronary artery disease, reporting simple CHD findings in adults, and the incorporation of mechanical circulatory support (MCS) devices. A table of basic assumptions and definitions is provided, along with a glossary table for recommended morphologic descriptions. Measurement tables include reporting precision recommendations that should be consistent across clinical and core echo laboratories, registries, and the National Institutes of Health Common Data Elements repository.[4] We include recommendations for incorporating prior or suggested multimodality imaging data. Because the ASE's clinical practice guidelines and standards are continually surveilled for necessary published updates when needed ("living guidelines"), this reporting standards guideline also exists as a living guideline that becomes updated after significant source document updates are published.

Echocardiography's improved spatial and temporal resolution enables detailed cardiovascular morphological assessment and descriptions; the results may be more accurate and informative when certain standards are followed. We provide recommendations for terms, definitions, morphologic descriptions, and abbreviations that may critically influence readers' understanding and allow accurate data incorporation into electronic medical records and registries. Therefore, the recommendations will appear more granular than historical ones. Recommendations are not dictums, but consensus-driven strategies to improve reporting content. While many descriptions and linked numerical data should be concise and easily understood, our recommendations support the need for preserving interpreters' critical ability to synthesize, contextualize, and report findings with a nuanced analysis of the clinical scenario, particularly in summary statements, in ways that may not be reflected in standardized

TDI = Tissue Doppler Imaging

TEE = Transesophageal echocardiogram/ echocardiography

TR = Tricuspid regurgitation

TTE = Transthoracic echocardiogram/ echocardiography

TV = Tricuspid valve

UCA = Ultrasound contrast agent

UEA = Ultrasound enhancing agent

VA-ECMO = Veno-arterial extracorporeal membrane oxygenation

Vmax = Maximum Doppler velocity

VSD = Ventricular septal defect

VTI = Velocity time integral

WMS = Wall motion score

reporting templates. Important tenets for this updated guideline are that new recommendations should be easily implemented given current medical informatics practices in a way that improves reporting accuracy and enhances patient care, while also improving workflow.

METHODOLOGY

Writing Committee Composition

The members of the writing committee were selected based on their domain expertise in echocardiography, multimodality imaging, health informatics, artificial intelligence, and leadership experience in echo lab quality improvement, cardiac imaging registry, research core lab, and lab accreditation. Experts with a spectrum of backgrounds, such as geographic regions and clinical practice settings, were considered. The writing committee consisted of thirteen members, including two cardiac sonographers, one pediatric representative, two members with Intersocietal Accreditation Commission (IAC) expertise, three with artificial intelligence and data registry experience, one with imaging data expertise at the National Institutes of Health, and four with an international training background.

Relationships With Industry and Other Entities

The ASE has rigorous policies to ensure this document was developed without improper influence. All members of the writing committee were required to complete and submit a disclosure form showing all personal, professional, or business relationships that may pose actual, perceived, or potential conflicts of interest. The relationships with industry and other entities pertinent to this standard document are disclosed in the Conflict-of-Interest statements. The work of the writing committee is based on volunteerism and is supported exclusively by the ASE without commercial support.

Review of Literature

Relevant existing literature links were shared by email correspondence by all members of the writing committee.

Consensus Development

This writing committee was established in July 2022, using the processes described in the ASE Guideline Development Manual.[10] The chair and co-chair created writing committee subgroups and task assignments based on expertise and interests. ASE staff and writing committee subgroup leaders coordinated virtual meetings to review writing assignments, which were then incorporated into a master document after review and consensus from the entire writing committee.

Relation to Other Standards

The writing committee reviewed published data standards, IAC standards, ASE guidelines, and guidelines from other societies, such as the European Association of Cardiovascular Imaging (EACVI), were also important for consensus building.[11]

Peer Review and Public Comment

The document was posted online for a 21-day public comment period. The document was revised based on feedback from all reviewers including the ASE Guidelines and Standard Committee Chairs and members and with consideration of public comments.

STYLISTIC PRINCIPLES TO IMPROVE COMMUNICATION

An echocardiography report should use simple sentences that clearly describe the pathology, convey a message that can be translated into clinical care, and avoid excessively wordy or "teaching" statements, which can lead to confusion. Some echocardiography laboratories may favor concise bullet points, while others may prefer full sentences. However, agreement and consistency on writing styles among readers in each laboratory is recommended. For example, it may be sufficient to report "normal structure and function" when what constitutes normalcy for the structure referred to is likely to be universally understood (e.g., a trileaflet aortic valve). However, more descriptive statements may be required in less common situations or to emphasize normalcy. Vocabulary and terminology that adhere to existing guidelines should be favored, and consistent laboratory-specific terminology should be utilized when a universal nomenclature is not available. Unclear technical terms, names (e.g., McConnell's sign), and jargon (e.g., smoke [for spontaneous echo contrast]) that are either not accepted medical terms or that non-cardiologists or non-physicians are unlikely to understand, should be avoided.

Avoiding prepositional phrases is an easy way to shorten communication. When describing cardiac anatomy, structure (or morphology) and function should be reported consistently and in that order. Abnormal numerical values should be accompanied by a description of the associated pathology and not simply reported as values. For example, "left atrial volume index is 35 ml/m^2" should not stand alone but be accompanied by "left atrium is mildly dilated." Cardiac structure and function assessments should be reported as normal or abnormal and only graded (e.g., mild, moderate, severe) when current guidelines include grading recommendations. A consistent grading system should be developed within a laboratory in exceptional cases when grading outside of standard guideline recommendations is important (e.g., grading the severity of mitral annular calcification when contemplating mitral valve interventions or the degree to which valves are thickened). The descriptions of normal variants should be reported as such (e.g., Eustachian valve, Chiari network, Lambl's excrescence, mild dilatation of the left atrium during pregnancy). In general, communications using concise, broadly understood terminology are encouraged, and the use of arcane language is discouraged. See Table 1 for echocardiography reporting stylistic dos and don'ts. Certain colloquial descriptions found in medical literature may be helpful, but they should not be used in isolation. For example, "Diastolic doming of the anterior mitral valve leaflet (hockey-stick appearance) which is consistent with chronic rheumatic mitral valve disease."

Table 1 Stylistic dos and don'ts

Do	Don't	Examples
• Use simple sentences or phrases in the report.	• Use excessively wordy or "teaching" statements.	• Recommended: "Mitral annular disjunction is present" • Discouraged: There is separation between the mitral valve annulus, the left atrial wall, and the basal portion of the inferolateral left ventricular myocardium during systole. Therefore, there is mitral annular disjunction."
• Use consistent vocabulary in echocardiography reports within a laboratory and health system to describe the certainty of findings and grading of pathology.	• Allow individual readers within a laboratory to use inconsistent words to describe the certainty of findings or grading of pathology.	• Recommended: "A bicuspid AoV is (present, suspected)" • Recommended: "Mild paravalvular regurgitation" • Recommended: "The LV is dilated (or enlarged)" • Recommended: "Global vs. generalized LV systolic dysfunction"
• Use guideline-defined terminology and grading of pathology when this is available and lab-specific terminology when universal nomenclature is not available. A grading range may be used when data are not exclusively within a single grade (e.g., moderate-to-severe aortic stenosis may indicate moderate or severe stenosis and additional testing may be needed).	• Grading specific pathology when grades do not exist in current guidelines and/or use inconsistent grading of pathology within a laboratory.	• Recommended: "mild, moderate, or severe aortic stenosis" • Discouraged but permissible: "moderate-to-severe aortic stenosis." • Discouraged: "mild, moderate, or severe aortic valve calcification." (unless internal lab definition)
• Only utilize standard abbreviations that can be easily understood by a non-cardiologist, use them consistently, and define abbreviations when feasible.	• Use non-standard, complex, or outdated abbreviations or terms that are unlikely to be understood by a non-cardiologist. • Use abbreviations with multiple possible definitions (e.g., MVR could mean mitral valve replacement, mitral valve repair, or mitral valve regurgitation), see Table 3.	• Recommended: "There is severe asymmetric hypertrophy of the interventricular septum and systolic anterior motion of the mitral valve, consistent with hypertrophic cardiomyopathy." • Discouraged: "Severe asymmetric hypertrophy of IVS and SAM, suspect HOCM."
• Avoid prepositional phrases. Examples of prepositional words are: "in," "at," "on," "of," and "to."	• Use excessively wordy statements.	• Recommended: "The following segments are akinetic: ." (5 words) • Discouraged: "All *of the* following segments are akinetic: ." (7 words)- these add up
• Describe structure and function in that order.	• Inconsistently describe functional statements and anatomic descriptions.	• Recommended: "The aortic valve is normal in structure. There is no aortic stenosis or regurgitation." • Discouraged: "There is no aortic regurgitation. Trileaflet aortic valve. Normal aortic valve velocity."
• Numerical values, such as transvalvular gradients across a prosthetic valve or chamber volumes, should state whether the values are normal or abnormal with any proviso statements if necessary.	• Ignore abnormal values that may be explained by extenuating physiologic conditions.	• Recommended: "AoV gradients are increased which may be related to high stroke volume." "Left atrium is dilated, which may be normal in post-transplant heart" (describe the finding and provide insight). • Discouraged (diagnosis and numerical measurement mismatch error): "Normal LA size (LAVi 50 ml/m^2)."
• Numerical tables and qualitative and quantitative interpretive statements must agree throughout the report.	• Inconsistency in qualitative assessment and quantitative measurements. • Inconsistency in LVEF reporting.	• Recommended: "There is moderate LV systolic dysfunction with an LVEF of 35%". • Discouraged: "There is moderate LV systolic dysfunction with a visually assessed LVEF of 35%, 3D derived LVEF 42%, and 28% by biplane Simpson's method".

(*Continued*)

Table 1 (*Continued*)

Do	Don't	Examples
• Generate a summary statement highlighting key findings to answer pertinent clinical questions, and abnormal or critical findings, using simple points that can be interpreted independently. • Include illustrative image (s) if software allows, for masses, pericardial effusion, or other relevant findings.	• Generate a lengthy summary that repeats numerous "findings" statements not linked to exam indication or providing clinical relevance or data synthesis.	• Recommended: summary statement should include at least three elements: ventricular function, pathologic findings, and a comparison statement. Describe pertinent findings such as pericardial effusion when clinically relevant or as part of the exam indication. • Discouraged: Include a description of the pericardium in all report summaries. • Encouraged: when study indication is "new cardiac murmur," include pertinent negative finding: "No significant valve disease detected."
• The summary statement should include a comparison with prior echo studies and/or studies using other imaging modalities. • State whether the comparison was made by reviewing the prior study images or only a report.	• Fail to compare and document significant interval changes available in the electronic health record.	• Recommended: Compare LVEF and regional wall motion changes with a prior exam and describe any differences. Example: "Compared with prior TTE by images and report review dated XX, LVEF has declined." • Discouraged: Failing to make and report such comparisons or simply comparing written report findings when images are available (especially when interval changes are considered clinically significant).
• Documenting critical results communicated to the care team in the summary statement.	• Fail to communicate critical results to the care team and document this communication (see Table 11).	• Recommended: "These findings were discussed with the care team." • Discouraged: No documentation of critical findings.

Abbreviations are helpful communication shortcuts that can lessen time and effort expenditure by reducing words. However, the proliferation of abbreviations in medical literature and clinical reporting has become a significant communication impediment. Improper, inconsistent, and excessive use of abbreviations can lead to medically dangerous interpretation errors by human readers, or by natural language processing algorithms.[11-13] Abbreviations and acronyms should be defined when needed; their use should be limited to standard ones likely to be understood by a non-cardiologist and must be used in a consistent manner. In this document, "echo" is an abbreviation for three different words: echocardiography, echocardiogram and echocardiographic. When precision is needed, the full word echocardiography (a noun) represents both the professional field and the procedure; an echocardiogram (a noun) is a result (i.e., the images and report); and, echocardiographic (an adjective) is descriptive (e.g., echocardiographic measurements, findings, or artifacts).

In a recent examination of abbreviation usage by 114 guidelines documents published by seven cardiovascular and cardiovascular imaging societies over the past six years, there were >5,000 entries for 1,782 unique abbreviations.[14,15] The discrepancy rate was up to 14.5% in certain cases, with some common abbreviations having up to 4 different meanings (e.g., CA, PVR). This same document identified numerous commonly used abbreviations (e.g., LVEF) that we can recommend for standardized echo reporting, particularly when the meaning is also defined within the document. (see Table 2). Laboratories may develop internal abbreviation lists if the definitions are uniformly applied across interpreting physicians and their health systems. Avoid abbreviations listed in Table 3.

Acronyms are abbreviations formed from the initial letters of other words that are then said as a single word. Acronyms are frequently not understood by many readers. For example, "MAC" for mitral annular calcification or "SAM" for systolic anterior motion may be well-understood by echocardiographers reading this document, but they are unlikely to be understood by non-cardiologists reading an echocardiography report. Certain acronyms are permitted, but in general, should be avoided. Abbreviations should be avoided in the indications section and minimized in the summary statement.

ELEMENTS OF COMPREHENSIVE ECHOCARDIOGRAPHY REPORTS

Standard reporting assumptions and definitions are listed in Table 5. The discussion below and Table 10 provide detailed recommendations for the interpretation section of a comprehensive TTE and TEE (and stress echo in many cases) report based on required cardiac structure categories, reporting parameters specific to each structure (morphology, function, physiology), and the recommended findings to be included in the report. The following criteria and assumptions were used in developing these recommendations.

- "Yes" is used to indicate elements that should be reported consistently, as long as technically feasible.
- "No" is used to indicate elements that are usually not applicable to a specific modality and not expected in the report.
- "Yes, if present" is used to indicate elements that should be reported if present, abnormal, or if considered a pertinent negative based on the reason for the study.
- "Optional" is used to indicate elements that may be reported depending on the clinical context, study indication, and patient-specific factors, at the discretion of the reading physician.

Table 2 Recommended abbreviation

Abbreviation	Definition
2D	2-dimensional
3D	3-dimensional
AoAbd	Abdominal aorta
AoArch	Aortic arch
AoAsc	Ascending aorta
AoDesc	Descending aorta
AoSoV	Aortic root sinus of Valsalva
AoV	Aortic Valve
AR	Aortic regurgitation
AS	Aortic stenosis
ASD	Atrial septal defect
ASE	American Society of Echocardiography
AVA	Aortic valve area
bpm	Beats per minute
BSA	Body surface area
CAD	Coronary artery disease
CM	Cardiomyopathy
cm	Centimeter(s)
cm/s	Centimeter(s) per second
CMR	Cardiovascular magnetic resonance
CT	Computed tomography
CWD	Continuous wave Doppler
DI	Dimensionless index
DSE	Dobutamine stress echocardiography
ECMO	Extracorporeal membrane oxygenation
EROA	Effective regurgitant orifice area
GLS	Global longitudinal strain
HCM	Hypertrophic cardiomyopathy
HOCM	Hypertrophic obstructive cardiomyopathy
IABP	Intra-aortic balloon pump
IAS	Interatrial septum (septal)
ICE	Intracardiac echocardiography
in	inch(s)
IVC	Inferior vena cava
kg	kilogram
lb	pound
LA	Left atrium (atrial)
LAA	Left atrial appendage
LAAO	Left atrial appendage occlusion
LCC	Left coronary cusp
LV	Left ventricle (ventricular)
LVAD	Left ventricular assist device
LVEDD	Left ventricular end-diastolic dimension
LVEDV	Left ventricular end-diastolic volume
LVEDVi	Left ventricular end-diastolic volume index
LVEF	Left ventricular ejection fraction
LVESD	Left ventricular end-systolic dimension
LVESV	Left ventricular end-systolic volume
LVESVi	Left ventricular end-systolic volume index
LVH	Left ventricular hypertrophy
LVOT	Left ventricular outflow tract
LVOTO	Left ventricular outflow tract obstruction
m	meter(s)
m/s	meter(s) per second
MAC	Mitral annular calcification
max	maximal
MCS	Mechanical circulatory support
METS	Metabolic equivalents
MR	Mitral regurgitation
MS	Mitral stenosis
ms	millisecond
MV	Mitral valve
MVAA	Mitral valve annulus area
MVOA	Mitral valve orifice area
MVP	Mitral valve prolapse
NCC	Noncoronary cusp
PA	Pulmonary artery
PASP	Pulmonary arterial systolic pressure
PBAV	Percutaneous balloon aortic valvuloplasty
PBMV	Percutaneous balloon mitral valvuloplasty
PDA	Patent ductus arteriosus
PHT	Pressure half-time
PFO	Patent foramen ovale
PISA	Proximal isovelocity surface area
POCUS	Point-of-care ultrasound
PR	Pulmonic regurgitation
PS	Pulmonary stenosis
PV	Pulmonic valve
PVein	Pulmonary vein
PVL	Paravalvular leak
PWD	Pulsed wave Doppler
Qp:Qs	Pulmonary-to-systemic flow ratio
RA	Right atrium (atrial)
RAP	Right atrial pressure
RCC	Right coronary cusp
RPP	Rate pressure product
RV	Right ventricle (ventricular)
RVAD	Right ventricular assist device
RVEF	Right ventricular ejection fraction
RVOT	Right ventricular outflow tract
RVSP	Right ventricular systolic pressure

Table 2 (*Continued*)

Abbreviation	Definition
s	second
SAM	Systolic anterior motion
STE	Speckle tracking echocardiography
SV	Stroke volume
SVC	Superior vena cava
TAPSE	Tricuspid annular plane systolic excursion
TAVR/TAVI	Transcatheter aortic valve replacement/implantation
TDI	Tissue Doppler imaging
TEE	Transesophageal echocardiography
TEER	Transcatheter edge-to-edge repair
THV	Transcatheter heart valve
TMVR	Transcatheter mitral valve replacement
TPVR	Transcatheter pulmonary valve replacement
TR	Tricuspid regurgitation
Transverse Ao	Transverse aorta
TTE	Transthoracic echocardiography
TTVR	Transcatheter tricuspid valve replacement
TV	Tricuspid valve
TVAA	Tricuspid valve annulus area
TVOA	Tricuspid valve orifice area
UEA	Ultrasound enhancing agent
v	Velocity
VC	Vena contracta
VCA	Vena contracta area
ViR	Valve in ring
ViV	Valve in valve
Vmax	Maximum velocity
VSD	Ventricular septal defect
VTI	Velocity time integral

- Each structure is adequately visualized for interpretation.
- Various descriptions, including for masses, should reference Table 9.
- Reports should include appropriate information about additional diagnostic maneuvers (e.g., Valsalva maneuver, leg raising). Table 11 describes the recommendations for reporting maneuvers used during the echocardiogram.

Transthoracic Echocardiography Report

Demographic information, essential history, indication for the exam and priority of the study, should be included at the top of a TTE report (see Table 5). Vital signs such as blood pressure should be obtained at the bedside concurrent with the start of exam (not copied from records). Heart rate and rhythm, particularly significant bradycardia, tachycardia, and irregular rhythm, as well as paroxysmal occurrence of abnormal heart rate and rhythm disturbances during the exam, should be documented. When measurements of height and weight are not practical, information obtained from patients verbally or carried over from the medical record should be labeled as such. In addition to established measurement parameters (Table 6), a TTE report should include report headings for each of the following cardiac structures: left ventricle (LV), interventricular septum (IVS), right ventricle (RV), left atrium (LA, including pulmonary veins), interatrial septum (IAS), right atrium (RA), aortic valve (AoV), mitral valve (MV), pulmonic valve (PV), tricuspid valve (TV), aorta, pulmonary artery (PA), inferior vena cava (IVC), superior vena cava (SVC), pericardium, and when relevant implanted devices (e.g., MCS).[3,11,16,23] Appropriate interpretation details should be organized under the appropriate cardiac structure or device heading.

Reporting Cardiac Chambers. The echocardiography report should include an assessment of the LV size and indexed to the body surface area (BSA), wall thickness, and systolic and diastolic function. If any abnormalities are noted, they should be described in detail.[3,11,16-18,24] The details of ultrasound enhancing agents (UEAs) use should be stated in the report (see Table 5). The report should also describe RV morphology, structure, and systolic function.[24]

When strain evaluation is performed, results should be reported as either positive or negative, depending on the type of strain assessed. For example, LV and RV global longitudinal strain (GLS) are conventionally expressed as negative values.[25] Strain values should be consistently classified as normal, abnormal, or borderline according to established laboratory standards. Significant changes from prior studies (e.g., relative GLS change exceeding 15%) should be documented, clearly indicating whether the absolute strain value has increased or decreased to prevent confusion.[17] Strain results may vary with the imaging platform and data compression type, and this data should be captured in the demographics section (see Table 5).

The size and morphology of the LA should be described and indexed to the BSA, and any masses should be described. The pulmonary vein spectral Doppler blood flow patterns should be mentioned when significant mitral regurgitation (MR) is present or if there is suspicion for elevated LA or LV pressure. The RA size should be reported, and any masses should be described.[24]

The morphology and structure of the IVS and the presence of ventricular septal defects (VSDs) should be reported when indicated.[3,11] The morphology and structure of the IAS should also be reported.[3,11] Finally, if agitated saline contrast studies are performed, the absence or presence of shunting should be stated along with the maneuver used, if any. Commenting on the degree of shunting is recommended (e.g., "large amount of saline contrast seen in the left heart").

Reporting cardiac masses should include comments about location, attachment, size, echogenicity, shape, mobility, and differential diagnosis (such as neoplasm, vegetation, or thrombus).

Reporting Cardiac Valves. Each cardiac valve should be reported as structurally normal or abnormal. For the normal aortic valve, in addition to stating that it is structurally normal, reporting the normal presence of three leaflets and normal leaflet (cusp) mobility is recommended. Many normal tricuspid valves are not trileaflet, and reporting the number of TV leaflets, if properly visualized, is also recommended. Reporting pulmonary valve leaflet number may be deferred. Valve abnormalities should be described in detail, including an abnormal number of leaflets (congenital abnormalities), thickening, abnormal leaflet mobility, or other relevant findings such as calcifications or suspected types of degenerative changes (e.g., calcific, myxomatous, rheumatic). For all abnormal valves, the presence or absence of stenosis or regurgitation should be reported along with one of three severity qualifiers recommended by ASE guidelines:

Table 3 Abbreviations to avoid due to multiple meanings

Abbreviation	Possible Definitions
AI	Aortic insufficiency, artificial intelligence
ASA	Atrial septal aneurysm, alcohol septal ablation
AV	Aortic valve, atrioventricular, arteriovenous
BAV	Bicuspid aortic valve, balloon aortic valvuloplasty
CA	Coronary artery, cardiac amyloidosis, cardiac arrest, competitive athletes
CS	Coronary sinus, conscious sedation, cardiogenic shock
DT	Deceleration time, deep transgastric, destination therapy
IE	Infective endocarditis, interventional echo
MI	Mechanical index, myocardial infarction
MVR	Mitral valve replacement, mitral valve repair, mitral valve regurgitation
PE	Pulmonary embolism, pericardial effusion
PPM	Patient-prosthesis mismatch, permanent pacemaker
PVR	Pulmonic valve regurgitation, pulmonary valve replacement, paravalvular regurgitation, pulmonary vascular resistance
PW	Pulsed wave Doppler, posterior wall
TS	Tricuspid stenosis, transseptal
VA	Ventriculoatrial, veno-arterial, ventricular arrhythmia

Table 4 Suggested strategies to disambiguate confusing commonly used abbreviations

Abbreviation	Possible definitions
Ao	aorta
AoV	aortic valve
AoVReplaced	not AVR
AoVRepaired	not AVR
MVReplaced	not MVR
MVRepaired	not MVR
TVReplaced	not TVR
TVRepaired	not TVR
PVReplaced	not PVR
PVRepaired	not PVR
PVein	not PV

mild, moderate, or severe.[3,11,19,26-29] These severity qualifiers are supported by well-established published parameters. Numerical grading (e.g., grade I–IV) may also be included when supported by guideline-established criteria and can be particularly helpful in research settings or utilized by core labs in clinical trials. However, reporting numerical grades alone without the standard guideline-recommended qualifiers is discouraged. The writing committee acknowledges that terms such as "trace," "insignificant," "trivial," "physiologic," or "minimal" have been historically used to describe the presence of "less than mild" regurgitation. These jets often exhibit incomplete spectral Doppler displays. We recommend the use of "trace" in place of all other "less than mild" regurgitation descriptors.

"Trace" regurgitation of a structurally normal native valve or a prosthetic valve may be considered normal, whereas mild or greater aortic or mitral valve regurgitation should be classified as abnormal. However, for structurally normal native tricuspid or pulmonary valves, mild regurgitation may be regarded as a normal functional finding (physiologic). A statement such as "mild tricuspid regurgitation is present, which may be within normal limits", can be used in the report. For valve regurgitation, reporting tools should include the options: no (none), trace, mild, moderate and severe. Terms like "massive" or "torrential" may be used to further classify severe tricuspid regurgitation when appropriate.[26] For valve stenosis, reporting tools should include the options: no (none), mild, moderate, severe. "Very severe" valve stenosis may be used when criteria are met according to established guidelines.[30] "Critical" valve stenosis is not explicitly defined in major guidelines. However, a severely stenotic lesion may be additionally described as a "critical result" in the report summary based on pertinent associated findings and context. The classifications "mild-to-moderate" and "moderate-to-severe" for valve regurgitation or stenosis should be used sparingly when data is insufficient to assign a specific classification (see Table 8).

For prosthetic or repaired valves, the report should mention the type, size, motion, and function of the valve, any mass lesion, as well as stenosis or regurgitation grading.[31]

Reporting Arteries and Veins. The report should include information on the size and any abnormalities of the aorta and PA. Measurements of the aortic diameters should be performed according to established guidelines[17,32] and we recommend clearly reporting the specific segment measured (e.g., aortic root measured at the sinuses of Valsalva from the parasternal long axis view). The size and respiratory changes of the IVC are recommended but optional. The estimated right atrial pressure should always be reported, even if the observation is "unable to assess" due to imaging limitations. A description of the pulmonary vein flow should be included when appropriate. Abnormal hepatic vein Doppler waveform observations should be reported when warranted (e.g., pericardial pathology, volume status, TV pathology). Any vascular abnormalities (such as thrombus, tumors, catheters) should be reported and described.[3,11,16]

Reporting the Pericardium. Report the presence or absence of pericardial effusion. If a pericardial effusion or other abnormal pericardial finding is present, the report should describe the size (qualitatively and quantitatively if possible), location, and the presence or absence of hemodynamic compromise. The presence, suspicion for or absence of cardiac tamponade or constrictive physiology should be included in the report. Reporting the presence of pericardial adipose tissue depends on the clinical indication of the study and is under the discretion of the reader. Suspected pericardial pathologies such as masses or thickening should be reported.[3,11]

Table 5 Reporting standards assumptions

Reporting Standards Recommendations apply to the following protocols:
• Adult comprehensive transthoracic echocardiography (TTE)
• Adult limited (aka problem focused exam)
• Adult transesophageal echocardiography (TEE)
• Adult stress echo for ischemic heart disease
• Adult stress echo for structural heart disease
• Indicated techniques and associated maneuvers (e.g., three-dimensional [3D], strain, Valsalva, IV saline contrast) See Table 6
• Simple adult congenital heart disease assessment when present (e.g., shunt assessment)
• Mechanical circulatory support reporting includes device type and implant sites
Reporting Standard Recommendations do not address the following protocols:
• Pediatric echocardiography
• Comprehensive adult congenital heart disease
• Point-of-care ultrasound (POCUS)
Exams are performed by adult echocardiography laboratory
Reporting recommendations do not address staff training, credentialing, or privileging
Recommendations do not address billing or reimbursement matters
Reports include the following data fields
• **Header** Health facility name, echo lab site address and contact information
• **Protocol** including basic and special protocols

• **Date & time** information adequate to assess workflow (turnaround times)
  • Date & time ordered-to-date & time performed
  • Date & time performed-to-date & time interpreted (and distributed)

• **Prior exam identification** (if known/available)
• **Indication(s)** should be listed and appropriate in the context of the clinical history, physical findings (including lab and ECG data), and prior imaging studies.
• **Clinical information** (e.g., known/suspected disease [signs, symptoms, related interventions], and related other prior imaging studies).
• **Demographic information** adequate to analyze and improve local/internal health system quality of care and compatible with research registries   ◦ Age (date of birth), gender, race/ethnicity, height, weight, body surface area.
• **Priority** (e.g., routine, high priority, urgent, stat) (see Table 8)
• **Cardiac rhythm and rate** (baseline cardiac rhythm and significant paroxysmal rhythm disturbances during the exam; bradycardia/tachycardia)
• **Blood pressure** obtained at the bedside concurrent with the start of exam (not copied from records). For physiologic interventions (maneuvers) or at stages of stress testing the concurrent blood pressure is re-entered in a sequential fashion as appropriate.
• **Imaging platform make and model**
• **Transducer type make and model (TTE or TEE)**
• **Ultrasound Enhancing Agent [(no / yes – type & dose), reaction (no / yes – describe)]**
• **Additional information (including complications, prior imaging technical notes)**

• **Measurements Table (see Table 6)**
  • Hemodynamic and volume measurements (e.g., calculated pressures, stroke volumes, regurgitant volumes, LVEF, LA Volume) should be reported as whole numbers.
  • When bracketed ranges may be appropriate (e.g., RAP = 0-5 mm Hg, SPAP = 25-30 mm Hg, the average of such ranges may be used [single number]).
  • Reporting precision should be appropriate. Velocity, area, and most linear measurements should not be reported with accuracy >0.1 (e.g., AoV Vmax = 4.2 m/sec is appropriate [not 4.21 m/sec], AVA = 1.2 cm^2 is appropriate [not 1.22 cm^2], AoSoV dimension = 4.2 cm is appropriate [not 4.21 cm].

• **Multiple measurements: Baseline, after maneuver(s), stages of stress protocols**
  • Analysis and reporting systems should provide multiple repeated measurement fields that are tagged to the appropriate stage of the exam, enabling repeated sampling and pertinent calculations to accommodate the wide range of protocols recommended for ischemic and non-ischemic stress protocols, maneuvers, and mechanical circulatory support device changes.
  • Rather than providing an exhaustive list of potential scenarios for stress echo and physiologic maneuver reporting, we recommend maximal flexibility in the ability for laboratories to define protocols and to be able to readily activate the needed observational statements and/or measurement packages at each stage of a protocol or after an intervention in addition to all baseline evaluations.

• **Interpretation:** anatomical and functional descriptions of the 4 cardiac chambers, the 4 valves, pulmonary veins (as appropriate), pericardium, aorta, pulmonary artery, SVC, IVC, and any pertinent devices or extracardiac structures - if cannot evaluate, so state.

(*Continued*)

Table 5 (*Continued*)

• **Summary Statement:** important findings synthesis, integration, diagnosis, comparison, and reconciliation with prior echo or other imaging findings; may suggest other complementary imaging modality. "Critical findings" should be labeled as such and appear obvious to the reader (e.g., first summary entry).
• **Personnel**
• **Ordering** clinician (preferably with contact information)
• **Performing** (sonographer/physician)
• **Trainee Performing** (when applicable)
• **Trainee Interpreting** (when applicable)
• **Interpreting physician** "signature" with date/time stamp
• **Other Fields** (e.g., teaching case, credentialing case, research names)
Report distribution (including critical results) is **timely** in accordance with institutional policy
Report formats are **electronic** and **print-ready** for distribution according to the healthcare facility's internal standards in accordance with patient confidentiality standards
Abbreviations use should be limited and carefully defined (see Table 2) and avoided in the indication(s) and summary statement fields
Acronym Abbreviations (e.g. clinical trial names) should be avoided or defined by full name within the report

Reporting Extracardiac Findings. The report should include extracardiac findings such as pleural effusions (left, right, or bilateral) and ascites. Other suspected incidental abnormalities in the chest, abdomen, and neck within the field of view of the echocardiogram should be described. Additional dedicated imaging with other modalities may be recommended.

Reporting the Use of Ultrasound Enhancing Agents. A UEA should be used when there is poor visualization of the endocardium and two or more contiguous segments cannot be adequately visualized for the assessment of LV function and regional wall motion.[17] If a UEA is used, the type of UEA (agent) the administered dose and any reaction should be stated in the report (see Table 5).[3,11,33] Within echocardiography guidelines, UEA has been established as the preferred terminology for microbubbles employed to improve endocardial border delineation. This clarification assists patients and referring physicians in distinguishing it from agitated saline contrast, iodinated contrast, and gadolinium chelates.[20,33,34] However, within the radiology community, the term ultrasound contrast agent (UCA) is considered synonymous with UEA, with contrast-enhanced ultrasound referring to the technique of using UEAs/UCAs with ultrasound imaging.

Reporting the Use of Agitated Intravenous Saline Contrast. An intravenous saline study, performed during normal breathing and with maneuvers (e.g., Valsalva, abdominal compression), can detect intracardiac and intrapulmonary shunting.[20,34] The report should specify if shunting occurs early during normal breathing (patent foramen ovale (PFO) or atrial septal defect (ASD) or after maneuvers (Table 11). PFO shunting may occur only after Valsalva release or when RA pressure exceeds LA pressure, even if transiently. Delayed bubbles in the left atrium after several cardiac cycles suggest intrapulmonary shunting. In addition to qualitatively reporting the amount of shunting, the report should mention the likely shunt location (atrial septal vs intrapulmonary) and nuances such as the intravenous saline study's reliability related to image quality and patient cooperation.

Reporting Additional Maneuvers. Physiologic maneuvers, generally used to provoke right-to-left shunt, evaluate left ventricular outflow tract (LVOT) obstruction, or LV diastolic filling, should be reported in the appropriate section of the report that has been specifically designated with the reporting tool. A recent review outlining techniques for the most common provocative maneuvers and their reporting is described in Table 11.[16-21]

Transesophageal Echocardiography Report

In addition to the basic parameters, a TEE report should include information regarding the medications used during the procedure (referencing sedation provided by the anesthesiology service if applicable), comments about the ease or difficulty in TEE transducer insertion, and the presence or absence of complications. The report should provide information regarding the morphology and function of the cardiac structures imaged, and describe any abnormalities identified. When compared with TTE, the quantitative evaluation of cardiac morphology/structure and function by TEE can be limited by factors related to the imaging technique itself (e.g., LA volume), or the paucity of normative data, and qualitative evaluation may be sufficient. However, an effort should be made to provide quantitative data when possible and when clinically necessary.[23] Additionally, the scope of structures examined in detail via TEE, and consequently included in the report, may vary based on the specific study indication. Table 10 provides a summary of the recommended components for a comprehensive TEE report.

Reporting Cardiac Chambers. The TEE report should include information about the size and systolic function of both ventricles. A qualitative assessment is required, with quantitative parameters provided optionally. Additionally, any regional wall motion abnormalities, structural abnormalities, masses, or devices should be reported and described when present. References to wall thickness, hypertrophy, and quantitative assessments of systolic or diastolic function are optional albeit less commonly reported, given that normative data in current guidelines primarily relies on TTE.[16] Advanced methods such as three-dimensional (3D) imaging can enable quantitative evaluation despite lack of well-established normative range.[17] Conversely, TEE offers superior visualization of the right and left atria, the IAS, and venous connections compared to TTE. Consequently, the report should address the presence or absence of interatrial

Table 6 Measurement dictionary

Name of Measurement	Abbreviation	Unit	Suggested number of decimal places
Left Ventricle (LV)			
LV end-diastolic dimension	LVEDD	cm	1
LV end-systolic dimension	LVESD	cm	1
Interventricular septal wall diastolic dimension	IVSD	cm	1
LV posterior wall diastolic dimension	LVPWD	cm	1
Relative wall thickness	RWT	N/A	2
LV end-diastolic volume	LVEDV	ml	0
LV end-diastolic volume index	LVEDVi	ml/m^2	0
LV end-systolic volume	LVESV	ml	0
LV end-systolic volume index	LVESVi	ml/m^2	0
LV ejection fraction	LV EF	%	0
LV fractional shortening	LV FS	%	0
Left ventricular outflow tract diameter	LVOTd	cm	1
Left ventricular outflow tract velocity time integral	LVOT VTI	cm	0
LVOT peak gradient at rest	LVOT peak PG (rest)	mm Hg	0
LVOT peak gradient (Valsalva)	LVOT peak PG (Valsalva)	mm Hg	0
LVOT mean gradient	LVOT mean PG	mm Hg	0
LV Stroke volume	LV SV	cm^3	0
LV Stroke volume index	LV SVi	cm	0
Cardiac output	CO	l/min	1
Cardiac index	CI	l/min/m^2	1
Left ventricular global longitudinal strain	LV GLS	%	1
LV regional wall motion score	LV RWMS	N/A	0
LV regional wall motion score index	LV RWMSi	N/A	0
LV regional thickness	N/A	cm	1
LV regional thickness percent	N/A	%	0
Tau	τ	ms	0
Right Ventricle (RV)			
RV end-diastolic volume	RVEDV	ml	0
RV end-diastolic volume index	RVEDVi	ml/m^2	0
RV end-systolic volume	RVESV	ml	0
RV end-systolic volume index	RVESVi	ml/m^2	0
RV wall thickness	RV wall thickness	cm	1
Right ventricular systolic pressure	RVSP	mm Hg	0
Pulmonary artery systolic pressure	PASP	mm Hg	0
Tricuspid annular plane systolic excursion	TAPSE	cm	1
Basal RV free wall peak systolic velocity	RV TDI s'	cm/s	1
Right ventricular ejection fraction	RV EF	%	0
Right ventricular fractional area change	RV FAC	%	0
Right ventricular outflow tract dimension	RVOTd	cm	1
Right ventricular basal dimension (RV focused view)	RV basal dimension	cm	1
Right ventricular outflow tract velocity time integral	RVOT VTI	cm	0
RV stroke volume	RV SV	ml	0
RV stroke volume index	RV SVi	ml/m^2	0
Right ventricular outflow tract peak velocity	RVOT peak vel	m/s	1
Right ventricular outflow tract peak pressure gradient	RVOT peak PG	mm Hg	0
Right ventricular outflow tract mean pressure gradient	RVOT mean PG	mm Hg	0
Right ventricular outflow tract acceleration time	RVOT AccT	msec	0

(*Continued*)

Table 6 (*Continued*)

Name of Measurement	Abbreviation	Unit	Suggested number of decimal places
Right ventricular free wall longitudinal strain	RVFWS	%	1
Right ventricular global longitudinal strain	RVGLS	%	1
Left Atrium (LA)			
LA volume	LAV	ml	0
LA volume index	LAVi	ml/m^2	0
LA area	LA area	cm^2	1
LA anteroposterior dimension	LA AP	cm	1
LA medial-to-lateral dimension (length)	N/A	cm	1
LA pressure	LAP	mm Hg	0
LA strain (LA reservoir strain, LA conduit strain, LA contractile strain)	LAS (LASr, LAScd, LASct)	%	1
LA Appendage (LAA)			
LAA orifice area	N/A	cm^2	1
LAA ostium and landing zone (0, 45, 90, 135 degrees)	N/A	mm	0
LAA depth (0, 45, 90, 135 degrees)	N/A	cm	1
LAA filling velocity	N/A	m/s	2
LAA emptying velocity	N/A	m/s	2
Right Atrium (RA)			
Right atrial area	RA area	cm^2	1
Right atrial pressure	RAP	mm Hg	0
RA posterior-to-annulus dimension (length)	N/A	cm	1
RA major dimension	N/A	cm	1
RA minor dimension	N/A	cm	1
RA volume	RAV	ml	0
RA volume index	RAVi	ml/m^2	0
Mitral Valve (MV)			
MV peak E-wave velocity	MV E	m/s	2
MV peak A-wave velocity	MV A	m/s	2
MV E to A velocity ratio	MV E/A	N/A	1
MV PWD velocity at annulus	N/A	m/s	2
MV peak pressure gradient	MV peak PG	mm Hg	0
MV mean pressure gradient	MV mean PG	mm Hg	0
MV E wave deceleration pressure half-time	MV PHT	msec	0
MV E wave deceleration time	MV DcT	msec	0
MV orifice area (continuity equation)	MVOA (continuity)	cm^2	1
MV orifice area (pressure half-time)	MVOA (PHT)	cm^2	1
MV orifice area (planimetry)	MVOA (planimetry)	cm^2	1
3D MV orifice area	3D MVOA	cm^2	1
MV annulus area	MVAA	cm^2	1
3D MV annulus area	3D MVAA	cm^2	1
MV velocity time integral	MV VTI	cm	0
Mitral annular lateral e' velocity	MV lateral e'	cm/s	1
Mitral annular medial e' velocity	MV medial e'	cm/s	1
MV E wave velocity to lateral e' velocity ratio	MV lateral E/e'	N/A	0
MV E wave velocity to medial (septal) e' velocity ratio	MV medial E/e'	N/A	0
MV Average lateral E/e' and medial E/e'	MV average E/e'	N/A	0
MR peak velocity	MR peak Vel	m/s	1
MR velocity time integral	MR VTI	cm	0

(*Continued*)

Table 6 (*Continued*)

Name of Measurement	Abbreviation	Unit	Suggested number of decimal places
MR peak pressure gradient	MR peak PG	mm Hg	0
MR dp/dt	MR dp/dt	mm Hg/s	0
MR vena contracta	MR VC	cm	1
3D MR vena contracta area	3D MR VCA	cm^2	2
MR PISA radius	MR PISA r	cm	1
MR PISA aliasing velocity	MR PISA aliasing vel	cm/s	1
MR PISA EROA	MR PISA EROA	cm^2	2
3D MR EROA	3D MR EROA	cm^2	2
Aortic Valve (AoV)			
AoV peak velocity	AoV peak vel	m/s	1
AoV peak gradient	AoV peak PG	mm Hg	0
AoV mean gradient	AoV mean PG	mm Hg	0
AoV area (continuity equation)	AVA (continuity)	cm^2	1
AoV annulus area (planimetry)	AoVAA (planimetry)	cm^2	1
AoV annulus diameter	AoVAd	cm	1
AoV velocity time integral	AoV VTI	cm	0
AoV dimensionless index (either by velocity or by VTI)	AoV DI	N/A	2
AR vena contracta	AR VC	cm	1
3D AR vena contracta area	3D AR VCA	cm^2	2
AR peak velocity	AR peak vel	m/s	1
AR pressure half-time	AR PHT	ms	0
AoV prothesis acceleration time	AoV AccT	ms	0
Tricuspid Valve (TV)			
TV peak E-wave velocity	TV E	m/s	2
TV peak A-wave velocity	TV A	m/s	2
TV E/A ratio	TV E/A	N/A	1
TV PWD velocity at annulus	N/A	m/s	2
Tricuspid lateral annulus e' velocity	TV e'	cm/s	1
TV E/e' ratio	TV E/e'	N/A	1
TV peak pressure gradient	TV peak PG	mm Hg	0
TV mean pressure gradient	TV mean PG	mm Hg	0
TV velocity time integral	TV VTI	cm	0
TV orifice area (PISA)	TVOA (PISA)	cm^2	1
TV orifice area (continuity equation)	TVOA (continuity)	cm^2	1
TV orifice area (planimetry)	TVOA (planimetry)	cm^2	1
3D TV orifice area	3D TVOA	cm^2	1
TV annulus area	TVAA	cm^2	1
3D TV annulus area	3D TVAA	cm^2	1
TR peak velocity	TRmax Vel	m/s	1
TR peak pressure gradient	TRmax PG	mm Hg	0
TR PISA radius	TR PISA r	cm	1
TR PISA aliasing velocity	TR PISA aliasing vel	cm/s	1
TR velocity time integral	TR VTI	cm	0
TR PISA EROA	TR PISA EROA	cm^2	2
3D TR EROA	3D TR EROA	cm^2	2
TR vena contracta	TR VC	cm	1
3D TR vena contracta area	3D TR VCA	cm^2	2

(*Continued*)

Table 6 (*Continued*)

Name of Measurement	Abbreviation	Unit	Suggested number of decimal places
Pulmonic Valve (PV)			
Pulmonary sinotubular junction	Pulmonary STJ	cm	1
Pulmonary ventriculoarterial junction	Pulmonary VAJ	cm	1
PV peak velocity	PV peak vel	m/s	1
PV peak gradient	PV peak PG	mm Hg	0
PV velocity time integral	PV VTI	cm	0
Pulmonary regurgitation pressure half-time	PR PHT	msec	0
Pulmonary valve regurgitation diastolic peak velocity	PRmax Vel diastolic	m/s	1
Pulmonary valve regurgitation end-diastolic velocity	PR Vel end-diastolic	m/s	1
Pulmonary Artery (PA)			
Main pulmonary artery diameter	mPA	cm	1
Right pulmonary artery diameter	rPA	cm	1
Left pulmonary artery diameter	lPA	cm	1
Aorta			
Aortic root sinus of Valsalva	AoSoV	cm	1
Aortic sinotubular junction	AoSTJ	cm	1
Ascending aorta	AoAsc	cm	1
Aortic arch	AoArch	cm	1
Descending aorta	AoDesc	cm	1
Abdominal aorta	AoAbd	cm	1
Coronary Artery			
Left main coronary artery diameter	LM diameter	cm	1
Left main coronary artery height from aortic valve insertion	LM height	cm	1
Right coronary artery diameter	RCA diameter	cm	1
Right coronary artery height from aortic valve insertion	RCA height	cm	1
Fossa ovalis/atrial septum/ventricular septum			
Fossa ovalis dimensions (2D and/or 3D)	N/A	cm	1
Atrial septal rims	N/A	cm	1
Atrial septal defect dimensions (major and minor by 2D and/or 3D)	ASD dimensions (major and minor)	cm	1
Atrial septal defect area (3D)	3D ASD area	cm^2	1
Peak velocity across an ASD	ASD Peak vel	m/sec	1
ASD Pulmonic flow: systemic flow ratio	ASD Qp:Qs	N/A	1
Ventricular septal defect dimensions (major and minor by 2D and/or 3D)	VSD dimensions (major and minor)	cm	1
Ventricular septal defect area (3D)	3D VSD area	cm^2	1
Peak velocity across an VSD	VSD Peak vel	m/sec	1
Peak gradient across an VSD	VSD peak PG	mm Hg	0
Systemic Veins			
Inferior vena cava dimension	IVC	cm	1
Vital signs			
Body mass index	BMI	kg/m^2	1
Body surface area	BSA	m^2	2
Height (meters or inches)	HT	m or in(s)	2 or 0
Weight (kilograms or pounds)	WT	kg(s) or lb(s)	1 or 0
Respiratory rate*	RR	per min	0
Blood pressure	BP	mm Hg	0

(*Continued*)

Table 6 (*Continued*)

Name of Measurement	Abbreviation	Unit	Suggested number of decimal places
Heart rate	HR	bpm	0
Rate pressure product	RPP	mm Hg x beats/minute	0
Mechanical Circulatory Support			
Ventricular septal direction	L/R/Neutral	N/A	N/A
AoV opening pattern	Y/N/barely/intermittent	N/A	N/A
AoV opening duration	AoVOdur	ms	0
Inflow cannula peak velocity	N/A	m/sec	1
Outflow graft peak systolic velocity	N/A	m/sec	1
Outflow graft nadir diastolic velocity	N/A	m/sec	1

For additional interventional echocardiography related specific measurements, please refer to relevant ASE guidelines.[22]
*Optional.

shunting, and the shunt detection technique(s) employed. The report should also describe any atrial structural abnormalities including abnormal venous connections or abnormal venous flow patterns.[20,34,35] Reports should include evaluation and commentary on the left atrial appendage (LAA), optionally noting its shape and providing measurements appropriate for specific devices when indicated.[22] LAA comments should note the presence or absence of a thrombus and spontaneous echo contrast, and optionally attempting to grade it.[23,34] Additionally, LAA emptying velocity should be reported when indicated.

Reporting Cardiac Valves. The TEE report for cardiac valves should mirror the content of the TTE report, including the description of valvular structure and function, with quantitative information when acquired. Enhanced visualization capabilities of TEE often facilitate precise identification and localization of pathology within specific leaflets or scallops, necessitating a more detailed description. Additional morphologic and quantitative parameters specific to screening and planning for structural valve interventions should be reported when applicable.[22] TEE excels in detecting valvular vegetations; when noted, their detailed characteristics and their location with respect to leaflet(s) or other anatomic structures should be described. Similarly, prosthetic valve assessment is recommended to adhere to TTE standards, leveraging TEE's superior imaging for detailed descriptions of pathology and its location. Any identified abnormalities such as abscesses, fistulas, fractures, perforations, pannus, thrombi, or vegetations should be documented and described by leaflet or structure location, size, shape, mobility, and textural features if applicable.[16,19,23,31]

Reporting Arteries and Veins. TEE has a superior ability to evaluate the thoracic aorta; therefore, aortic size and any associated pathology should be reported.[23,32] Though not always imaged by TEE, the IVC and hepatic veins can be imaged when indicated, and if properly visualized, their size and flow pattern should also be reported.[23] Pulmonary vein anatomy descriptions may be important in congenital anomalies, following lung transplant, or in the setting of other pathology (e.g., neoplasm, thrombus) or device placements. Therefore, reporting systems should provide specific fields for comments, which may be used on a case-by-case basis.

Reporting the Pericardium. TEE findings should be reported as described for TTE.

Stress Echocardiography Report

Stress echo encompasses specific protocols for the assessment of coronary artery disease (ischemic heart disease) and other specific protocols designed for a variety of structural heart diseases.[36,37] Rather than focusing on protocols, we will discuss reporting for different cardiac structures (and the needed reporting tools and associated elements) separately, since one or more components may be needed, depending upon the clinical situation, including study indication and unexpected observations during the exam. Tables 12 and 13 provide elements for stress echo reporting.

The stress echo report should include the study date, type of stress test performed (i.e., exercise [treadmill, supine bike], pharmacologic), and indication for the test.[3,11,36-38] The test indication should describe the clinical question being addressed. In addition, the imaging protocol should be stated, as well as the exercise time, pharmacologic peak dose, maximum heart rate, systolic blood pressure (BP) response to stress, and if the appropriate level of stress was achieved. Moreover, the adequacy of the workload, such as rate pressure product (RPP), based on age and sex should be included in the report.[37] If cardiac symptoms, electrocardiogram (ECG) changes, or arrhythmias are present and/or if the test needs to be terminated early, the report should note these events. At each protocol stage (exercise [baseline, post-exercise] and pharmacologic [baseline and low, intermediate, and peak dose]), relevant changes in structure, function, and physiology should be reported.[11,36-38] A summary statement for the stress echo for coronary artery disease evaluation should include the presence or absence of myocardial ischemia, ECG evidence of ischemia or dysrhythmia, patient's symptoms during stress, and pertinent baseline echocardiographic findings.

Reporting the Left Ventricle. The LV chamber and myocardium should be reported as recommended for TTE. Statements regarding systolic BP, global systolic function, and regional wall motion should be provided.[11,37] The LV segments and LV regional wall motion should be described using the terms in Table 7. A regional wall motion score (16-64) and/or estimated wall motion score index (1.0-4.0) may be derived. A bull's eye diagram display is optional.

These report elements should be reported at baseline and at each stage of the stress echo protocol.[36,37] In additional stages, comparison statements should also be included in the report. At each stage, the LV chamber size and regional score should be compared and reported as

Table 7 Left ventricular segment names and wall motion score

Apical Four Chamber View	Segment Names
	Basal inferoseptum
	Mid Inferoseptum
	Apical Septum
	Basal Anterolateral
	Mid Anterolateral
	Apical Lateral
Apical Two Chamber View	
	Basal Inferior
	Mid Inferior
	Apical Inferior
	Basal Anterior
	Mid Anterior
	Apical Anterior
Apical Three Chamber View	
	Basal Inferolateral
	Mid Inferolateral
	Apical Lateral
	Basal Anteroseptum
	Mid Anteroseptum
	Apical Septum
	Apical cap
Segmental Analysis (inward motion / systolic thickening)	Wall motion score
Normal, hyperkinesis, thickening > 50%	1
Hypokinesis	2
Akinesis, severe hypokinesis, thickening < 10%	3
Dyskinesis (paradoxical systolic motion)	4
Aneurysmal (diastolic deformation)	5

unchanged, increased, or reduced.[11,36,37] In addition, the LV global systolic function should be reported with a specific comment on whether the LV ejection fraction increased, decreased, was biphasic, or remained unchanged. In patients with hypertrophic cardiomyopathy, Doppler assessment of LV intraventricular and outflow velocities should be reported with descriptions of location and severity of obstruction at baseline, and during stress and recovery, if present.

Reporting the Right Ventricle. The RV chamber and myocardium should be reported as recommended for TTE. When clinical indications for stress echo are focused on the right ventricle such as evaluation of pulmonary hypertension, and mitral stenosis, quantitative RV measures, should be reported at baseline, during and after exercise if available and when stress-related normative values exist. Reporting fields should allow for RV measurements to be incorporated into each phase of stress. At a minimum, a qualitative assessment of the RV chamber size and function should be reported at each stage. Whenever RV abnormalities exist (at baseline and/or with stress), a statement comparing RV size and function at rest and during stress should be included.[11,36,37]

Reporting the Interventricular Septum. Interventricular septal motion should also be described in the stress echo report if abnormal.[11,36,37] Interventricular septal motion should be described as normal (rightward), leftward, paradoxical, or otherwise abnormal (conduction abnormality) or flattened if appropriate. Septal motion and position should be reported for each stage of the protocol as part of the regional wall motion analysis and bull's eye display, but also independent of wall scoring as many septal motion abnormalities may occur from causes other than ischemia (e.g., RV pressure overload, RV volume overload, conduction abnormalities, ventricular interdependence, constriction) and may become exaggerated during stress testing.

Reporting the Mitral Valve. Various mitral valve parameters may be measured during stress if the exam is intended to assess MR, mitral stenosis (MS), or mitral valve flow parameters related to diastolic stress echo exams. In general, exercise stress protocols are recommended when mitral valve assessment is needed. Pharmacologic stress may be used for MS evaluation. It is recommended that the stress protocol employed is clearly indicated by linking each stage's parameters to the appropriate baseline, individual stress stages, and recovery stage (when utilized) headers.

Mitral valve structure and function at baseline should be reported. Depending upon the mitral valve abnormality being assessed, reporting tools should allow for complete mitral valve assessment and related parameters (e.g., systolic PA pressure estimate) at baseline and at each stage of stress. While a new valve morphology description may not be necessary at each stress stage, any change in MR severity (or lack thereof) should be reported at each stage. If MR is present, the report should state if MR severity is unchanged, increased, or reduced during stress.[36,37] Assessment of MR severity at each stage of stress may be required as an add-on to a coronary ischemia stress protocol. In a protocol designed to evaluate non-ischemic MR, the severity of MR may be assessed at each stage. In MS protocols, the functional data during each stage will determine if stenosis is progressive or severe which the report should reflect. If mitral valve parameters are gathered in the context of a diastolic heart failure assessment (often not related to the degree of MR or MS), this should be evident in the diastolic stress test summary statement.

Reporting the Aortic Valve. Stress echocardiography is sometimes used to evaluate the severity of aortic stenosis. The reporting tool must allow for a comprehensive aortic valve assessment, including aortic valve morphology at baseline and all required aortic stenosis Doppler parameters at all stress stages. The report summary should synthesize baseline and stress data to address aortic stenosis severity in a clear manner.

Reporting the Tricuspid Valve. If indicated, the TV can also be evaluated with stress echocardiography. Careful measurement and reporting of the maximal tricuspid regurgitation (TR) velocity (and estimated systolic PA pressure) is most important for evaluating dyspnea, breathlessness, and fatigue, and for assessing diastolic function or valve disease. The severity of TR, the peak TR velocity, and the corresponding systolic PA pressure should be assessed at each protocol stage and described as unchanged or increased and reported as mild, moderate, severe, massive, or torrential.

Reporting the Use of Ultrasound Enhancing Agents. A UEA should be used in stress echocardiography when there is insufficient visualization of the endocardium to adequately assess wall motion. If a UEA is used, the report should state the UEA type, the route and dose (i.e., intravenous bolus vs infusion) and any reaction.[3,11,33,37]

Table 8 Reporting standards terminology and definitions

Terminology	Definition
Clinical Echocardiography Laboratory	Performs and interprets clinically indicated examinations for an appropriately licensed medical facility.
Echocardiography Core Laboratory	Part of a cardiovascular research center, offering expert independent interpretation of echo exams for clinical trials, partnering as a research collaborator with trial investigators including academic and industry sponsors. Core labs may perform their own exams or interpret exams performed by clinical echo labs that have been formally trained as clinical research sites through contractual agreements.
Registry	Third-party clinical research data repository.
Consultative Echocardiography	A limited or comprehensive examination requested by a patient's primary treating clinician, typically performed and interpreted by a separate specialist team having specialized training (sonographer or physician) in an echocardiography laboratory with full-feature cardiovascular ultrasound equipment. This definition is distinctive from POCUS below.
Comprehensive echocardiography	A complete TTE evaluation as defined by Mitchell *et al.* or a complete TEE exam as defined by Hahn, *et al.* including all standard imaging views and techniques along with additional imagining methods (e.g., strain, 3D, ultrasound enhancing agents [UEA], maneuvers, IV saline contrast or specific quantitative calculations) depending upon the reason for exam and encountered findings.[16,23]
Limited (i.e., problem-focused exam) echocardiography	An exam performed using an abbreviated protocol, typically as a follow-up to a recent comprehensive exam to focus on answering specific clinical questions. The limited exam is also performed by the consultative echo lab using a full-feature machine employing basic and advanced imaging and quantitative measurement techniques as necessary for addressing the clinical indication.
Point-of-care ultrasound (POCUS)[7]	The acquisition, interpretation, and immediate clinical integration of ultrasonographic imaging performed by a treating clinician. Importantly, the general term is not defined by the location where the exam is performed, the capability of the imaging device, or the practitioner's specialty.
Draft report	Measurements, worksheets, and findings that may be entered in writing or electronically generated by experienced sonographers and physicians-in-training for laboratory internal use. A draft report is one that has not been reviewed or approved by an interpreting physician. Therefore, a draft report should not be visible in the electronic record or otherwise issued to external care providers. A draft report can only be provided to the interpreting physician for subsequent editing and approval.
Preliminary report	A verbal or written report generated by an appropriately trained physician, that is approved for clinical use but has not yet been finalized by the interpreting physician. A preliminary report does not include all recommended reporting components but provides preliminary findings to the ordering provider and is sometimes visible in the electronic health record when needed for expedient clinical decision-making.
Final report	A written complete report that has been reviewed, signed, and dated manually or electronically by the interpreting physician. The final report should identify and reconcile any differences with any previously issued preliminary report(s).
Amended report	Whenever changes are made to a previously "final report," an amended report is created. The amended report will refer to the prior reference report by date and time and include clear language that highlights clinically relevant revisions from the prior report. Reporting systems should then allow reporting of only the most recently amended report by the interpreting physician.
Priority assignments	
Routine	Clinically indicated exam, stable patient, can be performed as soon as possible per lab policy.
High	Stable patient but pressing need for clinical decision-making.
Urgent	Requires prompt medical attention due to impending unstable clinical state (may complete another current in-progress exam expeditiously before promptly performing the urgent exam).

(*Continued*)

Table 8 (*Continued*)

Terminology	Definition
Emergent (STAT)	Needed immediately, preempting other tasks, including in-progress exams if necessary.
Descriptions	
Morphology	The study of how things are put together. Bio-morphology deals with the form and structure of living things. Because echocardiography is used to study cardiovascular structure(s), the echo report includes morphological descriptions. A recommended taxonomy and morphological descriptive terms are found in Table 7.
Structure(s)	Normal, normal variant or pathologic tissues or other prosthetic or uncertain cardiac findings.
Severity	
None, Trace, Mild(ly), Moderate(ly), and Severe(ly)	ASE guidelines-based descriptions for abnormalities of function (regurgitation or stenosis) and size (volume or thickness) based on quantitative and semi-quantitative measures. Note: some cardiac structures with abnormal features have *not* been categorized into grades (e.g., degree of leaflet thickening) and in these cases, labs are encouraged to develop internal standards for consistency.
None	When condition clearly excluded
Trace	Less than mild (for valve regurgitation)
Mild(ly)	A clearly detected observation (or degree of other abnormality) usually of no suspected current clinical significance that may or may not be due to a structural or functional abnormality, but it is defined by reference values in ASE guidelines.
Moderate(ly)	An obvious abnormal observation of suspected current or future clinical significance and defined by reference values in ASE guidelines.
Severe(ly)	An obvious abnormal observation of suspected current or future clinical significance and defined by reference values in ASE guidelines.
Massive and Torrential	May describe subgroups of severe tricuspid regurgitation.[26]
Mild-to-Moderate and Moderate-to-Severe	These descriptors do not exist in ASE guidelines tables. They should be used only sparingly when missing or discrepant data prohibits a "mild", "moderate" or "severe" designation. If used, they should have an accompanying statement explaining the reasons for this mixed grade category. Numerical grading systems for valvular regurgitations may be considered when appropriately measured and associated with validated clinical outcomes.
Acuity of Findings	
Routine	Findings clinically warrant no special prioritization for communication.
Significant	Findings are clinically impactful and should be highlighted in the report summary. Significant findings can include important changes which can be further characterized as "new", "resolved", "worse", or "improved". Findings may or may not warrant an interpreting physician's direct communication to the care team.
Urgent	Findings are significant abnormalities or changes from prior testing that require clinical action within hours. Direct personal notification to the care provider is recommended.
Critical	Findings represent a threat to life and require immediate direct verbal notification to the ordering provider (communication within minutes).

MECHANICAL CIRCULATORY SUPPORT

Patients with durable and temporary surgical and percutaneous MCS devices may undergo a baseline examination protocol, which requires a single set of standard heart failure protocol measurements for analysis and reporting. Additionally, measurements may be needed during a single examination (analogous to a stress echo exam) after a change in device speed setting or position, or a drug or fluid challenge. Reporting metrics unique to MCS speed change protocols include aortic valve opening duration (if present), inflow cannula and outflow graft flow velocities, atrial and ventricular septal positions, and aortic regurgitation duration. For aortic micro-axial flow pumps, the inflow zone-to-aortic annulus position (linear measurement) should be reported at baseline examination and after repositioning. Temporary support devices may be implanted in the circulation surgically or percutaneously and reporting fields for cannulation sites should be available, noting that two or more devices may be operating concurrently in the same patient. Interpretation of MCS echocardiography

Table 9 Select descriptors

Descriptor	Definition	Examples (phrases)
Abutting	Mass, foreign body or lesion that touches an adjacent cardiac structure	Inflow cannula ***abutting*** LV septal endocardium
Adjacent to	next to or nearby	The pacing lead is ***adjacent*** to the fossa ovalis
Aneurysm (aneurysmal)	An outward bulging of a structure (vessel, chamber, septum)	LV apex appears ***aneurysmal***
Attached to	Connected with	A small mobile mass is ***attached*** to the AoV right coronary cusp
Billowing	Motion of redundant leaflet or other tissue over a large area.	***Billowing*** TV anterior leaflet motion
Blueberry-on-top	Colloquial term for the central blue surrounded by red pattern on global longitudinal strain bull's eye map. May indicate apical hypertrophic cardiomyopathy; should not be used in isolation	***Blueberry-on-top*** GLS bull's eye map appearance of isolated apical abnormality suggests apical hypertrophic cardiomyopathy
Calcified / calcific	Calcium deposits that are hyperechoic with acoustic shadowing	***Calcified*** appearance of posterior MV annulus
Cherry-on-top	Colloquial term for the central red surrounded by blue pattern on global longitudinal strain bull's eye map. May indicate cardiac amyloidosis; should not be used in isolation	***Cherry-on-top*** GLS bull's eye map appearance of apical sparing suggests cardiac amyloidosis
Circumscribed / demarcated	Clear or distinguished borders	The mass appears well ***circumscribed***
Collapsed / collapse	Shrinking of a cardiac chamber or vessel	There is early RV diastolic ***collapse***
Compressed / compressing	Physical deformation of / by adjacent or surrounded structure	Markedly dilated aortic root ***compresses*** the LA.
Curvilinear	Bent line	A ***curvilinear*** pacing lead
Cylindroid / tubular dilatation	Lengthy dilatation in the form of a cylinder	***Cylindroid / tubular*** aneurysmal dilation of the descending thoracic aorta
Cystic	Appearing to have a fluid-filled sac	The echo-free area is well-demarcated (***cystic*** appearance)
Dehiscence	Separation along a line of weakness	***Dehiscence*** of posterior aspect of bioprosthetic MV sewing ring
Diastolic doming	Often used to describe rheumatic mitral valve appearance in diastole	MV ***diastolic doming*** suggests rheumatic degeneration
Dilatation	Enlargement of a vessel	Aortic ***dilatation***
Dilated	Expanded, enlarged, or widened normally or abnormally in all dimensions	***Dilated*** left ventricle
Doming	Leaflets adopting an architectural dome shape during forward flow	Systolic ***doming*** suggests bicuspid AoV
D-shaped	Shape of RV chamber in cross-section view associated with RV pressure overload	(See septal flattening instead)
Dumbbell appearance	Colloquial term associated with Atrial septal thickening that spares the fossa ovalis	The atrial septum in cross section has a ***dumbbell appearance*** suggesting atrial septal hypertrophy
Dyssynchronous	Incoordinated movement	***Dyssynchronous*** septal motion
Echogenic / hyperechoic	Reflecting ultrasound waves well	***Echogenic / Hyperechoic*** mass
Echolucent / Hypoechoic	Describing structures that poorly reflect ultrasound waves. Also referred to as echo-free	***Echolucent / Hypoechoic*** areas within the mass
Ectatic / ectasia	Enlargement or distension of a tubular structure such as an artery	***Ectatic*** coronary artery
Fibrinous	The appearance of containing fibrin	***Fibrinous*** pericardial effusion
Fibrotic appearance	Abnormally hyperechoic areas within a structure or strands within a fluid collection	Stranded material in the pleural space appears ***fibrotic***. The noncoronary cusp appears fibrotic (hyperechoic)

(*Continued*)

Table 9 (*Continued*)

Descriptor	Definition	Examples (phrases)
Filamentous / filiform	Thin in diameter resembling a thread	A highly mobile ***filamentous*** mass on the RA pacing lead
Fish mouth appearance	Cross section view of the rheumatic mitral valve with commissural fusion	MV ***fish mouth appearance*** suggests rheumatic degeneration
Fixed	Immobile/stationary/non-mobile	A ***fixed*** mass is seen in the main pulmonary artery.
Flail	Uncontrolled movement due to injury	***Flail*** MV anterior leaflet motion
Flattened	Flat	Ventricular septal systolic ***flattening*** suggests RV pressure overload (D-shaped septum)
Friable	Appearing to be easily crumbled	Vegetation / myxoma appears ***friable***
Frondlike	Spreading segmented leaf-like appearance (like a fern or palm plant frond)	Mobile ***frondlike*** mass attached to the . . .
Fungating	Large, complex irregular, protruding mass	***Fungating*** mass surrounds the RA pacing lead
Fusiform	Gradual/progressive dilatation to describe aneurysm shape; spindle-shaped	***Fusiform*** aortic aneurysm
Gelatinous	Amorphous semi-solid mass, semimobile, largely hypoechoic in appearance	***Gelatinous*** appearance suggests fresh thrombus
Globular	Roughly in the shape of a globe or sphere	A ***globular*** mass (8 mm) suggestive of a papillary fibroelastoma
Heterogeneous	Having dissimilar elements or constituents	***Heterogeneous*** internal appearance suggests abscess formation
Hockey stick deformity	Colloquial term used to describe MV rheumatic degeneration; should not be used in isolation	MV anterior leaflet diastolic doming and distal leaflet thickening and restricted motion (***hockey stick* deformity**) suggests rheumatic degeneration
Highly mobile	Unrestricted motion	A ***highly mobile*** mass
Homogeneous	Uniform appearance	***Homogeneous*** appearance is unchanged
Honeycombed	Multiply septated structure in a regular pattern	Cystic structure with a ***honeycombed*** appearance.
Hypertrophy (hypertrophic enlargement)	Thickening of a cardiac wall	***Hypertrophy*** appears limited to the basal anterior septum.
Impinging	Compressing	Suspected loculated pericardial suspected hematoma ***impinges*** upon the RV.
Infiltration	Invading or penetrating tissue planes	Suspect basal lateral RV free wall ***infiltration***
Intramural	Within the boundaries of a structure	Consistent with ***intramural*** hematoma (e.g., of myocardial / aortic segment)
Irregularly shaped	A shape with edges or sides of varying lengths, angles or degrees	Sessile mass with ***irregular*** surface
Laminar flow	Fluid flowing in undisrupted parallel velocity layers	Color Doppler confirms ***laminar flow*** in the LVOT
Layered	Arranged in layers or striations	Mural thrombus with a ***layered*** appearance
Linear	Arranged in a straight line	Hyperechoic ***linear*** mobile mass on the . . .
Lobe	Gross anatomical division	Left ***lobe*** of the liver is seen in the parasternal long axis view
Lobule	Smaller division of a lobe	Irregular mass with multiple internal ***lobules***
Loculated	Trapped within separate compartments	***Loculated*** pericardial effusion
Locule	Small chamber or cavity	Multiple internal ***locules*** suggest echinococcal cyst
Membranous	Thin usually mobile tissue layer / mass	***Membranous*** dissection flap
Multilobar / multilobular	Consisting of multiple lobes or lobules	***Multilobular*** mass
Myxomatous degeneration	Characteristic thickening and redundancy affecting various valve components	Leaflet thickening, redundancy and mobility suggests ***myxomatous* degeneration**
Necrotic	Disorganized, amorphous, irregular, heterogeneously echoic material within a tissue structure	***Necrotic*** appearance due to central heterogeneous echo lucency

(*Continued*)

Table 9 (*Continued*)

Descriptor	Definition	Examples (phrases)
Nodular	Protuberances shaped like small, rounded lumps	***Nodular*** aortic plaque
Organized	Well circumscribed, hyperechoic mass with different texture from the surrounding tissues	An ***organized*** apical thrombus
Oval shaped / ovoid	Rounded but elongated in one direction (egg-like)	***Ovoid*** mass
Paradoxical	Having seemingly contradictory phases or process	***Paradoxical*** interventricular septal motion suggests RV volume overload.
Pedunculated	Attached by a thin stalk enabling movement	***Pedunculated*** mass
Polypoid	Looks like a polyp –a growth projecting from a mucous membrane (can be sessile or pedunculated)	Sessile ***polypoid*** mass; ***polypoid*** vegetation
Prolapse	Slipping or bulging backwards past normal location	MV posterior leaflet ***prolapse***
Protruding	Appearing to stick out from a reference structure	***Protruding*** mass
Redundant	Excessive, usually applied to tissue	***Redundant*** chordae tendineae; ***redundant*** mitral valve leaflet
Respirophasic	Motion or signal that is related to respiratory effort	***Respirophasic*** change in ventricular septal position suggests constrictive physiology
Restricted	Limited movement	***Restricted*** leaflet motion
Reverse doming	Leaflets adopting an architectural dome shape during regurgitant flow	***Reverse doming*** (prolapse) suggests bicuspid aortic valve
Spherical	Shaped like a ball	***Spherical*** mass
Saccular	Shaped like a sack - to describe aneurysm shape	***Saccular*** aneurysm of the ascending aorta
Sail-like	Often used to describe elongated anterior tricuspid leaflet in Ebstein's anomaly	***Sail-like*** appearance of TV anterior leaflet
Sclerotic	Tissue stiffening from hyperechoic suspected connective tissue infiltration	Aortic valve cusps appear ***sclerotic***
Septated (septate)	Divided into parts by a septum (or septae)	Multiple ***septations*** suggest hydatid (echinococcal) cyst
Septum (pl. septae)	A partition that divides two cavities	Akinetic LV ***septum***
Sessile	Attached by a broad base that prohibits significant movement	Protruding immobile ***sessile*** mass
Tethered	Confined or with restricted range of motion	The leaflets are apically displaced and ***tethered***
Thickened	Abnormally larger in width or thickness	***Thickened*** leaflet base
Thinned	Smaller in width or thickness	Basal inferior myocardial ***thinning***
Ulcer / ulcerated	Disrupted lining of a tissue or organ with smooth or usually irregular surface; ulcer crater	An ***ulcerated*** plaque in the superior aortic arch
Verrucous	Raised growths with a wart-like appearance on a leaflet or other endocardial surface	Location of multiple small leaflet masses suggest ***verrucous*** endocarditis
Well circumscribed / well demarcated	With clear or distinguished borders	***Well circumscribed / well demarcated*** appearance suggestive of a myocardial fibroma
Examples of commonly described Imaging Artifacts		
Acoustic shadowing	Strongly reflecting structures greatly diminish echos from deeper structures	The LA is not well visualized due to strong aortic valve prosthesis ***acoustic shadowing***
Acoustic Speckle	Near field artifact	Prominent LV apical near-field ***acoustic speckle*** artifact. Recommend UEA to better exclude LV apical thrombus

(*Continued*)

Table 9 (*Continued*)

Descriptor	Definition	Examples (phrases)
Comet tail	Merged close reverberations extending deeper than reflector	The unusual hyperechoic signal in the LV likely represents ***comet tail*** artifact from a proximal extracardiac foreign body and not a thrombus
Mirror image	Deeper duplicate image of real anatomy	Cardiac ***mirror image*** artifact is noted within the left pleural effusion (parasternal long axis view)
Refraction	Side-by-side duplicate image	Unusual appearance of the aortic valve in short axis is likely ***refraction*** artifact and not aortic dissection
Reverberation	Multiple equally spaced reflections	Prominent RV lead ***reverberation*** in the subcostal 4 chamber impairs ability to exclude RV thrombus
Side lobes	A strong reflector outside the central beam	Suspect aortic root sinotubular junction calcium -related ***side lobe*** artifacts and less likely, aortic root dissection

exams requires description of device type(s), inflow and outflow locations, speed(s), and setting(s). Device types, appropriate annotation and reporting abbreviations, device-specific central and peripheral implant locations, and MCS imaging protocols are found in reviews by Stainback *et al.* and Estep *et al.*[39,40]

REPORT COMMUNICATION: FROM PRELIMINARY REPORT TO FINAL REPORT

The patient demographic information within a report is often autopopulated. Its completeness and accuracy must be confirmed. Echo measurements and findings can be initially completed by a sonographer as part of a draft report. A preliminary report (verbal or written) can only be prepared by a physician. Only a physician qualified for independent interpretation of echocardiography studies can issue a final report and make it available to the ordering provider.[41,42] Any significant changes between the preliminary and final reports must be noted and echocardiography labs should establish a process for communicating significant changes between the preliminary and final reports and consider developing a mechanism for tracking the frequency of these changes.

STAT or urgent studies should be prioritized. It is recommended that the cardiac sonographer alert the reporting physician of any findings requiring immediate attention, but it is the reporting physician's responsibility to expeditiously communicate critical or urgent findings to the ordering provider. The sonographer should not render a diagnostic opinion or generate a preliminary report.[41]

In addition to routine communication of the echocardiography findings in the patient's medical record, urgent or critical findings that may require immediate changes in the plan or intervention should be directly communicated to the ordering provider or the care team based on the acuity and significance of the finding.[3,42] This communication should be documented in the echocardiography report or elsewhere, based on the individual laboratory policy for critical results communication.[42] The laboratory should have a procedure for tracking compliance with this reporting policy. A list of critical findings that may warrant direct communication both from the sonographer to the interpreting physician and from interpreting physician to the care team is proposed in Table 14. However, each laboratory should develop a critical findings list, and a communication system that adapts to the institution's needs. The reporting physician should consider the indication, patient history, and acuity of a finding and exert clinical judgment when determining the urgency and method for communicating these findings. Similarly, findings that represent a significant abnormality or change from prior testing may require clinical action in the short term, and those may warrant direct personal notification to the ordering clinician are outlined in Table 14.

If a prior echocardiogram (images or report) is readily available in the same electronic medical record or a picture archiving and communication system (PACS), it is recommended that a statement be included to address any significant changes from the prior study. Differences in echocardiographic findings between a previous report and a current report may occur for several reasons including technical, physiologic, and pathologic causes. For example, the prior study may have been performed during atrial fibrillation and the current exam is being performed during normal sinus rhythm.

Although it is left to the discretion of the interpreting physician to recommend additional imaging (e.g., the use of UEA to better assess LV regional wall motion or TEE to further assess the valves) and/or clinical consultation considering the individualized clinical context, we believe recommending clinical consultation in the summary statement of an echo report in certain situations, especially when urgent action is indicated (see Tables 14 and 15). As an example, the following language may be considered: *"This patient has significant aortic stenosis that, according to the current American College of Cardiology/American Heart Association/ASE valvular heart disease guidelines, may warrant treatment. As clinically appropriate, further evaluation and/or referral should be considered."* Table 15 highlights examples of echocardiographic findings that may be regarded as significant changes and might warrant additional imaging or consultation, and comparison statements that could be reported. The extent to which an imaging report is able to reach the referring clinician and appropriately impact clinical decision-making in an electronic notification environment is the subject of continued investigation.[44]

COMPARISON WITH PRIOR REPORTS, CARDIOVASCULAR MAGNETIC RESONANCE AND CARDIAC COMPUTED TOMOGRAPHY

It is increasingly likely that a prior noninvasive cardiac study has been performed and either the study or the report is available for

Table 10 Recommendations for comprehensive transthoracic and transesophageal echocardiography structured reporting

Cardiac Structure	Categories	Parameters	TTE	TEE	Recommended Reported Findings
Left Ventricle*	Morphology/ Structure	Size	Yes	Yes†	Normal or abnormal (small or dilated), grading (e.g., mild, moderate, severely dilated).
		Wall thickness	Yes	Optional†	Normal or abnormal, increased or decreased (thinned), grading (e.g., mild, moderate, severely increased).
		Left ventricular mass	Yes	No	Normal or abnormal, LV hypertrophy, concentric or eccentric, grading (e.g. mild, moderate, severe).
		Intracavitary or myocardial masses	Yes, if present	Yes, if present	Normal variant or, if abnormal, report suspected etiology (consistent with), and description. (see Table 9)
		Left ventricular upper septal morphology	Yes, if present	Yes, if present	e.g., discrete subaortic membrane, discrete upper septal hypertrophy, asymmetric septal hypertrophy. Describe consequent hemodynamic changes.
		Aneurysm, pseudoaneurysm or diverticulum	Yes, if present	Yes, if present	Describe location, size, associated thrombus or masses.
	Function: Systolic	Global systolic function	Yes	Yes	Normal, hyperdynamic or reduced, grading (e.g., mild, moderate, severely reduced).
		Ejection fraction	Yes	Optional	Normal or abnormal, percentage or range, and method utilized for evaluation (e.g., two dimensional [2D] linear, 2D/3D volumetric, or visual, or a combination). Recommend reporting one LVEF value in one report.
		Regional wall motion abnormalities	Yes	Yes	Absent or present, regional location, grading (e.g. normal or hyperkinetic, hypokinetic, akinetic, dyskinetic).
		Obstructive lesions (dynamic or structural)	Yes, if present	Optional	Presence or absence. Report peak gradient at rest, and with physiologic maneuvers if dynamic. (see Table 11)
		Myocardial strain	When indicated	Optional	Percent global longitudinal strain (GLS), normal or abnormal, comparison with previous findings.
	Function: Diastolic	Diastolic function or LV relaxation	Yes	Optional	Normal, abnormal (impaired), or indeterminate.
		Filling pressures	Yes	Optional	Normal, elevated or indeterminate (optional referring to left atrial pressure or LV end-diastolic pressure).
		Grade of LV diastolic dysfunction (if abnormal)	Yes, if present	Optional	Grade 1 (I), 2 (II), or 3 (III).
Interventricular Septum*	Morphology/ Structure	Defect: Presence or absence, location and description	Yes, if present	Yes, if present	e.g., perimembranous, inlet, muscular, outlet, size, number.
	Physiology	Abnormal motion	Yes, if present	Yes, if present	e.g., flattening in systole and/or diastole, dyssynchronous, paradoxical motion (and reason or explanation).
	Shunt	Size/location/detection technique	Yes, if present	Yes, if present	Presence or absence, detection technique (e.g., color flow Doppler, continuous wave Doppler [CWD], pulsed wave Doppler [PWD]), shunt direction, and peak PG across the defect.

Right Ventricle*	Morphology/ Structure	Size	Yes	Yes†	Normal or abnormal (small or dilated). Grading when reliably measurable (e.g., mild, moderate, severely dilated).
		Wall thickness (if increased)	Yes	Yes	Normal or increased.
		Intracavitary or myocardial masses	Yes, if present‡	Yes, if present	Normal variant or, if abnormal, report suspected etiology (consistent with), and description. (see Table 9)
		Catheters or device leads	Yes, if present‡	Yes, if present	Describe location, associated masses.
	Function: Systolic	Global systolic function	Yes	Yes†	Normal, or reduced. Grading when reliably measurable (e.g., mild, moderate, severely reduced).
		Additional RV function parameters (minimum of one parameter measured)	Yes	Optional†	Normal or abnormal: tricuspid annular plane systolic excursion (TAPSE), RV fractional area change (RV FAC), Doppler tissue imaging-derived RV TDI s', right ventricular index of myocardial performance (RIMP), myocardial strain (free wall and/or global), 3D-ejection fraction.
		Regional wall motion abnormalities	Yes, if present	Yes, if present	Absent or present, location, grading (normal or hyperkinetic, hypokinetic, akinetic, dyskinetic).
Left Atrium*	Morphology/ Structure	Size	Yes	Optional†	Normal or dilated, grading in TTE (mild, moderate, severely dilated).
		Intracavitary masses	Yes, if present‡	Yes, if present	Presence or absence, suspected etiology (consistent with), and description. (see Table 9)
	Left Atrial Appendage	Morphology	No	Optional	Simple or complex, shape (windsock, cauliflower, broccoli, cactus, other), describe number and location of accessory lobes.
		Size (if screening for structural heart interventions)	No	Optional	2D and/or 3D measurements of ostium, depth and device-specific landing zone measurements (as per sizing recommendations).
		Intracavitary masses	Yes, if present‡	Yes, if present	Presence or absence, suspected etiology (consistent with), and description. (see Table 9)
		Spontaneous echo contrast	Yes, if present‡	Yes, if present	Presence or absence, grading (mild, moderate, severe, or 0-4+).
		Emptying velocity	No	When indicated	Normal or reduced, optionally provide qualitative assessment or velocity in m/s.
		Devices	Yes, if present‡	Yes, if present	Describe left atrial appendage (LAA) device type and size (if known), any pathologic findings including device malposition, peri-device leak, or thrombus, if adequately visualized to make this assessment.
	Pulmonary Veins	Number and location	No	Optional	Normal or abnormal
		Flow pattern	When indicated	When indicated	Normal, systolic blunting, systolic reversal.
	Function	Left atrial strain	When indicated	No	Normal or abnormal.
Right Atrium*	Morphology/ Structure	Size	Yes	Optional	Normal, or dilated (optional qualitative assessment although reference ranges are currently unavailable).
		Intracavitary masses	Yes, if present‡	Yes, if present	Presence or absence, suspected etiology (including prominent normal structures such as Eustachian valve, Chiari network, Crista terminalis), and description per Table 9.
		Spontaneous echo contrast	Yes, if present‡	Yes, if present	Presence or absence
		Catheters or device leads	Yes, if present‡	Yes, if present	Describe location, associated masses.

(*Continued*)

Table 10 (*Continued*)

Cardiac Structure	Categories	Parameters	TTE	TEE	Recommended Reported Findings
Interatrial Septum*	Morphology/ Structure	Structural abnormalities	Yes	Yes	Including lipomatous hypertrophy, aneurysmal septum, bowing, patent foramen ovale or atrial septal defect.
		Interatrial septal communications	When indicated‡	When indicated	Presence or absence, description.
		Devices	Yes, if present‡	Yes, if present	Describe atrial septal device type and size (if known), any pathologic findings including device malposition, peri-device leak, or thrombus, if adequately visualized to make this assessment.
	Shunt	Shunt description	Yes, if present	Yes, if present	Presence or absence, direction, location (intracardiac vs intrapulmonary), and quantification if feasible (including Qp:Qs).
		Detection technique	Yes, if present	Yes, if present	Color flow Doppler and or agitated saline.
Aortic Valve*	Morphology/ Structure	Structurally normal	Yes	Yes	Report whether the aortic valve is structurally normal (assumes no structural abnormalities). Additionally reporting a trileaflet valve is recommended.
		Structural abnormalities	Yes, if present‡	Yes, if present	Bicuspid (describe type), unicuspid, quadricuspid. Thickening, annular or valvular calcification, perforation, masses and suspected etiology, other valvular abnormalities.
		Abnormal motion	Yes, if present‡	Yes, if present	Restricted leaflet motion, doming, eccentric closure, flail.
	Function: Stenosis	Presence and severity	Yes, if present	Yes, if present	Presence or absence. Grading (mild, moderate, severe). Report mechanism, if possible.
		Quantitative measurements	Yes	Yes	Peak velocity and gradient, mean gradient, aortic valve area and method (continuity equation, 2D or 3D planimetry), dimensionless index.
	Function: Regurgitation	Presence and severity	Yes	Yes	Presence or absence. Grading (mild, moderate, severe). Report mechanism (primary, secondary, or mixed), if possible.
		Quantitative and semi-quantitative mesurément	Yes	Yes	Vena contracta width or area, jet percentage of LVOT diameter, pressure half-time (PHT), diastolic flow reversal in the descending aorta, effective regurgitant orifice, regurgitant volume, regurgitant fraction.
Mitral Valve*	Morphology/ Structure	Structurally normal	Yes	Yes	Report whether the mitral valve is structurally normal (assumes no structural abnormalities).
		Structural abnormalities (if present)	Yes, if present‡	Yes, if present	Thickening, annular or valvular calcification, clefts or perforations, masses and suspected etiology, abnormalities of the subvalvular apparatus or chordae tendineae.
		Abnormal motion (if present)	Yes, if present‡	Yes, if present	Restricted leaflet motion, prolapse, flail. Identify affected scallops if possible.
	Function: Stenosis	Presence and severity	Yes, if present	Yes, if present	Presence or absence. Progressive (mild, moderate), or severe. Report mechanism (rheumatic, calcific, other) if possible.
		Quantitative measurements	Yes	Yes	Mean gradient (provide rhythm and heart rate), mitral valve area and method (continuity equation, PHT, 2D or 3D planimetry).
	Function: Regurgitation	Presence and severity	Yes	Yes	Presence or absence. Grading (mild, moderate, severe). Report mechanism (primary, secondary, or mixed), if possible.
		Quantitative and semi-quantitative measurements	Yes	Yes	Vena contracta width or area, systolic flow reversal in pulmonary veins, effective regurgitant orifice, regurgitant volume, regurgitant fraction.

Pulmonic Valve*	Morphology/ Structure	Structurally normal	Yes‡	Yes	Report whether the pulmonic valve is structurally normal (assumes no structural abnormalities), if adequately visualized to make this assessment.
		Number of leaflets	No	Optional	Trileaflet, bicuspid, quadricuspid, if adequately visualized to make this assessment.
		Structural abnormalities (if present)	Yes, if present‡	Yes, if present	Thickening, annular or valvular calcification, perforation, masses and suspected etiology, other valvular abnormalities.
		Abnormal motion (if present)	Yes, if present‡	Yes, if present	Restricted leaflet motion, doming, flail.
	Function: Stenosis	Presence and severity	Yes	Yes	Presence or absence. Grading (mild, moderate, severe). Report mechanism, if possible.
		Quantitative measurements	Yes	Optional	Peak velocity, peak gradient.
	Function: Regurgitation	Presence and severity	Yes	Yes	Presence or absence. Grading (mild, moderate, severe). Report mechanism (primary, secondary, or mixed, if possible.
		Quantitative and semi-quantitative measurements (if feasible)	Yes	Yes	Vena contracta width, jet percentage of pulmonary annulus diameter, PHT, diastolic flow reversal in pulmonary artery branches.
Tricuspid Valve*	Morphology/ Structure	Structurally normal	Yes	Yes	Report whether the tricuspid valve is structurally normal (assumes no structural abnormalities). Reporting number of leaflets is recommended when sufficiently well visualized to make this assessment (especially if not trileaflet).
		Structural abnormalities	Yes, if present‡	Yes, if present	Thickening, annular or valvular calcification, abnormal leaflet insertion, perforation, masses and suspected etiology, presence and effect of any device leads.
		Abnormal motion	Yes, if present‡	Yes, if present	Restricted leaflet motion, prolapse, flail. Identify affected leaflet, if possible.
	Function: Stenosis	Presence or absence	Yes	Yes	Present or absent. Report mechanism, if possible.
		Quantitative measurements	Yes	Yes	Mean gradient (provide rhythm and heart rate), and if feasible tricuspid valve area and method (continuity equation, PHT, 2D or 3D planimetry).
	Function: Regurgitation	Presence and severity (qualitative)	Yes	Yes	Presence or absence. Mild, moderate, severe, massive, torrential. Report mechanism (primary, secondary, or mixed), if possible.
		Quantitative and semi-quantitative measurements	Yes	Yes	Vena contracta width or area, effective regurgitant orifice, regurgitant volume, regurgitant fraction, systolic flow reversal in hepatic veins.
		Right ventricular systolic pressure	Yes	Yes	Estimated right ventricular systolic pressure (or pulmonary artery systolic pressure) derived from peak TR gradient and estimated RAP, when available. If unable to calculate it, explain the reason (e.g., TR jet insufficient for estimation of RVSP)

(*Continued*)

Table 10 (*Continued*)

Cardiac Structure	Categories	Parameters	TTE	TEE	Recommended Reported Findings
Prosthetic Valves or Repaired Valves	Morphology/ Structure	Prosthetic valve or repair	Yes	Yes	Mechanical (describe type), bioprosthetic (describe material, stented or stentless), or repair (describe type and device as appropriate).
		Valve motion	Yes	Yes	Normal or abnormal, including rocking motion, dehiscence, leaflet restriction.
		Pathologic findings	Yes‡	Yes	Leaflet thickening or perforation, abscess, fistula, fracture, other prosthetic valve abnormalities. Describe location and leaflet affected, if possible.
		Masses	Yes	Yes	Presence or absence, suspected etiology (thrombus, or vegetation). Report size, location, leaflet affected, and description. (see Table 9)
	Function: Stenosis	Presence	Yes	Yes	Present, absent, or possible. Describe other abnormalities that may affect valve velocity and gradients (e.g., patient-prosthesis mismatch, high flow).
		Quantitative measurements as applicable	Yes	Yes	Peak velocity and gradient, mean gradient, effective orifice area (+/- index), dimensionless index (aortic valve), acceleration time (aortic valve), MV VTI/LVOT VTI, planimetered valve area by 2D or 3D if performed (bioprosthetic valves).
	Function: Regurgitation	Presence and severity (qualitative)	Yes	Yes	Presence or absence. Trace, mild, moderate, severe. Describe if valvular or paravalvular.
		Quantitative and semi-quantitative measurements as applicable	Yes‡	Yes	Vena contracta width or area, effective regurgitant orifice, regurgitant volume, regurgitant fraction as appropriate, jet percentage of LVOT width or circumference (aortic valve), PHT, diastolic flow reversal in the descending aorta (aortic valve) or pulmonary artery (pulmonic valve), systolic flow reversal in the pulmonary veins (mitral valve) or hepatic veins (tricuspid valve).
Pericardium*	Morphology/ Structure	Describe pericardial abnormalities	Yes	Yes	Thickening, calcification, cysts, masses or other abnormalities.
	Effusion	Presence and size (semi-quantitative)	Yes	Yes	Presence or absence of effusion, and size (small, medium, large), consider providing measurements for serial follow-up.
		Location	Yes	Yes	Circumferential or localized (near LV, RV, LA, RA, transverse sinus).
		Content/appearance	Yes	Yes	Hypoechoic, fibrinous, stranding, adhesions, clots.
	Physiology	Tamponade physiology or constriction	Yes	Yes	Presence or absence of tamponade physiology or constriction, chamber collapse, respiratory variation of valvular flow.
	Epicardial fat	Presence when relevant	Optional	Optional	Describe when study indication is pericardial effusion.
Aorta*	Morphology/ Structure	Size (minimum of two locations measured)	Yes	Yes	Describe dilatation if present, providing measurements at multiple levels (annulus, sinuses of Valsalva, sinotubular junction, ascending aorta and aortic arch). Provide measurement comparison for serial follow-up.
		Describe abnormalities at any level of the examined portions of the thoracic aorta	Yes‡	Yes	Atheroma or plaque, intramural hematoma, aneurysms, grafts, dissection, coarctation.
Pulmonary Artery	Morphology/ Structure	Size	Optional	Optional	Normal, small or dilated, if adequately visualized to make this assessment or if associated with other pathology.
		Describe other abnormalities visualized	Yes, if present	Yes, if present	Including patent ductus arteriosus, thrombus, mass, compression, hypoplasia.

Inferior Vena Cava	Morphology/ Structure	Size	Yes	Optional	Normal or dilated, and respiratory change in dimension, estimated right atrial pressure. (see Table 11)
		Intracavitary masses or devices	Yes, if present	Yes, if present[†]	Presence of catheters, device leads, or other masses if present.
	Physiology	Hepatic vein flow pattern	Optional	Optional	Normal, systolic blunting, systolic reversal, constriction- related diastolic flow reversal.
Extracardiac[§]	Morphology/ Structure	Describe extracardiac abnormalities	Yes, if present	Yes, if present	Describe extracardiac abnormalities visualized in echocardiographic windows, and differential diagnosis when possible. Examples may include pleural effusion, ascites, abnormalities in the lung, abdomen or neck within the field of view.
Mechanical Circulatory Devices (if present)[§]	Morphology/ Structure	Describe the type of mechanical circulatory device	Yes, if present	Yes, if present	Intra-aortic balloon pump (IABP), Impella, TandemHeart, Veno-arterial extracorporeal membrane oxygenation (VA-ECMO), left ventricular assist device (LVAD) (type and model, if available). Annotate device settings and/or speed.
		Describe the location and position of the device components	Yes	Yes	As applicable depending on device type: inflow cannula or conduit, outflow graft, distance of Impella inlet position in the LV from the aortic annulus.
		Pathologic findings	Yes	Yes	Masses or thrombi associated with any of the device components, malposition, kinking, abnormal interaction with valvular structures or chamber walls.
	Function	Device flow	Yes	Yes	Inflow cannula and/or outflow graft velocity (normal, increased or decreased) or regurgitation, LVAD output, assessed by a combination of CWD, PWD and CFD.
		Hemodynamic impact	Yes	Yes	LV and RV size, interventricular septum position, LV and RV function, aortic valve opening, valvular regurgitation, total cardiac output, right atrial pressure estimate. These parameters can be described in the sections corresponding to each cardiac structure, but integration of these findings is recommended in the presence of a mechanical circulatory support device.

*Elements that are standard requirements by IAC.
[†]No normative data or reference range for TEE is currently available in ASE guidelines, and/or grading or additional descriptive elements may not be possible.
[‡]The sensitivity of TTE to assess these structures is lower than TEE and therefore all descriptive elements may not be possible.
[§]Though it may be desirable to include separate sections for these structures, laboratories whose structured reports do not allow for this can consider incorporating them into other sections, as long as it is done consistently for all readers.

Table 11 Physiological maneuvers at the time of study when indicated.

Report Section	Maneuver	Report Description
Atrial Septum (interatrial septal communication / shunt)	Normal respiration + IV saline Valsalva (release) + IV saline Cough + IV saline Abdominal (IVC) compression + IV saline Forced expiration + IV saline Bed tilt + IV saline	Describe presence or absence of shunt before maneuver and during maneuver
Mitral Valve regurgitation severity	Valsalva	Describe change in severity of MR with maneuver
LV (dynamic LV/LVOT obstruction)	Valsalva Standing Squatting Exercise (supine bicycle ergometry) Exercise (post exertion [treadmill test], supine bicycle ergometry) Amyl nitrite inhalation	Describe peak velocity of dynamic LVOT obstruction before maneuver and during maneuver
LV (diastolic function)	Valsalva	Describe mitral inflow before maneuver and during maneuver to distinguish normal LV filling from pseudonormal or to determine whether restrictive LV filling is reversible
IVC (RA pressure)	Inspiration / sniff	Describe change in IVC diameter with maneuver and whether IVC collapses >50%, examples: IVC diameter >2.1 cm that collapses <50% with a sniff suggests high RA pressure of 15 mm Hg (range, 10–20 mm Hg). This type of description is optional. Reporting RA pressure is sufficient.
Venous anomaly (congenital persistence of left superior vena cava)	IV saline (left arm)	Describe left arm agitated saline contrast injection and evidence of contrast in coronary sinus prior to right heart

References.[16-21]

comparison to the echocardiogram. This section provides guidance on how to address those comparisons in a consistent and clinically relevant manner. See also the "Report Communication: From Preliminary Report to Final Report" section regarding when to recommend that consultation be considered.

It is important to recognize that each of the commonly performed cardiovascular diagnostic tests has its own indications, strengths, and limitations. Similarly, each modality has its own normal range values that must be taken into consideration when providing comparison comments. It is common that the noted change in LVEF between different modalities represents a difference in technology and method of quantitation rather than a clinically relevant difference in left ventricular systolic function.

When reports for other imaging modalities are readily available in the same electronic medical record, it is recommended that a statement be included that addresses the correlation of findings on the echocardiogram to these reports. Some examples of comparison statements are provided below and are categorized by correlation type by modality and either report review or image review. When a change in echocardiographic finding advances from normal to abnormal or from less than severe to a severe reported value, this should be considered a "significant" interval change. Otherwise, the reported change should be considered of "uncertain clinical significance."

Examples of global comparison with prior echo study statements (focusing on changes in chamber dimensions, ventricular function, valve physiology, and clinical indication for the exam) appear below.

- "In comparison to the previous report from xx (month/day/year; include time if same day), there has been no significant interval change."
- "In comparison with the previous reported study from xx (month/day/year; include time if same day), there has been a significant interval change in xx (e.g., the reported aortic valve stenosis is worse)."
- "In comparison with the previous reported study from xx (month/day/year; include time if same day), the interval changes in xx (e.g., the maximal aortic valve gradient has increased) are of uncertain clinical significance."

Comparison with prior images

- "In direct side-by-side comparison of images to the previous study from xx (month/day/year; include time if same day), there has been no significant interval change."
- "In direct side-by-side comparison of images with the previous study from xx (month/day/year; include time if same day), there has been a significant interval change in xx (e.g., the aortic stenosis severity has increased from moderate to severe)."
- "In direct side-by-side comparison of images from the previous study from xx (month/day/year; include time if same day), the interval changes in xx (e.g., the aortic valve gradient has increased) are of uncertain clinical significance."

Comparison with prior studies from a different diagnostic modality (this should only be included when the reader is an expert in the relevant multimodality imaging):

Comparison with a prior report (images may not be available):

- "In comparison to a reported xx (include modality, e.g., cardiovascular magnetic resonance [CMR]) study from xx (month/day/year; include time if same day), there has been no significant interval change."

Table 12 Stress echocardiography descriptors

Cardiac Structure	Parameter	Findings and Essential Measurements	Additional Detailed Information
Left Ventricle*	Structure	Chamber size (indexed LVEDD/LVESD). LV volume measurements are optional.	Normal, small, or dilated
Left Ventricle*	Structure	Morphology	Normal, concentric or eccentric hypertrophy, spherical, regional hypertrophy
Myocardium*	Structure	Morphology	Normal, thin, thick, echo-bright
Left Ventricle*	Systolic function	Global	LVEF: normal, reduced, increased
Left Ventricle*	Systolic function	Regional wall motion score	Wall motion score (WMS) (16-64); WMS index (1.0-4.0)
Left Ventricle*	Systolic function	Regional motion	Normokinesis (NK), hypokinesis (HK: mild, moderate or severe HK), akinesis (AK) or dyskinesis (DK) per 16, 17-segment model
Left Ventricle*	Systolic function	Regional thickening	Normal (40%), HK (11-39%), AK (0-10%), DK (0%)
Left Ventricle*	Systolic function	Regional display	Bull's eye display
Right ventricle	Structure	Chamber Size	Normal, small, or dilated
Right ventricle	Structure	Morphology	Normal, hypertrophy
Right ventricle	Systolic function	Global	Normal, reduced; TAPSE
Interventricular septum	Structure	Morphology	Normal, rightward or leftward, systolic or diastolic flattening
Mitral valve	Structure	Morphology	Normal; mitral valve prolapse; mitral stenosis
Mitral valve	Physiology	Regurgitation	Absent; mild; moderate; severe
Mitral valve	Physiology	Stenosis	Mean transmitral gradient, RVSP
Mitral inflow	Physiology	PWD	E wave (avg)
Mitral annulus	Physiology	Tissue Doppler Imaging (TDI)	E/e' ratio (avg)
Tricuspid valve	Physiology	Regurgitation	Absent; mild; moderate; severe; massive; torrential
Tricuspid valve	Physiology	Color flow Doppler (CFD)-guided CWD	TRmax Vel
Aortic valve	Physiology	Regurgitation	Absent; mild; moderate; severe

*Needed for ischemic indications. Certain additional variables may be needed based on unexpected baseline or stress-induced echocardiographic findings or study indications.

- "In comparison with a reported xx (include modality, e.g., CMR) study from xx (month/day/year; include time if same day), there has been a significant interval change in xx (focus on chamber dimension, ventricular function, valve physiology and clinical indication for the exam)."
- "In comparison with a reported xx (include modality, e.g., CMR) study from xx (month/day/year; include time if same day), the interval changes in xx (focus on chamber dimension, ventricular function, valve physiology, and clinical indication for the exam) are of uncertain clinical significance."

Comparison with image (only if the reader has sufficient multimodality imaging expertise):

- "In direct comparison to a xx (modality) study from xx (month/day/year), there has been no significant interval change."
- "In direct comparison with a xx (modality) study from xx (month/day/year), there has been a significant interval change in xx (focus on chamber dimension, ventricular function, valve physiology, and clinical indication for the exam)."
- "In direct comparison with a xx (modality) study from xx (month/day/year), the interval changes in xx (focus on chamber dimension, ventricular function, valve physiology and clinical indication for the exam) are of uncertain clinical significance."

Important considerations for comparison statements:

- Significant changes should be further classified as new, resolved, worse, or improved findings.
- If no previous imaging study or report is available for comparison, this should be included in the comparison statement (e.g., "There is no previous study available for direct comparison").
- These comparison statements should include recent studies (within 1 year) of the same type of imaging modality (e.g., TTE, TEE, exercise, or pharmacologic stress).
- These comparison statements may include studies performed more remotely (>1 year) with the same type of imaging modality.
- These comparison statements may include recent studies using a different type of imaging modality such as cardiac computed tomography or CMR when the interpreting physician is able to

Table 13 Baseline and stress comparisons for stress echocardiography

Stage Comparisons			
Cardiac Structure	**Parameters**	**Findings and Essential Measurements**	**Additional Detailed Information**
Left Ventricle	Structure	Chamber size (indexed LVEDD/LVESD; optional indexed LV volumes)	Unchanged; increased; reduced
Left Ventricle	Systolic function	Global	LVEF: normal, reduced, increased
Left Ventricle	Systolic function	Regional wall motion score	Unchanged; increased; reduced
Right ventricle	Structure	Chamber Size	Unchanged; increased; reduced
Right ventricle	Systolic function	Global	Unchanged; increased; reduced
Interventricular septum*	Structure	Morphology	Normal, rightward or leftward; systolic or diastolic flattening
Mitral valve	Physiology	Regurgitation	Unchanged; increased; reduced MR
Mitral valve	Physiology	Stenosis	Changes in transmitral mean gradient, RVSP
Mitral annulus	Physiology	Tissue Doppler Imaging	Unchanged; increased E/e' ratio (average)
Tricuspid valve	Physiology	CFD-guided CWD	Unchanged; increased TRmax Vel

For non-ischemic evaluation protocols, variation in reporting elements should match specific indications.[36]
For treadmill stress echocardiography, baseline and immediate post-stress data are recorded and reported.
*Reporting ventricular septal abnormality during stress or recovery is needed when abnormal.

provide comparisons that address the known technical differences related to the comparison study modality.
- All comparisons to previous report comments should include the date of the study being compared and a statement of whether the findings are new, unchanged, resolved, improved, or worsened.
- All comparisons to previous report comments should include a summary statement on the clinical significance of the comparison

Table 14 Examples of critical or urgent consultation findings in echocardiography reports*

Acuity of Echocardiography Findings and Communication	Examples of Pathology
Critical findings: Findings that represent a threat to life and require immediate clinical action. A direct verbal notification to the ordering provider or clinician immediately after the finding is identified is recommended (communication in minutes).	• Suspected cardiac tamponade • Suspected aortic dissection or acute aortic syndrome • Complications of myocardial infarction, including ventricular septal rupture, ventricular or papillary muscle rupture, or pseudoaneurysm • Thrombus in transit • Acute RV dysfunction and suspected acute pulmonary embolism • Left ventricular assist device or VA-ECMO complications • Severe valve obstruction/stenosis in prosthetic or native valves, especially if acute or new
Urgent findings: Findings that represent a significant abnormality or change from prior testing and may require clinical action in the short term. Direct personal notification to the ordering provider or clinician is recommended, either verbally or utilizing other means of communication at the discretion of the interpreting physician (communication in hours).	• New large pericardial effusion without tamponade • New severe left or right ventricular dysfunction • New suspected vegetation, intracardiac mass or thrombus • Orthotopic heart transplant with signs of acute rejection, including newly depressed LVEF • Suspected cardiogenic shock, low cardiac output in hypotensive patients • New LV outflow tract obstruction (pre-Valsalva resting gradient >30 mm Hg) • High-risk findings on a stress echocardiogram
Significant findings: Significant findings in the echocardiogram that may warrant consultation and additional or follow-up testing (in addition to critical and urgent findings detailed above).	• Significant reduction in the LV systolic or diastolic function • Significant change in RV systolic function • Significant aortic dilatation • Findings suggesting specific cardiomyopathies (e.g., hypertrophic cardiomyopathy, infiltrative cardiomyopathy, cardiac amyloidosis) • Change in the size of a pericardial effusion • Known valve stenosis or regurgitation in prosthetic or native valves that is progressing to severe

*The reporting physician should consider the indication, patient history, acuity of a finding, and exert clinical judgment when determining the urgency and method for communication of these findings.

Table 15 Examples of echocardiography findings that are new or significant and may warrant consultation and/or follow-up testing

Cardiovascular Structure	Examples of Significant Changes	Examples of Comparison Statements
Left Ventricle	Significant reduction in the LVEF (more than 10-point reduction for any reason **and** <53%) Significant change in LV diastolic function, leading to increased filling pressures (Worsening in LV global longitudinal strain below lower limits of normal for equipment and software utilized in the echocardiography lab or a relative change in GLS >15% from baseline)[43]	"LVEF is now mildly/moderately/severely reduced." "The reported change in LV systolic function might be due to:" (consider selecting from the following: an actual worsening in the LV systolic function; or may not be an actual worsening in the LV systolic function but is likely due to a difference in imaging or measurement technique; change in imaging quality; LV foreshortening; change in rhythm or heart rate; change in BP; change in therapy such as inotropes or IABP; interval surgery) "Significant diastolic dysfunction or increased LV filling pressures are evident" "LV global longitudinal strain is abnormal" or "There is a significant / non-significant change in LV global longitudinal strain." Depending on the clinical context, this can be reported as subclinical LV dysfunction (e.g., a relative change in GLS >15% from baseline)[43]
Right Ventricle	Change from normal to abnormal RV systolic function as assessed by a combination of qualitative and quantitative parameters[17,24] Qualitative (subjective) change in RV systolic function, which requires visual comparison with images from the prior study	"RV systolic function is reduced" "RV systolic function has worsened / improved" "The reported change in RV systolic function might be due to:" (consider selecting from the following: an actual worsening in the RV systolic function; or may not be an actual worsening in the RV systolic function but might be due to a difference in imaging, measurement technique, or parameter utilized to determine RV systolic function; change in rhythm or heart rate; interval surgery)
Atria	Change in LA or RA size from normal to abnormal (knowing technical caveats) Any new masses or other abnormal structures	"Left atrium is now mild/moderately/severely enlarged" "Right atrium is now mild/moderately/severely enlarged"" "There is a thrombus in the left atrial appendage" "There is a mobile mass attached to the device lead in the right atrium"
Valves	Changes in the severity of native or prosthetic valvular stenosis or regurgitation, especially if progression to severe Changes in valve morphology and structure, including flail leaflet, perforation, dehiscence, papillary muscle rupture Any masses or other abnormal structures affecting the cardiac valves	"Aortic/mitral/tricuspid/pulmonic stenosis/regurgitation is now severe" "There is new (+/-mild)/moderate/severe aortic/mitral/tricuspid/pulmonic/prosthetic valve stenosis/regurgitation" "The reported change in AS gradient severity might be due to:" (consider selecting from the following): - an actual worsening in the severity of the AS - an actual worsening in the AS severity - might be due to a difference in imaging or measurement technique; change in imaging quality - change in LV stroke volume - change in BP
Aorta	Severe aortic dilation (aneurysm ≥5.5 cm and >5.0 cm in patients with a bicuspid aortic valve)	"There is new ascending aorta dilatation" "The ascending aorta diameter has increased from 4.0 cm to 4.5 cm"
Pericardium	Change in the size of a pericardial effusion, especially if changes are rapid Change in the hemodynamic significance of a pericardial effusion, development of cardiac tamponade physiology	"There is a new small/medium/large pericardial effusion when compared with the pre-procedure images one hour prior" "Pericardial effusion size has increased from small/medium to medium/large" "There is echocardiographic evidence of tamponade / constrictive physiology"

findings: "clinically significant," "clinically insignificant," or "uncertain significance."

A noninvasive cardiovascular study is often available for comparison with the echocardiogram. Expertise in multimodality imaging is also becoming more frequent and allows for accurate comparisons between the echocardiogram and the other available diagnostic studies. It is not adequate to simply compare reported findings between studies since each modality has its own reported normal ranges. For example, reporting a difference in LVEF between a

nuclear single-photon emission computed tomography myocardial perfusion imaging report and an echocardiogram may imply a clinical difference when there is none. Comparisons between imaging modalities should only be reported by experts in multiple imaging modalities and with ability to review the images from each modality. Optimal comparisons should search for changes in ventricular and atrial dimensions, ventricular global and regional systolic function, valve pathology, and hemodynamics.

Learning from SCMR Reporting Guidelines: the Society for Cardiovascular Magnetic Resonance (SCMR) recently updated their guidelines for reporting CMR examinations.[45] There are many commonalities between these two noninvasive diagnostic modalities including overlapping appropriateness indications for acquisition and highly comprehensive assessment capabilities that include structure and function. Therefore, similar recommendations for standardized reporting would seem logical.

Common to CMR reporting and less often included in echo reporting are disease-specific reporting protocols. There may come a time when this approach is more commonly recommended for echocardiography. As echo labs evolve and increasingly become overwhelmed with the high volume of requests, and the need for rapid throughput, coupled with the additional time requirements for the acquisition of advanced parameters, disease-specific protocols may offer a solution. Potential CMR reporting protocols that may be worthwhile to consider for echo reporting include chronic ischemic heart disease, cardiomyopathies, heart transplantation, diseases of the aorta, and valvular heart diseases.

Finally, important to all noninvasive imaging reports including CMR and echocardiography is that the summary statement specifically relates the relevant findings to the study indication. With the goal of linking the report to clinical management and outcomes, the summary should provide enough information for the referring clinician to consider appropriate next steps for patient management.

REPORT SUMMARY STATEMENT

A summary statement should be included in each echocardiography report. For consistency, the term "summary statement" is preferred by consensus over "concluding statement" or "conclusions." The summary statement should be placed at the top of a report (e.g., immediately following the demographics and indications sections). The summary statement for a comprehensive TTE report should encompass five essential elements: 1) assessment of left and right ventricular function, 2) presence or absence of significant valvular abnormalities, 3) clinically important positive findings, 4) pertinent negative findings (when applicable), and 5) a comparison statement. For TEE reports and limited TTE reports, the summary statement may be more focused, encompassing key clinically important positive findings and pertinent negative findings related to the study's indication. For stress echocardiography reports, the summary statement should include the overall study interpretation (normal, ischemia, fixed wall motion abnormality, or combination [ischemia exams] or as appropriate for structural heart disease exams).

The summary should present these findings in clear, straightforward sentences or bullet points that can be interpreted independently and should not simply reproduce whole sections of the body of the report. It must highlight key positive or pertinent negative findings that address the clinical questions related to the study's indication (e.g., "Valvular vegetations are not evident"), with critical findings clearly labeled (Table 14). Documentation of any communication of these critical results to the care team should be included within the summary (e.g., "Critical result was communicated to the requesting team"). The specific wording of critical result communication and documentation is under the discretion of an individual laboratory.

A comparison is recommended in all summary statements. The comparison statement should provide details on how the current study compares with previous echocardiography studies or other imaging results, noting whether any clinically significant changes are observed (Table 15). It should specify whether the comparison was made by reviewing prior study images or reports (e.g., "By direct side-by-side comparison of images with the previous study dated 'month/day/year,' the LV systolic function has normalized"). While it is not mandatory to recommend serial echocardiography studies, additional imaging, or clinical consultation, it should be considered based on the clinical context.

INTEGRATION OF ADULT CONGENITAL HEART DISEASE FINDINGS

To date, there are no published standards for comprehensive TTE and TEE echocardiography reporting of congenital heart disease (CHD). The IAC has provided basic standards for adult congenital heart disease (ACHD) echo reporting that are intentionally not all inclusive. This is because there are more than thirty discrete types of CHD ranging in complexity from a simple atrial septal defect (ASD) to complex forms of heterotaxy and single ventricle syndromes. There are 367 congenital cardiac terms included in the 11th revision of the International Classification of Diseases involving defects at every level of cardiac segmental anatomy and dueling nomenclature systems that are continuing to progress towards harmonization.[46] A comprehensive reporting scheme for ACHD is outside the scope of this adult reporting standards document and will be the focus of a future ASE standards document.

With improved survival for those born with CHD, the last few decades have seen a shift towards a greater number of ACHD patients. Echocardiograms for ACHD patients with complex conditions should ideally be reported by physicians with expertise in congenital heart disease, as understanding the imaging implications of their CHD and cardiac surgical procedure(s) requires specialized training. ACHD patients with certain common, isolated, and acyanotic defects can be accurately reported in most adult echocardiography labs with necessary report elements listed in Table 16. Recent updated reporting nomenclature recommendations for bicuspid aortic valve can be found elsewhere.[46,47]

Inevitably, adult echo labs without ACHD expertise will image complex ACHD as an initial diagnosis or in ACHD patients previously either lost to ACHD specialist follow-up or who have poor access to such facilities. In cases of complex ACHD cases, we recommend reporting on the anatomic structure and function at each level of segmental anatomy (Table 17) with subsequent referral to an adult congenital specialist, specifying this in the report.

For example, "Due to the complexity of the congenital heart disease, we recommend referral as soon as possible (or immediately) to a cardiology practice or center with specific expertise in adult congenital heart disease."

Table 16 Recommended report elements for ACHD echocardiography

ACHD Type	Report should Include:
Atrial septal defect (ASD)	• ASD number and location (secundum, primum, sinus venosus, coronary sinus) • Defect size (2 axes) • Direction of shunting and mean gradient • Right heart chamber sizes • Qp:Qs calculation when possible • Evidence of pulmonary hypertension • For device intervention: rim diameters and total septal length • Residual shunt, device position if post-repair or device intervention
Ventricular septal defect (VSD)	• VSD number and location • Defect size (2 axes) • Direction of shunting and peak gradient • Left heart chamber sizes • Evidence of pulmonary hypertension • For device intervention: adequacy of rims, adjacent structures, +/-aortic valve prolapse/insufficiency • Residual shunt, device position if post-repair or device intervention
Sub-aortic stenosis	• Type (membrane, ridge, LVOT hypoplasia, mixed) • Size and shape of ridge or membrane • Relationship with aortic valve and aortic valve function • Peak and mean LVOT gradient • LV size and thickness • Residual stenosis if post-repair or intervention
Bicuspid aortic valve – updated nomenclature[47]	• Number of aortic sinuses and commissures • Location and degree of commissural fusion • Aortic valve function • Aortic root sinus of Valsalva and ascending aortic diameters (+/- asymmetric dilation) • LV size and thickness • Rule out coarctation of the aorta • Residual valve function if post-repair or intervention
Coarctation of the aorta	• Narrowest diameter and length of narrowing at coarctation • Degree of obstruction (peak and mean gradient) • Diastolic flow continuation at coarctation • Location in relationship to the origin of subclavian artery • Transverse arch and post-coarctation diameters • Aortic arch branching and sidedness • Presence of patent ductus arteriosus or collateralization • Blunted/abnormal Doppler pattern in the abdominal aorta • Residual gradient and presence of aortic dilation, aneurysm, or dissection if post-repair or intervention
Patent ductus arteriosus (PDA)	• PDA diameter and location • Direction of shunt with peak gradient • Left heart chamber sizes and function • For device intervention: PDA length and shape • Residual shunt, device position if post-repair or device intervention
Congenital persistence of left superior vena cava	• Drainage (coronary sinus, unroofed coronary sinus, left atrium) • Presence of a bridging vein

In general, a comprehensive ACHD echocardiography report will include details on all cardiac segmental anatomy within the heart and surrounding vascular structures (Table 17), including critical 3D relationships only shown with appropriate image acquisition sweeps. Adequate ACHD echo reporting is dependent on the proper image acquisition (see ASE congenital echocardiographic guidelines) and detailed records of prior congenital cardiac surgeries that are often difficult to accurately report de novo from echocardiographic images, especially those obtained with limited imaging windows.[35,48]

LIMITED ECHOCARDIOGRAPHY STUDY REPORTS

The contents and extent of a limited echocardiography protocol report depends upon the reason for the exam. The current IAC standards and guidelines stipulate a limited echocardiography study may be performed when the patient has undergone a recent complete examination, and a limited exam is needed for surveillance of a previously identified condition with the extent of the exam depending upon the indication. The determination of the appropriate time interval between a comprehensive exam and a follow-up limited exam is

Table 17 Recommended levels of segmental anatomy for ACHD reporting

Segmental Anatomy
Visceral/atrial situs
Systemic veins
Pulmonary veins
Atria
Atrial septum
Atrio-ventricular valves
Ventricles
Ventricular septum
Outflow tracts/arterial valves
Great arteries
Coronary arteries
Branch pulmonary arteries
Aortic arch

dependent on the study indication and is under the discretion of the treating physicians and an individual laboratory.

A limited study examines a single area of the heart or answers a single clinical question.[11] This is within the realm of consultative echocardiography performed by echocardiography laboratories. Reports for limited studies should include a statement that a comprehensive study was recently performed (including date of comprehensive TTE) or that the study was performed for additional or focused clinical information. The limited study report should include relevant structure and function comments on all images obtained and not solely comments related to the indications. For example, all visualized cardiac chambers and valves (though limited in extent) should be commented on, even if the exam was primarily to assess the amount of pericardial effusion present. Reporting should be limited to the extent of the exam. Redundancy should be avoided. However, a new incidental finding should be reported.

Overall, the components of the report should mirror the comprehensive echocardiogram, including quantitative elements that are typically confined to the component-specific descriptions to address a well-specified clinical concern. For example, using a limited quantitative echocardiogram may be appropriate and cost-effective for determining LV ejection fraction or other indicators of responses to therapy in patients with heart failure or patients undergoing cardiotoxic chemotherapy.[49]

ECHOCARDIOGRAPHY CORE LABORATORIES

Although this guideline is primarily intended for clinical practice echocardiography labs, most recommendations are also pertinent for laboratories related to echocardiography research—echo core laboratories (ECL).[50] ECLs are a critical part of the research infrastructure underlying clinical and translational studies. ECLs ensure the quality and reproducibility of echocardiographic measurements made as well as standardization of the measurement techniques employed to produce accurate and valid results. An important aspect of ECL activities involves documentation of the methods used for obtaining measurements, the quality improvement (QI) checks that were employed, and the results of the underlying measurement activity.[51]

Several key elements should be included in ECL documentation to ensure quality practices are met. First, an ECL should have a written standard operating procedure document that outlines both routine procedures employed by the laboratory, as well as any procedures that are specific to the given research project being conducted. If there are multiple associated clinical echo lab sites collecting or reviewing echocardiographic data to support ECL functions, standard operating procedures as well as the documentation supporting these procedures (e.g., site manuals) should be uniform across sites. This documentation should outline the procedures for 1) training and evaluating the performance of expert readers, 2) image receipt, storage, and tracking, 3) the actual measurements and techniques to be performed, 4) any QI efforts that are to be employed, and 5) how measurements or findings are recorded and verified for accuracy before reporting. Reports should clearly name and provide qualifications for the key personnel involved in interpretation of a research echocardiogram as well as any individuals overseeing the quality and conduct of those interpreting these studies. To the extent possible, measurements and findings should be reported in a manner mirroring the language and key elements of routine adult echocardiography reports (Tables 6 and 10).[16,23] However, as the scope and specificity of ECL activities may extend beyond those data elements captured as part of routine adult echocardiogram interpretation, the ECL report should be dictated by the individual study goals and the language and elements customized to fulfill the research needs of the study.

A core element of ECL reporting involves documentation of QI efforts undertaken by laboratory staff. Prespecified QI and review tasks should be performed by all ECLs. These may include training and oversight of ECL staff, determination of inter- and intra-rater variability measures to quantify the reproducibility, repeatability, and reliability of measurements, determination of temporal drift in repeated measurements performed across time, and periodic audits of a subset of the echocardiogram images and reports to verify adherence to best practices. The procedures for conducting these QI activities, the timing of their occurrences with respect to the study timeline, the involved personnel, and the results of these activities should be clearly delineated, and these QI reports should be stored in a secure fashion to protect confidentiality.

QUALITY IMPROVEMENT OF ECHOCARDIOGRAPHY REPORTS

An essential component of a high-quality echocardiography lab is a well-designed QI program that ensures that each member is performing and interpreting studies in a consistent, uniform fashion that aligns with published guidelines when these documents are available. The IAC has published standards for QI that are recommended for all echocardiography labs.[11] An established and written QI program is a mandatory standard for laboratory accreditation by the IAC that is supported by the ASE. At a minimum, it must include evaluation and documentation of test appropriateness, technical quality, interpretive quality, and report completeness and timeliness. Of note, the published IAC standards are the minimum that should be achieved. Echo labs performing special procedures or caring for complex patients may require a more rigorous QI program. Each individual echo lab should therefore have an established QI program that meets or exceeds the IAC standards.

Table 18 Recommended echo exam quality review statements when appropriate

Overall Echo Image Quality: excellent/good/fair/poor/non-diagnostic	Further Explanations if Known
The echo study quality was suboptimal (fair, poor or non-diagnostic).	Large body habitus, pulmonary disease, small rib spaces, breast implants, difficulty in positioning, mechanical ventilation
All acoustic windows were present and interpretable	
The following windows were not present and/or not interpretable:	Parasternal, apical, subcostal, suprasternal notch
Diagnostic Adequacy (excellent/good/inadequate, in respective of overall image quality)	Inadequate diagnostic value should be addressed in the summary

A quality echo report should provide a comprehensive yet concise assessment of the findings of each of the cardiac elements. Additionally, these studies should include:

- timely image acquisition and interpretation
- appropriate indication for the study
- compliance with IAC standards
- high technical image quality
- adherence to lab protocols
- a description of all elements in the structured report
- accurate interpretation of images
- date and time report was signed by the reader.

Additionally, each report should include a statement pertaining to the overall quality of the echo images followed by an explanation for the presence of suboptimal images. A reporting statement regarding the diagnostic quality of one or more acoustic window(s) may be useful to support diagnostic uncertainties and to support alternate imaging recommendations. Recommended language for the echo exam quality statements is noted in Table 18. Comments related to technical image quality and diagnostic adequacy should be separated. In many cases, certain measurements, such as Doppler assessments, may be highly accurate even if the overall image quality is suboptimal.

Individual sections of the echo report should include a comment about each cardiac structure pertaining to that section. If a particular structure is not seen, a statement reflecting this should be included in the appropriate section. Inconsistencies and discrepancies should be avoided. In particular, the description of measurements should match guideline-based severity cut-offs of these measurements when available. It is recognized, however, that echocardiographic parameters used for the assessment of a single lesion may not be entirely concordant; expertise and clinical judgement should be employed to make the final decision. Discordant measurements should be explained in the report if possible. Data used to train augmented intelligence for echo reporting should be carefully curated.

The echo lab should strive for internal consistency in reporting echo findings among all readers in the lab according to ASE guidelines when available. To highlight key pathology, view or image numbers that best demonstrate the pathology should be included in the report. If feasible, key images can be embedded into the echo report. A summary statement should be included in each echo report.

ELECTRONIC STORAGE OF ECHOCARDIOGRAPHY DATA

While no Digital Imaging and Communications in Medicine (DICOM) standard exists for report storage, echo measurements are currently stored and transferred to electronic health records in DICOM structured reporting files. For any parameter, the average, maximum, or minimum measurement may be stored and transferred since storage and file transfer settings are variable. Moreover, physician-adjusted measures that are reported in the final report may not be reflected in the DICOM structured reporting measures. Continued quality improvement of these settings and fields is not widely performed and this can have important ramifications when mining data for big data efforts.[52]

ARTIFICIAL INTELLIGENCE TOOLS FOR AUGMENTING ECHOCARDIOGRAPHY REPORTS AND FUTURE DIRECTIONS

There is growing interest in leveraging artificial intelligence, particularly LLMs, for structured reporting in medical imaging.[53,54] LLMs have demonstrated remarkable proficiency in understanding and generating coherent, contextually relevant diagnoses in echocardiography reports.[55] The extent to which this should be utilized depends upon the ongoing development of validation models and interpretating physician oversight. A few studies have explored their effectiveness in summarizing echocardiographic findings into structured impressions.[5,56,57]

In addition to artificial intelligence-driven models that directly extract standardized echocardiographic measurements from images, these tools can further enhance documentation by autopopulating structured fields and reducing redundant tasks for clinicians. Augmented reporting with artificial intelligence could involve several key steps, such as 1) populating correct measurements using prespecified rules, 2) flagging inconsistencies or missing data points, reducing reporting errors and enhancing patient safety, 3) prompting users to verify or update critical information before finalizing reports, 4) seamlessly extracting and incorporate relevant patient history, ensuring a comprehensive diagnostic report that aligns with prior echocardiographic findings and cardiovascular imaging comparisons, 5) automated quality improvement tools and linking the decisions and displaying them with relevant guidelines, references, and differential diagnoses, 6) tailoring LLMs on echocardiography reports for different audiences, generating detailed versions for specialists and simplified summaries for referring physicians and patients,[5] 7) actual conveyance of (not just sending) the appropriate diagnoses and acuity level to referring care providers, 8) ongoing output validation processes for generative models that change over time.

While the technology and clinical evidence continues to evolve, the current guidelines emphasize the need to integrate these techniques within a unified framework that improves clinical workflow. Enhancing the performance of LLMs while addressing their limitations—such as hallucinations, insufficient domain knowledge, and variability across diverse healthcare settings—will be important. Additionally, integrating LLMs with existing echocardiography reporting tools, electronic health record systems and reporting software, requiring robust information system integration, and rigorously validating their impact in clinical studies will be crucial.

CONCLUSION

The practice of echocardiography and cardiovascular imaging has witnessed significant technological advancements and evolution over the past two decades, surpassing the parameters set forth in the 2002 Recommendations for a Standardized Report for Adult Transthoracic Echocardiography. This 2025 ASE Guideline for Standardization of Adult Echocardiography Reporting reflects the contemporary state of the field, acknowledging the wealth of updated science and consensus-driven guidelines that have become integral to the practice of echocardiography.

The standardization of echo reporting enhances interoperability among healthcare systems ensuring efficient communication for timely decision-making. Artificial intelligence algorithms in healthcare rely on consistent, uniform, and well-organized data related to cardiac imaging for training and validation, which enables the integration of these technologies into clinical workflows.

Emphasizing the critical need for standardization and precision in reporting format and language, particularly concerning clinically actionable items, this guideline sets a new standard for clarity and consistency. Encompassing TTE, TEE, and stress echocardiography reporting, it thoroughly addresses the entire spectrum of communication: from preliminary to final reporting and from final report to clinical consultation. Addressing the complexities of reporting, this guideline provides guidance on comparing and correlating with other imaging modalities, learning from similar initiatives in imaging societies, and accommodates the nuances of simple adult CHD, and limited study reports.

Looking ahead, the guideline serves as a foundation for future endeavors, informing the development of guidelines for pediatric echocardiography and POCUS reporting. These guidelines may help redefine the role of echocardiography in patient care from passive, descriptive reporting to active physician-guided participation in patient management. A call to action for stakeholders, including industry partners in imaging, to design reporting platforms to accommodate and comply with standards is imperative. By addressing these emerging areas, the ASE reaffirms its commitment to excellence, innovation, and standardized practices in the dynamic field of echocardiography.

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REVIEWERS

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