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CLINICAL DATA STANDARDS

# 2019 ACC/AHA/ASE Key Data Elements and Definitions for Transthoracic Echocardiography

A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Data Standards (Writing Committee to Develop Cardiovascular Endpoints Data Standards) and the American Society of Echocardiography

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This document was approved by the American College of Cardiology Clinical Policy Approval Committee, the American Heart Association Science Advisory and Coordinating Committee, and the American Society of Echocardiography Board of Directors in January 2019, and by the American Heart Association Executive Committee in March 2019.

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The Comprehensive RWI Data Supplement table is available at http://jaccjacc.acc.org/Clinical_Document/TTE_DS_Author_Comprehensive_RWI_Table_4.3.2019.pdf.

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## PREAMBLE

The American College of Cardiology (ACC) and the American Heart Association (AHA) support their members' goal to improve the care of patients with cardiovascular disease through professional education, research, and development of guidelines and standards and by fostering policies that support optimal patient outcomes. The ACC and AHA recognize the importance of the use of clinical data standards for patient management, assessment of outcomes, and conduct of research, and the importance of defining the processes and outcomes of clinical care, whether in randomized trials, observational studies, registries, or quality-improvement initiatives.

Clinical data standards strive to define and standardize data relevant to clinical concepts, with the primary goal of facilitating uniform data collection by providing a platform of clinical terms with corresponding definitions and data elements. Broad agreement on a common vocabulary with reliable definitions used by all is vital to pool and/or compare data across clinical trials to promote interoperability with electronic health records and to assess the applicability of research to clinical practice. The ultimate purpose of clinical data standards is to contribute to the infrastructure necessary to accomplish the ACC's mission of fostering optimal cardiovascular care and disease prevention and the AHA's mission of being a relentless force for a world of longer, healthier lives.

The specific goals of clinical data standards are:

1. To establish a consistent, interoperable, and universal clinical vocabulary as a foundation for both clinical care and clinical research, including clinical trials
2. To promote the ubiquitous use of electronic health records and facilitate the exchange of data across systems through harmonized, standardized definitions of key data elements
3. To facilitate the further development of clinical registries, quality- and performance-improvement programs, outcomes evaluations, and clinical research, including the comparison of results within and across these initiatives

The key elements and definitions are intended to facilitate the consistent, accurate, and reproducible capture of clinical concepts; standardize the terminology used to describe cardiovascular diseases and procedures; create a data environment conducive to the assessment of

patient management and outcomes for quality and performance improvement and clinical and translational research; and increase opportunities for sharing data across disparate data sources. The ACC/AHA Task Force on Clinical Data Standards (Task Force) selects cardiovascular conditions and procedures that will benefit from creation of a standard dataset. Subject matter experts are selected to examine/consider existing standards and develop a comprehensive, yet not exhaustive, standard dataset. When undertaking a data collection effort, only a subset of the elements contained in a clinical data standard listing may be needed, or conversely, users may want to consider whether it may be necessary to collect some elements not listed. For example, in the setting of a randomized clinical trial of a new drug, additional information would likely be required regarding study procedures and drug therapies.

The ACC and AHA recognize that there are other national efforts to establish clinical data standards, and every attempt is made to harmonize newly published standards with existing standards. Writing committees are instructed to consider adopting or adapting existing nationally and internationally recognized data standards if the definitions and characteristics are useful and applicable to the set under development. In addition, the ACC and AHA are committed to continually expanding their portfolio of data standards and will create new standards and update existing standards as needed to maintain their currency and promote harmonization with other standards as health information technology and clinical practice evolve.

The Health Insurance Portability and Accountability Act privacy regulations, which went into effect in April 2003, have heightened all practitioners' awareness of our professional commitment to safeguard our patients' privacy. The Health Insurance Portability and Accountability Act privacy regulations (1) specify which information elements are considered "protected health information." These elements may not be disclosed to third parties (including registries and research studies) without the patient's written permission. Protected health information may be included in databases used for healthcare operations under a data use agreement. Research studies using protected health information must be reviewed by an institutional review board or a privacy board.

We have included identifying information in all clinical data standards to facilitate uniform collection of these elements when appropriate. For example, a longitudinal clinic database may contain these elements because access is restricted to the patient's caregivers. Conversely, registries may not contain protected health information unless specific permission is granted by each patient. These fields are indicated as protected health information in the data standards.

In clinical care, caregivers communicate with each other through a common vocabulary. In an analogous manner, the integrity of clinical research depends on firm adherence to prespecified procedures for patient enrollment and follow-up; these procedures are guaranteed through careful attention to definitions enumerated in the study protocol, case report forms, and clinical event committee charters. When data elements and definitions are standardized across studies, comparison, pooled analysis, and meta-analysis are enabled, thus deepening our understanding of individual studies.

The recent development of quality-performance measurement initiatives, particularly those for which the comparison of providers is an implicit or explicit aim, has further raised awareness about the importance of data standards. Indeed, a wide audience, including nonmedical professionals such as payers, regulators, and consumers, may draw conclusions about care and outcomes. To understand and compare care patterns and outcomes, the data elements that characterize them must be clearly defined, consistently used, and properly interpreted.

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## 1. INTRODUCTION

Echocardiography is an integral and valued part of the evaluation and management of patients with known or suspected heart disease. It offers insight into morphologic features and physiologic functioning of the myocardium, valves, pericardium, coronary arteries, and great vessels. Substantial advances in technology have occurred within the past decade, advancing clinical applications and enhancing diagnostic accuracy. Although many options for imaging the heart and adjacent structures are available in addition to echocardiography, echocardiography is by far the most commonly performed imaging examination, and this field has demonstrated leadership in promoting research and in establishing guidelines and practice standards for the performance of echocardiographic imaging. Indeed, these existing guidelines and standards documents formed the basis for the data elements enumerated here; this document has purposefully avoided creating new standards. Echocardiography is included in patient decision-making and is often referenced in guidelines and other data standards. However, differing definitions of echocardiographic parameters abound, potentially leading to misunderstanding and confusion, and remains a robust barrier to the structured reporting required for clinical interoperability, clinical research, registries, and clinical databases (2). The ACC, AHA, and the American Society of Echocardiography (ASE) have joined forces to lead the multisocietal effort that has culminated in the development of this document,

which provides a critical platform for structured reporting for echocardiographic imaging. The development of common data elements is also anticipated to further the development of important quality metrics and support quality improvement efforts in echocardiography (3).

## 2. METHODOLOGY

### 2.1. Writing Committee Composition

The Task Force selected members of the writing committee jointly with ASE. The writing committee consisted of 11 individuals with domain expertise in cardiovascular medicine, echocardiography, clinical research, epidemiology, outcomes assessment, medical informatics, health information management, and healthcare services research and delivery.

### 2.2. Relationships With Industry and Other Entities

The Task Force makes every effort to avoid actual or potential conflicts of interest that might arise as a result of an outside relationship or a personal, professional, or business interest of any member of the writing committee. Specifically, all members of the writing committee are required to complete and submit a disclosure form showing all such relationships that could be perceived as real or potential conflicts of interest. These statements are reviewed by the Task Force and updated when changes occur. Authors' and peer reviewers' relationships with industry and other entities pertinent to this data standards document are disclosed in Appendixes 1 and 2, respectively. In addition, for complete transparency, the disclosure information of each Writing Committee member—including relationships not pertinent to this document—is available as an online supplement. The work of the Writing Committee was supported exclusively by the ACC and AHA without commercial support and was closely assisted by the ASE. Writing committee members volunteered their time for this effort. Meetings of the writing committee were confidential and attended only by committee members and staff.

### 2.3. Review of Literature and Existing Data Definitions

A series of reference publications provided the foundation for the cardiovascular imaging data element concepts identified by the writing committee of the ACC (www.acc.org), the AHA (professional.heart.org), and the ASE (http://asecho.org/guidelines/guidelines-standards/). Many of these documents are referenced in the tables below. In general, we did not include text, diagrams, measurement cutpoints, and other content that is redundant to these standards. Importantly, we avoided changing existing standards whenever possible, as well as not repeating them unnecessarily so as to limit the length of this document.

### 2.4. Consensus Development

The Task Force established the writing committee in March 2015, per the processes described in the Task Force's methodology paper (4). The work of the writing committee was accomplished via a series of teleconferences and web conferences, along with extensive email correspondence. The review work was distributed among subgroups of the writing committee on the basis of their interest and expertise in the components of the terminology set. The proceedings of the workgroups were then assembled, resulting in the vocabulary and associated descriptive prose in Appendixes 3 to 8. All members reviewed and approved the final vocabulary.

### 2.5. Relation to Other Standards

The writing committee reviewed the unpublished work of the U.S. Food and Drug Administration Cardiovascular Imaging Data Standards workgroup along with available published data standards and clinical guidelines. Current echocardiography guidelines from the ASE and other societies were also instrumental in defining the data elements within this document. A particularly important source document was the 2008 multisociety data elements document for cardiac imaging (5).

The writing committee anticipates that this transthoracic echocardiography (TTE) vocabulary will facilitate the uniform adoption of these terms, where appropriate, by the clinical care, clinical and translational research, regulatory, quality and outcomes, and electronic health records communities.

### 2.6. Peer Review, Public Review, and Board Approval

The "2019 ACC/AHA/ASE Key Data Elements and Definitions for Transthoracic Echocardiography" was reviewed by official reviewers nominated by ACC, AHA, and ASE. To increase its applicability further, the document was posted on the ACC, AHA, and ASE websites for a 30-day public comment period. This document was approved by the ACC Clinical Policy Approval Committee, by the AHA Science Advisory and Coordinating Committee, and by the ASE Board of Directors in January 2019, and by the AHA Executive Committee in March 2019. The writing committee anticipates that these data standards will require review and updating in the same manner as other published guidelines, performance measures, and appropriate use criteria. The writing committee will therefore review the set of data elements periodically, starting with the anniversary of publication of the standards, to ascertain whether modifications should be considered.

## 3. DATA ELEMENTS AND DEFINITIONS

This TTE data element set contains a broad range of data elements for adult and pediatric echocardiography. The

use case for these data elements include supporting regulatory reporting of TTE data, clinical reporting, and ongoing efforts to harmonize electronic medical records and improve interoperability. As such, the organizational framework for these data elements is a TTE case report form or clinical report, with similar section headings that draw on the data elements in the Appendixes. It is not intended to represent all possible TTE reports.

The following assumptions and conventions were used in the preparation of the TTE data elements and should be considered in their application.

1. Interpretations are assumed to be made by a qualified imager on the basis of findings in the imaging study, rather than other components of the history or physical. The ASE and ACC provide recommendations regarding professional training and competency.
2. Reference ranges are specifically not provided for qualitative data elements because they are available through national standards documents to define qualitative categories and are referenced in Appendixes.
3. Reference ranges are also not provided for quantitative data elements (numbers), which are represented by "Float" as the permissible values. The intent of a quantitative data element is to collect the actual value. The assertion of a reference range implies interpretation and as such potentially influences measurement of the actual value. Interpretations of quantitative values are specific to each implementation and as such are beyond scope of this set of standard data elements.
4. Data elements for individual measurements (i.e., regurgitant jet area, valve gradients and area) may be presented individually as well as overarching data elements that can provide an integrated impression of the severity of cardiac valve regurgitation and cardiac valve stenosis. This allows compliance with the recommendations that the assessment of cardiac valve regurgitation and cardiac valve stenosis be performed as an overall assessment integrating all available data. Thus, these assessments are represented as a single qualitative stenosis or regurgitation data element for each valve (mitral regurgitation severity; mitral stenosis severity).
5. Every effort was made to maximize the information conveyed by each data element. As such, whenever possible, "indicator" elements (e.g., presence or absence) were combined with grade of severity, type or location elements by adding permissible values of "none," "unknown," and either "present, unable to characterize further" or "indeterminate" to the more specific, descriptive severity, type or location permissible values.
6. "Qualitative" and "quantitative" were used in the data element name only when these were the only term that differentiated 2 elements.
7. Words that reflect data type were used in the data element name (i.e., diameter is always a numeric value; severity is always a qualitative value; "size" is usually qualitative but can be quantitative, so the definition of the size data elements describes the intended value).
8. Definition of clinical concepts associated with a specific data element follow the data element definition. For example, the definition for "annular calcification" follows the definition for "annular calcification severity."
9. Clinical concepts used in the definitions of multiple data elements are not defined in this document. Although a common understanding of the meaning of these concepts is necessary to accurately and consistently report data for the elements where these concepts are used, this document assumes that the reader is familiar with general cardiovascular terminology (e.g., diastole and systole).
10. The data elements are meant to include those options chosen by most laboratories but not to prescribe their use. For example, the permissible values for valvular regurgitation include trace, mild, mild-to-moderate, moderate, moderate-to-severe and severe descriptors, but most laboratories will use a subset of these (e.g., mild, moderate, severe). In this sense, the data elements should be thought of as a vocabulary: only those words that accurately convey the intended meaning in a given setting should be used.
11. Whenever possible, we used the standard 17-segment left ventricular model; however, we acknowledge that there are implementations that use other segmentation schema, including a 16-segment model and those that divide the apex in 6 segments.
12. Standard terms, such as "body surface area," are defined here because they are included in other data elements documents and are outside the scope of this one.

The tables in Appendixes 3 to 8 contain data elements addressing left and right heart structures, left and right heart function, aorta and pulmonary artery, right heart hemodynamics, congenital heart disease, and heart valves. In each table, data elements are listed and defined. Permissible values for each element and the definition of each are provided, along with references to current guidelines and standards documents, when available.

### 3.1. Left and Right Heart Structures

Appendix 3 provides the qualitative data elements and measurements that are typically available for assessment of cardiac chamber sizes, wall thickness, and geometry. It

has sections (in this order) on left atrium, right atrium, left ventricle, and right ventricle. Qualitative assessments are noted in relationship to normal values, as codified in the appropriate, referenced guideline and standards document(s).

### 3.2. Left and Right Heart Function

Appendix 4 provides the data elements and measurements that are typically available for assessment of left ventricular global systolic function, including ejection fraction, stroke volume, cardiac output, right ventricular systolic function, and left ventricular diastolic function. Also included are data elements for segmental wall motion abnormality, global systolic longitudinal strain, diastolic function, and dyssynchrony. The appendix also has a section on right ventricular systolic function. Qualitative assessments are noted in relationship to normal values, as codified in the appropriate, referenced guideline and standards document(s).

### 3.3. Aorta

Appendix 5 provides the data elements and measurements that are typically available for assessment of the aorta. This includes measurements of various portions of the aorta including sinuses of valsalva, ascending aorta, transverse arch, descending thoracic, and abdominal aorta. It also defines and characterizes aortic pathology including dissection, coarctation of the aorta, aortic aneurysm, and thoracic aortic aneurysm. Qualitative assessments are noted in relationship to normal values, as codified in the appropriate, referenced guideline and standards document(s).

### 3.4. Right Heart Hemodynamics and Pulmonary Artery

Appendix 6 provides the data elements and parameters that are typically available for the right heart hemodynamics and pulmonary artery assessments. These elements should describe quantitative assessments of relevant structures (e.g., the inferior vena cava diameter) that are used to assess hemodynamics (e.g., the inferior vena cava) and related functional assessments, such as measurement of right ventricular systolic pressure derived by using the tricuspid regurgitation jet velocity. Together, these anatomic sizes and functional assessments, when compared with normal values, as codified in the appropriate, referenced guideline and standards document(s), will allow assessment to identify pathologically elevated right-sided pressures.

### 3.5. Congenital Heart Disease

Appendix 7 provides the data elements, definitions, and permissible values related to some of the more common congenital heart diseases, although these lesions represent only a fraction of all the congenital cardiovascular malformations encountered in clinical practice. In addition, there is wide variability in presentation for each lesion because of equally wide variability in associated morphology and physiology, often resulting in heterogeneous nomenclature and definitions across the spectrum of congenital heart diseases. In an effort to bridge these frequently competing classification systems, the International Society for Nomenclature of Pediatric and Congenital Heart Disease developed the International Pediatric and Congenital Cardiac Code (http://www.ipccc.net/), a comprehensive list of congenital cardiovascular malformations that contains >1,000 diagnostic terms related to pediatric and congenital cardiac disease and crossmaps the terms from the most commonly used nomenclature systems into a single coding structure. From this list, the International Society for Nomenclature of Pediatric and Congenital Heart Disease identified a subset of 319 congenital heart disease terms that were incorporated into the 11th revision of the *International Classification of Diseases (ICD-11)* of the World Health Organization, and the terms, definitions, synonyms, and associated commentaries (6). Several common congenital heart diseases are listed in the other tables, most notably aortic coarctation (Appendix 5) and bicuspid aortic valve (listed under CDE "Number of Cusps" in Appendix 8).

### 3.6. Heart Valves

Appendix 8 contains the data elements needed to describe and quantify valvular heart disease. The actual quantitative methods are not described in detail but should be performed using the methods put forth in the appropriate guidelines from ACC and ASE. Normal values for qualitative and quantitative measures are as codified in the appropriate, referenced guideline and standards document(s). The tables are organized into sections on valve structure, cusp/leaflet motion, regurgitation, and stenosis.

## 4. INFORMATICS OF CONTROLLED VOCABULARIES

The ACC/AHA/ASE key data elements for TTE were identified and described per the informatics principles articulated in the "ACC/AHA 2013 Methodology for Developing Clinical Data Standards" (4). Each data element represents the smallest clinically meaningful unit of information (4). Each data element is identified with a label and definition of the data element, along with the values that are allowed (permissible values) as responses to describe the state of the data element. Where unique to echocardiography, definitions of the permissible values were also defined. Every effort was made to ensure the data element definitions and the permissible value definitions were clinically precise and unambiguous. The permissible

values comprising a value set are intended to be mutually exclusive. As such, the data elements are positioned for representation in the "Clinical Data Interchange Standards Consortium Study Data Tabulation Model Cardiovascular Therapeutic Area User Guide" and "Clinical Data Interchange Standards Consortium" controlled terminology, for formal development in controlled vocabularies such as Logical Observation Identifiers Names and Codes, and for representation in metadata repositories such as the National Cancer Institute Enterprise Vocabulary Server. This approach positions the terms as semantically interoperable common data elements, supports linkages with national distributed research platforms, and facilitates the uniform adoption by the clinical, regulatory, quality, and health information technology communities.

## STAFF



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**KEY WORDS** ACC/AHA Clinical Data Standards, health informatics, transthoracic echocardiography

## APPENDIX 1. AUTHOR RELATIONSHIPS WITH INDUSTRY AND OTHER ENTITIES (RELEVANT)—2019 ACC/AHA/ASE KEY DATA ELEMENTS AND DEFINITIONS FOR TRANSTHORACIC ECHOCARDIOGRAPHY

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| Neil J. Weissman | MedStar Health—Chief Scientific Officer; MedStar Health Research Institute—President; Georgetown University School of Medicine—Professor | None | None | None | None | None | None |
| Rebecca Wilgus | Duke Clinical Research Institute—Project Leader, Clinical Research Informatics | None | None | None | None | None | None |

This table represents the relationships of committee members with industry and other entities that were determined to be relevant to this document. These relationships were reviewed and updated in conjunction with all meetings and/or conference calls of the writing committee during the document development process. The table does not necessarily reflect relationships with industry at the time of publication. A person is deemed to have a significant interest in a business if the interest represents ownership of ≥5% of the voting stock or share of the business entity, or ownership of ≥$5,000 of the fair market value of the business entity; or if funds received by the person from the business entity exceed 5% of the person's gross income for the previous year. Relationships that exist with no financial benefit are also included for the purpose of transparency. Relationships in this table are modest unless otherwise noted.

According to the ACC/AHA, a person has a *relevant* relationship IF: a) the *relationship or interest* relates to the same or similar subject matter, intellectual property or asset, topic, or issue addressed in the *document*; or b) the *company/entity* (with whom the relationship exists) makes a drug, drug class, or device addressed in the *document*, or makes a competing drug or device addressed in the *document*; or c) the *person or a member of the person's household*, has a reasonable potential for financial, professional or other personal gain or loss as a result of the issues/content addressed in the *document*.

*Significant relationship.

ACC indicates American College of Cardiology; AHA, American Heart Association; and ASE, American Society of Echocardiography.

## APPENDIX 2. REVIEWER RELATIONSHIPS WITH INDUSTRY AND OTHER ENTITIES—2019 ACC/AHA/ASE KEY DATA ELEMENTS AND DEFINITIONS FOR TRANSTHORACIC ECHOCARDIOGRAPHY

| Reviewer | Representation | Employment | Consultant | Speakers Bureau | Ownership/ Partnership/ Principal | Personal Research | Institutional, Organizational, or Other Financial Benefit | Expert Witness |
|---|---|---|---|---|---|---|---|---|
| Richard Kar-Hang Cheng | Official Reviewer—AHA | University of Washington Medical Center—Associate Professor of Cardiology, Assistant Professor of Medicine, Adjunct Assistant Professor of Radiology | ■ Alnylam<br>■ Ionis Pharmaceuticals | None | None | ■ Foundation for Sarcoidosis Research | ■ Abbott Laboratories–Momentum 3‡<br>■ Amgen Inc.–COSMIC-HF‡<br>■ AstraZeneca Pharmaceuticals–DAPA-HF‡<br>■ Alnylam Pharmaceuticals–ENDEAVOR‡<br>■ Bayer HealthCare Pharmaceuticals, Inc.–COMPASS‡<br>■ Bayer Healthcare Pharmaceuticals–GLOBAL-CHF‡<br>■ Roche–ICON-RELOADED‡<br>■ HeartWare– ENDURANCE‡ | None |
| Sherif F. Nagueh | Official Reviewer—ASE | Houston Methodist Hospital—Professor of Cardiology | None | None | None | None | ■ Gilead Sciences, Inc.–LIBERTY/ HCM - GS-US-361-1157‡<br>■ MyoKardia–MYK-461-005, Explorer‡<br>■ MyoKardia–Protocol MYK-461-006 (MAVERICK Study)‡ | None |
| Eva M. Lonn | Content Reviewer | McMaster University—Professor, Division of Cardiology | ■ Amgen<br>■ Bayer Healthcare Pharmaceuticals<br>■ Novartis Canada<br>■ Sanofi-Aventis<br>■ Servier Canada<br>■ The Medicines Company (DSMB) | None | None | ■ AstraZeneca*<br>■ Bayer Healthcare Pharmaceuticals*<br>■ Resvirologix<br>■ Population Health Research Institute | ■ Amgen Inc.–FOURRIER‡<br>■ Bayer Healthcare Pharmaceuticals–COMPASS‡<br>■ Canadian Institutes of Health Research–SODIUM-HF‡<br>■ Eli Lilly and Company– ACCELERATE‡<br>■ GSK– HARMONY‡<br>■ Hoffman LaRoche– DALGENE‡<br>■ Novartis Corporation– TRANSITION‡<br>■ NHLBI– GUIDE-IT‡<br>■ Population Health Research Institute–TIPS-3‡<br>■ Sanofi-Aventis– APPRISE‡ | None |
| Carol Mitchell | Content Reviewer | University of Wisconsin Hospital—Assistant Professor, Cardiovascular Medicine | None | None | None | None | ■ American Society of Echocardiography†<br>■ Davies Publishing, Inc.<br>■ Elsevier<br>■ Joint Review Committee on Education in Diagnostic Medical Sonography†<br>■ Wolters Kluwer | None |
| Lawrence G. Rudski | Content Reviewer | McGill University—Professor of Medicine | None | None | ■ Medtronic* | None | ■ General Electric*<br>■ Canadian Society of Echocardiography† | None |

This table represents all relationships of reviewers with industry and other entities that were reported at the time of peer review, including those not deemed to be relevant to this document, at the time this document was under review. The table does not necessarily reflect relationships with industry at the time of publication. A person is deemed to have a significant interest in a business if the interest represents ownership of ≥5% of the voting stock or share of the business entity, or ownership of ≥$5,000 of the fair market value of the business entity; or if funds received by the person from the business entity exceed 5% of the person's gross income for the previous year. Relationships that exist with no financial benefit are also included for the purpose of transparency. Relationships in this table are modest unless otherwise noted. Names are listed in alphabetical order within each category of review. Please refer to http://www.acc.org/guidelines/about-guidelines-and-clinical-documents/relationships-with-industry-policy for definitions of disclosure categories or additional information about the ACC/AHA Disclosure Policy for Writing Committees.

*Significant relationship.

†No financial benefit.

‡This disclosure was entered under the Clinical Trial Enroller category in the ACC's disclosure system. To appear in this category, the author acknowledges that there is no direct or institutional relationship with the trial sponsor as defined in the ACC/AHA Disclosure Policy for Writing Committees.

ACC indicates American College of Cardiology; AHA, American Heart Association; ASE, American Society of Echocardiography; DSMB, Data and Safety Monitoring Board; and NHLBI, National Heart, Lung, and Blood Institute.

## APPENDIX 3. LEFT AND RIGHT HEART STRUCTURES

### A. Left Heart Structures – Left Atrium

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Sources |
|---|---|---|---|---|
| **Left atrial size or volume** | A qualitative description of the size or volume of the left atrium. | ■ Normal<br>■ Reduced<br>■ Mildly enlarged<br>■ Moderately enlarged<br>■ Severely enlarged<br>■ Dilated, unable to characterize further<br>■ Unknown | | Lang RM, Badano LP, Mor-Avi V, et al. Recommendations for cardiac chamber quantification by echocardiography in adults: an update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. J Am Soc Echocardiogr. 2015;28:1-39.e14.(7) |
| | | Reduced | Size of the left atrium is smaller than normal. | |
| | | Mildly enlarged | Size of the left atrium is slightly larger than normal. | |
| | | Moderately enlarged | Size of the left atrium is moderately larger than normal. | |
| | | Severely enlarged | Size of the left atrium is considerably larger than normal. | |
| | | Dilated, unable to characterize further | Size of the left atrium is larger than normal, but the enlargement cannot be quantified. | |
| | | Unknown | Size of left atrium is unknown. | |
| **Left atrial antero-posterior diameter** | The cross-sectional diameter of the left atrium measured in an antero-posterior direction at end-ventricular systole reported in cm. | Float | | |
| **Left atrial medial-lateral diameter** | The cross-sectional diameter of the left atrium measured in a medial lateral direction at end-ventricular systole reported in cm. | Float | | |
| **Left atrial superior-inferior diameter** | The cross-sectional diameter of the left atrium measured in a superior-inferior direction at end-ventricular systole reported in cm. | Float | | |
| **Left atrial area** | The area of the left atrium at end-ventricular systole in the 4-chamber view reported in $cm^2$. | Float | | |
| **Left atrial volume** | The volume of the left atrium at end-ventricular systole reported in mL. | Float | | |

*(Continued on the next page)*

## APPENDIX 3. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Sources |
|---|---|---|---|---|
| **Left atrial volume calculation method** | The method used to calculate volume for the left atrium. | ■ M-mode<br>■ Area-length<br>■ 2D single-plane method of discs (2D single-plane)<br>■ 2D biplane method of discs (2D biplane)<br>■ 3D<br>■ Other<br>■ Unknown | | Lang RM, Badano LP, Mor-Avi V, et al. Recommendations for cardiac chamber quantification by echocardiography in adults: an update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. J Am Soc Echocardiogr. 2015;28:1-39.e14.(7) |
| | | M-mode | Measurement of volume by extrapolation from a diameter measured on M-mode echo. | |
| | | Area-length | Measurement of volume by extrapolation from planimetry of a single imaging plane and an orthogonal long-axis diameter. | |
| | | 2D single-plane method of discs (2D single-plane) | Measurement of volume by extrapolation from planimetry of a single long-axis imaging plane. | |
| | | 2D biplane | Measurement of volume by extrapolation from planimetry of 2 orthogonal long-axis imaging planes. | |
| | | 3D | Direct summation of volume enclosed by the endocardial borders. | |
| | | Other chamber volume calculation method | Chamber volume calculation method is different from the methods previously described. | |
| | | Unknown | Chamber volume calculation method is unknown. | |
| **Left atrial volume index** | The left atrial volume divided by body surface area reported in mL/m$^2$. | Float | | |

2D indicates 2-dimensional; 3D, 3-dimensional; CDE, common data element; and echo, echocardiography.

### B. Right Heart Structures – Right Atrium

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Sources |
|---|---|---|---|---|
| **Right atrial size or volume** | A qualitative description of the size or volume of the right atrium. | ■ Normal<br>■ Reduced<br>■ Mildly enlarged<br>■ Moderately enlarged<br>■ Severely enlarged<br>■ Dilated, unable to characterize further<br>■ Unknown | | Lang RM, Badano LP, Mor-Avi V, et al. Recommendations for cardiac chamber quantification by echocardiography in adults: an update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. J Am Soc Echocardiogr. 2015;28:1-39.e14.(7) |
| | | Normal | Size of right atrium is normal. | |
| | | Reduced | Size of the right atrium is smaller than normal. | |
| | | Mildly enlarged | Size of the right atrium is slightly larger than normal. | |
| | | Moderately enlarged | Size of the right atrium is moderately larger than normal. | |
| | | Severely enlarged | Size of the right atrium is considerably larger than normal. | |
| | | Dilated, unable to characterize further | Size of the left atrium is larger than normal, but the enlargement cannot be quantified | |
| | | Unknown | Size of right atrium is unknown. | |

(Continued on the next page)

## APPENDIX 3. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Sources |
|---|---|---|---|---|
| **Right atrial medial-lateral diameter** | The cross-sectional diameter of the right atrium measured in a medial lateral direction at end-ventricular systole reported in cm. | Float | | Lang RM, Badano LP, Mor-Avi V, et al. Recommendations for cardiac chamber quantification by echocardiography in adults: an update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. J Am Soc Echocardiogr. 2015;28:1-39.e14.(7) |
| **Right atrial superior-inferior diameter** | The cross-sectional diameter of the right atrium measured in a superior-inferior direction at end-ventricular systole reported in cm. | Float | | |
| **Right atrial area** | The area of the right atrium measured using the apical 4-chamber view at end ventricular systole reported in $cm^2$ | Float | | |
| **Right atrial volume** | The volume of the right atrium at end-ventricular systole reported in mL. | Float | | |
| **Right atrial chamber volume calculation method** | The method used to calculate right atrial volume. | ■ Area length<br>■ 2D single-plane<br>■ 2D biplane<br>■ 3D<br>■ Other<br>■ Unknown | | Lang RM, Badano LP, Mor-Avi V, et al. Recommendations for cardiac chamber quantification by echocardiography in adults: an update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. J Am Soc Echocardiogr. 2015;28:1-39.e14.(7) |
| | | Area length | Measurement of volume by extrapolation from planimetry of area derived from an imaging plane and a long-axis diameter. | |
| | | 2D single-plane | Measurement of volume by extrapolation from planimetry of a single long-axis imaging plane. | |
| | | 2D biplane | Measurement of volume by extrapolation from planimetry of 2 orthogonal long-axis imaging planes. | |
| | | 3D | Direct summation of volume enclosed by the endocardial borders. | |
| | | Other | Chamber volume calculation method is different from the methods described on this list. | |
| | | Unknown | Volume calculation method is unknown. | |

2D indicates 2-dimensional; 3D, 3-dimensional; and CDE, common data element.

## APPENDIX 3. CONTINUED

### C. Left Heart Structures – Left Ventricle

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Sources |
|---|---|---|---|---|
| **Left ventricular wall thickness region name** | The region of the left ventricular wall associated with qualitative thickness findings. | ■ Anterior<br>■ Apical<br>■ Inferior<br>■ Lateral<br>■ Septal<br>■ Inferolateral (posterior) | | Cerqueira MD, Weissman NJ, Dilsizian V, et al. Standardized myocardial segmentation and nomenclature for tomographic imaging of the heart: a statement for healthcare professionals from the Cardiac Imaging Committee of the Council on Clinical Cardiology of the American Heart Association. Circulation. 2002;105:539-42.(8) |
| | | Anterior | Front portion of the left ventricular wall. | |
| | | Apical | Tip of the left ventricle. | |
| | | Inferior | Lower or diaphragmatic portion of the left ventricular wall. | |
| | | Lateral | Portion of the free wall of the left ventricular wall between posterior and anterior segments. | |
| | | Septal | Myocardial wall separating the left and right ventricle. | |
| | | Inferolateral (posterior) | Bottom portion of the left ventricular wall lateral to inferior segment. Also called posterior wall | |
| **Left ventricular wall thickness (by region), qualitative** | The qualitative description of the assessment of the thickness of the left ventricular wall regions at end-diastole. | ■ Normal<br>■ Thinned<br>■ Increased<br>■ Unknown | | Lang RM, Badano LP, Mor-Avi V, et al. Recommendations for cardiac chamber quantification by echocardiography in adults: an update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. J Am Soc Echocardiogr. 2015;28:1-39.e14.(7) |
| | | Normal | Regional thickness of left ventricular wall is normal. | |
| | | Thinned | Regional left ventricular wall thickness is thinner than normal. | |
| | | Increased | Regional left ventricular wall thickness is greater than normal. | |
| | | Unknown | Regional left ventricular wall thickness is unknown. | |

*Continued on the next page*

## APPENDIX 3. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Sources |
|---|---|---|---|---|
| **Left ventricular wall segment name** | The region of the left ventricular wall associated with segmental wall motion findings (see section on left ventricular function below). The left ventricle is divided into basal, mid, and apical segments by dividing it into thirds along the long axis, with basal corresponding to the region form mitral annulus to the tips of the papillary muscles; mid includes the entire length of the papillary muscles; apex corresponds to the area beyond the papillary muscles to just before the cavity ends, and the apical cap is the area of myocardium beyond the end of the left ventricular cavity. There are 6 segments at the base and mid ventricle, and 4 at the apex (plus an apical cap). | ■ Basal anterior<br>■ Basal anteroseptal<br>■ Basal inferoseptal<br>■ Basal inferior<br>■ Basal inferolateral (basal posterior)<br>■ Basal anterolateral<br>■ Mid anterior<br>■ Mid anteroseptal<br>■ Mid inferoseptal<br>■ Mid inferior<br>■ Mid inferolateral (mid posterior)<br>■ Mid anterolateral<br>■ Apical anterior<br>■ Apical septal<br>■ Apical inferior<br>■ Apical lateral<br>■ Apical cap | | Cerqueira MD, Weissman NJ, Dilsizian V, et al. Standardized myocardial segmentation and nomenclature for tomographic imaging of the heart: a statement for healthcare professionals from the Cardiac Imaging Committee of the Council on Clinical Cardiology of the American Heart Association. Circulation. 2002;105:539-42.(8) |
| | | Basal anterior | Front portion of the left ventricular wall at the base. | |
| | | Basal anteroseptal | Portion of the ventricular septum closest to the anterior segment at the base. | |
| | | Basal inferoseptal | Portion of the ventricular septum closest to the inferior segment at the base. | |
| | | Basal inferior | Lower or diaphragmatic portion of the left ventricular wall at the base. | |
| | | Basal inferolateral (basal posterior) | Inferior portion of the left ventricular free wall that is lateral to the inferior wall (sometimes called posterior wall) at the base. | |
| | | Basal anterolateral | Portion of the left ventricular free wall between the anterior and inferolateral segments at the base. | |
| | | Mid anterior | Front portion of the left ventricular wall at the level of the mid left ventricle. | |
| | | Mid anteroseptal | Portion of the ventricular septum closest to the anterior segment at the level of the mid left ventricle. | |
| | | Mid inferoseptal | Portion of the ventricular septum closest to the inferior segment at the level of the mid left ventricle. | |
| | | Mid inferior | Lower or diaphragmatic portion of the left ventricular wall at the level of the mid left ventricle. | |
| | | Mid inferolateral (mid posterior) | Inferior portion of the left ventricular free wall that is lateral to the inferior wall (sometimes called posterior wall) at the level of the mid left ventricle. | |
| | | Mid anterolateral | Portion of the left ventricular free wall between the anterior and inferolateral segments at the level of the mid left ventricle. | |
| | | Apical anterior | Front portion of the left ventricular wall at the level of the apex. | |
| | | Apical septal | Portion of the ventricular septum at the apex. | |
| | | Apical inferior | Lower or diaphragmatic portion of the left ventricular wall at the apex. | |
| | | Apical lateral | Portion of the free wall of the left ventricular wall at the apex. | |
| | | Apical cap | Cap of muscle of the left ventricular apex beyond the left ventricular cavity. | |

*Continued on the next page*

## APPENDIX 3. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Sources |
|---|---|---|---|---|
| **Left ventricular septal wall thickness at end-diastole** | The thickness of the left ventricular septal wall at end-diastole reported in mm. | Float | | |
| **Left ventricular septal wall thickness at end-systole** | The thickness of the left ventricular septal wall at end-systole reported in mm. | Float | | |
| **Left ventricular inferolateral wall thickness at end-diastole** | The thickness of the left ventricular inferolateral wall at end-diastole reported in mm. | Float | | |
| **Left ventricular inferolateral wall thickness at end-systole** | The thickness of the left ventricular inferolateral wall at end-systole reported in mm. | Float | | |
| **Left ventricular wall thickness (overall)** | The qualitative description of the assessment of the overall thickness of the left ventricular wall at end-diastole. | ■ Normal<br>■ Thinned<br>■ Increased<br>■ Unknown | | Lang RM, Badano LP, Mor-Avi V, et al. Recommendations for cardiac chamber quantification by echocardiography in adults: an update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. J Am Soc Echocardiogr. 2015;28:1-39.e14.(7) |
| | | Normal | Overall thickness of left ventricular wall is normal. | |
| | | Thinned | Overall left ventricular wall thickness is less than normal. | |
| | | Increased | Overall left ventricular wall thickness is greater than normal. | |
| | | Unknown | Overall left ventricular wall thickness is unknown. | |

*Continued on the next page*

## APPENDIX 3. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Sources |
|---|---|---|---|---|
| **Left ventricular size or volume at end-diastole** | The qualitative description of the size or volume of the left ventricle at end-diastole. | ■ Normal<br>■ Reduced<br>■ Mildly enlarged<br>■ Moderately enlarged<br>■ Severely enlarged<br>■ Unknown | | Lang RM, Badano LP, Mor-Avi V, et al. Recommendations for cardiac chamber quantification by echocardiography in adults: an update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. J Am Soc Echocardiogr. 2015;28:1-39.e14.(7) |
| | | Normal | Size of left ventricle at end-diastole is normal. | |
| | | Reduced | Size of the left ventricle at end-diastole is smaller than normal. | |
| | | Mildly enlarged | Size of left ventricle at end-diastole is slightly larger than normal. | |
| | | Moderately enlarged | Size of left ventricle at end-diastole is moderately larger than normal. | |
| | | Severely enlarged | Size of left ventricle at end-diastole considerably larger than normal. | |
| | | Unknown | Size of left ventricle at end-diastole is unknown. | |
| **Left ventricular size or volume at end-systole** | The qualitative description of the size or volume of the left ventricle at end-systole. | ■ Normal<br>■ Reduced<br>■ Mildly enlarged<br>■ Moderately enlarged<br>■ Severely enlarged<br>■ Unknown | | Lang RM, Badano LP, Mor-Avi V, et al. Recommendations for cardiac chamber quantification by echocardiography in adults: an update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. J Am Soc Echocardiogr. 2015,28:1-39.e14.(7) |
| | | Normal | Size of left ventricle at end-systole is normal. | |
| | | Reduced | Size of the left ventricle at end-systole is smaller than normal. | |
| | | Mildly enlarged | Size of left ventricle at end-systole is slightly larger than normal. | |
| | | Moderately enlarged | Size of left ventricle at end-systole is moderately larger than normal. | |
| | | Severely enlarged | Size of left ventricle at end-systole considerably larger than normal. | |
| | | Unknown | Size of left ventricle at end-systole is unknown. | |
| **Left ventricular diameter at end-diastole** | The left ventricular cavity minor-axis diameter, measured at end-diastole at its broadest point perpendicular to the left ventricle long axis, which is usually slightly below the mitral valve leaflet tips, and reported in cm. | Float | | Lang RM, Badano LP, Mor-Avi V, et al. Recommendations for cardiac chamber quantification by echocardiography in adults: an update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. J Am Soc Echocardiogr. 2015;28:1-39.e14.(7) |
| **Left ventricular diameter at end-systole** | The left ventricular cavity minor-axis diameter, measured at end-systole at its broadest point perpendicular to the left ventricle long axis, which is usually slightly below the mitral valve leaflet tips, and reported in cm. | Float | | |

*Continued on the next page*

## APPENDIX 3. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Sources |
|---|---|---|---|---|
| **Left ventricular volume at end-diastole** | The volume of the left ventricular cavity at end-diastole reported in mL. | Float | | |
| **Left ventricular volume at end-systole** | The volume of the left ventricular cavity at end-systole reported in mL. | Float | | |
| **Left ventricular volume calculation method** | The method used to calculate volume for the left ventricle. | ■ M-mode<br>■ Area length<br>■ 2D single-plane method of discs (2D single-plane)<br>■ 2D biplane method of discs (2D biplane)<br>■ 3D<br>■ Other<br>■ Unknown | | Lang RM, Badano LP, Mor-Avi V, et al. Recommendations for cardiac chamber quantification by echocardiography in adults: an update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. J Am Soc Echocardiogr. 2015;28:1-39.e14.(7) |
| | | M-mode | Measurement of volume by extrapolation from a single short-axis diameter measured on M-mode echo. | |
| | | Area-length | Measurement of volume by extrapolation from planimetry of a single short-axis imaging plane and an orthogonal long-axis diameter. | |
| | | 2D single-plane method of discs | Measurement of volume by extrapolation from planimetry of a single long-axis imaging plane. | |
| | | 2D biplane method of discs | Measurement of volume by extrapolation from planimetry of a 2-orthogonal long-axis imaging planes. | |
| | | 3D | Direct summation of volume enclosed by the endocardial borders. | |
| | | Other | Chamber volume calculation method is different from the methods described on this list. | |
| | | Unknown | Chamber volume calculation method is unknown. | |
| **Left ventricular volume index** | The left ventricular volume divided by body surface area reported in mL/$m^2$. | Float | | |

*Continued on the next page*

## APPENDIX 3. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Sources |
|---|---|---|---|---|
| **Left ventricular mass qualitative** | The qualitative description of the left ventricular mass. | ■ Normal<br>■ Reduced<br>■ Mildly increased<br>■ Moderately increased<br>■ Severely increased<br>■ Unknown | | Lang RM, Badano LP, Mor-Avi V, et al. Recommendations for cardiac chamber quantification by echocardiography in adults: an update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. J Am Soc Echocardiogr. 2015;28:1-39.e14.(7) |
| | | Normal | Left ventricular mass is normal for sex and body size. | |
| | | Reduced | Left ventricular mass is smaller than normal for sex and body size. | |
| | | Mildly increased | Left ventricular mass is slightly larger than normal for sex and body size. | |
| | | Moderately increased | Left ventricular mass is moderately larger than normal for sex and body size. | |
| | | Severely increased | Left ventricular mass is considerably larger than normal for sex and body size. | |
| | | Unknown | Mass of the left ventricle is unknown. | |
| **Left ventricular mass quantitative** | The calculated mass of the left ventricle reported in g. | Float | | |
| **Left ventricular mass index** | The left ventricular mass divided by body surface area reported in g/m$^2$. | Float | | |
| **Left ventricular geometry description** | Description of left ventricular geometry and remodeling. Left ventricular geometry is defined as normal or by the pattern of hypertrophy and/or dilation at end-diastole. | ■ Normal geometry<br>■ Concentric remodeling<br>■ Concentric hypertrophy<br>■ Eccentric remodeling<br>■ Eccentric hypertrophy<br>■ Asymmetric remodeling<br>■ Asymmetric hypertrophy<br>■ Unknown | | Lang RM, Badano LP, Mor-Avi V, et al. Recommendations for cardiac chamber quantification by echocardiography in adults: an update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. J Am Soc Echocardiogr. 2015;28:1-39.e14.(7) |
| | | Normal geometry | Thickness of the left ventricular wall and chamber size are normal for sex and body size; neither hypertrophy nor dilation are present. | |
| | | Concentric remodeling | Wall thickness is increased, but left ventricular mass is normal. | |
| | | Concentric hypertrophy | Hypertrophy is present, and chamber size is normal or reduced. | |
| | | Eccentric remodeling | Chamber size is increased, but left ventricular mass is normal. | |
| | | Eccentric hypertrophy | Both increased chamber size and hypertrophy are present. | |
| | | Asymmetric remodeling | Wall thickness in any region is disproportionately increased compared with other regions, but left ventricular mass is normal. | |
| | | Asymmetric hypertrophy | Wall thickness in any region is disproportionately increased compared with other regions, and hypertrophy is present. | |
| | | Unknown | Geometry of the left ventricle is unknown. | |

*Continued on the next page*

## APPENDIX 3. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Sources |
|---|---|---|---|---|
| **Left ventricular non-compaction syndrome** | The presence or absence of left ventricular noncompaction syndrome. Noncompaction of the left ventricle is defined as a type of cardiomyopathy characterized by ventricular trabeculations that are more than twice the thickness of the compacted myocardium. Typically measured at the mid left ventricular posterolateral wall. | ■ Present<br>■ Absent<br>■ Unknown | | Chin TK, Perloff JK, Williams RG, et al. Isolated noncompaction of left ventricular myocardium: a study of eight cases. Circulation. 1990;82:507-13.(9)<br>Jenni R, Oechslin E, Schneider J, et al. Echocardiographic and pathoanatomical characteristics of isolated left ventricular non-compaction: a step towards classification as a distinct cardiomyopathy. Heart. 2001;86:666-71.(10) |
| | | Present | Left ventricular noncompaction syndrome is present. | |
| | | Absent | Left ventricular noncompaction syndrome is not present. | |
| | | Unknown | The presence of left ventricular noncompaction syndrome is unknown. | |

2D indicates 2-dimensional; 3D, 3-dimensional; CDE, common data element; and echo, echocardiography.

## APPENDIX 3. CONTINUED

### D. Right Heart Structures - Right Ventricle

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Sources |
|---|---|---|---|---|
| **Right ventricular wall thickness at end-diastole** | The qualitative description of the static, end-diastolic thickness of right ventricular wall. | ■ Normal<br>■ Thinned<br>■ Increased<br>■ Unknown | | Lang RM, Badano LP, Mor-Avi V, et al. Recommendations for cardiac chamber quantification by echocardiography in adults: an update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. J Am Soc Echocardiogr. 2015;28:1-39.e14.(7) |
| | | Normal | Thickness of right ventricular wall is normal at end-diastole. | |
| | | Thinned | Right ventricular wall thickness at end-diastole is thinner than normal. | |
| | | Increased | Right ventricular wall thickness at end-diastole is larger than normal. | |
| | | Unknown | Right ventricular wall thickness is unknown. | |
| **Right ventricular wall thickness at end-diastole, quantitative** | The quantitative measurement of the end-diastolic thickness of the right ventricular free wall reported in mm. | Float | | |
| **Right ventricular size or volume at end-diastole** | The qualitative description of the size or volume of the right ventricle at end-diastole. | ■ Normal<br>■ Reduced<br>■ Mildly enlarged<br>■ Moderately enlarged<br>■ Severely enlarged<br>■ Unknown | | Lang RM, Badano LP, Mor-Avi V, et al. Recommendations for cardiac chamber quantification by echocardiography in adults: an update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. J Am Soc Echocardiogr. 2015;28:1-39.e14.(7) |
| | | Normal | Size of right ventricle at end-diastole is normal. | |
| | | Reduced | Size of the right ventricle at end-diastole is smaller than normal. | |
| | | Mildly enlarged | Size of right ventricle at end-diastole is slight larger than normal. | |
| | | Moderately enlarged | Size of right ventricle at end-diastole is moderately larger than normal. | |
| | | Severely enlarged | Size of right ventricle at end-diastole is considerably larger than normal. | |
| | | Unknown | Size of right ventricle is unknown. | |

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## APPENDIX 3. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Sources |
|---|---|---|---|---|
| **Right ventricular size or volume at end-systole** | The qualitative description of the size or volume of the right ventricle at end-systole. | ■ Normal<br>■ Reduced<br>■ Mildly enlarged<br>■ Moderately enlarged<br>■ Severely enlarged<br>■ Unknown | | Lang RM, Badano LP, Mor-Avi V, et al. Recommendations for cardiac chamber quantification by echocardiography in adults: an update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. J Am Soc Echocardiogr. 2015;28:1-39.e14.(7) |
| | | Normal | Size of right ventricle at end-systole is normal. | |
| | | Reduced | Size of the right ventricle at end-systole is smaller than normal. | |
| | | Mildly enlarged | Size of right ventricle at end-systole is slightly larger than normal. | |
| | | Moderately enlarged | Size of right ventricle at end-systole is moderately larger than normal. | |
| | | Severely enlarged | Size of right ventricle at end-systole is considerably larger than normal. | |
| | | Unknown | Size of right ventricle is unknown. | |
| **Right ventricular diameter at end-diastole** | The size of the minor-axis cross-sectional diameter measurement of the right ventricular chamber just below the tricuspid valve at end-diastole reported in cm. | Float | | |
| **Right ventricular diameter at end-systole** | The minor-axis cross-sectional diameter measurement of the right ventricular chamber just below the tricuspid valve at end-systole reported in cm. | Float | | |
| **Right ventricular area at end-diastole** | The area of the right ventricle at end-diastole as measured by planimetry of a single longitudinal right ventricular image (usually the apical 4-chamber view) reported in $cm^2$. | Float | | |
| **Right ventricular area at end-systole** | The area of the right ventricle at end-systole as measured by planimetry of a single longitudinal right ventricular image (usually the apical 4-chamber view) reported in $cm^2$. | Float | | |
| **Right ventricular volume at end-diastole** | The volume of the right ventricle at end-diastole reported in mL. | Float | | |

*Continued on the next page*

## APPENDIX 3. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Sources |
|---|---|---|---|---|
| **Right ventricular volume at end-systole** | The volume of the right ventricle at end-systole reported in mL. | Float | | |
| **Right ventricular volume calculation method** | The method used to calculate volume for the right ventricle. | ■ 3D<br>■ Other method<br>■ Unknown | | |
| | | 3D chamber volume calculation method | Direct summation of volume enclosed by the endocardial borders as interpolated from planimetry of at least 3 orthogonal imaging planes. | |
| | | Other method | Volume calculation method is different from the methods described in this list. | |
| | | Unknown | Volume calculation method is unknown. | |
| **Right ventricular volume index at end-diastole** | The right ventricular volume divided by body surface area reported in mL/m$^2$. | Float | | |
| **Arrhythmogenic right ventricular cardiomyopathy** | The presence or absence of ARVC (sometimes called dysplasia).<br><br>ARVC is an inherited cardiomyopathy characterized by ventricular arrhythmia, right ventricular wall thinning and right ventricular dysfunction. | ■ Present<br>■ Absent<br>■ Unknown | | Marcus FI, McKenna WJ, Sherrill D, et al. Diagnosis of arrhythmogenic right ventricular cardiomyopathy/dysplasia: proposed modification of the task force criteria. Circulation. 2010;121:1533-41.(11) |
| | | Present | ARVC is present. | |
| | | Absent | ARVC is not present. | |
| | | Unknown | The presence of ARVC is unknown. | |

3D indicates 3-dimensional; ARVC, arrhythmogenic right ventricular cardiomyopathy; and CDE, common data element.

## APPENDIX 4. LEFT AND RIGHT HEART FUNCTION

### A. Left Ventricular Systolic Function

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Sources |
|---|---|---|---|---|
| **Left ventricular systolic function** | The qualitative description of the systolic function of the left ventricle (left ventricular fractional area change or ejection fraction), which may include integration of visual assessment and quantitative measures. | ■ Normal<br>■ Hyperdynamic<br>■ Mildly reduced<br>■ Moderately reduced<br>■ Severely reduced<br>■ Unknown | | Lang RM, Badano LP, Mor-Avi V, et al. Recommendations for cardiac chamber quantification by echocardiography in adults: an update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. J Am Soc Echocardiogr. 2015;28:1-39.e14.(7) |
| | | Normal | Left ventricular systolic function is normal. | |
| | | Hyperdynamic | A greater than normal proportion of blood within the left ventricular cavity is ejected during systole. | |
| | | Mildly reduced | The proportion of blood ejected from the left ventricle during systole is slightly reduced compared with normal. | |
| | | Moderately reduced | The proportion of blood relative to normal being ejected from the left ventricle during systole is moderately smaller than normal. | |
| | | Severely reduced | The proportion of blood relative to normal being ejected from the left ventricle during systole is considerably less than normal. | |
| | | Unknown | Systolic function of the left ventricle is unknown. | |
| **Left ventricular ejection fraction, estimated** | The visual estimate of the LVEF reported as a percentage using either a single value or the midpoint when a range is reported.<br>LVEF is defined as the proportion of blood ejected during left ventricular contraction of the heart. | Float | | |
| **Left ventricular ejection fraction, calculated** | The calculated resting LVEF is the percentage of blood ejected during left ventricular contraction of the heart and expressed as a percentage. It is calculated using the formula: LVEF=([EDV-ESV]/EDV) × 100. Where LVEF is defined as the percentage of blood ejected during a left ventricular contraction of the heart.<br>EDV is defined as the volume of blood in the left ventricle at the end of ventricular filling.<br>ESV is defined as the volume of blood remaining in the left ventricle at the end of ventricular ejection. | Float | | |

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## APPENDIX 4. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Sources |
|---|---|---|---|---|
| **Left ventricular outflow tract diameter at mid-systole** | The quantitative measurement of the mid-systolic diameter of the left ventricular outflow tract at the level of the insertion of the aortic valve leaflet reported in cm, usually measured from a view that depicts the long axis of the left ventricular outflow tract. | Float | | |
| **Left ventricular outflow tract peak velocity** | The highest velocity of systolic blood flow through the LVOT reported in cm/s or m/s. | Float | | |
| **Left ventricular outflow tract velocity time integral** | The systolic velocity time integral at the level of the LVOT just below the zone of acceleration reported in cm. Velocity time integral is defined as the integral of the instantaneous flow velocity curve during left ventricular ejection. | Float | | |
| **Left ventricular stroke volume, volumetric** | The blood volume ejected from the left ventricle with each contraction reported in mL. This assessment includes total flow (effective total flow, aortic regurgitation, and mitral regurgitation). This is calculated as the difference between end-diastolic left ventricular volume and end-systolic left ventricular volume. | Float | | |
| **Left ventricular stroke volume, Doppler** | The blood volume ejected from the left ventricle through the aortic valve with each contraction reported in mL. This assessment includes forward flow (effective forward flow and regurgitant flow from aortic regurgitation) but not backward flow (from mitral regurgitation). This is typically measured as the product of cross-sectional area of the left ventricular outflow tract and velocity time velocity of the systolic LVOT blood flow velocity. | Float | | |
| **Cardiac output** | The estimated blood volume ejected from the left ventricle (volumetric method) or forward flow (Doppler method) per unit time reported in L/min. | Float | | |
| **Cardiac output determination method** | The method used to determine cardiac output. | ■ Volumetric cardiac output method<br>■ Doppler cardiac output method | | |
| | | Volumetric cardiac output | Cardiac output is calculated using the formula: volumetric stroke volume multiplied by heart rate. | |
| | | Doppler cardiac output | Cardiac output is directly measured using the formula: Doppler stroke volume multiplied by heart rate. | |
| **Cardiac index** | The calculation of cardiac output divided by body surface area reported in L/min/$m^2$. | Float | | |

*Continued on the next page*

## APPENDIX 4. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Sources |
|---|---|---|---|---|
| **Left ventricular systolic dyssynchrony overall** | The qualitative description of the coordination of the sequence of activation, contraction and motion of segments of the left ventricular wall (intraventricular dyssynchrony). | ■ None<br>■ Mildly delayed<br>■ Moderately delayed<br>■ Severely delayed<br>■ Unknown | | Bax JJ, Ansalone G, Breithardt OA, et al. Echocardiographic evaluation of cardiac resynchronization therapy: ready for routine clinical use? A critical appraisal. J Am Coll Cardiol. 2004;44:1-9.(12) |
| | | None | Activation and contraction of all portions of the left ventricle are nearly simultaneous. | |
| | | Mildly delayed | The normal sequence of activation and contraction of some segments of the left ventricle is slightly prolonged in some sections but not others. | |
| | | Moderately delayed | The normal sequence of activation and contraction of some segments the left ventricle is moderately prolonged. | |
| | | Severely delayed | The normal sequence of activation and contraction of some segments of the left ventricle is considerably prolonged in some sections. | |
| | | Unknown | The presence and/or severity of left ventricular dyssynchrony is unknown. | |
| **Tei index (or myocardial performance index)** | An index of systolic function calculated as isovolumic time (isovolumic contraction time plus isovolumic relaxation time) divided by ventricular ejection time for the left or right ventricle.<br>This index is reported as a number without units. | Float | | |
| **Left ventricular peak dP/dt instantaneous** | Estimated peak instantaneous rate of the rise of left ventricular pressure during early contraction.<br>dP/dt is a formula representing change in pressure over change in time, reported as mm Hg/s. | Float | | |
| **Left ventricular mean dP/dt** | Estimated mean rate of the rise of left ventricular pressure during the duration of isovolumic contraction.<br>dP/dt is a formula representing change in pressure over change in time, reported as mm Hg/s. | Float | | |
| **Left ventricular pulsed tissue Doppler S′** | The peak velocity of the lateral or septal mitral annular myocardium during systole reported as cm/s | Float | | |

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## APPENDIX 4. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Sources |
|---|---|---|---|---|
| **Left ventricular wall segment function** | The qualitative description of left ventricle motion reported for each segment of the 17-segment model | ■ Normal<br>■ Hyperkinetic<br>■ Hypokinetic<br>■ Akinetic<br>■ Dyskinetic<br>■ Aneurysmal<br>■ Not seen | | |
| | | Normal | Normal systolic segmental motion or thickening. | |
| | | Hyperkinetic | Increased systolic segmental motion or thickening. | |
| | | Hypokinetic | Decreased systolic segmental motion or thickening. | |
| | | Akinetic | Minimal or no segmental motion or thickening. | |
| | | Dyskinetic | Left ventricular wall segment moves outward during systole. | |
| | | Aneurysmal | Deformation throughout the cardiac cycle, often associated with wall thinning. | |
| | | Not Seen | Left ventricular segmental wall motion type is not seen. | |
| **Left ventricular global longitudinal systolic strain** | The maximal deformation of the left ventricular myocardium at peak systole, averaged over the entire ventricle expressed as a percentage. Because this is a negative number (the direction of deformation is compression), numbers closer to zero (or less negative) represent worse function. | Float | | Voigt JU, Pedrizzetti G, Lysyansky P, et al. Definitions for a common standard for 2D speckle tracking echocardiography: consensus document of the EACVI/ASE/Industry Task Force to standardize deformation imaging. J Am Soc Echocardiogr. 2015;28:183-93.(13) |

CDE indicates common data element; EDV, end-diastolic volume; ESV, end-systolic volume; LVEF, left ventricular ejection fraction; and LVOT, left ventricular outflow tract.

## APPENDIX 4. CONTINUED

### B. Right Ventricular Systolic Function

| CDE Label | OCDE Definition | Permissible Values | Permissible Value Definitions | Sources |
|---|---|---|---|---|
| **Right ventricular systolic function** | The qualitative description of the systolic function of the right ventricle, which may include integration of visual assessment and quantitative measures. | ■ Normal<br>■ Hyperdynamic<br>■ Mildly reduced<br>■ Moderately reduced<br>■ Severely reduced<br>■ Unknown | | Lang RM, Badano LP, Mor-Avi V, et al. Recommendations for cardiac chamber quantification by echocardiography in adults: an update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. J Am Soc Echocardiogr. 2015;28:1-39.e14.(7) |
| | | Normal | Right ventricular systolic function is normal. | |
| | | Hyperdynamic | A greater than normal proportion of blood within the right ventricular cavity is ejected during systole. | |
| | | Mildly reduced | The proportion of blood ejected from the right ventricle during systole is slightly reduced compared with normal. | |
| | | Moderately reduced | The proportion of blood relative to normal being ejected from the right ventricle during systole is moderately smaller than normal. | |
| | | Severely reduced | The proportion of blood relative to normal being ejected from the right ventricle during systole is considerably less than normal. | |
| | | Unknown | Systolic function of the right ventricle is unknown. | |
| **Right ventricular fractional area change, estimated** | The visual estimate of the RV FAC reported as a percentage using either a single value or the midpoint when a range is reported. RV FAC is defined as the proportion of RV area change (reduction) during right ventricular systole. | Float | | |
| **Right ventricular fractional area change, calculated** | The calculated resting RV FAC, expressed as a percentage, based on the formula: RV FAC=([RV EDA − RV ESA]/RV EDA) × 100 where RV FAC is defined as the amount of RV area change during right ventricular systole. EDA is defined as the planar area of a chamber at the end of ventricular filling, in this case, the right ventricle. ESA is defined as the planar area of a chamber at the end of ventricular ejection, in this case, the right ventricle | Float | | |
| **Right ventricular ejection fraction, estimated** | The visual estimate of the RVEF reported as a percentage using either a single value or the midpoint when a range is reported. RVEF is defined as the proportion of blood ejected during right ventricular systole. | Float | | |

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## APPENDIX 4. CONTINUED

| CDE Label | OCDE Definition | Permissible Values | Permissible Value Definitions | Sources |
|---|---|---|---|---|
| **Right ventricular ejection fraction, calculated** | The calculated resting RVEF, expressed as a percentage, based on the formula: RVEF=([EDV – ESV]/EDV) × 100 where RVEF is defined as the amount of blood ejected during right ventricular contraction of the heart. EDV is defined as the amount of blood in the right ventricle at the end of ventricular filling. ESV is defined as the amount of blood remaining in the right ventricle at the end of ventricular ejection. | Float | | |
| **Right ventricular total longitudinal systolic strain** | The longitudinal deformation of the right ventricular fee wall and septum during systole expressed as a percentage. Because this is a negative number (the direction of deformation is compression), numbers closer to zero (or less negative) represent worse function. | Float | | Voigt JU, Pedrizzetti G, Lysyansky P, et al. Definitions for a common standard for 2D speckle tracking echocardiography: consensus document of the EACVI/ASE/Industry Task Force to standardize deformation imaging. J Am Soc Echocardiogr. 2015;28:183-93.(13) |
| **Right ventricular free wall global longitudinal systolic strain** | The deformation of the right ventricular free wall myocardium at peak systole, expressed as a percentage. Because this is a negative number (the direction of deformation is compression), numbers closer to zero (or less negative) represent worse function. | Float | | Voigt JU, Pedrizzetti G, Lysyansky P, et al. Definitions for a common standard for 2D speckle tracking echocardiography: consensus document of the EACVI/ASE/Industry Task Force to standardize deformation imaging. J Am Soc Echocardiogr. 2015;28:183-93.(13) |

CDE indicates common data element; EDA, end-diastolic area; EDV, end-diastolic volume; ESA, end-systolic area; ESV, end-systolic volume; FAC, fractional area change; RV, right ventricular; and RVEF, right ventricular ejection fraction.

### C. Left Ventricular Diastolic Function

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Sources |
|---|---|---|---|---|
| **Left ventricular diastolic function** | The evaluation of diastolic properties of the left ventricle including those related to lusitropy (relaxation) and compliance (stiffness), based on schema developed for echocardiography, using patterns of mitral inflow and annular velocities, tricuspid regurgitation velocity, left atrial size and pulmonary vein flow velocities. Left ventricular diastolic function is defined as relaxation and filling during the period after aortic valve closure and before aortic valve opening. | ■ Normal<br>■ Grade 1<br>■ Grade 2<br>■ Grade 3<br>■ Unknown | | Nagueh SF, Smiseth OA, Appleton CP, et al. Recommendations for the evaluation of left ventricular diastolic function by echocardiography: an update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. J Am Soc Echocardiogr. 2016;29:277-314.(14) |
| | | Normal | Left ventricular relaxation and filling during the period after aortic valve closure and before aortic valve opening is normal. | |
| | | Grade 1 | Mildly abnormal relaxation pattern. | |
| | | Grade 2 | Pseudonormal filling pattern. | |
| | | Grade 3 | Restrictive filling pattern. | |
| | | Unknown | Left ventricular diastolic function is unknown. | |

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## APPENDIX 4. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Sources |
|---|---|---|---|---|
| **Systolic pulmonary vein flow velocities** | Peak velocity of forward systolic pulmonary vein flow, reported as cm/s, or S. | Float | | |
| **Early-mid diastolic pulmonary vein flow velocities** | Peak velocity of early and mid-diastolic forward pulmonary vein flow, reported as cm/s, or D. | Float | | |
| **Atrial systolic pulmonary vein flow velocities** | Peak velocity of retrograde pulmonary vein flow, during atrial systole, reported as cm/s, or a. | Float | | |
| **Pulmonary vein dominance** | Timing of the dominant (highest velocity or VTI) component of pulmonary vein flow. | ■ Systole<br>■ Diastole<br>■ Equivocal | | |
| | | Systole | Peak velocity of flow in systole is greater than in diastole. | |
| | | Diastole | Peak velocity of flow in diastole is greater than in systole. | |
| | | Equivocal | Peak velocity of flow is similar in systole and in diastole. | |
| **Mitral annulus e′ velocity (septal)** | The peak velocity of septal mitral annular motion during early diastole often preceding the rapid filling phase reported in cm/s. | Float | | |
| **Mitral annulus a′ velocity (septal)** | The peak velocity of septal mitral annular motion during late diastole or the atrial systolic phase reported in cm/s. | Float | | |
| **Mitral annulus e′ velocity (lateral)** | The peak velocity of lateral mitral annular motion during early diastole or the rapid filling phase reported in cm/s. | Float | | |
| **Mitral annulus a′ velocity (lateral)** | The peak velocity of lateral mitral annular motion during late diastole or the atrial systolic phase reported in cm/s. | Float | | |
| **Mitral annulus s′ velocity (septal)** | The peak velocity of septal mitral annular motion during systole reported in cm/s. | Float | | |
| **Mitral annulus s′ velocity (septal)** | The peak velocity of septal mitral annular motion during systole reported in cm/s. | Float | | |
| **Mitral valve peak E velocity** | The peak velocity of blood flow across the mitral valve measured at the level of the leaflet tips during early diastole or the rapid filling phase reported in cm/s. | Float | | |
| **Mitral valve peak A velocity** | The peak velocity of blood flow across the mitral valve measured at the level of the leaflet tips during late diastole or the atrial systolic phase reported in cm/s. | Float | | |
| **E/A ratio** | The ratio of peak early to peak late transmitral flow velocities. This ratio is reported without units. | Float | | |

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## APPENDIX 4. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Sources |
|---|---|---|---|---|
| **Left ventricular filling pressure** | Estimated pressure in the left ventricle in diastole, as assessed by the ratio of ratio of peak early transmitral to peak early annular motion velocities. | ■ Normal<br>■ Elevated | | |
| | | ■ Normal | Normal E/e' is <15 (any measurement) | |
| | | ■ Elevated | Elevated E/e' is >15 (any measurement) | |
| **Mitral inflow deceleration time** | The time required for mitral inflow velocity to fall from E to zero, measured in ms. | Float | | |
| **Color M-mode flow propagation velocity** | The slope of propagation early diastolic mitral inflow toward the left ventricular apex (Vp), measured in cm/s. | Float | | |
| **Isovolumic ventricular relaxation time** | The time interval between aortic valve closure and mitral valve opening, measured in ms. | Float | | |

CDE indicates common data element; and VTI, velocity time integral.

## APPENDIX 5. AORTA

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Source |
|---|---|---|---|---|
| **Sinuses of Valsalva size** | The qualitative assessment of the end-diastolic size of aortic root usually at the level of the sinuses of Valsalva. | ■ Normal<br>■ Reduced<br>■ Mildly enlarged<br>■ Moderately enlarged<br>■ Severely enlarged<br>■ Unknown | | Evangelista A, Flachskampf FA, Erbel R, et al. Echocardiography in aortic diseases: EAE recommendations for clinical practice. Eur J Echocardiogr. 2010;11:645-58.(15) Goldstein SA, Evangelista A, Abbara S, et al. Multimodality imaging of diseases of the thoracic aorta in adults. J Am Soc Echocardiogr. 2015;28:119-82.(16) |
| | | Normal | Cross-sectional diameter of the aortic root is normal. | |
| | | Reduced | The diameter of the sinuses of Valsalva is normal. | |
| | | Mildly enlarged | The diameter of the sinuses of Valsalva is slightly larger than normal. | |
| | | Moderately enlarged | The diameter of the sinuses of Valsalva is moderately larger than normal. | |
| | | Severely enlarged | The diameter of the sinuses of Valsalva is severely larger than normal. | |
| | | Unknown | Size of sinuses of Valsalva is visualized but is unknown. | |
| **Sinus of Valsalva diameter end-diastole** | The end-diastolic cross-sectional diameter of the aorta at the level of the sinuses of Valsalva reported in cm. | Float | | |
| **Sinus of Valsalva diameter mid-systole** | The mid-systolic (maximal expansion) cross-sectional diameter of the aorta at the level of the sinuses of Valsalva reported in cm. | Float | | |
| **Sino-tubular junction diameter end-diastole** | The end-diastolic cross-sectional diameter of the aorta at the level of the sinotubular junction reported in cm. | Float | | |

*Continued on the next page*

## APPENDIX 5. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Source |
|---|---|---|---|---|
| **Sino-tubular junction diameter mid-systole** | The mid-systolic (maximal expansion) cross-sectional diameter of the aorta at the level of the sinotubular junction reported in cm. | Float | | |
| **Ascending aorta diameter end-diastole** | The largest end-diastolic cross-sectional diameter of the ascending aorta measured above the level of the sinotubular junction and reported in cm. | Float | | |
| **Ascending aorta diameter mid-systole** | The largest mid-systolic (maximal expansion) cross-sectional diameter of the ascending aorta measured above the level of the sinotubular junction and reported in cm. | Float | | |
| **Thoracic aorta diameter end-diastole** | The largest end-diastolic cross-sectional diameter of the descending thoracic aorta diameter reported in cm. | Float | | |
| **Thoracic aorta diameter mid-systole** | The largest mid-systolic (maximal expansion) cross-sectional diameter of the descending thoracic aorta diameter reported in cm. | Float | | |
| **Aortic coarctation presence/severity** | The qualitative description of the presence and severity of the aortic coarctation. An aortic coarctation is defined as a congenital malformation of the aorta in which there is a discrete luminal narrowing of the junction between the aortic arch and the descending aorta. | ■ None<br>■ Present<br>■ Mild<br>■ Moderate to severe<br>■ Unknown | | Evangelista A, Flachskampf FA, Erbel R, et al. Echocardiography in aortic diseases: EAE recommendations for clinical practice. Eur J Echocardiogr. 2010;11:645-58.(15) International Society for Nomenclature of Paediatric and Congenital Heart Disease (ISNPCHD) IPCCC 09.29.01.(6) |
| | | Present | Aortic coarctation is present but the severity could not be quantified. | |
| | | Mild | Aortic coarctation is present and is hemodynamically insignificant. | |
| | | Moderate to severe | Aortic coarctation is present and is hemodynamically significant. | |
| | | Unknown | The presence of aortic coarctation is unknown. | |
| **Aortic coarctation peak gradient** | The quantitative description of the severity of the aortic coarctation as measured by the peak systolic gradient across the coarctation, reported in mm Hg or velocity in m/s. | Float | | |
| **Aortic aneurysm** | An aortic aneurysm is defined as a permanent localized or diffuse dilatation of the aorta, having at least a 50% increase in diameter compared with the normal diameter. | ■ Present<br>■ Absent<br>■ Unknown | | |
| | | Present | An aortic aneurysm is present. | |
| | | Absent | An aortic aneurysm is not present. | |
| | | Unknown | The presence of an aortic aneurysm is unknown. | |

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## APPENDIX 5. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Source |
|---|---|---|---|---|
| **Aortic dissection, location unspecified** | The presence or absence of an aortic dissection in a nonspecific location. An aortic dissection is defined as a disruption of the intimal layer of the aorta with formation of a false lumen and/or bleeding within the wall of the aorta. | ■ Present<br>■ Absent<br>■ Unknown | | Hiratzka LF, Bakris GL, Beckman JA, et al. 2010 ACCF/AHA/AATS/ACR/ASA/SCA/SCAI/SIR/STS/SVM guidelines for the diagnosis and management of patients with thoracic aortic disease: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines, American Association for Thoracic Surgery, American College of Radiology, American Stroke Association, Society of Cardiovascular Anesthesiologists, Society for Cardiovascular Angiography and Interventions, Society of Interventional Radiology, Society of Thoracic Surgeons, and Society for Vascular Medicine. J Am Coll Cardiol. 2010;55:e27-129.(17) |
| | | Present | An aortic dissection is present. | |
| | | Absent | An aortic dissection is not present. | |
| | | Unknown | The presence of an aortic dissection is unknown. | |
| **Thoracic aortic aneurysm** | A thoracic aortic aneurysm is defined as a permanent localized or diffuse dilatation of the thoracic aorta, having at least a 50% increase in diameter compared with the normal diameter. | ■ Present<br>■ Absent<br>■ Ascending<br>■ Descending<br>■ Both<br>■ Unknown | | Hiratzka LF, Bakris GL, Beckman JA, et al. 2010 ACCF/AHA/AATS/ACR/ASA/SCA/SCAI/SIR/STS/SVM guidelines for the diagnosis and management of patients with thoracic aortic disease: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines, American Association for Thoracic Surgery, American College of Radiology, American Stroke Association, Society of Cardiovascular Anesthesiologists, Society for Cardiovascular Angiography and Interventions, Society of Interventional Radiology, Society of Thoracic Surgeons, and Society for Vascular Medicine. J Am Coll Cardiol. 2010;55:e27-129.(17) |
| | | Present | A thoracic aortic aneurysm is present but cannot be localized. | |
| | | Absent | A thoracic aortic aneurysm is not present. | |
| | | Ascending | A thoracic aortic aneurysm is present in ascending aorta. | |
| | | Descending | A thoracic aortic aneurysm is present in the descending aorta. | |
| | | Both ascending and descending | A thoracic aortic aneurysm is present in both the ascending and descending aorta. | |
| | | Unknown | The presence of a thoracic aortic aneurysm is unknown. | |
| **Thoracic aortic dissection classification** | The presence, absence or classification (using the Stanford Classification system) of a thoracic aortic aneurysm. A thoracic aortic dissection is defined as a disruption of the media layer of the thoracic aorta with bleeding within and along the wall of the aorta. | ■ Absent<br>■ Stanford Class A<br>■ Stanford Class B<br>■ Present, unable to characterize further<br>■ Unknown | | Hiratzka LF, Bakris GL, Beckman JA, et al. 2010 ACCF/AHA/AATS/ACR/ASA/SCA/SCAI/SIR/STS/SVM guidelines for the diagnosis and management of patients with thoracic aortic disease: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines, American Association for Thoracic Surgery, American College of Radiology, American Stroke Association, Society of Cardiovascular Anesthesiologists, Society for Cardiovascular Angiography and Interventions, Society of Interventional Radiology, Society of Thoracic Surgeons, and Society for Vascular Medicine. J Am Coll Cardiol. 2010;55:e27-129.(17) |

*Continued on the next page*

## APPENDIX 5. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Source |
|---|---|---|---|---|
| | | Absent | A thoracic aortic dissection is not present. | |
| | | Stanford Class A | All dissections involving the ascending aorta regardless of site of origin. | |
| | | Stanford Class B | All dissections not involving the ascending aorta. | |
| | | Present, unable to characterize further | A thoracic aortic aneurysm dissection is present, but classification cannot be further described. | |
| | | Unknown | Presence, absence and classification of thoracic aorta dissection are unknown. | |
| **Suprarenal abdominal aortic aneurysm** | The presence or absence of an abdominal aortic aneurysm that originates above the renal arteries.<br>A suprarenal abdominal aortic aneurysm (present suprarenally only) is defined as a permanent localized dilatation of the infradiaphragmatic aorta, having at least a 50% increase in diameter compared with the normal diameter. | ■ Present<br>■ Absent<br>■ Unknown | | Hiratzka LF, Bakris GL, Beckman JA, et al. 2010 ACCF/AHA/AATS/ACR/ASA/SCA/SCAI/SIR/STS/SVM guidelines for the diagnosis and management of patients with thoracic aortic disease: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines, American Association for Thoracic Surgery, American College of Radiology, American Stroke Association, Society of Cardiovascular Anesthesiologists, Society for Cardiovascular Angiography and Interventions, Society of Interventional Radiology, Society of Thoracic Surgeons, and Society for Vascular Medicine. J Am Coll Cardiol. 2010;55:e27-129.(17) |
| | | Present | A suprarenal abdominal aortic aneurysm is present. | |
| | | Absent | A suprarenal abdominal aortic aneurysm is not present. | |
| | | Unknown | The presence of a suprarenal abdominal aortic aneurysm is unknown. | |
| **Infrarenal abdominal aortic aneurysm** | The presence or absence of an abdominal aortic aneurysm that originates below the renal arteries.<br>An infrarenal abdominal aortic aneurysm is defined as a permanent localized dilatation of the infradiaphragmatic aorta (below the renal arteries), having at least a 50% increase in diameter compared with the normal diameter. | ■ Present<br>■ Absent<br>■ Unknown | | Hiratzka LF, Bakris GL, Beckman JA, et al. 2010 ACCF/AHA/AATS/ACR/ASA/SCA/SCAI/SIR/STS/SVM guidelines for the diagnosis and management of patients with thoracic aortic disease: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines, American Association for Thoracic Surgery, American College of Radiology, American Stroke Association, Society of Cardiovascular Anesthesiologists, Society for Cardiovascular Angiography and Interventions, Society of Interventional Radiology, Society of Thoracic Surgeons, and Society for Vascular Medicine. J Am Coll Cardiol. 2010;55:e27-129.(17) |
| | | Present | An infrarenal abdominal aortic aneurysm is present. | |
| | | Absent | An infrarenal abdominal aortic aneurysm is not present. | |
| | | Unknown | The presence of an infrarenal abdominal aortic aneurysm is unknown. | |

CDE indicates common data element.

## APPENDIX 6. RIGHT HEART HEMODYNAMICS AND PULMONARY ARTERY

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Source |
|---|---|---|---|---|
| **Inferior vena cava size** | A qualitative description of the size of the inferior vena cava. | ■ Normal<br>■ Reduced<br>■ Dilated<br>■ Unknown | | Rudski LG, Lai WW, Afilalo J, et al. Guidelines for the echocardiographic assessment of the right heart in adults: a report from the American Society of Echocardiography. J Am Soc Echocardiogr. 2010;23:685-713.(18) |
| | | Normal | The size of the inferior vena cava is normal. | |
| | | Reduced | The size of the inferior vena cava is smaller than normal. | |
| | | Dilated | The size of the inferior vena cava is larger than normal. | |
| | | Unknown | The size of the inferior vena cava is unknown. | |
| **Inferior vena cava size** | Inferior vena cava size is measured as the cross-sectional diameter of the vessel assessed at quiet end-expiration approximately 0.5–3.0 cm below its junction with the right atrium and reported in cm. | Float | | |
| **Inferior vena cava size, with sniff** | Cross-sectional diameter of the inferior vena cava assessed during a sharp inhalation reported in cm. | Float | | |
| **Inferior vena cava collapse** | The extent of reduction in resting inferior vena cava diameter with a sniff or sharp inhalation compared with baseline value before inhalation. | ■ Normal<br>■ Abnormal<br>■ Unknown | | |
| | | Normal | Inferior vena cava collapse ≥50% reduction is present. | |
| | | Abnormal | Inferior vena cava collapse is <50% reduction. | |
| | | Unknown | The presence of inferior vena cava collapse is unknown. | |
| **Coronary sinus size, qualitative** | The size of the coronary sinus. | ■ Normal<br>■ Dilated<br>■ Unknown | | |
| | | Normal | The size of the coronary sinus is normal. | |
| | | Dilated | The size of the coronary sinus is increased. | |
| | | Unknown | The size of the coronary sinus is unknown. | |
| **Mean right atrial pressure, estimated** | The estimated mean pressure in right atrium reported in mm Hg based on inferior vena cava size and collapse with sniff. | ■ Normal right atrial pressure<br>■ Intermediate right atrial pressure<br>■ Elevated right atrial pressure | | Rudski LG, Lai WW, Afilalo J, et al. Guidelines for the echocardiographic assessment of the right heart in adults: a report from the American Society of Echocardiography. J Am Soc Echocardiogr. 2010;23:685-713.(18) |
| | | Normal right atrial pressure | Normal right atrial pressure, estimated as 3 mm Hg (0–5 mm Hg), as indicated by resting inferior vena cava diameter ≤2.1 cm that collapses >50% with a sniff. | |
| | | Intermediate right atrial pressure | Intermediate right atrial pressure, estimated as 8 mm Hg (5–10 mm Hg), when resting inferior vena cava diameter and collapse do not fit either the normal or elevated categories. | |
| | | Elevated right atrial pressure | Elevated right atrial pressure, estimated as 15 mm Hg (10–20 mm Hg), as indicated by resting inferior vena cava diameter >2.1 cm that collapses <50% with a sniff. | |

*Continued on the next page*

## APPENDIX 6. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Source |
|---|---|---|---|---|
| **Pulmonary artery hypertension** | The probable presence or absence of pulmonary hypertension (mean pressure in the pulmonary arteries is equal or higher than 25 mm Hg at rest or 30 mm Hg during physical activity) based on assessment of the tricuspid regurgitation jet velocity. | ■ Present<br>■ Absent<br>■ Unknown | | McLaughlin VV, Archer SL, Badesch DB, et al. ACCF/AHA 2009 expert consensus document on pulmonary hypertension: a report of the American College of Cardiology Foundation Task Force on Expert Consensus Documents and the American Heart Association. Developed in collaboration with the American College of Chest Physicians, American Thoracic Society, Inc., and the Pulmonary Hypertension Association. J Am Coll Cardiol. 2009;53:1573–619.(19) |
| | | Present | Pulmonary hypertension is present. | |
| | | Absent | Pulmonary hypertension is not present. | |
| | | Unknown | The presence of pulmonary hypertension is unknown. | |
| **Right ventricular systolic pressure, estimated** | The quantitative estimate of the peak pressure of blood in the right ventricle during cardiac systole reported in mm Hg and calculated from the tricuspid regurgitation peak systolic velocity and estimated right atrial pressure. | Float | | |
| **Main pulmonary artery size** | The qualitative description of main pulmonary artery size during diastole. | ■ Normal<br>■ Reduced<br>■ Mildly dilated<br>■ Moderately dilated<br>■ Severely dilated<br>■ Unknown | | Lang RM, Badano LP, Mor-Avi V, et al. Recommendations for cardiac chamber quantification by echocardiography in adults: an update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. J Am Soc Echocardiogr. 2015;28:1-39.e14.(7) |
| | | Normal | Size of main pulmonary artery is normal. | |
| | | Reduced | Main pulmonary artery size is smaller than normal. | |
| | | Mildly dilated | Main pulmonary artery size is slightly more dilated than normal. | |
| | | Moderately dilated | Main pulmonary artery size is moderately more dilated than normal. | |
| | | Severely dilated | Main pulmonary artery size is considerably more dilated than normal. | |
| | | Unknown | Size of main pulmonary artery is unknown. | |
| **Main pulmonary artery diameter** | The cross-sectional diameter of the pulmonary artery measured just distal to the pulmonic valve measured in diastole in cm. | Float | | |

CDE indicates common data element.

## APPENDIX 7. CONGENITAL HEART DISEASE

Note: This is an incomplete presentation of the data elements used to describe congenital heart disease. All definitions (unless otherwise stated) are obtained from the International Pediatric and Congenital Cardiac Code (IPCCC) as published by the International Society for Nomenclature of Pediatric and Congenital Heart Disease (ISNPCHD) (http://www.ipccc.net/). The IPCCC number for each lesion is listed in the Source column. For a more complete listing of congenital heart diseases, please see the ISNPCHD website (http://www.ipccc.net/) and 2017 publication (20).

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Source |
|---|---|---|---|---|
| **Systemic venous anomaly** | A congenital cardiovascular malformation in which there is an abnormality of a mediastinal systemic vein (including the superior vena cava, inferior vena cava, coronary sinus, hepatic veins, brachiocephalic veins, and/or azygos veins). | ■ Present<br>■ Absent<br>■ Unknown | | IPCCC 04.05.00 |
| | | Present | Systemic venous anomaly is present. | |
| | | Absent | Systemic venous anomaly is not present. | |
| | | Unknown | The presence of systemic venous anomaly is unknown. | |
| **Systemic venous anomaly type** | The type of systemic venous anomaly. | ■ Interrupted inferior vena cava<br>■ Left superior vena cava<br>■ Other type of systemic venous anomaly<br>■ Present, but unable to characterize further | | |
| | | Interrupted inferior vena cava | A congenital cardiovascular malformation in which there is an absence of the renal-to-hepatic segment of the inferior vena cava with connection to a superior vena cava through the azygos venous system. | IPCCC 04.03.10 |
| | | Left superior vena cava | A congenital cardiovascular malformation in which there is a left superior vena cava. | IPCCC 04.01.25 |
| | | Other type of systemic venous anomaly | Neither persistent left superior vena cava nor interrupted inferior vena cava. | |
| | | Present, but unable to characterize further | Systemic venous anomaly is present, but type cannot be further described. | |
| **Total anomalous pulmonary venous connection** | A congenital cardiovascular malformation in which none of the pulmonary veins connect to the morphological left atrium. | ■ Present<br>■ Absent<br>■ Unknown | | IPCCC 04.08.05 |
| | | Present | Total anomalous pulmonary venous connection is present. | |
| | | Absent | Total anomalous pulmonary venous connection is not present. | |
| | | Unknown | The presence of total anomalous pulmonary venous connection is unknown. | |

*Continued on the next page*

## APPENDIX 7. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Source |
|---|---|---|---|---|
| **Total anomalous pulmonary venous connection location** | The type or location of the total anomalous pulmonary venous connection(s). | ■ Infracardiac<br>■ Cardiac<br>■ Mixed<br>■ Supracardiac<br>■ Present, but unable to characterize further | | |
| | | Infracardiac | A congenital cardiovascular malformation with infradiaphragmatic total anomalous pulmonary venous connection. | IPCCC 04.08.20 |
| | | Cardiac | A congenital cardiovascular malformation with total anomalous pulmonary venous connection to the right atrium directly, to the coronary sinus, or to both. | IPCCC 04.08.10 |
| | | Mixed | A congenital cardiovascular malformation with total anomalous pulmonary venous connection at ≥2 levels (supracardiac, cardiac, or infracardiac). | IPCCC 04.08.30 |
| | | Supracardiac | A congenital cardiovascular malformation with total anomalous pulmonary venous connection to the superior vena cava or one of its venous tributaries. | IPCCC 04.06.00 |
| | | Present, but unable to characterize further | Total anomalous pulmonary venous connection is present, but type cannot be further described. | |
| **Partial anomalous pulmonary venous connection** | A congenital cardiovascular malformation in which ≥1 (but not all) of the pulmonary veins connect anomalously to the right atrium or to ≥1 of its venous tributaries and the remaining pulmonary veins connect to the left atrium. | ■ Present<br>■ Absent<br>■ Unknown | | IPCCC 04.07.01 |
| | | Present | Partial anomalous pulmonary venous connection is present. | |
| | | Absent | Partial anomalous pulmonary venous connection is not present. | |
| | | Unknown | The presence of partial anomalous pulmonary venous connection is unknown. | |
| **Partial anomalous pulmonary venous connection type** | The type of partial anomalous pulmonary venous connection. | ■ Anomalous left pulmonary vein(s)<br>■ Anomalous right pulmonary vein(s)<br>■ Present, but unable to characterize further | | |
| | | Anomalous left pulmonary vein(s) | A congenital cardiovascular malformation with anomalous connection of ≥1 left pulmonary veins. | |
| | | Anomalous right pulmonary vein(s) | A congenital cardiovascular malformation with anomalous connection of ≥1 right pulmonary veins. | |
| | | Present, but unable to characterize further | Partial anomalous pulmonary venous return is present, but the affected pulmonary veins cannot be further described. | |
| **Atrial septal defect (interatrial communication is a synonym)** | A congenital cardiovascular malformation in which there is a hole or pathway between the atrial chambers. | ■ Present<br>■ Absent<br>■ Unknown | | IPCCC 05.04.01 |
| | | Present | Atrial septal defect is present. | |
| | | Absent | Atrial septal defect is not present. | |
| | | Unknown | The presence of atrial septal defect is unknown. | |

*Continued on the next page*

## APPENDIX 7. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Source |
|---|---|---|---|---|
| **Atrial septal defect number (qualitative)** | A qualitative description of the number atrial septal defects. | ■ Single<br>■ Multiple | | |
| | | Single | One atrial septal defect is present. | |
| | | Multiple | >1 Atrial septal defect is present. | |
| **Atrial septal defect or abnormality morphology type** | The type of atrial septal defect or morphology. | *(Multi-select)*<br>■ Patent foramen ovale<br>■ Primum atrial septal defect<br>■ Secundum atrial septal defect<br>■ Sinus venosus defect<br>■ Unroofed coronary sinus<br>■ Atrial septal aneurysm<br>■ Hyperlipomatous<br>■ Present, but unable to characterize<br>■ Unknown | | |
| | | Patent foramen ovale | A congenital cardiovascular finding in which there is a small interatrial communication (or potential communication) confined to the region of the fossa ovalis characterized by no deficiency of septum primum and a normal limbus with no deficiency of the septum secundum. | IPCCC 05.03.01 |
| | | Primum atrial septal defect | A congenital cardiovascular malformation that is a variant of an atrioventricular septal defect with an interatrial communication just above the atrioventricular valve, no interventricular communication just below the atrioventricular valve, separate right and left atrioventricular valvular orifices, and varying degrees of malformation of the left-sided component of the common atrioventricular valve (the bridging leaflets of the common atrioventricular valve are bound down to the crest of the scooped out ventricular septum so that the potential for shunting through the atrioventricular septal defect is possible only at the atrial level and not at the ventricular level). | IPCCC 06.06.01 |
| | | Secundum atrial septal defect | A congenital cardiovascular malformation in which there is an interatrial communication confined to the region of the fossa ovalis, most commonly attributable to a deficiency of septum primum, but deficiency of septum secundum may also contribute. | IPCCC 05.04.02 |
| | | Sinus venosus defect | A congenital cardiovascular malformation in which there is a vena cava and/or pulmonary vein(s) that overrides the atrial septum or septum secundum producing an interatrial or anomalous venoatrial communication. | IPCCC 05.05.00 |
| | | Unroofed coronary sinus | A congenital cardiovascular malformation in which there is direct communication between the left atrium and the coronary sinus. | IPCCC 04.04.13 |
| | | Atrial septal aneurysm | A congenital cardiac finding in which the septum primum is abnormally large (and redundant) and results in aneurysmal protrusion into 1 or both atria. | |
| | | Hyperlipomatous (lipomatous hypertrophy of interatrial groove is a synonym) | Increased interatrial septal thickness caused by lipid deposition. | IPCCC 10.17.32 |
| | | Present, but unable to characterize further | An atrial septal defect is present, but the type cannot be further described. | |
| | | Unknown | The presence of an atrial septal defect is unknown. | |

*Continued on the next page*

## APPENDIX 7. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Source |
|---|---|---|---|---|
| **Atrial septal defect size** | The qualitative description of the size of the atrial septal defect. | ■ Small<br>■ Moderate to large<br>■ Present, but unable to characterize further | | |
| | | Small | An atrial septal defect that is likely to be hemodynamically insignificant. | |
| | | Moderate to large | An atrial septal defect that is likely to be hemodynamically significant. | |
| | | Present, but unable to characterize further | An atrial septal defect is present, but size cannot be further described. | |
| **Atrial septal defect size, quantitative** | The quantitative measurement of the size of the atrial septal defect. | Float | | |
| **Cor triatriatum sinister (divided left atrium is a synonym)** | A congenital cardiovascular malformation in which there is a partition that divides the left atrium into a posterior chamber receiving some or all of the pulmonary veins and an anterior chamber communicating with the left atrial appendage and atrioventricular junction (usually the mitral valve). | ■ Present<br>■ Absent<br>■ Unknown | | IPCCC 05.02.01 |
| | | Present | Cor triatriatum sinister is present. | |
| | | Absent | Cor triatriatum sinister is not present. | |
| | | Unknown | The presence of cor triatriatum sinister is unknown. | |
| **Ebstein anomaly** | A congenital malformation of the tricuspid valve and right ventricle that is characterized by downward (apical) displacement of the functional annulus, usually involving the septal and inferior (posterior) leaflets. | ■ Present<br>■ Absent<br>■ Unknown | | IPCCC 06.01.34 |
| | | Present | Ebstein anomaly is present. | |
| | | Absent | Ebstein anomaly is not present. | |
| | | Unknown | The presence of Ebstein anomaly is unknown. | |
| **Congenital tricuspid valve dysplasia** | A congenital malformation of the tricuspid valve commonly consisting of leaflet thickening and restricted mobility with normally hinged leaflets. | ■ Present<br>■ Absent<br>■ Unknown | | IPCCC 06.01.03 |
| | | Present | Congenital tricuspid valve dysplasia is present. | |
| | | Absent | Congenital tricuspid valve dysplasia is not present. | |
| | | Unknown | The presence of congenital tricuspid valve dysplasia is unknown. | |
| **Congenital mitral valve stenosis** | A congenital malformation of the mitral valve in which there is narrowing or stricture of the valvar orifice (obstruction to flow). | ■ Present<br>■ Absent<br>■ Unknown | | IPCCC 06.02.07 |
| | | Present | Congenital mitral valve stenosis is present. | |
| | | Absent | Congenital mitral valve stenosis is not present. | |
| | | Unknown | The presence of congenital mitral valve stenosis is unknown. | |

*Continued on the next page*

## APPENDIX 7. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Source |
|---|---|---|---|---|
| **Congenital mitral valve stenosis type** | The type of congenital mitral stenosis. | ■ Mitral annular hypoplasia<br>■ Subvalvular mitral stenosis<br>■ Supravalvular or intravalvular mitral ring<br>■ Present, but unable to characterize further | | |
| | | Mitral annular hypoplasia | A congenital malformation of the mitral valve in which there is annular hypoplasia (incomplete development or underdevelopment so that it is abnormally small [below the lower limit of normal adjusted for body size]). | IPCCC 06.02.04 |
| | | Subvalvular mitral stenosis | A congenital cardiovascular malformation in which there is stenosis of the subvalvular components (chordae tendineae and/or papillary muscles) of the mitral valve (including mitral stenosis associated with parachute mitral valve, mitral arcade, and hammock mitral valve). | IPCCC 06.02.22 |
| | | Supravalvular or intravalvular mitral ring | A congenital cardiovascular malformation in which a ridge of tissue is attached or integral to the atrial side of the mitral valvular leaflet(s). | IPCCC 05.02.22 |
| | | Present, but unable to characterize further | Congenital mitral stenosis is present, but the type cannot be further described. | |
| **Complete atrioventricular canal defect (complete atrioventricular septal defect is a synonym)** | A congenital cardiovascular malformation with a common atrioventricular junction, an interatrial communication just above the atrioventricular valve, an interventricular communication just below the atrioventricular valve, and varying degrees of malformation of the left-sided component of the common atrioventricular valve; there is unrestrictive interventricular communication (no interventricular pressure gradient), and the bridging leaflets usually float to varying extent within the atrioventricular septal defect. | ■ Present<br>■ Absent<br>■ Unknown | | IPCCC 06.06.09 |
| | | Present | Complete atrioventricular canal defect is present. | |
| | | Absent | Complete atrioventricular canal defect is not present. | |
| | | Unknown | The presence of complete atrioventricular canal defect is unknown. | |
| **Ventricular septal defect** | A congenital cardiovascular malformation in which there is a hole or pathway between the ventricular chambers. | ■ Present<br>■ Absent<br>■ Unknown | | IPCCC 07.10.00<br>Lopez L, Houyel L, Colan SD, et al. Classification of ventricular septal defects for the eleventh iteration of the International Classification of Diseases - striving for consensus: a report from the International Society for Nomenclature of Paediatric and Congenital Heart Disease. Ann Thorac Surg. 2018;106:1578-89.(21) |
| | | Present | Ventricular septal defect is present. | |
| | | Absent | Ventricular septal defect is not present. | |
| | | Unknown | The presence of ventricular septal defect is unknown. | |

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## APPENDIX 7. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Source |
|---|---|---|---|---|
| **Ventricular septal defect type** | The type of ventricular septal defect or morphology. | *(Multi-select)*<br>■ Inlet<br>■ Membranous (perimembranous and central perimembranous are synonyms)<br>■ Muscular<br>■ Outlet<br>■ Present, but unable to characterize further<br>■ Unknown | | |
| | | Inlet | A congenital cardiovascular malformation in which there is a ventricular septal defect that opens predominantly into the inlet component of the right ventricle in the absence of a common atrioventricular junction. | IPCCC 07.14.05 |
| | | Membranous (perimembranous and central perimembranous are synonyms) | A congenital cardiovascular malformation in which there is a ventricular septal defect that 1) occupies the space that is usually closed by the interventricular part of the membranous septum, 2) is adjacent to the area of fibrous continuity between the leaflets of an atrioventricular valve and an arterial valve, and 3) is located at the center of the base of the ventricular mass. | IPCCC 07.10.01 |
| | | Muscular (trabecular muscular is a synonym) | A congenital cardiovascular malformation in which there is a ventricular septal defect within the trabeculated component of the ventricular septum. | IPCCC 07.11.01 |
| | | Outlet | A congenital cardiovascular malformation in which there is a ventricular septal defect that opens to the outlet of the right ventricle between or above the limbs of the septal band. | IPCCC 07.12.00 |
| | | Present, but unable to characterize further | A ventricular septal defect is present, but the type cannot be further described. | |
| **Ventricular septal defect number, qualitative** | A qualitative description of the number ventricular septal defects. | ■ None<br>■ Single<br>■ Multiple | | |
| | | None | A ventricular septal defect is not present (intact ventricular septum). | |
| | | Single | One ventricular septal defect is present. | |
| | | Multiple | A congenital cardiac malformation in which there are multiple ventricular septal defects, which could be of any type. | IPCCC 07.15.04 |

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## APPENDIX 7. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Source |
|---|---|---|---|---|
| **Ventricular septal defect size** | The qualitative description of the size of the ventricular septal defect. | ■ Small<br>■ Moderate to large<br>■ Present, but unable to characterize further | | |
| | | Small | A septal defect that is likely to be hemodynamically insignificant. | |
| | | Moderate to large | A septal defect that is likely to be hemodynamically significant. | |
| | | Present, but unable to characterize further | A ventricular septal defect is present, but the size cannot be further described. | |
| **Ventricular septal defect size, quantitative** | The quantitative measurement of the size of the ventricular septal defect. | Float | | |
| **Tetralogy of Fallot** | A group of cardiovascular malformations with biventricular atrioventricular alignments or connections characterized by anterosuperior deviation of the conal or outlet septum or its fibrous remnant, narrowing or atresia of the pulmonary outflow, a ventricular septal defect of the malalignment type, and biventricular origin of the aorta (tetralogy of Fallot will always have a ventricular septal defect, narrowing or atresia of the pulmonary outflow, and aortic override). | ■ Present<br>■ Absent<br>■ Unknown | | IPCCC 01.01.01 |
| | | Present | Tetralogy of Fallot is present. | |
| | | Absent | Tetralogy of Fallot is not present. | |
| | | Unknown | The presence of tetralogy of Fallot is unknown. | |
| **Double-chambered right ventricle** | A congenital cardiovascular malformation in which the right ventricle is divided into 2 chambers, 1 inferior including the inlet and trabecular portions of the right ventricle and 1 superior including the infundibulum. | ■ Present<br>■ Absent<br>■ Unknown | | IPCCC 07.03.01 |
| | | Present | Double-chambered right ventricle is present. | |
| | | Absent | Double-chambered right ventricle is not present. | |
| | | Unknown | The presence of double-chambered right ventricle is unknown. | |
| **Functionally single ventricle (functionally univentricular heart is a synonym)** | A spectrum of congenital cardiovascular malformations in which the ventricular mass may not readily lend itself to partitioning that commits 1 ventricular pump to the systemic circulation and another to the pulmonary circulation. | ■ Present<br>■ Absent<br>■ Unknown | | IPCCC 01.01.22 |
| | | Present | Functionally single ventricle is present. | |
| | | Absent | Functionally single ventricle is not present. | |
| | | Unknown | The presence of functionally single ventricle is unknown. | |

*Continued on the next page*

## APPENDIX 7. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Source |
|---|---|---|---|---|
| **Functionally single ventricle type** | The type of functional single ventricle. | ■ Double inlet left ventricle<br>■ Hypoplastic left heart syndrome<br>■ Mitral atresia<br>■ Tricuspid atresia<br>■ Present, but unable to characterize further<br>■ Other type of functional single ventricle | | |
| | | Double inlet left ventricle | A congenital cardiovascular malformation in which both atria connect to a morphologically left ventricle, either via 2 separate atrioventricular valves or a common atrioventricular valve, such that all or nearly all of the total atrioventricular junctional (annular) area is committed to the left ventricular chamber. | IPCCC 01.04.04 |
| | | Hypoplastic left heart syndrome | A spectrum of congenital cardiovascular malformations with normally aligned great arteries, no common atrioventricular junction, and underdevelopment of the left heart with significant hypoplasia of the left ventricle, associated with atresia, stenosis, or hypoplasia of the aortic and/or mitral valves and hypoplasia of the ascending aorta and aortic arch. | IPCCC 01.01.09 |
| | | Mitral atresia | A congenital cardiovascular malformation with absence of the mitral valvar annulus or an imperforate mitral valve. | IPCCC 06.02.01 |
| | | Tricuspid atresia | A congenital cardiovascular malformation with absence of the tricuspid valvar annulus or an imperforate tricuspid valve. | IPCCC 06.01.01 |
| | | Present, but unable to characterize further | A functionally single ventricle is present, but the type cannot be further described. | |
| | | Other type of functional single ventricle | A type of functionally single ventricle different from those described above. | |
| **Congenital pulmonary atresia** | A congenital malformation in which there is no opening between any ventricle and the pulmonary arterial tree. | ■ Present<br>■ Absent<br>■ Unknown | | IPCCC 09.05.16 |
| | | Present | Congenital pulmonary atresia is present. | |
| | | Absent | Congenital pulmonary atresia is not present. | |
| | | Unknown | The presence of congenital pulmonary atresia is unknown. | |
| **Congenital aortic stenosis** | A congenital cardiac malformation of the left ventricular outflow tract, aortic valve leaflets, or proximal aorta in which there is narrowing or stricture (obstruction to flow). | ■ Present<br>■ Absent<br>■ Unknown | | |
| | | Present | Congenital aortic stenosis is present. | |
| | | Absent | Congenital aortic stenosis is not present. | |
| | | Unknown | The presence of congenital aortic stenosis is unknown. | |

*Continued on the next page*

## APPENDIX 7. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Source |
|---|---|---|---|---|
| **Congenital aortic stenosis type** | The type of congenital aortic stenosis. | ■ Valvular congenital aortic stenosis<br>■ Subvalvular: attributable to fibromuscular shelf<br>■ Subvalvular: attributable to fibromuscular tunnel<br>■ Subvalvular: attributable to indeterminate type<br>■ Supravalvular: attributable to diffuse narrowing<br>■ Supravalvular: due to fibrous membrane<br>■ Supravalvular: attributable to hourglass deformity<br>■ Supravalvular: attributable to indeterminant type<br>■ Indeterminate type and location | | |
| | | Valvular congenital aortic stenosis | A congenital cardiac malformation of the aortic valve in which there is stenosis. narrowing or stricture (obstruction to flow). | IPCCC 09.15.01 |
| | | Subvalvular stenosis: attributable to fibromuscular shelf | A congenital cardiovascular malformation in which there is subaortic stenosis attributable to a discrete fibrous and/or muscular ridge. | IPCCC 07.09.03 |
| | | Subvalvular stenosis: attributable to fibromuscular tunnel | A congenital cardiovascular malformation in which there is a long-segment fibrous and/or muscular subaortic stenosis. | IPCCC 07.09.16 |
| | | Subvalvular stenosis: attributable to indeterminate type | A type of subvalvular aortic stenosis that is visualized but cannot be described further. | |
| | | Supravalvular: attributable to diffuse narrowing | A type of supravalvular aortic stenosis in which the obstruction results from diffuse long-segment or tubular narrowing of the proximal aorta. | |
| | | Supravalvular: due to fibrous membrane | A type of supravalvular aortic stenosis in which the obstruction results from a discrete fibrous membrane within the aortic lumen. | |
| | | Supravalvular: attributable to hourglass deformity | A type of supravalvular aortic stenosis in which the area of obstruction is shaped like an hourglass. | |
| | | Supravalvular stenosis: attributable to indeterminant type | The type of supravalvular aortic stenosis cannot be described further. | |
| | | Supravalvular stenosis of indeterminate type and location | The type and location of supravalvular stenosis is unknown. | |
| **Congenital pulmonary artery stenosis** | A congenital malformation of the pulmonary arteries in which there is discrete narrowing of the luminal diameter of ≥1 segments of a pulmonary arterial branch (below the lower limit of normal adjusted for body size). | ■ Present<br>■ Absent<br>■ Unknown | | IPCCC 09.10.27 |
| | | Present | Congenital pulmonary artery stenosis is present. | |
| | | Absent | Congenital pulmonary artery stenosis is not present. | |
| | | Unknown | The presence of a congenital pulmonary artery stenosis is unknown. | |
| **Congenital pulmonary artery stenosis severity** | The severity of congenital pulmonary artery stenosis. | ■ Mild<br>■ Moderate to severe<br>■ Unknown | | |
| | | Mild | Congenital pulmonary artery stenosis that is likely to be hemodynamically insignificant. | |
| | | Moderate to severe | Congenital pulmonary artery stenosis that is likely to be hemodynamically significant. | |
| | | Unknown | Presence of congenital pulmonary artery stenosis is unknown. | |

*Continued on the next page*

## APPENDIX 7. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Source |
|---|---|---|---|---|
| **Congenital pulmonary artery stenosis location** | The location of congenital pulmonary artery stenosis. | *(Multi-select)*<br>■ Left pulmonary artery<br>■ Right pulmonary artery<br>■ Main pulmonary artery<br>■ Present, but location unknown | | |
| | | Left pulmonary artery | A congenital malformation of the pulmonary arteries in which there is discrete narrowing of the luminal diameter of >1 segments of the left pulmonary artery (below the lower limit of normal adjusted for body size). | IPCCC 09.10.29 |
| | | Right pulmonary artery | A congenital malformation of the pulmonary arteries in which there is discrete narrowing of the luminal diameter of >1 segments of the right pulmonary artery (below the lower limit of normal adjusted for body size). | IPCCC 09.10.28 |
| | | Main pulmonary artery (congenital supravalvular pulmonary stenosis is a synonym) | A congenital malformation of the pulmonary arteries in which there is discrete narrowing of the luminal diameter of the pulmonary trunk at the level of the pulmonary sinotubular junction (below the lower limit of normal adjusted for body size). | IPCCC 09.07.15 |
| | | Present, but location unknown | Pulmonary artery stenosis is present, but its location could not be determined. | |
| **Anomalous coronary artery origin or course** | A congenital cardiovascular malformation in which the origin or course of a coronary artery is abnormal. | ■ Present<br>■ Absent<br>■ Unknown | | |
| | | Present | Anomalous coronary artery origin or course is present. | |
| | | Absent | Anomalous coronary artery origin or course is not present. | |
| | | Unknown | The presence of anomalous coronary artery origin or course is unknown. | |
| **Anomalous coronary artery origin or course type** | The type of anomalous coronary arterial origin or course. | *(Multi-select)*<br>■ Anomalous origin of left coronary artery<br>■ Anomalous origin of right coronary artery<br>■ Other type of anomalous origin of a coronary artery<br>■ Anomalous course of left coronary artery<br>■ Anomalous course of right coronary artery<br>■ Present unable to characterize further | | |
| | | Anomalous aortic origin of left coronary artery | A congenital malformation of the left coronary artery in which the left coronary artery arises from the aorta at a location other than its normal sinus. | |
| | | Anomalous aortic origin of right coronary artery | A congenital malformation of the right coronary artery in which the right coronary artery arises from the aorta at a location other than its normal sinus. | |
| | | Other type of anomalous aortic origin of a coronary artery | A type of anomalous aortic origin of a coronary artery that is different or unique from the previously described types of anomalous aortic origins of coronary arteries. | |
| | | Anomalous course of left coronary artery | A congenital malformation of the left coronary artery in which the coronary artery does not follow the normal path across the epicardium. | |
| | | Anomalous course of right coronary artery | A congenital malformation of the right coronary artery in which the coronary artery does not follow the normal path across the epicardium. | |
| | | Present unable to characterize further | Anomalous coronary arterial origin or course is present, but type cannot be further described. | |

*Continued on the next page*

## APPENDIX 7. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Source |
|---|---|---|---|---|
| **Congenital coronary artery fistula** | A congenital malformation of the coronary arteries in which a coronary artery communicates, through an anomalous channel, with a cardiac chamber or with any segment of the pulmonary circulation. | ■ Present<br>■ Absent<br>■ Unknown | | IPCCC 09.45.16 |
| | | Present | Congenital coronary artery fistula is present. | |
| | | Absent | Congenital coronary artery fistula is not present. | |
| | | Unknown | The presence of congenital coronary artery fistula is unknown. | |
| **Congenital coronary artery aneurysm** | A congenital malformation of the coronary arteries in which there is localized dilation of a coronary vessel, usually defined as an increase in caliber that exceeds 1.5 times the adjacent normal coronaries. | ■ Present<br>■ Absent<br>■ Unknown | | IPCCC 09.46.14 |
| | | Present | Congenital coronary artery aneurysm is present. | |
| | | Absent | Congenital coronary artery aneurysm is not present. | |
| | | Unknown | The presence of congenital coronary artery aneurysm is unknown. | |
| **Aortic sinus of Valsalva aneurysm** | A congenital malformation of the aorta where there is dilation of a single sinus of Valsalva. | ■ Present<br>■ Absent<br>■ Unknown | | IPCCC 09.18.01 |
| | | Present | Aortic sinus of Valsalva aneurysm is present. | |
| | | Absent | Aortic sinus of Valsalva aneurysm is not present. | |
| | | Unknown | The presence of aortic sinus of Valsalva aneurysm is unknown. | |
| **Interrupted aortic arch** | A congenital malformation of the aorta in which there is an absence of luminal continuity between the ascending and descending aorta. | ■ Present<br>■ Absent<br>■ Unknown | | IPCCC 09.29.31 |
| | | Present | Interrupted aortic arch is present. | |
| | | Absent | Interrupted aortic arch is not present. | |
| | | Unknown | The presence of interrupted aortic arch is unknown. | |
| **Right aortic arch** | A congenital malformation of the great vessels in which the aortic arch crosses to the right of the trachea. | ■ Present<br>■ Absent<br>■ Unknown | | IPCCC 09.28.15 |
| | | Present | Right aortic arch is present. | |
| | | Absent | Right aortic arch is not present. | |
| | | Unknown | The presence of right aortic arch is unknown. | |
| **Vascular ring** | A congenital malformation of the great vessels in which >1 of the following encircle the trachea and esophagus: the aorta and its major branches, the pulmonary trunk and its major branches, and ductus arteriosus or their vascular remnant(s). | ■ Present<br>■ Absent<br>■ Unknown | | IPCCC 09.31.00 |
| | | Present | Vascular ring is present. | |
| | | Absent | Vascular ring is not present. | |
| | | Unknown | The presence of vascular ring is unknown. | |

*Continued on the next page*

## APPENDIX 7. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Source |
|---|---|---|---|---|
| **Patent ductus arteriosus** | A congenital cardiovascular finding in which the ductus arteriosus is open beyond the normal age of spontaneous closure. | ■ Present<br>■ Absent<br>■ Unknown | | IPCCC 09.27.21 |
| | | Present | Patent ductus arteriosus is present. | |
| | | Absent | Patent ductus arteriosus is not present. | |
| | | Unknown | The presence of patent ductus arteriosus is unknown. | |
| **Patent ductus arteriosus severity** | The severity of patent ductus arteriosus. | ■ Small<br>■ Moderate to large | | |
| | | Small | Patent ductus arteriosus that is likely to be hemodynamically insignificant. | |
| | | Moderate to large | Patent ductus arteriosus that is likely to be hemodynamically significant. | |
| **Aortopulmonary collateral (systemic to pulmonary collateral artery is a synonym)** | A congenital cardiovascular malformation of the great vessels in which the blood supply to the lungs is derived completely or in part from collateral vessels that arise from the aorta or its branches. | ■ Present<br>■ Absent<br>■ Unknown | | IPCCC 09.08.18 |
| | | Present | Aortopulmonary collateral is present. | |
| | | Absent | Aortopulmonary collateral is not present. | |
| | | Unknown | The presence of aortopulmonary collateral is unknown. | |
| **Transposition of great arteries (transposition of great vessels is a synonym)** | A congenital cardiovascular malformation in which the morphologically right ventricle connects to the aorta and the morphologically left ventricle connects to the pulmonary trunk. | ■ Present<br>■ Absent<br>■ Unknown | | IPCCC 01.05.01 |
| | | Present | Transposition of great arteries is present. | |
| | | Absent | Transposition of great arteries is not present. | |
| | | Unknown | The presence of transposition of great arteries is unknown. | |
| **Congenitally corrected transposition** | A congenital cardiovascular malformation in which the morphologically right atrium connects to the morphologically left ventricle, the morphologically left atrium connects to the morphologically right ventricle, the morphologically right ventricle connects to the aorta, and the morphologically left ventricle connects to the pulmonary trunk. | ■ Present<br>■ Absent<br>■ Unknown | | IPCCC 01.01.03 |
| | | Present | Congenitally corrected transposition is present. | |
| | | Absent | Congenitally corrected transposition is not present. | |
| | | Unknown | The presence of congenitally corrected transposition is unknown. | |

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## APPENDIX 7. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Source |
|---|---|---|---|---|
| **Double outlet right ventricle** | A congenital cardiovascular malformation in which both great arteries arise entirely or predominantly from the morphologically right ventricle. | ■ Present<br>■ Absent<br>■ Unknown | | IPCCC 01.01.04 |
| | | Present | Double outlet right ventricle is present. | |
| | | Absent | Double outlet right ventricle is not present. | |
| | | Unknown | The presence of double outlet right ventricle is unknown. | |
| **Truncus arteriosus (common arterial trunk is a synonym)** | A congenital cardiovascular malformation in which a single arterial trunk arises from the heart, giving origin sequentially to the coronary arteries, >1 pulmonary arteries, and the systemic arterial circulation. | ■ Present<br>■ Absent<br>■ Unknown | | IPCCC 09.01.01 |
| | | Present | Truncus arteriosus is present. | |
| | | Absent | Truncus arteriosus is not present. | |
| | | Unknown | The presence of truncus arteriosus is unknown. | |

CDE indicates common data element.

## APPENDIX 8. HEART VALVES

### A. Valvular Structures

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Source |
|---|---|---|---|---|
| **Valve name** | The name of the cardiac valve for which additional findings are reported. | ■ Aortic valve<br>■ Mitral valve<br>■ Pulmonic valve<br>■ Tricuspid valve | | Nishimura RA, Otto CM, Bonow RO, et al. 2017 AHA/ACC focused update of the 2014 AHA/ACC guideline for the management of patients with valvular heart disease: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. Circulation. 2017;135:e1159-95.(22) |
| | | Aortic valve | A valve that is normally located between the left ventricle and the aorta. | |
| | | Mitral valve | A valve that is normally located between the left atrium and the left ventricle. | |
| | | Pulmonic valve | A valve that is normally located between the right ventricle and the pulmonary artery. | |
| | | Tricuspid valve | A valve that is normally located between the right atrium and the right ventricle. | |

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## APPENDIX 8. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Source |
|---|---|---|---|---|
| **Cardiac valve intervention type** | The categorical description of the type of cardiac valve prosthesis or device. | ■ Native no intervention<br>■ Native with intervention<br>■ Balloon or surgical valvuloplasty without device<br>■ Native with device: valvuloplasty ring or band<br>■ Native with device: Alfieri stitch<br>■ Native with device: clip<br>■ Native with device: type indeterminate<br>■ Native with indeterminate type or other intervention<br>■ Prosthetic mechanical<br>■ Prosthetic bioprosthetic<br>■ Prosthetic transcatheter<br>■ Prosthetic autograft<br>■ Prosthetic allograft<br>■ Prosthetic type indeterminate<br>■ Unknown | | |
| | | Native no intervention | Native valve without percutaneous or surgical intervention. | |
| | | Native with intervention | Native valve that has undergone percutaneous or surgical intervention. | |
| | | Balloon or surgical valvuloplasty without device | Native valve that has undergone valvuloplasty, but no device remains. | |
| | | Native with device: valvuloplasty ring or band | Native valve that has undergone valvuloplasty with a device or ring. | |
| | | Native with device: Alfieri stitch | Native valve that has undergone an open edge-to-edge repair. | |
| | | Native with device: clip | Native valve that has undergone a percutaneous edge-to-edge repair. | |
| | | Native with device: type indeterminate | Native valve that has undergone a procedure with device placement of unclear type. | |
| | | Native with indeterminate type or other intervention | Native valve that has undergone an intervention that cannot be described further. | |
| | | Prosthetic mechanical | Prosthetic valve made of non-biologic materials. | |
| | | Prosthetic bioprosthetic | Prosthetic valve made of biologic materials. | |
| | | Prosthetic transcatheter | Prosthetic valve placed percutaneously. | |
| | | Prosthetic allograft | Prosthetic valve made of human biologic materials. | |
| | | Prosthetic autograft | Prosthetic valve made of the patient's own tissue. | |
| | | Prosthetic type indeterminate | Prosthetic valve of unclear type. | |
| | | Unknown | Valve intervention type is unknown. | |

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## APPENDIX 8. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Source |
|---|---|---|---|---|
| **Annular size** | The qualitative description of the annulus size. | ■ Normal<br>■ Dilated<br>■ Reduced<br>■ Unknown | | |
| | | Normal | Size of annulus is normal. | |
| | | Dilated | Annulus size is greater than the normal range for body size and sex. | |
| | | Reduced | Size of annulus is smaller than normal. | |
| | | Unknown | Annulus size is unknown. | |
| **Annular diameter end-systole** | The end-systolic cross-sectional diameter of the valve annulus reported in cm. | Float | | |
| **Annular diameter end-diastole** | The end-diastolic cross-sectional diameter of the valve annulus reported in cm. | Float | | |
| **Annular diameter mid-systole** | The mid-systolic cross-sectional diameter of the valve annulus reported in cm. | Float | | |
| **Annular area mid-systole** | The mid-systolic cross-sectional area of the valve annulus reported in $cm^2$. | Float | | |
| **Annular circumference mid-systole** | The mid-systolic circumference of the valve annulus reported in cm. | Float | | |
| **Annular diameter measurement orientation** | The anatomic direction along which the annular diameter is measured. | ■ Anterior-posterior<br>■ Medial-lateral | | |
| | | Anterior-posterior | Measured in the anterior-posterior diameter | |
| | | Medial-lateral | Measured in the medial-lateral diameter. | |
| **Annular calcification severity** | The qualitative description of annular calcification.<br>Annular calcification is defined as the accumulation of calcium or mineral deposits on the valve annulus. | ■ None<br>■ Mild<br>■ Moderate<br>■ Severe<br>■ Unknown | | |
| | | None | Annular calcification is not present. | |
| | | Mild | There is a mild accumulation of calcium deposits on the annulus. | |
| | | Moderate | There is a moderate accumulation of calcium deposits on the annulus. | |
| | | Severe | There is a severe accumulation of calcium deposits on the annulus. | |
| | | Unknown | Presence of annular calcification is unknown. | |

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## APPENDIX 8. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Source |
|---|---|---|---|---|
| **Number of cusps (aortic and pulmonic)/ leaflets (mitral and tricuspid).** | The number of cusps/leaflets comprising the cardiac valve. | ■ 1<br>■ 2<br>■ 3<br>■ 4<br>■ Unknown | | |
| | | 1 | 1 cusp/leaflet. | |
| | | 2 | 2 cusps/leaflets. (An aortic valve with 2 cusps is also known as a bicuspid aortic valve, IPCCC 09.15.22.) | |
| | | 3 | 3 cusps/leaflets. | |
| | | 4 | 4 cusps/leaflets. | |
| | | Unknown | Number of cusps/leaflets is unknown. | |
| **Mitral valve leaflet name** | The mitral valve leaflet associated with reported structure findings. | ■ Anterior leaflet<br>■ Posterior leaflet | | Nishimura RA, Otto CM, Bonow RO, et al. 2017 AHA/ACC focused update of the 2014 AHA/ACC guideline for the management of patients with valvular heart disease: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. Circulation. 2017;135:e1159-95.(22) |
| | | Anterior leaflet | Leaflet closest to the anterior chest wall. | |
| | | Posterior leaflet | Leaflet closest to the posterior chest wall. | |
| **Aortic valve cusp name** | The aortic valve cusp associated with reported structure findings. | ■ Left coronary cusp<br>■ Right coronary cusp<br>■ Noncoronary cusp | | |
| | | Left coronary cusp | The cusp in the left sinus of Valsalva, below the left coronary ostium. | |
| | | Right coronary cusp | The cusp in the right sinus of Valsalva, below the right coronary ostium. | |
| | | Noncoronary cusp (posterior cusp is a synonym) | The cusp in the noncoronary sinus of Valsalva, which normally does not have a coronary ostium. | |
| **Pulmonic valve cusp name** | The pulmonic valve cusp associated with reported structure findings. | ■ Left cusp<br>■ Anterior cusp<br>■ Right cusp | | |
| | | Left cusp | Cusp closest to the left lateral chest. | |
| | | Anterior cusp | Cusp closest to the anterior chest wall. | |
| | | Right cusp | Cusp closest to the right lateral chest. | |
| **Tricuspid valve leaflet name** | The tricuspid valve leaflet associated with reported structure findings. | ■ Anterior leaflet<br>■ Posterior leaflet<br>■ Septal leaflet | | |
| | | Anterior leaflet | Leaflet closest to the anterior chest wall. | |
| | | Posterior leaflet | Leaflet closest to the posterior chest wall. | |
| | | Septal leaflet | Leaflet closest to the interventricular septum. | |

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## APPENDIX 8. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Source |
|---|---|---|---|---|
| **Cusp/leaflet disease likely cause** | The likely cause(s) of valve cusp/leaflet disease. | (*Multi-select*)<br>■ None<br>■ Congenital abnormality<br>■ Degenerative valve disease<br>■ Endocarditis<br>■ Iatrogenic<br>■ Mass<br>■ Myxomatous<br>■ Infiltrative<br>■ Inflammatory/rheumatoid<br>■ Carcinoid heart disease<br>■ Rheumatic heart disease<br>■ Functional<br>■ Ischemic<br>■ Prosthetic dysfunction<br>■ Traumatic<br>■ Other<br>■ Unknown | | |
| | | None | Cusp/leaflet is normal; cusp/leaflet disease is not present. | |
| | | Congenital abnormality | An abnormality of the valve present at birth. | |
| | | Degenerative valve disease | An acquired abnormality resulting from aging and/or calcification. | |
| | | Endocarditis | An abnormality of the valve related to an infection or other inflammation of the heart valve or related structures. | |
| | | Iatrogenic | An abnormality of the valve because of medical intervention including surgical trauma, medication, or radiation. | |
| | | Mass | An abnormality of the valve related to the presence of abnormal, benign or malignant tissue on the valve leaflets or related structures. | |
| | | Myxomatous | An abnormality of the valve related to the presence of myxomatous tissue in the valve or support structure. | |
| | | Infiltrative | An abnormality of the valve related to the presence of abnormal proteins or other compounds in valve leaflets or related structures. | |
| | | Inflammatory/rheumatoid | An abnormality of the valve related to inflammation or collagen vascular disease affecting the heart valve or related structures. | |
| | | Carcinoid heart disease | An abnormality of the valve related to systemic carcinoid syndrome. | |
| | | Rheumatic heart disease | An abnormality of the valve related to rheumatic fever. | |
| | | Functional | An abnormality of the valve related to abnormalities of the annulus and ventricle with a structurally normal valve leaflets. | |
| | | Ischemic | An abnormality of the valve related to poor perfusion of the myocardium. | |
| | | Traumatic | An abnormality of the valve caused by trauma. | |
| | | Prosthetic dysfunction | An abnormality related to the malfunction of a prosthetic heart valve. | |
| | | Other | Cause is different than the one(s) previously specified or mentioned. | |
| | | Unknown | Presence of cusp/leaflet disease is unknown. | |

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## APPENDIX 8. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Source |
|---|---|---|---|---|
| **Cusp/leaflet thickness measurement** | The greatest cross-sectional thickness of the cusp/leaflet of the valve reported in cm. | Float | | |
| **Cusp/leaflet thickness severity** | The qualitative description of the severity of cusp/leaflet thickening. | ■ None<br>■ Mild<br>■ Moderate<br>■ Severe<br>■ Unknown | | |
| | | None | The cross-sectional thickness of cusp/leaflet is normal. | |
| | | Mild | There is mildly increased cross-sectional thickness of the cusp/leaflet. | |
| | | Moderate | There is moderately increased cross-sectional thickness of the cusp/leaflet. | |
| | | Severe | There is severely increased cross-sectional thickness of the cusp/leaflet. | |
| | | Unknown | The cross-sectional thickness of cusp/leaflet is unknown. | |
| **Cusp/leaflet calcification measurement** | The greatest cross-sectional cusp/leaflet calcification diameter reported in cm. | Float | | |
| **Cusp/leaflet calcification calculation method** | The method used to measure cusp/leaflet calcification. | ■ Visual estimate<br>■ Planimetry<br>■ Volumetric<br>■ Radiographic<br>■ Unknown | | Dweck MR, Joshi NV, Rudd JH, et al. Imaging of inflammation and calcification in aortic stenosis. Curr Cardiol Rep. 2013;15:320.(23) |
| | | Visual estimate | The amount of calcium present is assessed qualitatively and without formal measurement. | |
| | | Planimetry | The amount of calcium present is measured directly by tracing the borders of calcification. | |
| | | Volumetric | The amount of calcium present is measured directly from 3D imaging by detecting the full borders of calcification and summing. | |
| | | Radiographic | The amount of calcium present is measured directly from radiographic imaging (transmission or tomographic) by summing the radiographic density of the calcium. | |
| | | Unknown | Method used to measure cusp/leaflet calcification is unknown. | |

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## APPENDIX 8. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Source |
|---|---|---|---|---|
| **Cusp/leaflet calcification severity** | The severity of cusp/leaflet calcification.<br>Cusp/leaflet calcification is defined as the accumulation of calcium or mineral deposits on the cusp or leaflet of the valve. | ■ None<br>■ Mild<br>■ Moderate<br>■ Severe<br>■ Unknown | | |
| | | None | Cusp/leaflet calcification is not present. | |
| | | Mild | There is mild calcification of the valve cusp/leaflet. | |
| | | Moderate | There is moderate calcification of the valve cusp/leaflet. | |
| | | Severe | There is severe calcification of the valve cusp/leaflet. | |
| | | Unknown | The severity of valve cusp/leaflet calcification is unknown. | |
| **Myxomatous cusp/leaflet** | The presence or absence of a myxomatous cusp/leaflet on a cardiac valve.<br>Myxomatous cusp/leaflet is defined as the degeneration of the cusp/leaflet itself or the supporting structures related to myxomatous processes. | ■ Present<br>■ Absent<br>■ Unknown | | |
| | | Present | A myxomatous cusp/leaflet is present. | |
| | | Absent | A myxomatous cusp/leaflet is not present. | |
| | | Unknown | The presence of a myxomatous cusp/leaflet is unknown. | |
| **Cusp/leaflet mass** | The presence or absence of a cusp/leaflet mass.<br>A cusp/leaflet mass is defined as an abnormal, benign or malignant pathologic tissue on the valve cusp/leaflet. | ■ Present, single<br>■ Present, multiple<br>■ Absent<br>■ Unknown | | |
| | | Present, single | A single cusp/leaflet mass is present. | |
| | | Present, multiple | >1 Cusp/leaflet mass are present. | |
| | | Absent | A cusp/leaflet mass is not present. | |
| | | Unknown | The presence of a cusp/leaflet mass is unknown. | |
| **Cusp/leaflet mass type** | The type of cusp/leaflet mass.<br>Cusp/leaflet mass is defined as an abnormal, benign or malignant pathologic tissue on the valve cusp/leaflet. | ■ Fibroelastoma/myxoma<br>■ Malignancy<br>■ Ruptured chordae<br>■ Thrombus<br>■ Vegetation | | |
| | | Fibroelastoma/myxoma | Primary cardiac tumor involving a heart valve. | |
| | | Malignancy | Primary or metastatic malignant tumor. | |
| | | Ruptured chordae | Disruption of the mitral or tricuspid chordae. | |
| | | Thrombus | Blood clot. | |
| | | Vegetation | A mass on a valve or adjacent structure related to infective or collagen vascular (inflammatory) endocarditis. | |

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## APPENDIX 8. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Source |
|---|---|---|---|---|
| **Cusp/leaflet mass size quantitative** | The maximal diameter measurement of the size of the cusp/leaflet mass generally reported in mm. Cusp/leaflet mass is defined as an abnormal, benign or malignant pathologic tissue on the valve cusp/leaflet. | Float | | |
| **Cusp/leaflet mass size qualitative** | The qualitative description of the size of a cusp/leaflet mass. Cusp/leaflet mass is defined as an abnormal, benign or malignant pathologic tissue on the valve cusp/leaflet. | ■ Small<br>■ Medium<br>■ Large<br>■ Present unable to characterize further | | |
| | | Small | Size of cusp/leaflet mass is small. | |
| | | Medium | Size of cusp/leaflet mass is medium. | |
| | | Large | Size of cusp/leaflet mass is large. | |
| | | Present unable to characterize further | A cusp/leaflet mass is present, but size cannot be further described. | |
| **Cusp/leaflet mass mobility type** | The description of cusp/leaflet mass mobility. Cusp/leaflet mass is defined as an abnormal, benign or malignant pathologic tissue on the valve cusp/leaflet. | ■ Fixed<br>■ Mobile<br>■ Unknown | | |
| | | Fixed (stationary is a synonym) | Mass does not move during cardiac motion. | |
| | | Mobile | Mass moves during cardiac motion. | |
| | | Unknown | Mass movement during cardiac motion is unknown. | |
| **Commissural fusion type** | The nature of the commissural fusion. Commissural fusion is defined as a condition whereby the edges of ≥2 cardiac valve cusps or leaflets are joined together. | ■ Absent<br>■ Partial<br>■ Complete<br>■ Unknown | | |
| | | Absent | Normal cusp separation with valve motion. | |
| | | Partial | Cusps or leaflets of cardiac valve do not separate fully. | |
| | | Complete | >2 Cardiac valve cusps or leaflets do not separate with valve motion. | |
| | | Unknown | Presence of commissural fusion is unknown. | |

*Continued on the next page*

## APPENDIX 8. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Source |
|---|---|---|---|---|
| **Mitral commissural fusion location** | The anatomic location of the fused cardiac valve commissures of the mitral valve. | ■ Anterolateral<br>■ Posteromedial | | |
| | | Anterolateral | Commissural fusion is located anteriorly in the ventricle under the aortic valve's left coronary cusp. | |
| | | Posteromedial | Commissural fusion is located posteriorly in the ventricle under the aortic valve's noncoronary cusp. | |
| **Aortic commissural fusion location** | The location of commissural fusion in the aortic valve. | ■ Left noncoronary cusp<br>■ Right coronary cusp to left coronary cusp<br>■ Right noncoronary cusp | | |
| | | Left noncoronary cusp | Fusion of the commissure between the aortic valve's left coronary cusp and noncoronary cusp. | |
| | | Right coronary cusp to left coronary cusp | Fusion of the commissure between the aortic valve's right coronary cusp and left coronary cusp. | |
| | | Right noncoronary cusp | Fusion of the commissure between the aortic valve's right coronary cusp and noncoronary cusp. | |

3D indicates 3-dimensional; and CDE, common data element.

### B. Cusp/Leaflet Motion and Prolapse

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Source |
|---|---|---|---|---|
| **Cusp/leaflet prolapse severity** | The severity of cusp/leaflet prolapse. | ■ None<br>■ Mild<br>■ Moderate<br>■ Severe<br>■ Unknown | | |
| | | None | The cusp/leaflet does not billow proximal to the annular plane. | |
| | | Mild | Mild billowing proximal to the annular plane when the valve is closed. | |
| | | Moderate | Moderate cusp/leaflet billowing proximal to the annular plane when the valve is closed. | |
| | | Severe | Severe cusp/leaflet billowing proximal to the annular plane when the valve is closed. | |
| | | Unknown | Severity of cusp/leaflet billowing proximal to the annular plane when the valve is closed is unknown. | |

*Continued on the next page*

## APPENDIX 8. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Source |
|---|---|---|---|---|
| **Cusp/leaflet prolapse or flail timing** | The time during the cardiac cycle when the valve cusp leaflet prolapse or flail occurs. | ■ Holosystolic<br>■ Mid to late systolic | | |
| | | Holosystolic | Occurring throughout ventricular systole or beyond the period of ventricular ejection to include isovolumic contraction and relaxation. | |
| | | Mid to late systolic | Occurring at or after the mid-point of ventricular systole or ejection. | |
| **Flail cusp/leaflet severity** | The severity of a flailing cardiac valve cusp/leaflet.<br>Flail cusps/leaflets are defined as cusps/leaflets that fail to coapt normally and synchronously during valve closure. | ■ None<br>■ Mild<br>■ Moderate<br>■ Severe<br>■ Unknown | | Zoghbi WA, Adams D, Bonow RO, et al. Recommendations for noninvasive evaluation of native valvular regurgitation: a report from the American Society of Echocardiography. Developed in collaboration with the Society for Cardiovascular Magnetic Resonance. J Am Soc Echocardiogr. 2017;30:303-71.(24) |
| | | None | Cusp/leaflets coapt normally and synchronously. Flail leaflets are not present. | |
| | | Mild | Mild failure of cusp/leaflets to coapt normally and synchronously during valve closure. | |
| | | Moderate | Moderate failure of cusp/leaflets to coapt normally and synchronously during valve closure. | |
| | | Severe | Severe failure of cusp/leaflets to coapt normally and synchronously during valve closure. | |
| | | Unknown | Severity of cusp/leaflets failure to coapt normally and synchronously during valve closure is unknown. | |
| **Restricted motion severity** | The severity of restricted motion of a cardiac valve cusp/leaflet. | ■ None<br>■ Mild<br>■ Moderate<br>■ Severe<br>■ Unknown | | |
| | | None | Cusp/leaflet motion is not restricted. | |
| | | Mild | Mildly limited cusp/leaflet motion. | |
| | | Moderate | Moderately limited cusp/leaflet motion. | |
| | | Severe | Severely limited cusp/leaflet motion. | |
| | | Unknown | Severity of limited cusp/leaflet motion is unknown. | |

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## APPENDIX 8. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Source |
|---|---|---|---|---|
| **Cusp/leaflet doming severity** | The severity of doming of a cardiac valve cusp/leaflet. Doming is an abnormality of cusp/leaflet motion characterized by an abnormal outward rounding or outpouching of the cusp/leaflet that may result in incomplete valve opening or valvular stenosis. | ■ None<br>■ Mild<br>■ Moderate<br>■ Severe<br>■ Unknown | | |
| | | None | Cusp/leaflet doming is not present. | |
| | | Mild | Mild doming of the cusp/leaflet. | |
| | | Moderate | Moderate doming of the cusp/leaflet. | |
| | | Severe | Severe doming of the cusp/leaflet. | |
| | | Unknown | Severity of cusp/leaflet doming is unknown. | |
| **Cusp/leaflet tethering severity** | The severity of the tethering of a cardiac valve cusp/leaflet. Cusp/leaflet tethering defined as displacement of cusp/leaflet and papillary muscles related to abnormal tension via the chordae and dilatation of the left ventricle. Cusp/leaflet tethering often results in regurgitant blood flow across the valve. | ■ None<br>■ Mild<br>■ Moderate<br>■ Severe<br>■ Unknown | | |
| | | None | There is no displacement of cusps/leaflets or abnormality of the subvalvular structures. | |
| | | Mild | Mild tethering of the cusp/leaflet caused by cusp/leaflet displacement or abnormality of the subvalvular structures. | |
| | | Moderate | Moderate cusp/leaflet displacement or tethering of the subvalvular structures. | |
| | | Severe | Severe cusp/leaflet displacement or tethering of the subvalvular structures. | |
| | | Unknown | Severity of cusp/leaflet tethering is unknown. | |

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## APPENDIX 8. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Source |
|---|---|---|---|---|
| **Mitral valve systolic anterior motion severity** | The severity of systolic anterior motion of the cardiac valve cusp/leaflet. Systolic anterior motion of the cusp/leaflet is defined as abnormal anterior motion of the mitral valve cusp/leaflet toward the septum during left ventricular contraction. | ■ None<br>■ Mild<br>■ Moderate<br>■ Severe<br>■ Unknown | | |
| | | None | Mitral valve cusp/leaflet motion is normal. | |
| | | Mild | Mild abnormal anterior motion of the mitral valve cusp/leaflet toward the septum during left ventricular contraction. | |
| | | Moderate | Moderate abnormal anterior motion of the mitral valve cusp/leaflet toward the septum during left ventricular contraction. | |
| | | Severe | Severe abnormal anterior motion of the mitral valve cusp/leaflet toward the septum during left ventricular contraction. | |
| | | Unknown | Severity of abnormal anterior motion of the mitral valve cusp/leaflet toward the septum during left ventricular contraction is unknown. | |

CDE indicates common data element.

### C. Regurgitation

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Source |
|---|---|---|---|---|
| **Valvular regurgitation severity** | The overall interpretation of the severity of valvular regurgitation based on the integration of all information obtained during the imaging study. | ■ None<br>■ Trace<br>■ Mild<br>■ Mild to moderate<br>■ Moderate<br>■ Moderate to severe<br>■ Severe<br>■ Unknown | | Zoghbi WA, Adams D, Bonow RO, et al. Recommendations for noninvasive evaluation of native valvular regurgitation: a report from the American Society of Echocardiography. Developed in collaboration with the Society for Cardiovascular Magnetic Resonance. J Am Soc Echocardiogr. 2017;30:303-71.(24) |
| | | None | Regurgitant flow is not present. | |
| | | Trace | Minimal leakage valve is present. | |
| | | Mild | Mild leakage of the valve is present. | |
| | | Mild to moderate | Mild-to-moderate leakage of the valve is present. | |
| | | Moderate | Moderate leakage of the valve is present. | |
| | | Moderate to severe | Moderate-to-severe leakage of the valve is present. | |
| | | Severe | Severe leakage of the valve is present. | |
| | | Unknown | Presence of regurgitant flow is unknown. | |

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## APPENDIX 8. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Source |
|---|---|---|---|---|
| **Cardiac valve regurgitation likely cause** | The interpretation of the likely cause(s) of cardiac valve regurgitation. | *(Multi-select)*<br>■ Congenital abnormality<br>■ Degenerative valve disease<br>■ Endocarditis<br>■ Iatrogenic<br>■ Mass<br>■ Myxomatous<br>■ Infiltrative<br>■ Inflammatory/rheumatoid<br>■ Carcinoid heart disease<br>■ Rheumatic heart disease<br>■ Functional<br>■ Ischemic<br>■ Traumatic<br>■ Prosthetic dysfunction<br>■ Other<br>■ Unknown | | |
| | | Congenital abnormality | An abnormality of the valve present at birth. | |
| | | Degenerative valve disease | An acquired abnormality resulting from abnormal aging and/or calcification. | |
| | | Endocarditis | An abnormality of the valve related to an infection or other inflammation of the heart valve or related structures. | |
| | | Iatrogenic | An abnormality of the valve caused by medical intervention. | |
| | | Mass | An abnormality of the valve related to the presence of abnormal tissue on the valve leaflets or related structures. | |
| | | Myxomatous | An abnormality of the valve related to the presence of myxomatous tissue on the valve leaflets or related structures. | |
| | | Infiltrative | An abnormality of the valve related to the presence of abnormal proteins or other compounds in valve leaflets or related structures. | |
| | | Inflammatory/rheumatoid | An abnormality of the valve related to inflammation or collagen vascular disease affecting the heart valve or related structures. | |
| | | Carcinoid heart disease | An abnormality of the valve related to systemic carcinoid syndrome. | |
| | | Rheumatic heart disease | An abnormality of the valve related to involvement of the heart valve or related structures related to rheumatic fever. | |
| | | Functional | An abnormality of the valve related to abnormalities of the annulus and ventricle with a structurally normal valve leaflets. | |
| | | Ischemic | An abnormality of the valve related to poor perfusion of the myocardium. | |
| | | Traumatic | An abnormality of the valve related to trauma. | |
| | | Prosthetic dysfunction | An abnormality related to the malfunction of a prosthetic heart valve. | |
| | | Other | Cause is different than the one(s) previously specified or mentioned. | |
| | | Unknown | Cause of cardiac valve regurgitation is unknown. | |

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## APPENDIX 8. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Source |
|---|---|---|---|---|
| **Mitral or tricuspid regurgitant jet area** | The mitral or tricuspid regurgitant jet cross-sectional area measured in any view at any time during systole and reported in $cm^2$. | Float | | |
| **Mitral or tricuspid regurgitant jet area to left or right atrial area ratio** | The ratio of the mitral or tricuspid regurgitant jet area to left or right atrial area. This ratio is reported without units. | Float | | |
| **Regurgitant jet width** | The regurgitant jet width measured in on an image that is perpendicular to the jet and reported in mm. (Also known as vena contracta.) | Float | | |
| **Aortic or pulmonic regurgitant jet width to left or right ventricular outflow tract diameter ratio** | The ratio of the aortic or pulmonic regurgitant jet width to left ventricular outflow tract or right ventricular outflow tract diameter. This ratio is reported without units. | Float | | |
| **Effective regurgitant orifice area** | The quantitative measurement of the effective regurgitant orifice area of the valve reported in $cm^2$. | Float | | |
| **Effective regurgitant orifice area measurement method** | The method used to measure effective regurgitant orifice area. | ■ Planimetry<br>■ Proximal isovelocity surface area method<br>■ Volumetric | | |
| | | Planimetry | A method whereby the valve effective regurgitant orifice or the vena contracta is obtained by direct measurement. | |
| | | Proximal isovelocity surface area method | A method whereby an assessment of flow convergence and acceleration proximal to the regurgitant jet is used to obtain the effective regurgitant orifice area. | |
| | | Volumetric | A method whereby the difference in stroke volume at 2 locations in the heart (1 that includes the regurgitant flow, 1 that does not) is divided by the velocity time integral of the maximal velocity through the valve. | |
| **Regurgitant volume** | A quantitative description of the volume of backward flow of blood across the orifice of a cardiac valve expressed in mL. | Float | | |
| **Regurgitant volume measurement method** | The method used to assess regurgitant volume of the cardiac valve. | ■ Doppler volumetric method<br>■ Flow convergence method | | |
| | | Doppler volumetric method | A method whereby the difference in stroke volume at 2 locations in the heart (1 that includes the regurgitant flow, 1 that does not) is divided by the velocity time integral of the maximal velocity through the valve. | |
| | | Flow convergence method | The method whereby regurgitant volume is calculated by multiplying the effective regurgitant orifice area (derived from the surface area of the isovelocity shell associated with flow acceleration proximal to the regurgitant valve) times the velocity time integral of the maximal velocity through the valve regurgitation. | |

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## APPENDIX 8. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Source |
|---|---|---|---|---|
| **Regurgitant fraction** | The measurement of backward flow of blood across the orifice of a cardiac valve expressed as a percentage of forward flow. | Float | A derived measurement using the regurgitant volume (see above) divided by the total forward stroke volume across the regurgitant valve. | |
| **Vena contracta width** | The width of the vena contracta reported in mm. | Float | A linear dimension of the narrowest portion of the regurgitant jet as defined by color Doppler. | |
| **Vena contracta area** | The area of the vena contracta reported in $mm^2$. | Float | The area of the narrowest portion of the regurgitant jet as defined by color Doppler. | |
| **Eccentric regurgitant jet** | The presence or absence of an eccentric jet. An eccentric regurgitant jet is defined as a regurgitant jet that is obliquely directed toward a wall of the receiving chamber rather than toward the center of the cavity. | ■ Present<br>■ Absent<br>■ Unknown | | |
| | | Present | An eccentric regurgitant jet is present. | |
| | | Absent | An eccentric regurgitant jet is not present. | |
| | | Unknown | The presence of an eccentric regurgitant jet is unknown. | |
| **Regurgitant jet direction** | The direction a regurgitant jet. | ■ Eccentric anteromedial<br>■ Eccentric posterolateral<br>■ Eccentric, unspecified<br>■ Central<br>■ Multiple<br>■ Unknown | | |
| | | Eccentric anteromedial | An eccentric jet is present directed at the front and septal wall of the heart. | |
| | | Eccentric posterolateral | An eccentric jet is present directed at the back and side wall of the heart. | |
| | | Eccentric, unspecified | An eccentric jet is present, but the direction is unknown. | |
| | | Central | The regurgitant jet is directed into the middle of the receiving chamber and not toward a wall. | |
| | | Multiple | Multiple eccentric jets are present. | |
| | | Unknown | The presence of a regurgitant jet is unknown. | |
| **Cardiac valve regurgitation jet location** | The anatomic location of cardiac valve regurgitation. | ■ Transvalvular and paravalvular<br>■ Paravalvular<br>■ Transvalvular<br>■ Indeterminate | | |
| | | Transvalvular and paravalvular | Regurgitation both within and outside the annulus. | |
| | | Paravalvular | Regurgitation outside the annulus. | |
| | | Transvalvular | Regurgitation through the valve leaflets within the annulus. | |
| | | Indeterminate | Location of regurgitation cannot be described. | |

## APPENDIX 8. CONTINUED

### D. Stenosis

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Source |
|---|---|---|---|---|
| **Valvular stenosis severity** | The overall interpretation of the severity of valve stenosis based on the integration of all information obtained during the imaging study. | ■ None<br>■ Mild<br>■ Mild to moderate<br>■ Moderate<br>■ Moderate to severe<br>■ Severe<br>■ Unknown | | Baumgartner H, Hung J, Bermejo J, et al. Echocardiographic assessment of valve stenosis: EAE/ASE recommendations for clinical practice. J Am Soc Echocardiogr. 2009;22:1-23.(25)<br>Baumgartner H, Hung J, Bermejo J, et al. Recommendations on the echocardiographic assessment of aortic valve stenosis: a focused update from the European Association of Cardiovascular Imaging and the American Society of Echocardiography. J Am Soc Echocardiogr. 2017;30:372-92.(26) |
| | | None | Valvular stenosis is not present. | |
| | | Mild | The valve orifice is mildly narrowed or stenotic. | |
| | | Mild to moderate | The valve orifice is mildly to moderately narrowed or stenotic. | |
| | | Moderate | The valve orifice is moderately narrowed or stenotic. | |
| | | Moderate to severe | The valve orifice is moderately to severely narrowed or stenotic. | |
| | | Severe | The valve orifice is considerably narrowed or stenotic. | |
| | | Unknown | Presence of valve stenosis is unknown. | |

CDE indicates common data element.

### E. Other Terminologies

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Source |
|---|---|---|---|---|
| **Peak velocity** | The quantitative measurement of peak velocity of blood flow across the cardiac valve reported in cm/s. | Float | | |
| **Mean velocity** | The quantitative measurement of mean velocity of blood across the cardiac valve reported in cm/s. | Float | | |
| **Peak gradient** | The quantitative measurement of peak gradient of pressure across the cardiac valve reported in mm Hg. | Float | | |
| **Mean gradient** | The quantitative measurement of mean pressure gradient of blood flow across the cardiac valve reported in mm Hg. | Float | | |
| **Velocity time integral** | The velocity time integral of the blood flow across the cardiac valve; the area under the velocity time curve reported in cm.<br>Velocity time integral is defined as the integral of the flow velocity curve during forward flow across the valve. | Float | | |

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## APPENDIX 8. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Source |
|---|---|---|---|---|
| **Valve area** | The quantitative measurement of valve area reported in $cm^2$. | Float | The functional area of a valve. | |
| **Valve area measurement method** | The method used to measure valve area. | ■ Continuity equation using stroke volume VTI<br>■ Continuity equation using stroke volume (peak velocities)<br>■ Continuity equation using stroke volume (mean velocities)<br>■ Continuity equation using stroke volume derived from ventricular volumes<br>■ Pressure half time<br>■ Proximal isovelocity surface area method<br>■ Planimetry<br>■ Unknown | | Baumgartner H, Hung J, Bermejo J, et al. Echocardiographic assessment of valve stenosis: EAE/ASE recommendations for clinical practice. J Am Soc Echocardiogr. 2009;22:1-23.(25) |
| | | Continuity equation using VTI | Calculation of valve area using continuity equation according to the formula of pulsed wave Doppler derived subvalve stroke volume (in the absence of regurgitation) divided by VTI of target valve. | |
| | | Continuity equation using peak velocities | Calculation of valve area using continuity equation according to the formula of peak subvalve velocity × subvalve cross-sectional area divided by peak velocity of target valve. | |
| | | Continuity equation using mean velocities | Calculation of valve area using continuity equation according to the formula of subvalve or outflow tract cross-sectional area times mean subvalve velocity divided by mean velocity of distal to the valve. | |
| | | Continuity equation using stroke volume derived from ventricular volumes | Target valve area = stroke volume (derived from difference of (left ventricular end-diastolic volume and end-systolic volume) divided by VTI of target valve. | |
| | | Pressure half time (for mitral valve only) | Calculation of valve area as 220 divided by the time required for pressure to reach one half of its initial value or for velocity to reach (1/[square root of 2]) or 0.707 of its initial value (mitral valve only). | |
| | | Proximal isovelocity surface area method | Target valve area using an assessment of flow convergence and to the maximal velocity of the stenotic jet (mitral valve only). | |
| | | Planimetry | Anatomic (geometric) cross-sectional area of the valve orifice. | |
| | | Unknown | Method used to measure valve area is unknown. | |

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## APPENDIX 8. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Source |
|---|---|---|---|---|
| **Valve area index** | The quantitative measurement of valve area indexed to body surface area reported in $cm^2/m^2$. | Float | Simple ratio of valve area (by whichever method) divided by the body surface area. | |
| **Doppler Velocity Index (for aortic valve only)** | The ratio of left ventricular outflow tract velocity to peak aortic valve velocity or VTI divided by peak aortic valve VTI. This ratio is reported without units. | Float | Subvalvular velocity (by pulsed wave Doppler) divided by maximal velocity through valve (by continuous wave Doppler). | Baumgartner H, Hung J, Bermejo J, et al. Recommendations on the echocardiographic assessment of aortic valve stenosis: a focused update from the European Association of Cardiovascular Imaging and the American Society of Echocardiography. J Am Soc Echocardiogr. 2017;30:372-92.(26) |
| **Doppler Velocity Index measurement method (for aortic valve only)** | The Doppler method used to obtain the ratio of subvalvular to valvular flow velocities. | ■ Peak velocity<br>■ VTI | | Zoghbi WA, Chambers JB, Dumesnil JG, et al. Recommendations for evaluation of prosthetic valves with echocardiography and doppler ultrasound: a report from the American Society of Echocardiography's Guidelines and Standards Committee and the Task Force on Prosthetic Valves. Developed in conjunction with the American College of Cardiology Cardiovascular Imaging Committee, Cardiac Imaging Committee of the American Heart Association, the European Association of Echocardiography, a registered branch of the European Society of Cardiology, the Japanese Society of Echocardiography and the Canadian Society of Echocardiography. J Am Soc Echocardiogr. 2009;22:975-1014 (27) |
| | | Peak velocity | The ratio of the highest systolic velocity of the spectral Doppler signal recorded just proximal to the valve divided by the highest velocity distal to the stenotic valve. | |
| | | VTI | The ratio of the integral of the flow velocity curve during let ventricular ejection just proximal to the valve (by pulsed wave Doppler) divided by the integral of the instantaneous flow velocity curve across the stenotic aortic valve (by continuous Doppler). | |
| **Pressure half time (for mitral valve only)** | The time interval between the maximum pressure gradient in early diastole and the time point where the pressure gradient is 0.707 (square root of one-half) times the maximum initial value reported in ms. | Float | | |

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## APPENDIX 8. CONTINUED

| CDE Label | CDE Definition | Permissible Values | Permissible Value Definitions | Source |
|---|---|---|---|---|
| **Performance index (prosthetic valve only)** | The calculation of in vivo prosthetic valve area (by whichever method) divided by the internal orifice area specified by the manufacturer. This ratio is reported without units. | Float | | Zoghbi WA, Chambers JB, Dumesnil JG, et al. Recommendations for evaluation of prosthetic valves with echocardiography and doppler ultrasound: a report from the American Society of Echocardiography's Guidelines and Standards Committee and the Task Force on Prosthetic Valves. Developed in conjunction with the American College of Cardiology Cardiovascular Imaging Committee, Cardiac Imaging Committee of the American Heart Association, the European Association of Echocardiography, a registered branch of the European Society of Cardiology, the Japanese Society of Echocardiography and the Canadian Society of Echocardiography. J Am Soc Echocardiogr. 2009;22:975-1014.(27) |
| **Transcatheter heart valve annular position** | The anatomic position of the transcatheter heart valve. | ■ Appropriate position<br>■ Proximal position<br>■ Distal position<br>■ Unknown | | Holmes DR Jr, Mack MJ, Kaul S, et al. 2012 ACCF/AATS/SCAI/STS expert consensus document on transcatheter aortic valve replacement. J Am Coll Cardiol. 2012;59:1200-54.(28) |
| | | Appropriate position | The position that provides optimal functioning and minimizes leak for that type of prosthesis. | |
| | | Proximal position | More of the valve sits proximal to the annulus than is generally recommended for that type of prosthesis. | |
| | | Distal position | More of the valve sits distal to the annulus than is generally recommended for that type of prosthesis. | |
| | | Unknown | The anatomic position of the transcatheter heart valve is unknown. | |
| **Internal orifice area** | The area of the internal orifice of the cardiac valve reported in $cm^2$ as supplied by the manufacturer. | Float | | |

CDE indicates common data element; and VTI, velocity time integral.