Adult Echocardiography (AE)
2018 Job Task Analysis Summary Report

American Registry for Diagnostic Medical Sonography (ARDMS)

Contents

ACKNOWLEDGEMENTS[1]

A special thank you to the dedicated staff and volunteers who helped complete this process. Several hours of planning and meeting went into creating the final content outline. Their contributions will help our goal of maintaining the highest standard for patient care and safety in the healthcare community.

EXECUTIVE SUMMARY

The American Registry for Diagnostic Medical Sonography (ARDMS) is the globally recognized standard of excellence in sonography. ARDMS is responsible for the preparation of valid and reliable certification examinations in the field of sonography. Conducting job task analyses (JTAs) at the national and international levels facilitates ARDMS in evaluating the current practice expectations and performance requirements of the specialty. The 2018 Adult Echocardiography (AE) JTA was designed to collect information on the sonography-related work activities sonographer registrants perform in practice. The results of the JTA were used in updating the test content outline, which guides content distribution of the AE Examination. This report details the methodology, data collection and analysis, and survey results. It also includes the test content outline that resulted from the JTA.

BACKGROUND AND PURPOSE

The American Registry for Diagnostic Medical Sonography (ARDMS) recognizes that diagnostic medical sonography is a valuable tool in the healthcare industry. There are several healthcare professions that are utilizing sonography in practice to increase the efficacy of their patient care.

The ARDMS sonographer credentials are an indication of successful mastery and demonstration of the required knowledge and skills. The job task analysis (JTA) is paramount to understanding the critical tasks, and necessary knowledge, skills, and abilities. This process helps ensure the validity of a job-related content outline and becomes the foundation for the content on our exams.

METHODOLOGY

Job Task Analysis Panel

A JTA Panel consisting of nine subject matter experts (SMEs) led this project. The nine JTA Panel members were volunteers and some were members of the Assessment Committee (see Tables 1 in Appendix A). The Clinical Manager led the JTA panel and process. Panel members were selected through "snowball" sampling (i.e., initial panel members recruited acquaintances). Concerns were raised about the representativeness of the panel, so additional members were recruited. Those members were a part of the validation group (see below).

Overview of Process

Working meeting. On April 13-14, the JTA Panel and internal stakeholders began the JTA process. Internal stakeholders explained the process and purpose of the JTA, how to write task and KSA statements, and assembled a draft of the JTA survey. There was a review of the current content outline and tasks were modified, added, and removed.

Pilot survey and validation group. Twelve subject matter experts validated the initial draft of the JTA). On June 22, the Chair and Vice Chair of the Assessment Committee met with internal stakeholders to review the comments of the pilot survey. The survey was finalized and deemed ready to survey to the entire population of participants for this exam.

Survey Process

Survey Content

The final survey included 72 tasks. Tasks were rated for importance and frequency. The remaining 20 items were about demographics of the participant. Table 2 consists of a summary of the items.

Procedure and Participants

The survey was made available to participants as a web-based survey through the survey platform Qualtrics®. An invitation to participate in the survey was sent via email to the prospective participants.

ARDMS sent the JTA survey to 1,990 registrants. These registrants were selected randomly using a stratified sampling method so that the sample was representative of all registrants with an ARDMS Adult Echocardiography certification. Representativeness was based on the following demographic variables: role (i.e., physician or sonographer), gender, and geographic area. The survey was made available to the participants for two weeks between June 29 and July 16. All responses made by the participants were kept confidential.

Response Rates

A total of 514 (26% of those sampled) sonographers responded to the survey. Of these, 240 (47% of participants) reported that they currently perform adult echocardiography sonography. However, of the 240 participants, 195 completed the survey. The data analysis was based on the responses from the 195 sonographers who currently perform adult echocardiography sonography and completed the survey.

Data Analysis

Respondents were asked the following questions for each task: 1) How frequently do newly certified vascular sonographers perform this task? and 2) How important is the task in affecting clinical decisions and patient outcomes? The frequency and importance rating scales were scored 1-5. The response options for the frequency scale were Never (1), Rarely (2), Occasionally (3), Often (4), and Always (5). The response options for the importance scale were Not Important (1), Somewhat Important (2), Important (3), Very Important (4), and Critically Important (5).

The frequency and importance rating scales were combined into a single measure of overall criticality (ranging from 0-16) using a method in which values on the importance scale outweigh or outrank all values on the frequency scale, except for 'Never'. Higher criticality values indicate critical tasks for a sonographer performing diagnostic medical sonography examinations. The mean criticality score, for each task, was reviewed by the JTA Panel. In addition, the criticality values were summed within each domain. The sum of criticality for each domain is divided by the overall criticality score to determine the initial percentages of the examination content in each domain (Table 1).

Response Options		Overall Criticality Score
Importance	Frequency	
Critically Important (5)	Always (5)	16
	Often (4)	15
	Occasionally (3)	14
	Rarely (2)	13
Very Important (4)	Always (5)	12
	Often (4)	11
	Occasionally (3)	10
	Rarely (2)	9
Important (3)	Always (5)	8
	Often (4)	7
	Occasionally (3)	6
	Rarely (2)	5
Somewhat Important (2)	Always (5)	4
	Often (4)	3
	Occasionally (3)	2
	Rarely (2)	1
Not Important (1) All options	All options Never (1)	0 0

Table 1: Construction of overall Criticality Scale

SURVEY RESULTS

Select Demographics of Survey Participants

Of the 240 participants, 195 completed the survey. The data analysis was based on the responses from the 195 sonographers who currently perform adult echocardiography and completed the survey.

Table 2. Select Demographics for Survey Participants

Demographic	N (%)
Educator	**195 (100%)**
No	184 (94%)
Yes	11 (6%)
Gender	**193 (99%)**
Female	152 (79%)
Male	41 (21%)
Role	**195 (100%)**
Physician	13 (7%)
Sonographer	182 (93%)
Country of Work	**195 (100%)**
Canada	16 (8%)
Cuba	1 (1%)
Egypt	2 (1%)
Singapore	1 (1%)
South Korea	3 (2%)
Turkey	1 (1%)
United Kingdom	1 (1%)
United States	170 (87%)

Note(s). N = number of participants; We assessed response bias for the 45 respondents who did not complete the survey, based on available demographics from our database. We found no evidence to support a systematic bias for non-responders versus responders.
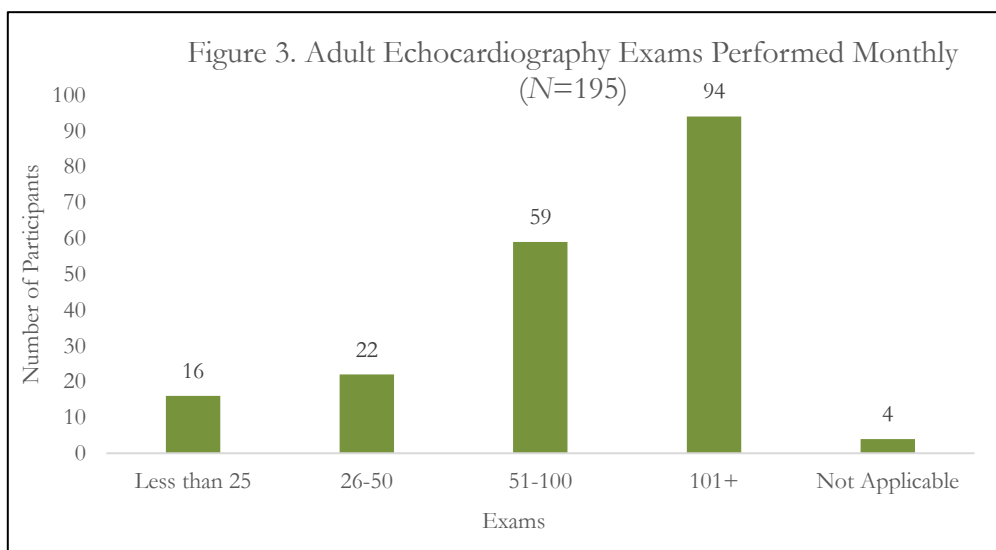

Figure 1. U.S. Census Region (N=170)

Figure 2. Years of Experience (N=195)
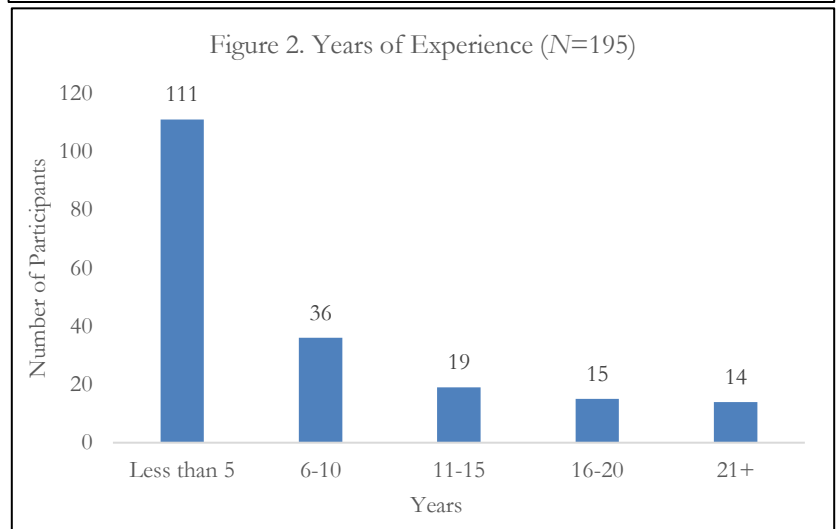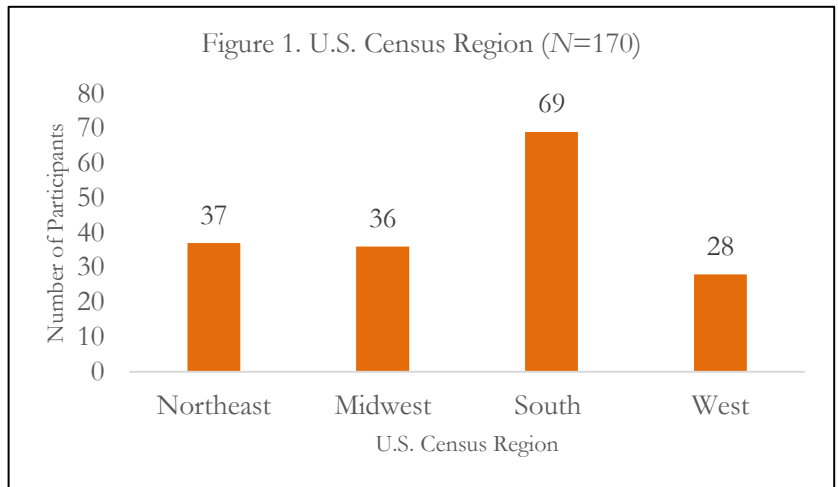

Figure 3. Adult Echocardiography Exams Performed Monthly (N=195)

6

Figure 4. Educational Attainment (*N*=195)
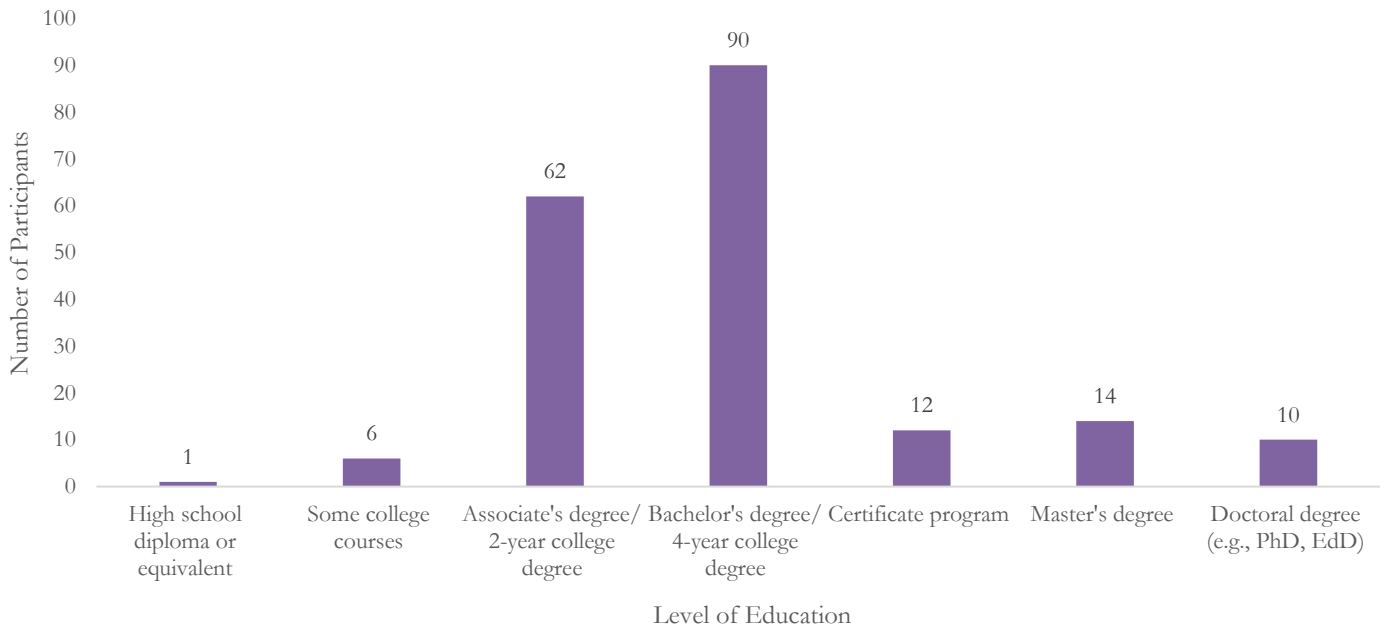
Figure 5. Environment for Performing Adult Echocardiography Exams*

Figure 6. At your institution who administers image enhancing agitated saline contrast?*

Figure 7. At your institution who administers echo contrast agents?*

Figure 8. At your institution who establishes intravenous lines?*
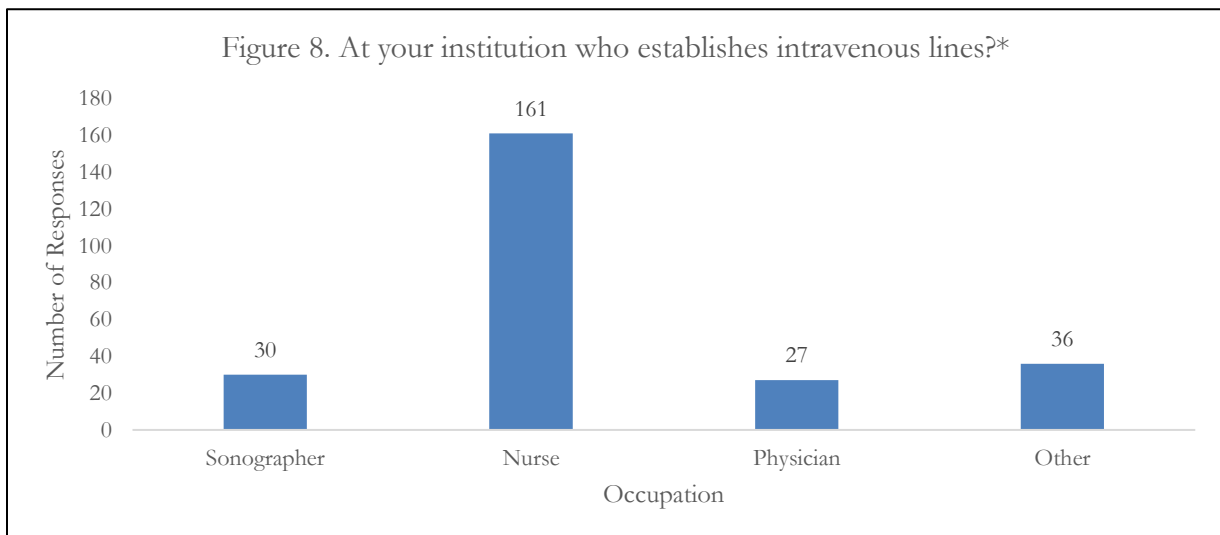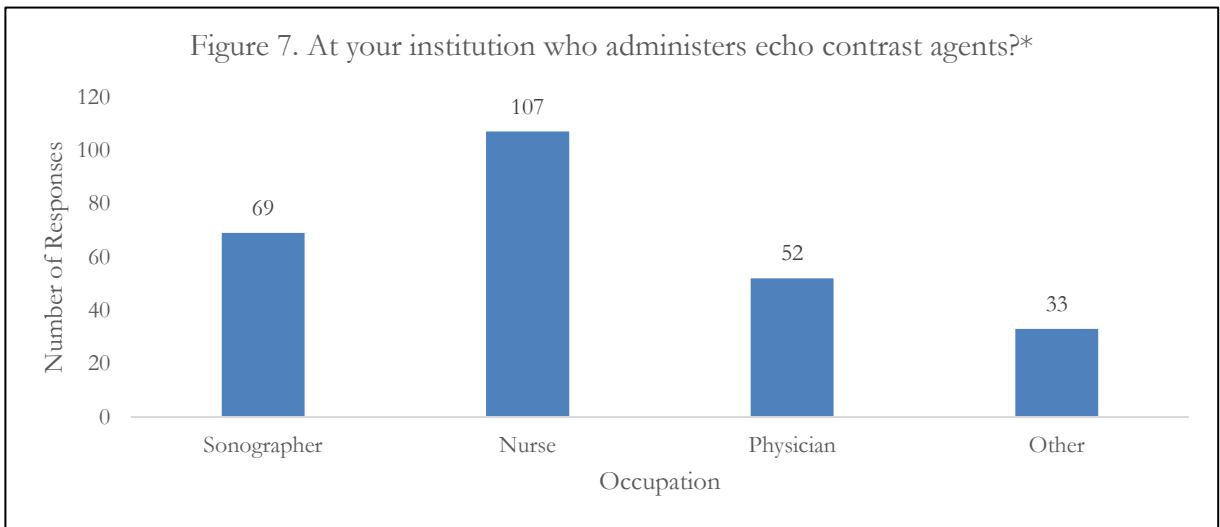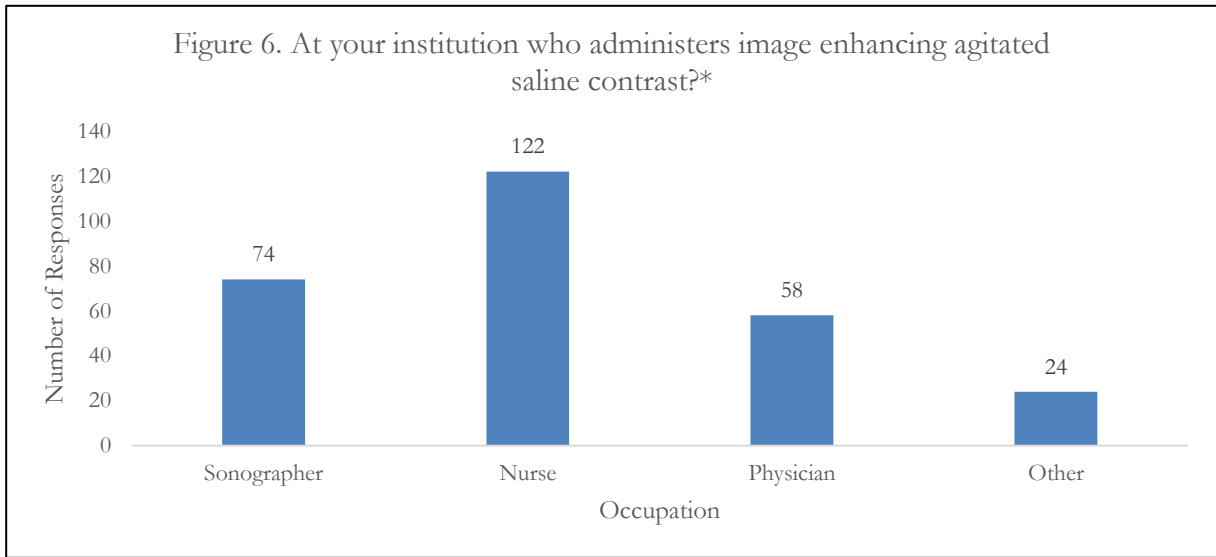
Note(s). * = Categories are not mutually exclusive (total N > 195).

CONCLUSION

When the survey concluded, Inteleos staff analyzed the results to determine criticality ratings of each of the task statements. These results were used to develop an ini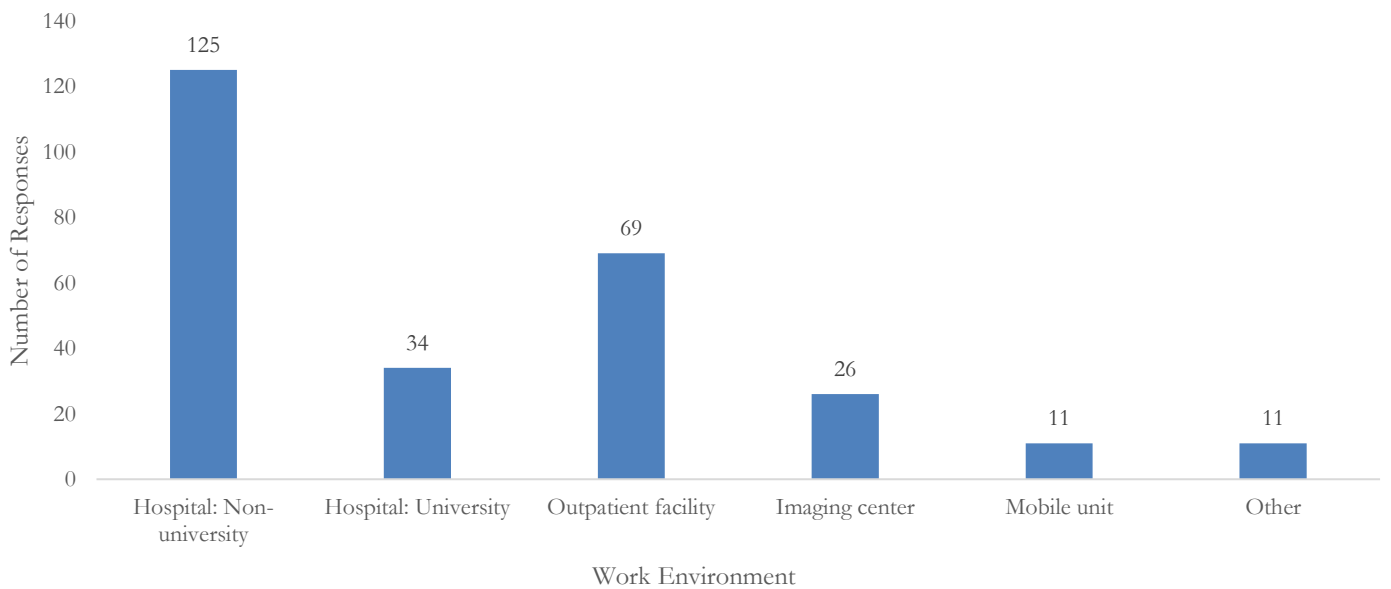tial list of tasks and domain weightings. This list was shared with the JTA Panel via a Qualtrics® survey to allow JTA Working Group members to review and provide feedback prior to the "Discussion of Results" call.

Discussion of Results

A call was held on August 13 to discuss the survey results with the JTA Panel. Eight of the nine members of the JTA Panel and six Inteleos staff members were in attendance. Fourteen tasks that were flagged (based on the abovementioned criteria) were reviewed by the JTA Panel. The descriptive statistics of those flagged tasks are in Table 6 (Appendix D). All members agreed to keep all 14 tasks. Likewise, the overall frequency, importance, and criticality statistics were presented by domain.

The JTA Panel also reviewed the preliminary content outline based on the data and the outline based on their task removals/combinations to decide what percentage of the examination should be in each domain. The JTA Panel could deviate ±10% in each domain from the preliminary content outline based on the 72 tasks. Table 3 displays the mutually agreed upon weighting for each domain.

Table 3. Summary of Results After Review of Flagged Items by JTA Panel

Domain	N	Criticality Sum	% of Total	Acceptable Range	Committee Recommendation
Anatomy and Physiology	12	131.74	17%	15-19%	17%
Pathology	33	356.20	46%	41-51%	46%
Clinical Care and Safety	5	58.83	8%	7-9%	8%
Measurement Techniques, Maneuvers, and Sonographic Views	17	178.19	23%	21-25%	23%
Instrumentation and Optimization	5	49.57	6%	5-7%	6%

Note(s). N = number of tasks.

FINAL Approval by JTA Panel

From October 12 to October 21, a survey was administered for the JTA Panel to approve the final content outline. There were no changes made to the final tasks, KSA statements, or domain weightings and the content outline was unanimously approved. Appendix E contains the final approved content outline. The ARDMS council voted and approved this content outline on November 8, 2018.

Approved AE Content Outline

Adult Echocardiography Examination Content Outline

(Outline Summary)

#	Domain	Subdomain	Percentage
1	**Anatomy and Physiology**	Normal Anatomy Normal Physiology	**17%**
2	**Pathology**	Abnormal Physiology and Perfusion Postoperative Evaluation	**46%**
3	**Clinical Care and Safety**	Clinical Care Safety	**8%**
4	**Measurement Techniques, Maneuvers, and Sonographic Views**	Measurement Techniques Maneuvers Sonographic Imaging Views	**23%**
5	**Instrumentation, Optimization, and Contrast**	Instrumentation and Optimization Contrast	**6%**

(Detailed Outline)

1.	Anatomy and Physiology 17%	Knowledge, skill, and/or ability related to normal anatomy and physiology
1.A.	**Normal anatomy**	
1.A.1.	Assess great vessels (aorta, pulmonary arteries, etc.)	Knowledge of normal cardiac anatomy and vessels Knowledge of anatomic variants related to the heart
1.A.2.	Assess cardiac anatomy and variants (chambers, false tendon, eustachian valve, Chiari network, etc.)	Ability to recognize and document normal cardiac anatomy and vessels
1.A.3.	Assess pericardium	Ability to recognize and document anatomic variants related to the heart
1.A.4.	Assess valve structure	Knowledge of normal hemodynamic response to stress testing and maneuvers
1.A.5.	Assess vessels of arterial and venous return (venae cavae, hepatic veins, coronary sinus, pulmonary veins)	Knowledge of normal systolic and diastolic function

1.A.6.	Assess wall segments (structure, nomenclature, etc.)	Knowledge of normal valve function and measurements
		Knowledge of normal arterial and venous return
1.B.	**Normal physiology**	Knowledge of the phases of the cardiac cycle
1.B.1.	Assess normal response to stress testing (blood pressure, wall augmentation, pharmacologic reaction, exercise type, etc.)	Knowledge of normal Doppler changes with respiration
		Knowledge of appearance of normal arterial and venous waveforms
1.B.2.	Assess normal systolic and diastolic function	Ability to recognize and document normal hemodynamic response to stress testing and maneuvers
1.B.3.	Assess normal valve function (gradient, pressure half-time, acceleration time, trivial regurgitation)	Ability to recognize and document normal systolic and diastolic function
		Ability to recognize and document normal valve function and measurements
1.B.4.	Assess normal arterial and venous return	Ability to recognize and document normal arterial and venous return
1.B.5.	Identify the phases of the cardiac cycle	
1.B.6.	Evaluate normal physiologic changes with maneuvers (Valsalva, respiratory, handgrip, postural)	Ability to identify and document the phases of the cardiac cycle
		Ability to recognize and document normal Doppler changes with respiration
		Ability to recognize and document normal arterial and venous waveforms
		Ability to document normal physiologic information
		Ability to perform, evaluate, and document Doppler interrogation of normal cardiac structures and associated vessels
2.	**Pathology 46%**	**Knowledge, skill, and/or ability related to pathology**
2.A.	**Abnormal physiology and perfusion**	
2.A.1.	Assess ventricular aneurysms (true, pseudo)	Knowledge of the appearance of abnormal cardiac structures and related vascular anatomy
2.A.2.	Assess aorta and sinus of Valsalva (aneurysm, dissection, prior repair, intramural hematoma, etc.)	Knowledge of abnormal hemodynamic response to stress testing
		Knowledge of appropriate Doppler interrogation techniques for abnormal cardiac structures and associated vessels
2.A.3.	Assess aortic valve regurgitation (etiology, type, mechanisms, associated findings)	

2.A.4.	Assess aortic valve stenosis (etiology, type, mechanisms, associated findings)	Knowledge of abnormal arterial and venous waveforms
2.A.5.	Assess arrhythmias and conduction disturbances (Electrocardiography (EKG) changes, flutter, fibrillation, ventricular tachycardia, etc.)	Knowledge of conditions that affect the heart and its vascular structures

Knowledge of abnormal Doppler changes with respiration |
| **2.A.6.** | Assess cardiac masses (thrombi, vegetations, tumors) | Knowledge of abnormal EKG findings

Knowledge of types of cardiac masses |
| **2.A.7.** | Assess abnormal diastolic function (grades, associated abnormalities, hemodynamics) | Knowledge of types of wall motion abnormalities

Knowledge of common congenital cardiac anomalies |
| **2.A.8.** | Assess endocarditis (complications, associated findings) | Ability to document abnormal cardiac structures and related vascular anatomy |
| **2.A.9.** | Assess ischemic cardiac diseases (mechanical complications of myocardial infarction) | Ability to recognize and document abnormal hemodynamic response to stress testing

Ability to perform and evaluate proper Doppler interrogation of pathologic states |
2.A.10.	Assess abnormal left ventricle (cardiomyopathies, left ventricular hypertrophy, etc.)	Ability to recognize and evaluate abnormal arterial and venous waveforms
2.A.11.	Assess abnormal left ventricle (strain)	Ability to identify and document conditions that affect the heart and its vascular structures
2.A.12.	Assess mitral valve regurgitation (etiology, type, mechanisms, associated findings)	Ability to recognize and evaluate abnormal Doppler changes with respiration
2.A.13.	Assess mitral valve stenosis (etiology, type, mechanisms, associated findings)	Ability to perform and evaluate Doppler interrogation of abnormal cardiac structures and associated vessels
2.A.14.	Assess pericardial disease	Ability to recognize abnormal EKG findings
2.A.15.	Assess abnormal pulmonary artery (clot, dilatation, catheter, changes due to pulmonary hypertension)	Ability to identify and document cardiac masses

Ability to demonstrate and evaluate wall motion abnormalities |
2.A.16.	Assess pulmonic valve regurgitation (etiology, type, mechanisms, associated findings)	Ability to identify and document common congenital cardiac anomalies
2.A.17.	Assess pulmonic valve stenosis (etiology, type, mechanisms, associated findings)	Ability to perform a comprehensive evaluation of cardiac pathologies
2.A.18.	Assess abnormal right ventricle (pulmonary hypertension, pulmonary embolism)	Knowledge of types of heart valve repair and replacement and their sonographic appearance

2.A.19.	Assess segmental wall motion abnormalities (corresponding coronary arteries; abnormal rest and stress)	Knowledge of intracardiac devices and their sonographic appearance
2.A.20.	Assess septal defects	Ability to perform echocardiographic evaluation of heart valve repairs, heart valve replacements, and intracardiac devices
2.A.21.	Identify and assess abnormal systolic function (ejection fraction in the setting of valvular dysfunction, etc.)	Ability to recognize and evaluate normal and abnormal postoperative findings
2.A.22.	Assess tricuspid valve regurgitation (etiology, type, mechanisms, associated findings)	
2.A.23.	Assess tricuspid valve stenosis (etiology, type, mechanisms, associated findings)	
2.A.24.	Assess abnormal arterial and venous return (venae cavae, hepatic veins, coronary sinus, pulmonary veins)	
2.A.25.	Assess abnormal structure and function of atria (volume, etc.)	
2.A.26.	Identify and evaluate Ebstein anomaly	
2.A.27.	Identify and evaluate patent ductus arteriosus	
2.A.28.	Identify and evaluate tetralogy of Fallot	
2.A.29.	Identify and evaluate coarctation of aorta	
2.A.30.	Identify and evaluate endocardial cushion defect	
2.A.31.	Identify and evaluate Marfan syndrome and associated findings	
2.B.	**Postoperative evaluation**	
2.B.1.	Assess valve repair or replacement (normal and abnormal prosthetic valve, transcatheter aortic valve replacement (TAVR), etc.)	
2.B.2.	Identify and evaluate intracardiac devices (closure devices, assist devices)	

3.	Clinical Care and Safety 8%	Knowledge, skill, and/or ability related to clinical care and safety
3.A.	Clinical care	
3.A.1.	Evaluate patient history and incorporate outside data (clinical assessment, physical history, other imaging modalities)	Knowledge and ability to apply patient history information to exam performed
		Knowledge of proper patient preparations, including fasting state, based on exam performed
3.A.2.	Prepare patient (positioning, EKG signal, blood pressure, fasting state, intravenous line)	Knowledge of how to properly position the patient based on the needs and limitations of the exam
		Knowledge of EKG findings
3.A.3.	Identify and communicate critical findings	Knowledge of proper placement of EKG leads
3.B.	Safety	Knowledge of sonographer's responsibility regarding intravenous line management
3.B.1.	Identify relative and absolute contraindications for echocardiographic procedures	Knowledge of critical echocardiographic findings and their characteristics
		Knowledge of proper ergonomic techniques
3.B.2.	Identify and manage medical emergencies	Ability to position the patient to obtain optimal results, based on exam protocol and the limitations of the patient or exam
		Ability to properly apply EKG leads and optimize signal
		Ability to carry out tasks related to sonographer's responsibility regarding intravenous line management
		Ability to obtain accurate blood pressure reading and understand readings
		Ability to practice proper ergonomic techniques
		Knowledge of contraindications for echocardiographic procedures
		Knowledge of types of medical emergencies that may occur in the echocardiography lab and how to identify them
		Knowledge of sonographer's role in managing medical emergencies
		Ability to identify contraindications for echocardiographic procedures

		Ability to react to and appropriately manage medical emergencies
4.	**Measurement Techniques, Maneuvers, and Sonographic Views 23%**	**Knowledge, skill, and/or ability related to measurement techniques, maneuvers, and sonographic views**
4.A.	**Measurement techniques**	
4.A.1.	Measure aortic valve (M-mode, planimetry, Doppler, left ventricular outflow tract measurement)	Knowledge of measurement techniques, including 2-D, 3-D, M-mode, and Doppler, and their application to the heart's chambers, vessels, and valves
4.A.2.	Measure parameters of diastolic function	Knowledge of pressure half-time, planimetry, arterial pressure, diameter, and shunt ratio measurement techniques and their application to the heart's chambers, vessels, and valves
4.A.3.	Measure great vessels and veins (dimensions, pulsed wave Doppler)	
4.A.4.	Measure left atrium (2-D, M-mode, Doppler)	Ability to perform all cardiac-related measurements
4.A.5.	Measure left ventricle (2-D, M-mode, Doppler)	Knowledge of types of provocative maneuvers and their application
4.A.6.	Measure left ventricle (3-D)	Ability to provide meaningful instructions to the patient regarding the performance of provocative maneuvers
4.A.7.	Measure mitral valve (M-mode, planimetry, Doppler)	
4.A.8.	Measure pulmonary artery pressure	Knowledge of standard echocardiographic views and their application
4.A.9.	Measure pulmonic valve (diameter, Doppler, M-mode)	
4.A.10.	Measure right ventricle (2-D, Doppler, M-mode)	Ability to obtain standard echocardiographic views and modify views based on clinical situation and findings
4.A.11.	Measure shunt ratios	
4.A.12.	Measure tricuspid valve (2-D, Doppler)	
4.B.	**Maneuvers**	
4.B.1.	Perform provocative maneuvers (Valsalva, cough, sniff, squat)	
4.C.	**Sonographic imaging views**	
4.C.1.	Obtain and optimize apical views	
4.C.2.	Obtain and optimize parasternal views (right and left)	
4.C.3.	Obtain and optimize subcostal views	

4.C.4.	Obtain and optimize suprasternal notch views	
5.	**Instrumentation, Optimization, and Contrast 6%**	**Knowledge, skill, and/or ability related to instrumentation, optimization, and contrast**
5.A.	**Instrumentation and optimization**	
5.A.1.	Recognize imaging artifacts (2-D, Doppler)	Knowledge of types of artifacts and their appearance Knowledge of function of non-imaging transducer Knowledge of settings on ultrasound console and their function as related to imaging, including Doppler Ability to recognize artifacts and modify scanning technique based on findings Ability to utilize non-imaging transducer Ability to properly adjust ultrasound console settings to optimize imaging, including Doppler Knowledge of harmonic imaging Knowledge of physical principles of contrast agents Knowledge of types of saline and echo-enhancing contrast agents and their application Ability to appropriately utilize contrast agents, including understanding contraindications Ability to optimize images when utilizing contrast agents