



Adult Echocardiography

Practice Analysis Detailed Report

Approved by the ARDMS Council on August 13, 2024

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ACKNOWLEDGEMENTS

Thank you to the subject matter expert volunteers who spent many hours developing the task inventory, evaluating the survey and responses, and reviewing the final content outline. Also, thank you to the nearly 500 Registered Diagnostic Cardiac Sonographers (RDCSs) certified in Adult Echocardiography around the world who took the time to participate in the practice analysis survey. This study was completed through the efforts of many individuals at Inteleos who worked together with our expert volunteer panel to identify tasks, construct the survey, administer the survey, and analyze the data.

EXECUTIVE SUMMARY

The American Registry for Diagnostic Medical Sonography (ARDMS), part of the Inteleos family of certifications, is the globally recognized standard of excellence in sonography. The ARDMS is responsible for the preparation of valid and reliable certification examinations in the field of sonography. Conducting practice analyses at the national and international levels allows the ARDMS to evaluate the current practice expectations and performance requirements within the field. The Adult Echocardiography (AE) practice analysis collected information on the requisite AE knowledge, skills, and abilities essential to sonography professionals. The practice analysis was conducted in several stages:

1. *Review and Revise Existing Content Outline*
2. *Expert Panel Meeting*
3. *Field Survey and Analysis*
4. *Final Task and Domain Weighting*
5. *Knowledge, Skills, and Abilities (KSA) Development*

The result of these activities led to the AE Practice Analysis Panel recommending a new Content Outline and list of KSAs (see Appendix H). This report details the methodology, data collection, analysis, and the recommended updated test content outline for the AE examination based on the results of the practice analysis.

BACKGROUND OF STUDY

The ARDMS recognizes that diagnostic medical sonography is a valuable tool in the healthcare industry. There are several healthcare professions that utilize sonography in practice to increase the efficacy of their patient care. Successful mastery and demonstration of the knowledge and skills required to hold ARDMS sonographer credentials will provide sonographers with an additional source of validation. This will support the veracity of the diagnostic sonography exams that these practitioners perform. The AE examination assesses the requisite adult echocardiography knowledge, skills, and abilities essential to sonographer-level professionals.

METHODOLOGY

Selection and Profile of Subject Matter Experts

The AE Assessment Committee members reviewed and proposed changes to the existing content outline. An AE Practice Analysis Expert Panel was recruited and participated in all of the other stages of the practice analysis with the exception of the survey which was sent to a larger sample as described in the *Field Survey and Analysis* section of this report. The AE Practice Analysis Expert Panel was comprised of members of the AE Assessment Committee and additional experts who were selected from a pool of current RDCSs certified in AE who indicated an interest in volunteering. Efforts were made to select a panel which represented the population of RDCSs certified in AE on several demographic features. For a list of panelists, their involvement, and this demographic breakdown, see Appendix A.

Review and Revise Existing Content Outline

On June 6, 2023, Cynthia Parshall, from Touchstone Consulting, facilitated a meeting with the AE Assessment Committee to collect feedback about the current AE content outline. The purpose of the meeting was to (a) learn what the committee members like and dislike about the outline, (b) identify outdated content, and (c) identify topics that may be missing from the outline. Prior to the meeting, Dr. Parshall prepared a set of pre-reading materials that provided instructions to perform a critical review of the content outline. Inteleos sent the materials to the committee

two weeks prior to the meeting for their review. See Appendix B for the agenda and Appendix C for the summary of this meeting. A revised content outline was prepared as a result of this meeting.

Expert Panel Meeting

On September 15-16, 2023, the AE Practice Analysis Expert Panel met in person to review and edit the revised content outline. The meeting was facilitated by Cynthia Parshall from Touchstone Consulting. The meeting agenda can be found in Appendix D. This meeting resulted in an edited version of the content outline to be used to develop a list of tasks for the field survey. This included 66 tasks organized into five domains. The tasks can be found in Appendix E.

Field Survey and Analysis

Field Survey Structure and Instructions to Survey Participants

The field survey was divided into two parts: demographic items and the task inventory items. A screening item was used at the beginning of the survey to ensure only those actively practicing AE sonography responded to the survey: “Do you currently perform and/or teach Adult Echocardiography ultrasound examinations?” Participants who selected “No” were thanked for their time and their survey was ended.

The tasks (grouped by domains) as developed by the practice analysis expert panel were presented to survey participants. The participants were asked to rate each task on an importance scale. The instructions for this section were:

In the next section of the survey, please examine the tasks associated with being an Adult Echocardiography Sonographer, and consider the following question:

How important is this task to **your** practice of Adult Echocardiography?

- *Absolutely essential*
- *Very important*
- *Of average importance*
- *Of little importance*
- *Not important at all*

The rating scale and weighting calculations are described in the *Data Analysis* section below.

Survey Administration Procedure and Response Rate

The survey was sent to a random sample of 1,999 RDCS Sonographer registrants who were, at the time, certified in AE. The survey was available from October 16, 2023 to October 30, 2023. Because we did not obtain a representative proportion of international responses from the first administration, the survey was administered again to 1,575 international registrants from February 1, 2024 to February 15, 2024. Of the 168 responses which met the selection criteria, 18 responses were selected through a stratified sampling method which controlled for: (a) proportion of international to domestic credential holders within the AE population, and (b) proportion of countries represented in the international AE population. The survey was administered both times via the web-based survey platform Qualtrics®. All responses to the survey were kept confidential. Responses from participants who did not complete the task inventory were not used as part of the data analysis.

Data Analysis

Task Inventory Analysis

Each option for the 66 task inventory items was assigned the following *importance* score:

- Absolutely essential = 5
- Very important = 4
- Of average importance = 3
- Of little importance = 2
- Not important at all = 1

The mean importance score was calculated for each task (see Appendix E). Tasks were assigned to three categories to assist in the discussion of importance scores.

- Green: Any task with an importance score of four or above. These tasks should only be removed from the outline if they are redundant or for some other extraordinary circumstance. A rationale must be provided if the task is recommended for removal.
- Yellow: Tasks with an importance score of less than four and greater than or equal to three. These tasks may be kept or removed. A rationale is required for any tasks that are removed.
- Red: Any task with an importance score lower than three. These tasks should be considered for removal. A rationale is required for any of these tasks that are kept.

Most of the tasks fell into the “green” category. Six tasks fell into the “yellow” category, and there were no tasks in the “red” category.

Initial Domain Weightings

The mean importance scores for each task were summed within each domain. The sum of the mean importance score for each domain was divided by the total mean importance score to determine the initial domain weightings (Table 1).

Table 1. Initial Domain Weightings (Prior to Expert Panel Review)

Domain #	Domain	# Tasks	Importance Sum	% of Total
1	Anatomy and Physiology	10	45.41	15%
2	Pathology	26	117.83	40%
3	Clinical Care and Safety	7	31.52	11%
4	Measurement Techniques, Maneuvers, and Sonographic Views	17	74.97	25%
5	Instrumentation, Optimization, and Contrast	6	25.94	9%
	<i>Total</i>	66	296	100%

Demographic Analysis

Responses to demographic questions were also analyzed. Appendix F contains highlights from the demographic analysis. Data from the survey responses, the total population (currently registered RDCSs but excluding physicians), and from the 2018 AE practice analysis are included where available. Here are the key findings:

- The survey respondents are representative of the total population across the dimensions of gender identification, age, location, and primary job function.
- The number of scans per month has remained relatively close between 2018 and the current analysis, with more respondents picking 100 or more per month than other options.

- When asked who injected saline, the highest frequency response in 2018 was “nurse”, while in the 2023 survey it was “sonographer”. The same was true when asked who administers echo contrast agents.

Final Task and Domain Weighting

The final tasks and domain weightings were determined by members of the AE Practice Analysis Expert Panel on a Zoom call held February 1, 2024. The panelists were provided the tasks and instructions one week prior to the call. See Appendix G for instructions provided to the panelists.

The AE Practice Analysis panel decided to keep all of the tasks so there was no change to the proposed domain weightings (see Table 2). The panel made some minor changes in wording of the tasks to improve clarity and consistency (see Appendix E). On the call the panel was informed about the second administration of the survey to international registrants that was still live in the field. Once the survey closed, data analysis demonstrated the international responses did not change the overall importance rating of any tasks, so the initial panel decisions were maintained. The panel was informed and was sent a draft content outline based on their decisions.

Table 2. Final Domain Weightings (Panel Recommendations- same as initial weightings)

Domain #	Domain	# Tasks	Importance Sum	% of Total
1	Anatomy and Physiology	10	45.41	15%
2	Pathology	26	117.83	40%
3	Clinical Care and Safety	7	31.52	11%
4	Measurement Techniques, Maneuvers, and Sonographic Views	17	74.97	25%
5	Instrumentation, Optimization, and Contrast	6	25.94	9%
	<i>Total</i>	66	296	100%

KSA Development

While reviewing the draft content outline, the practice analysis panel was asked to identify knowledge, skills, and abilities (KSAs) that are required to accomplish the tasks laid out in the updated content outline. They were provided with a brief training on the February 1st call. After the panel submitted a list of KSAs, Inteleos staff, including an in-house SME, compiled the results, editing for clarity and removing redundancies. The draft KSAs were shared once again with the panel. The resulting KSAs are included at the end of Appendix H.

FINAL CONTENT OUTLINE

The final version of the content outline with the KSAs can be found in Appendix H. This report, including the final version of the content outline recommended by the Practice Analysis Panel, will be presented to the ARDMS Council for approval. Upon approval of the content outline, this report will be amended to include the approval date.

Appendix A: Practice Analysis Participants

Table 3. Full List of Participants and Meetings Attended

<i>Full Name and Certifications</i>	<i>Review and Revise Existing Content Outline (Remote)</i>	<i>Expert Panel Meeting (In Person)</i>	<i>Final Task and Domain Weighting/KSA (Remote)</i>
Madeline Jankowski, RDCS (AE)	X		
Carissa Bregadze, RDCS (AE)	X		
Jean Woolard, RDCS (AE)	X		
Christie Crawford, RDCS (AE)	X	X	X
Sydnee Slocum, RDCS (AE)	X	X	X
Steven Maduri, RDCS (AE), RVT	X	X	
Tamera Thompson, RDCS (AE)		X	X
Samantha Kolupanowicz, RDCS (AE)		X	X
Brad Mehl, ACS, RDCS, RVT, RDMS, RTCRS		X	X
Sa'ad Dayem, RDCS (AE)		X	
Lynn Nguyen, RDCS (AE)		X	
Allison Huver, RDCS (AE)		X	X
Batina Kight, RDCS (AE, PE)		X	X

Table 4. Gender Identification of Population and Participants

<i>Gender</i>	<i>Percent in Population</i>	<i>Percent of Panelists</i>
Female	77%	77%
Male	23%	23%

Table 5. U.S. Census Region (for U.S. residents)

<i>Census Region</i>	<i>Percent in Population</i>	<i>Percent of Panelists</i>
Midwest	25%	17%
Northeast	18%	25%
West	20%	8%
South	37%	50%

Table 6. Country of Residence

	<i>Percent in Population</i>	<i>Percent of Panelists</i>
United States	92%	92%
Not United States	8%	8%

Appendix B: Review and Revise Existing Content Outline Meeting Agenda

Adult Echocardiography Assessment Committee Content Outline Review Thursday, June 6, 2023, 7:00 PM, ET

Join Zoom Meeting

<https://inteleos.zoom.us/j/93820843777?pwd=cVR5MFpicHlVdm1nbGY2dWFxcmlXdz09>

Meeting ID: 938 2084 3777

Passcode: 746229

- I. Welcome and Introductions – Kathy Kelly, Chief Assessment Officer
- II. Review of Practice Analysis process – Kathy Kelly
- III. Review of Content Outline and discussion – Cynthia Parshall, PhD, Touchstone Consulting and
Panel
- IV. Next Steps – Kathy Kelly

Appendix C: Review and Revise Existing Content Outline Meeting Summary

On June 6, 2023, the AE Assessment Committee members met to review the existing content outline. The purpose of the meeting was to (a) learn what the committee members like and dislike about the outline, (b) identify outdated content, and (c) identify topics that may be missing from the outline. Two weeks prior to the meeting, a set of pre-reading materials that provided instructions on performing a critical review of the content outline were prepared and sent to the committee.

The committee members identified a few instances where task statements could be combined most of these were in Domain 2: Pathology. The committee members also requested reordering of tasks to allow for similar tasks to be together in the content outline (e.g., keeping tasks about the left ventricle together). Overall, the suggested changes were minor.

Appendix D: Expert Panel Meeting

AE Practice Analysis September 15 – 16, 2023 Seattle, WA

Friday, September 15th

Topics	Description	Facilitator	Time
Breakfast			8:00-9:00 AM
Introductions/Ice Breaker	Welcome Introductions Agenda Review Opening Presentation Individual Task List Review	Kathy Kelly Haley Williams	9:00-10:30 AM
Break			10:30 - 10:45 AM
Group Activity	Review and discuss Domains 1 and 2	Kathy Kelly Haley Williams	10:45-12:30 PM
Lunch			12:30-1:30 PM
Group Activity	Review and discuss Domains 3-5	Kathy Kelly Haley Williams	1:30-3:00 PM
Break			3:00-3:15 PM
Group Activity	Finalize recommendations Item writing training	Kathy Kelly Haley Williams	3:15-5:00 PM
Dinner			6:00-8:00 PM

Saturday, September 16th

Topics	Description	Facilitator	Time
Breakfast			8:00-9:00 AM
Group Activity	Review updated task statements Item writing	Kathy Kelly Haley Williams	9:00-10:30 AM
Break			10:30 - 10:45 AM
Group Activity	Continue item writing and review	Kathy Kelly Haley Williams	10:45-12:30 PM
Lunch			12:30-1:30 PM
Group Activity	Continue item writing and review	Kathy Kelly Haley Williams	1:30-3:00 PM

Appendix E: Task Importance Score and Committee Decision

The tasks below were identified through the practice analysis process and were included on the survey for respondents to provide an importance rating. Cells in column C contain the mean importance rating for each task and are colored green, yellow, or red. Tasks in the “Green” category have a mean importance score of four or greater. Tasks in the “Yellow” category have a mean importance score of greater than or equal to three and less than four. Tasks in the “Red” category have a mean importance score of less than three (there are no “Red” tasks). The panel’s decisions are recorded in column D. Column E contains comments from the panel.

A. Content Code	B. Domain & Task	C. Mean Imp. Rating	D. Panel Decision	E. Comment
1	Anatomy and Physiology			
1.A	<i>Normal anatomy</i>			
1.A.01	Assess great vessels (aorta, pulmonary arteries, etc.)	4.60	Keep	
1.A.02	Assess cardiac anatomy and variants (chambers, false tendon, eustachian valve, Chiari network, etc.)	4.47	Keep	Change wording: "... and normal variants"
1.A.03	Assess pericardium	4.61	Keep	
1.A.04	Assess valve structure	4.89	Keep	
1.A.05	Assess vessels of arterial and venous return (venae cavae, hepatic veins, coronary sinus, pulmonary veins, etc.)	4.09	Keep	
1.A.06	Assess wall segments (structure, nomenclature, etc.)	4.89	Keep	
1.B	<i>Normal physiology</i>			
1.B.01	Assess normal response to stress testing (blood pressure, wall augmentation, pharmacologic reaction, exercise type, etc.)	4.24	Keep	
1.B.02	Assess normal systolic and diastolic function and left ventricular strain patterns	4.52	Keep	
1.B.03	Assess normal valve function (gradient, pressure half-time, acceleration time, trivial regurgitation)	4.75	Keep	
1.B.04	Identify phases of the cardiac cycle	4.34	Keep	
2	Pathology			
2.A	<i>Abnormal physiology and perfusion</i>			
2.A.01	Assess aortic and sinus of Valsalva abnormalities (aneurysm, dissection, prior repair, intramural hematoma, etc.)	4.63	Keep	

2.A.02	Assess aortic valve pathology (regurgitation, stenosis, valvular structure)	4.91	Keep	IHSME: move above mitral valve task. Cmte approved
2.A.03	Assess arrhythmias and conduction disturbances (electrocardiography [EKG] changes, flutter, fibrillation, ventricular tachycardia, etc.)	4.07	Keep	
2.A.04	Assess cardiac masses (thrombi, tumors)	4.74	Keep	
2.A.05	Assess abnormal diastolic function (grades, associated abnormalities, hemodynamics)	4.54	Keep	
2.A.06	Assess endocarditis (complications, vegetations, associated findings)	4.75	Keep	
2.A.07	Assess ischemic cardiac diseases (mechanical complications of myocardial infarction)	4.73	Keep	
2.A.08	Assess abnormal left ventricle (true aneurysms, pseudoaneurysms, left ventricular hypertrophy, hyperkinesis)	4.74	Keep	
2.A.09	Assess cardiomyopathies (dilated, hypertrophic, restrictive, etc.)	4.79	Keep	
2.A.10	Assess segmental wall motion abnormalities (corresponding coronary arteries, abnormal rest and stress)	4.76	Keep	
2.A.11	Assess abnormal left ventricle using strain (patterns, values)	3.94	Keep	Cmte agrees concept is important and needs to stay. Becoming more relevant
2.A.12	Identify and assess abnormal systolic function	4.78	Keep	
2.A.13	Assess mitral valve pathology (regurgitation, stenosis, valvular structure)	4.90	Keep	
2.A.14	Assess pericardial disease (effusion, constrictive, restrictive, etc.)	4.66	Keep	
2.A.15	Assess abnormal pulmonary artery (clot, dilatation, catheter, changes due to pulmonary hypertension)	4.28	Keep	
2.A.16	Assess pulmonic valve pathology (regurgitation, stenosis, valvular structure)	4.38	Keep	

2.A.17	Assess abnormal right ventricle (pulmonary hypertension, pulmonary embolism)	4.68	Keep	
2.A.18	Assess tricuspid valve pathology (regurgitation, stenosis, valvular structure)	4.74	Keep	
2.A.19	Assess abnormal arterial and venous return (venae cavae, hepatic veins, coronary sinus, pulmonary veins, etc.)	4.06	Keep	
2.A.20	Assess abnormal structure and function of atria (volume, etc.)	4.53	Keep	
2.A.21	Assess septal defects (patent foramen ovale, atrial and ventricular septal defects)	4.56	Keep	
2.A.22	Identify and evaluate congenital heart defects (Ebstein anomaly, patent ductus arteriosus, tetralogy of Fallot, aortic coarctation, endocardial cushion defect, etc.)	4.22	Keep	
2.A.23	Identify and evaluate connective tissue disorders (Marfan, Ehlers-Danlos)	4.15	Keep	
2.B	Postoperative evaluation			
2.B.01	Assess valve repair or replacement (normal and abnormal prosthetic valves, surgical or transcatheter valve procedures, etc.)	4.80	Keep	
2.B.02	Identify and evaluate intracardiac devices (closure devices, assist devices, pacemakers, etc.)	4.38	Keep	
2.B.03	Identify and evaluate post-surgical procedures for congenital heart diseases	4.10	Keep	
3	Clinical Care and Safety			
3.A	Clinical care			
3.A.01	Evaluate patient history and incorporate outside data (clinical assessment, physical history, other imaging modalities)	4.25	Keep	
3.A.02	Prepare and monitor patient (positioning, EKG signal, blood pressure, fasting state, intravenous line)	3.87	Keep	Cmte agrees to keep this task, it is an important concept; Wording change: remove "intravenous line" and replace with "heart rate", possibly add "etc." to end of list.

3.A.03	Identify and communicate critical findings	4.81	Keep	
3.A.04	Practice universal precautions	4.76	Keep	
3.A.05	Practice proper equipment cleaning and maintenance	4.74	Keep	
3.B	Safety			
3.B.01	Identify relative and absolute contraindications for echocardiographic procedures	4.44	Keep	
3.B.02	Identify and manage medical emergencies	4.66	Keep	
4	Measurement Techniques, Maneuvers, and Sonographic Views			
4.A	Measurement techniques and Maneuvers			
4.A.01	Measure aortic valve (M-mode, planimetry, Doppler, left ventricular outflow tract measurement)	4.71	Keep	
4.A.02	Measure mitral valve (M-mode, planimetry, Doppler)	4.63	Keep	
4.A.03	Measure pulmonic valve (M-mode, Doppler)	3.96	Keep	Cmte agrees to keep this task; wording change: remove "M-mode" and replace with "2-D"
4.A.04	Measure tricuspid valve (2-D, Doppler)	4.51	Keep	
4.A.05	Measure parameters of diastolic function	4.61	Keep	
4.A.06	Measure great vessels and veins (dimensions, Doppler)	4.28	Keep	
4.A.07	Measure atria (2-D, M-mode, Doppler)	4.58	Keep	
4.A.08	Measure left ventricle (2-D, 3-D, M-mode, Doppler)	4.78	Keep	
4.A.09	Measure pulmonary artery pressure	4.43	Keep	
4.A.10	Measure right ventricle (2-D, M-mode, Doppler)	4.39	Keep	
4.A.11	Measure shunt ratios	3.67	Keep	Cmte agrees to keep this task
4.A.12	Evaluate response to provocative maneuvers (Valsalva, cough, sniff, squat, etc.)	4.18	Keep	
4.B	Sonographic imaging views			
4.B.01	Obtain and optimize apical views	4.84	Keep	

4.B.02	Obtain and optimize parasternal views (right and left)	4.83	Keep	
4.B.03	Obtain and optimize subcostal views	4.67	Keep	
4.B.04	Obtain and optimize suprasternal notch views	4.27	Keep	
4.B.05	Obtain and optimize 3-D transesophageal echocardiogram (TEE) images for valve assessment	3.63	Keep	Cmte agrees to keep this task; this is an important and emerging task for sonographers and for their education; wording change: "Obtain and optimize 2-D and 3-D . . ."
5	Instrumentation, Optimization, and Contrast			
5.A	<i>Instrumentation and optimization</i>			
5.A.01	Recognize imaging artifacts (2-D, Doppler)	4.55	Keep	
5.A.02	Utilize non-imaging transducer	3.87	Keep	Cmte agrees to keep this task; this is very important and is utilized in most settings
5.A.03	Adjust console settings to achieve optimal Doppler recording	4.60	Keep	
5.A.04	Adjust console settings to achieve optimal imaging display, including harmonics	4.62	Keep	
5.A.05	Recognize critical findings and pathology on transesophageal echocardiogram (TEE)	4.10	Keep	
5.B	<i>Contrast</i>			
5.B.01	Utilize ultrasound enhancing agents (saline, contrast)	4.21	Keep	

Appendix F: Demographic Analysis

Figure 1: 2023 Age in population and 2023 survey responses

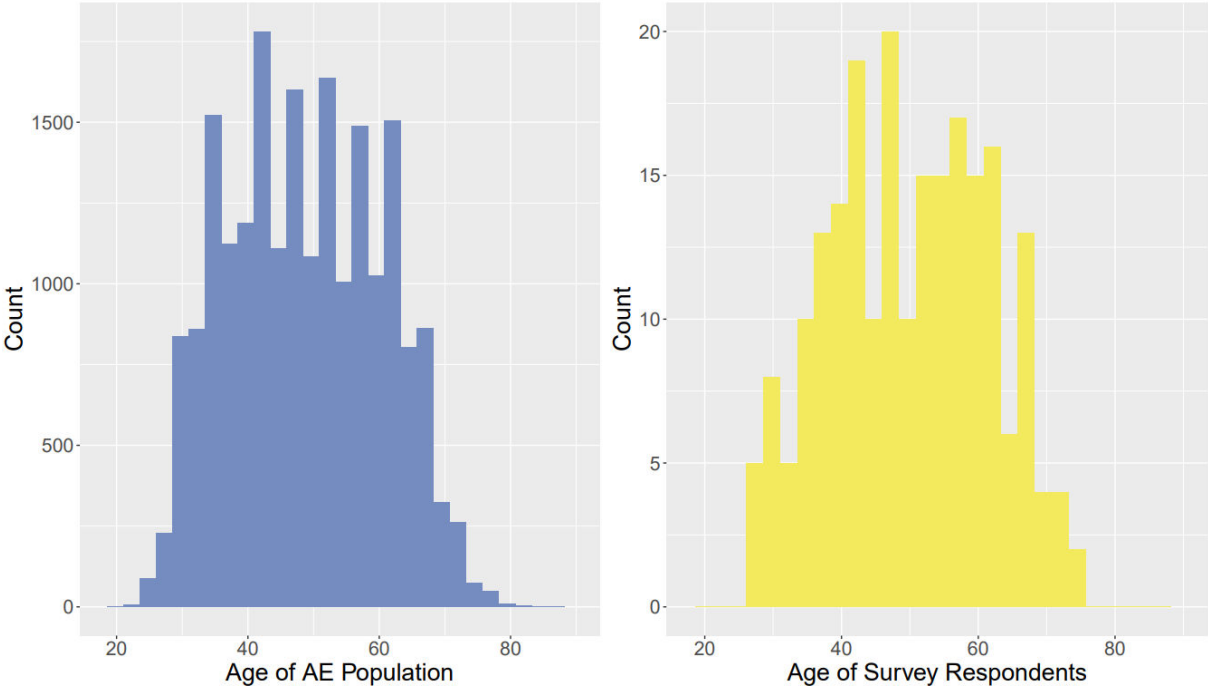


Figure 2: Gender in 2023 population and 2023 survey responses

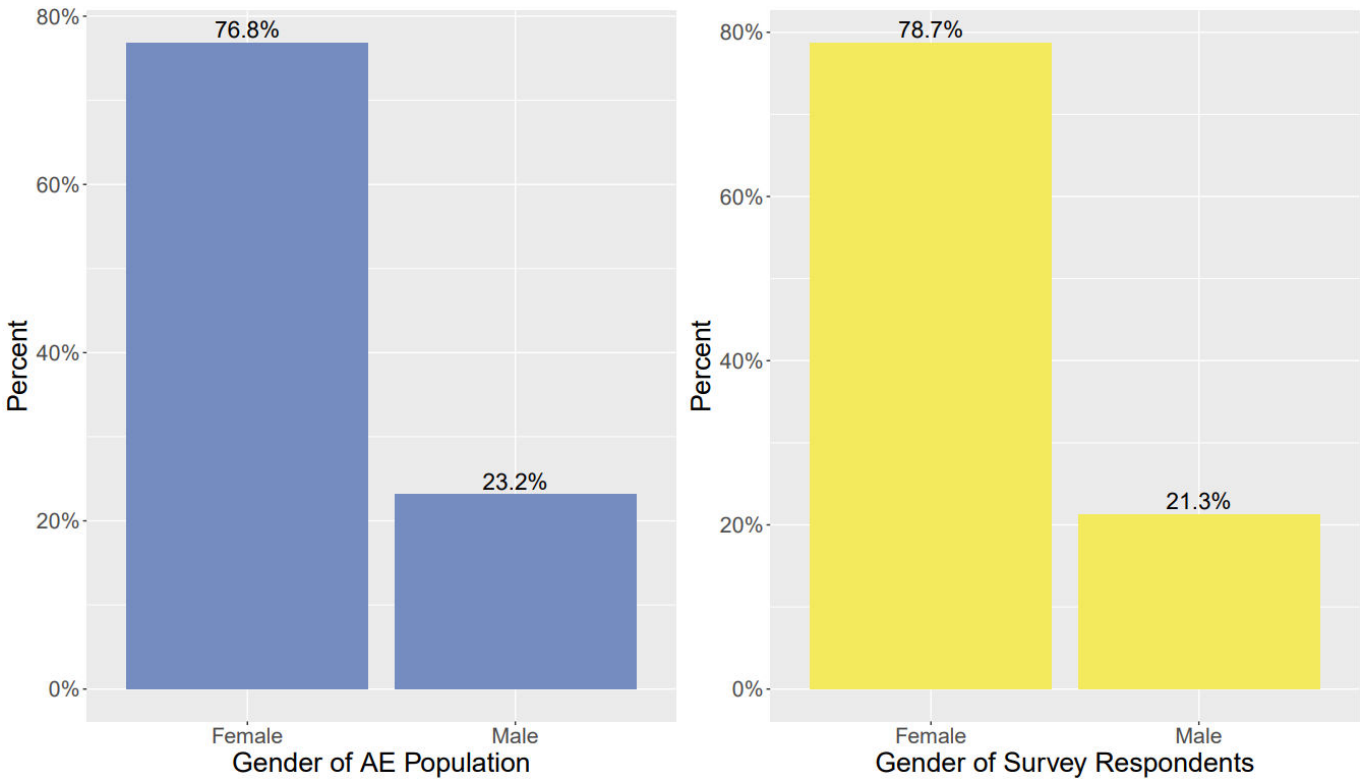


Figure 3: Country of Residence in 2023 population and 2023 survey responses

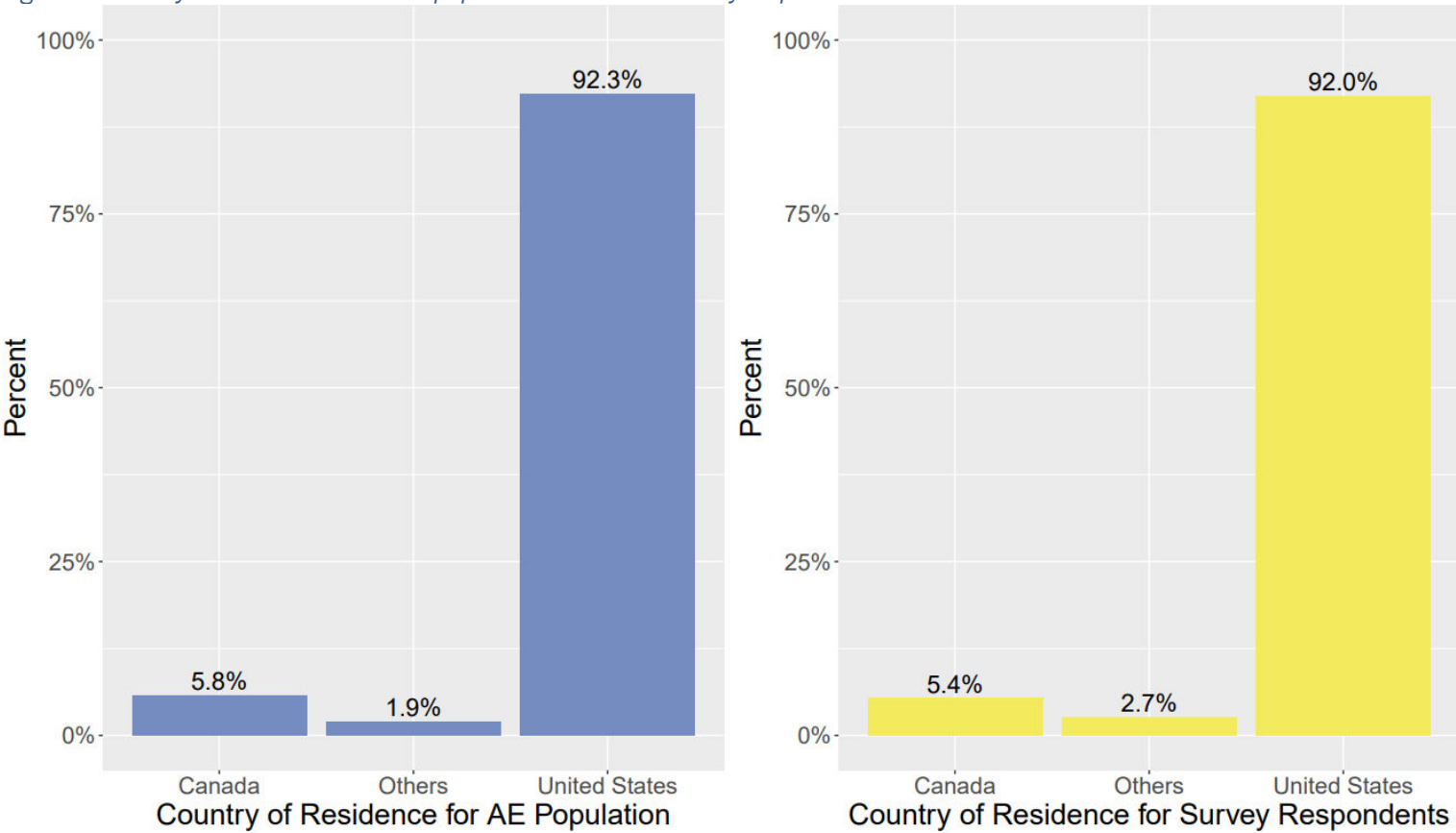


Figure 4: U.S. Census Region in 2023 population and 2023 survey responses (N=224)

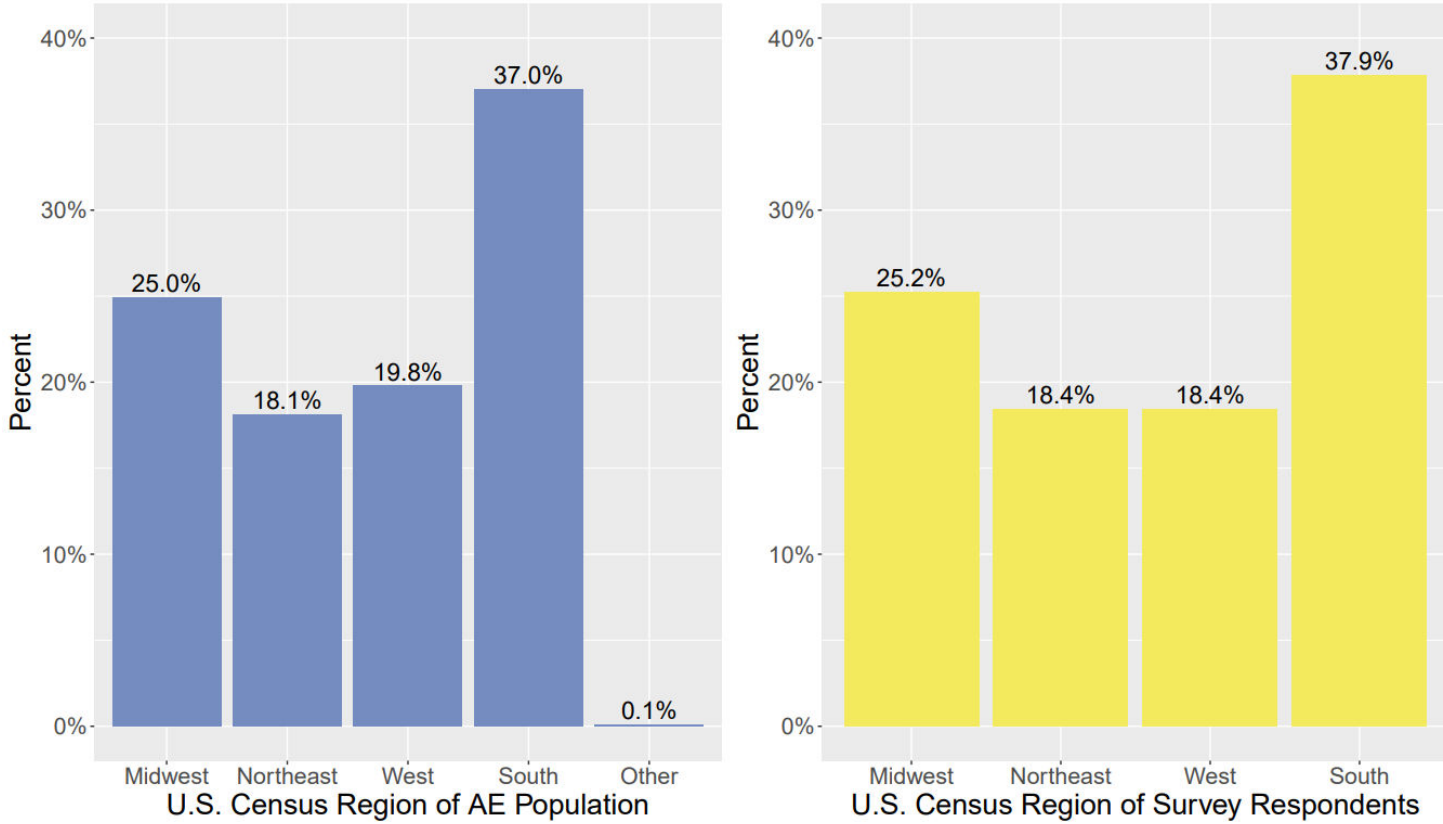


Figure 5: U.S geographic region in 2018 survey responses

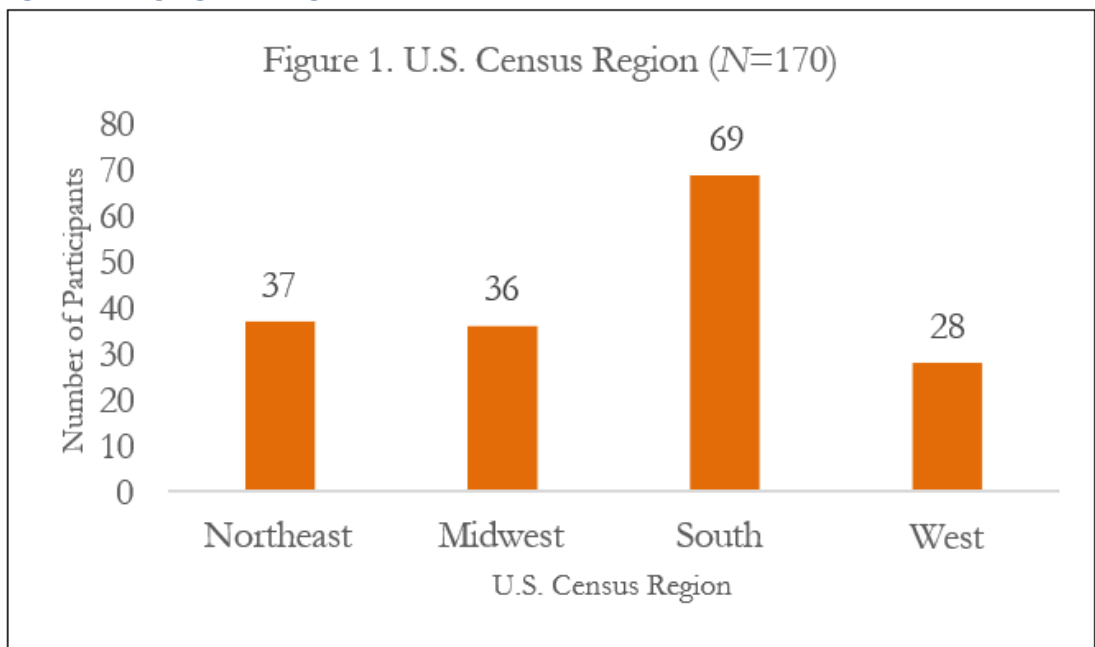


Figure 6: Primary job function in 2023 population

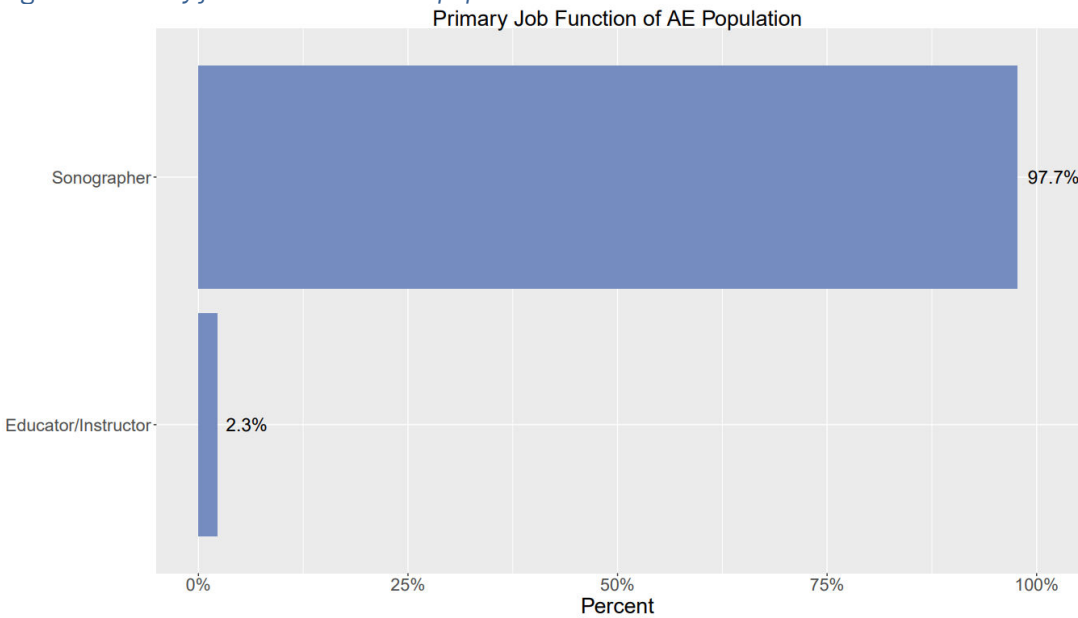


Figure 7: Primary job function in 2023 survey responses

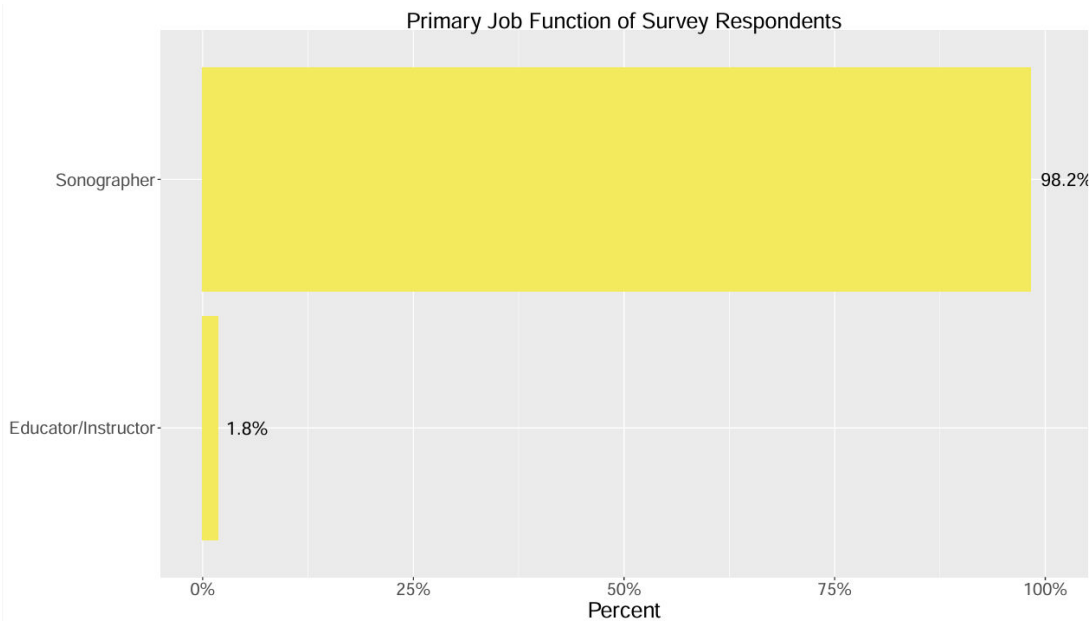


Figure 8: Education level in 2023 survey responses (N=224)

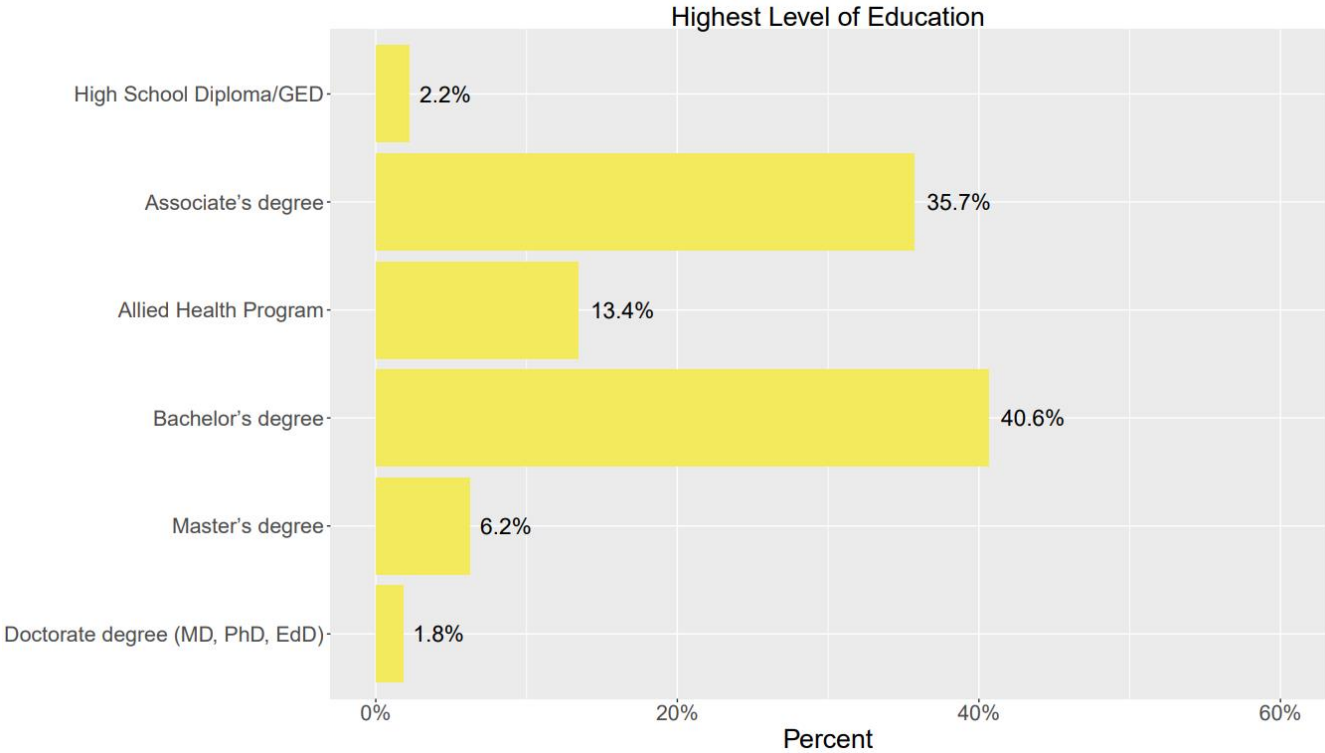


Figure 9: Education level in 2018 survey responses

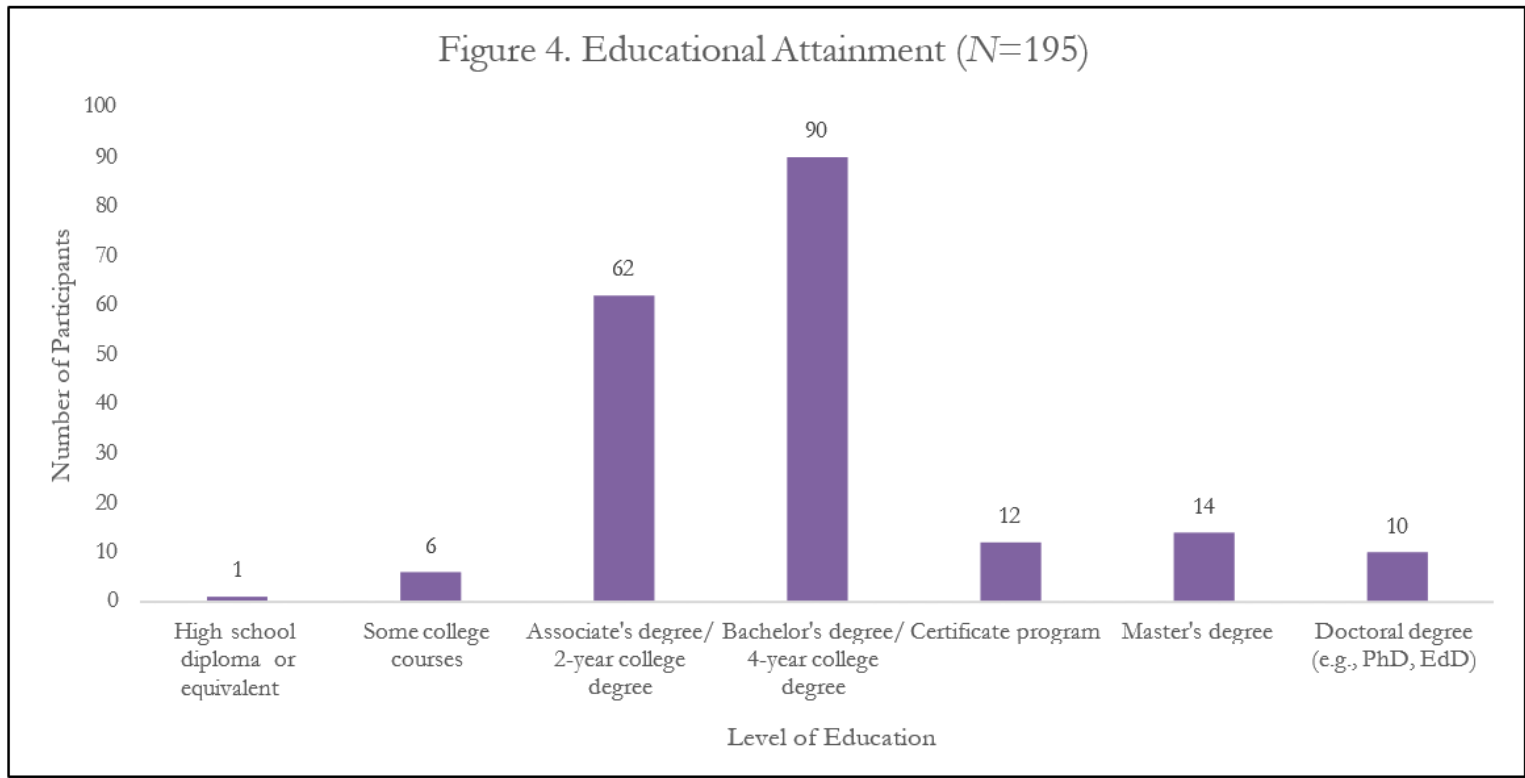


Figure 10: AE ultrasound exams performed per month in 2023 survey responses (N=224)
How many Adult Echocardiography ultrasound examinations do you perform monthly?

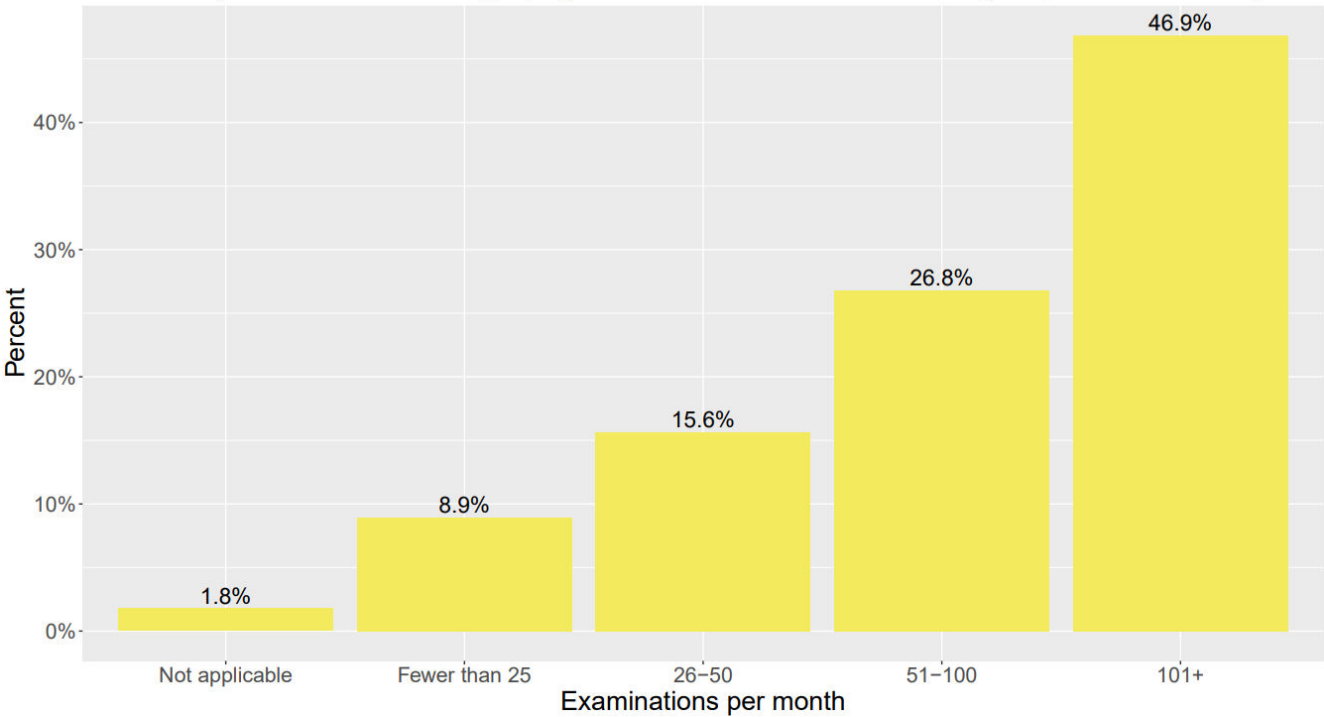


Figure 11: AE ultrasound exams performed per month in 2018 survey responses

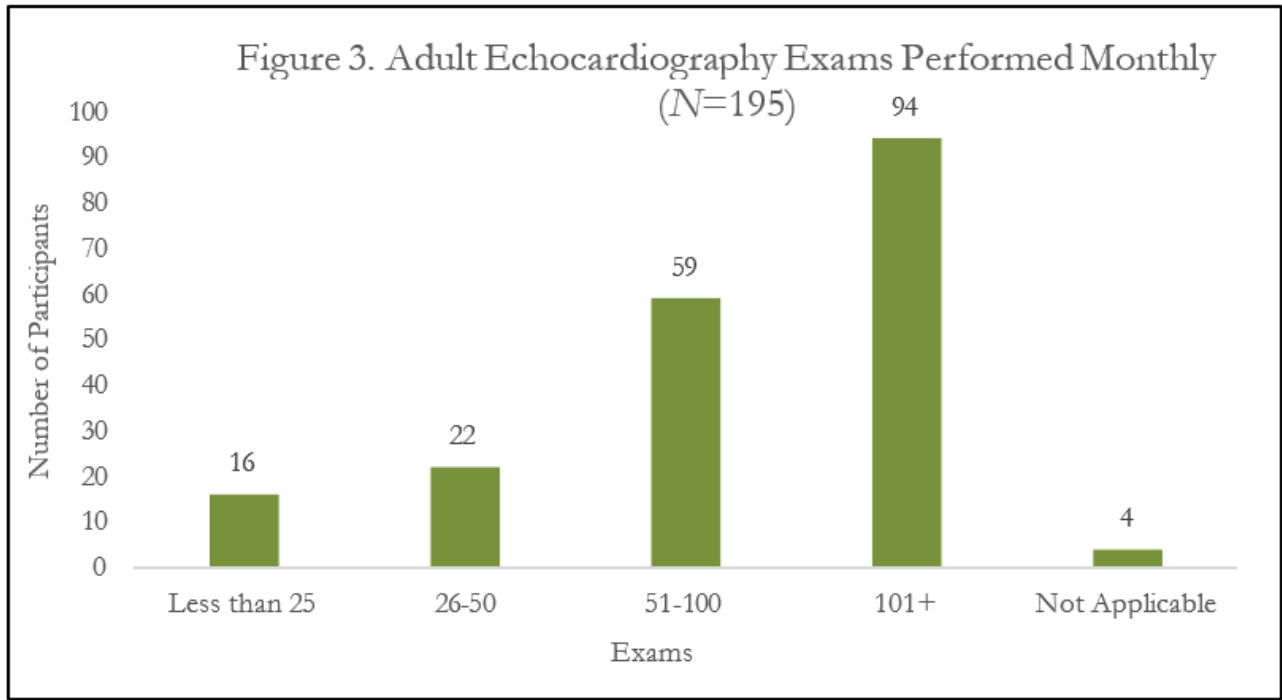


Figure 12: Work setting of the 2023 survey respondents (N=224)

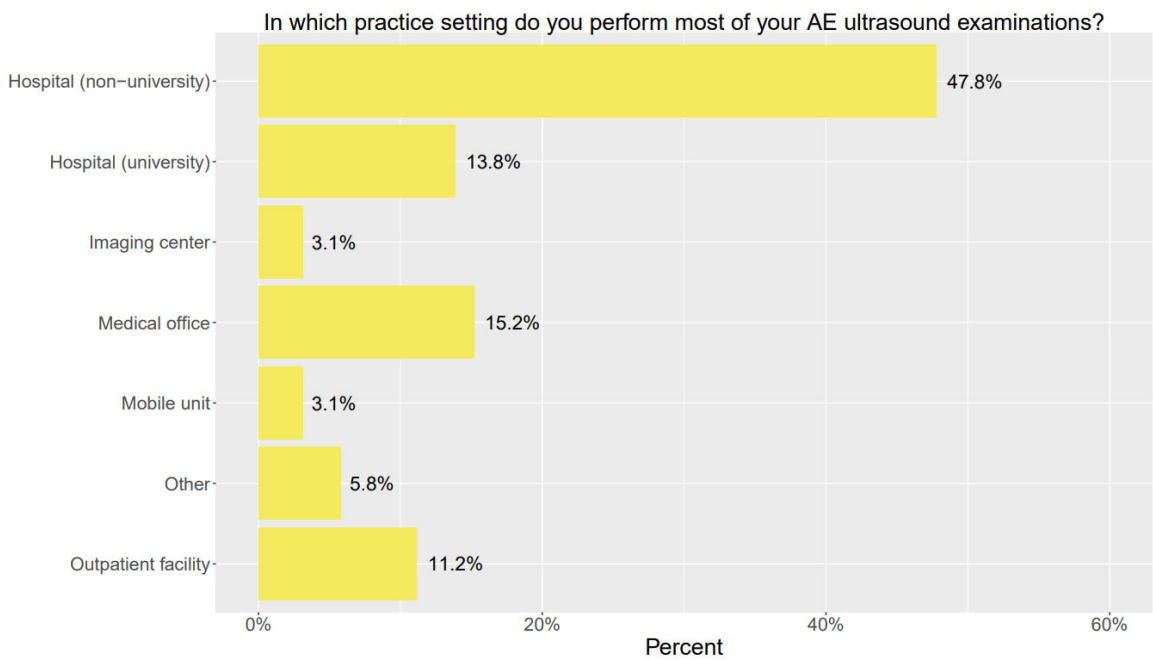


Figure 13: Work setting of the 2018 survey respondents

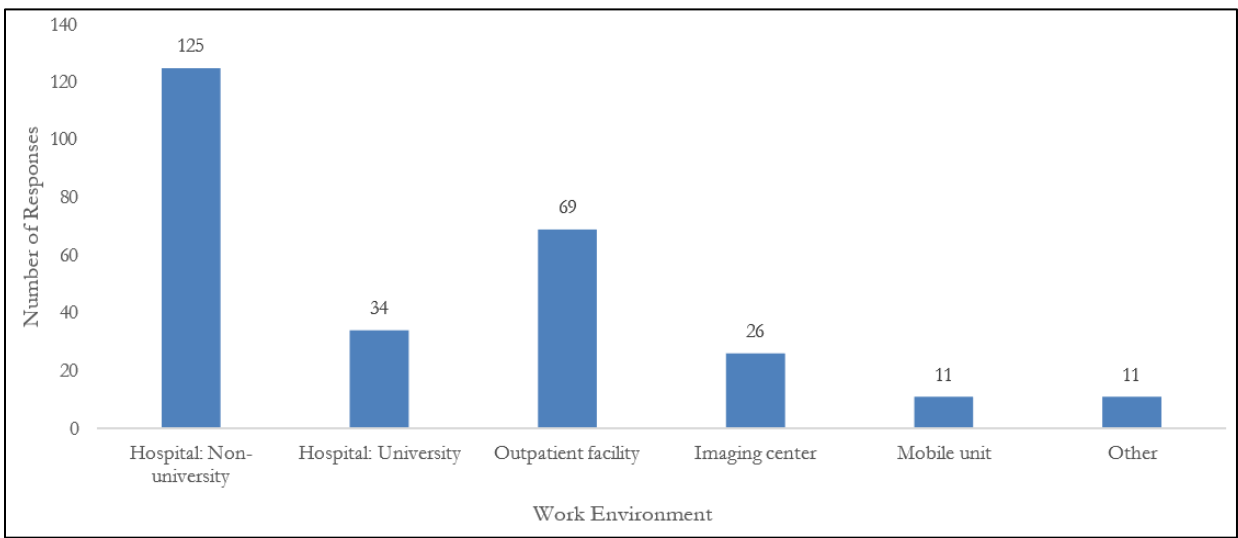


Figure 14: Years of experience in AE of the 2023 survey respondents (N=224)

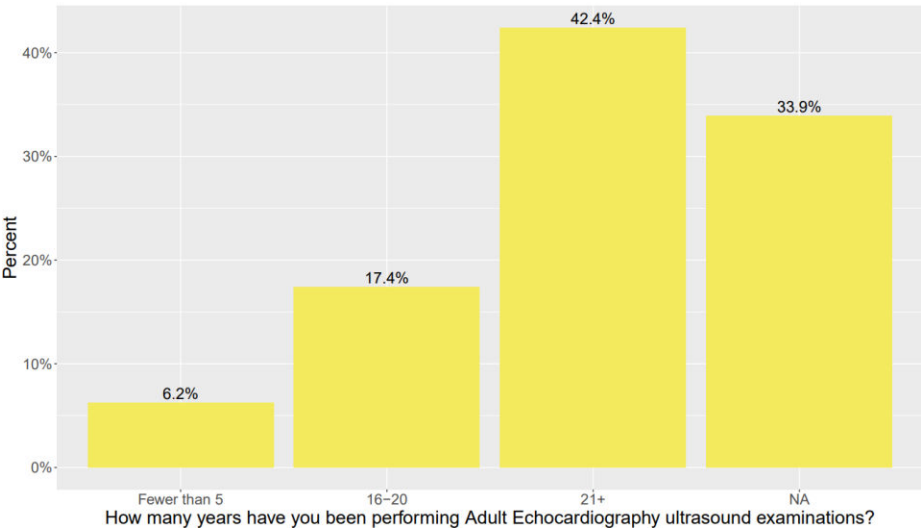


Figure 15: Years of experience in AE of the 2018 survey respondents (N=195)

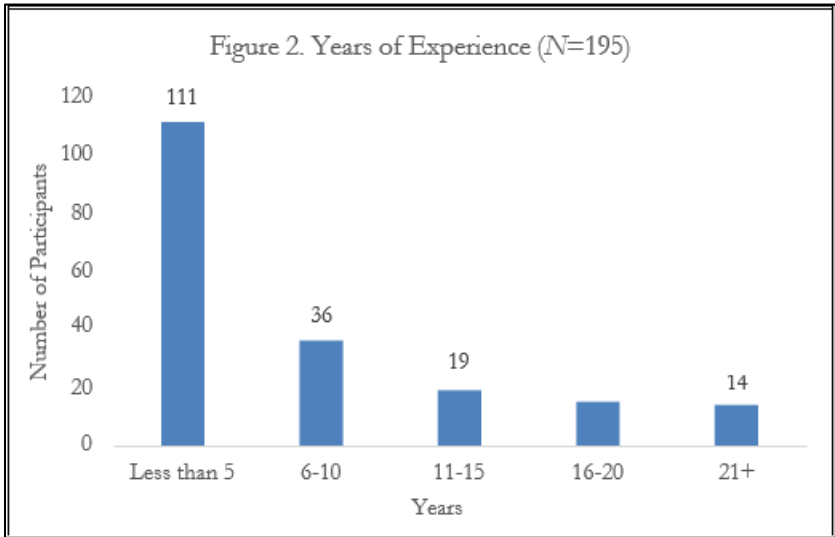


Figure 16: 2023 Survey response for who administers agitated saline contrast (N=224)

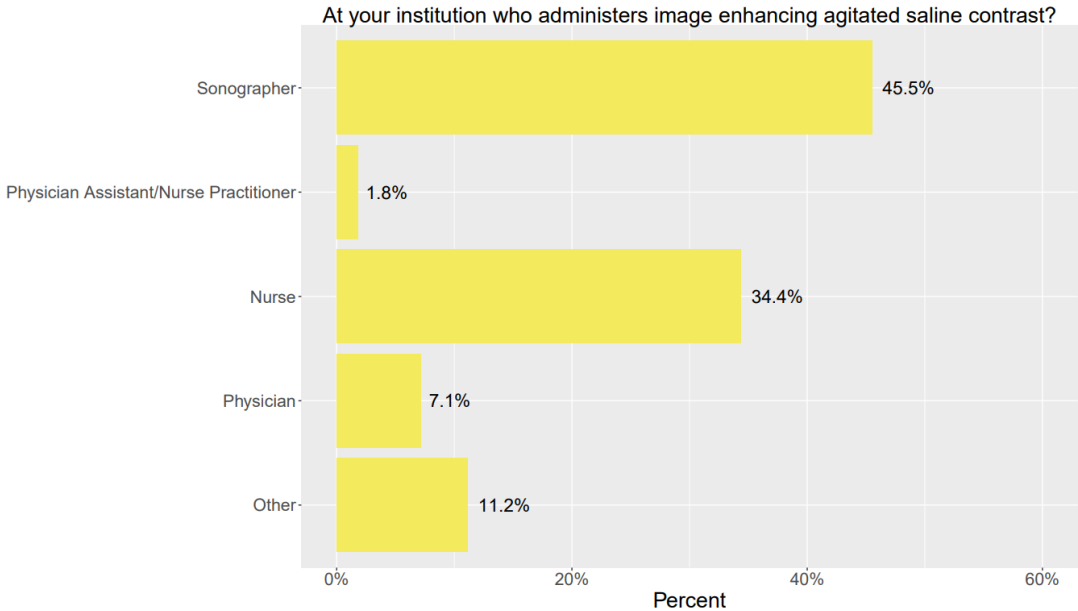


Figure 17: 2018 Survey response for who administers agitated saline contrast

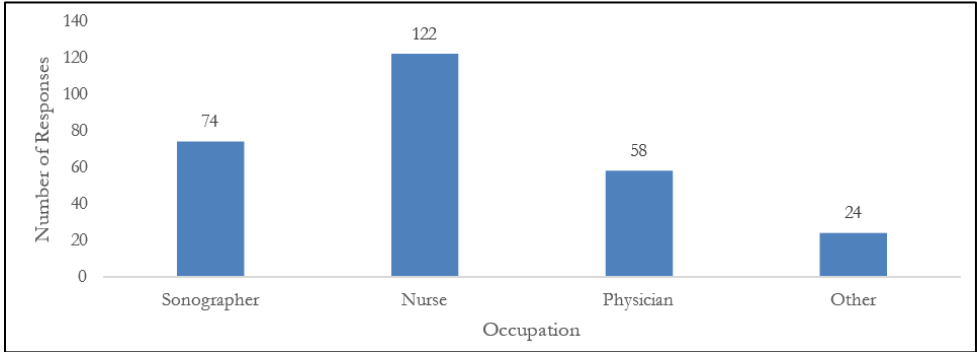


Figure 18: 2023 survey response for who administers echo contrast agents (N=224)

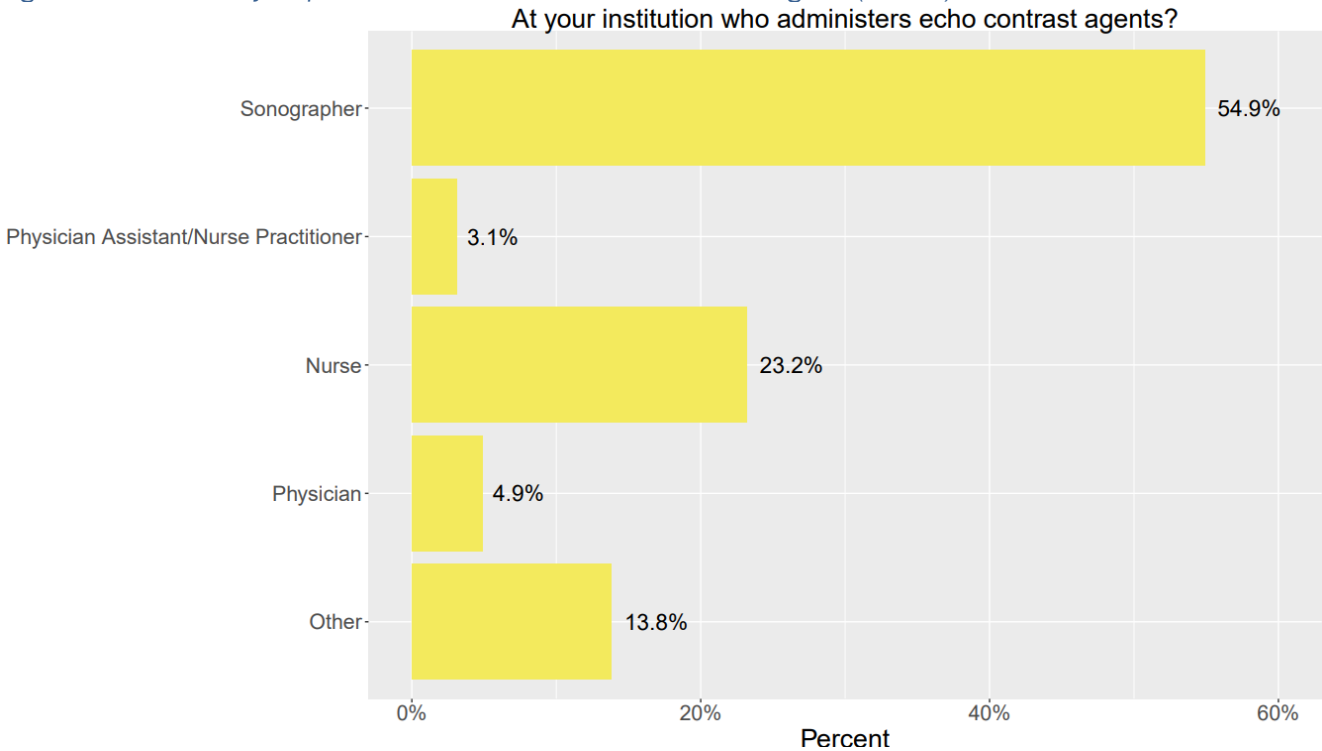


Figure 19: 2018 survey response for who administers echo contrast agents

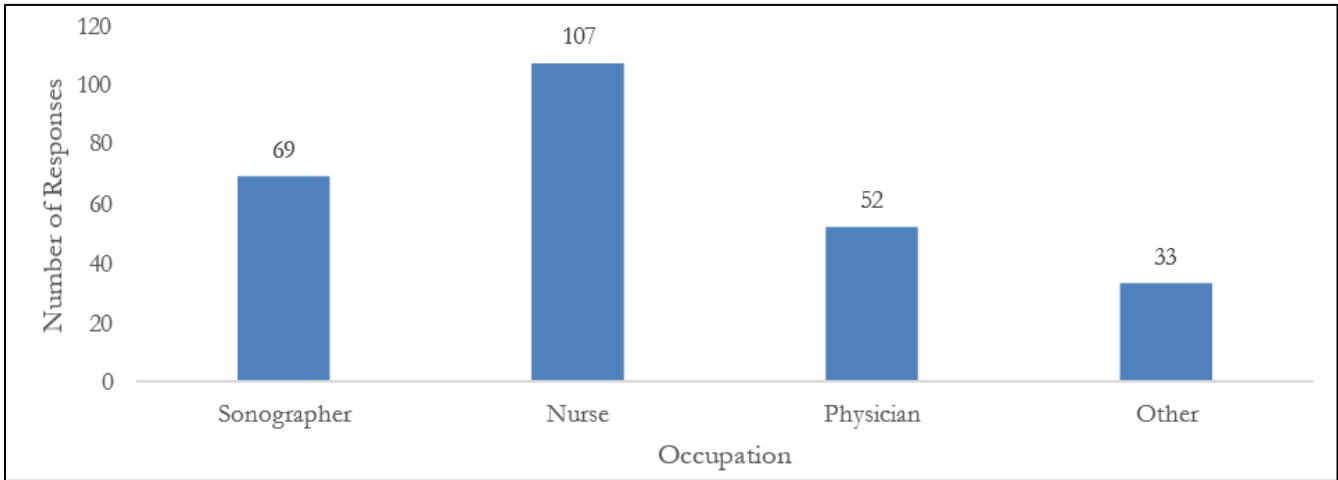


Figure 20: 2023 survey response for who establishes intravenous lines (N=224)

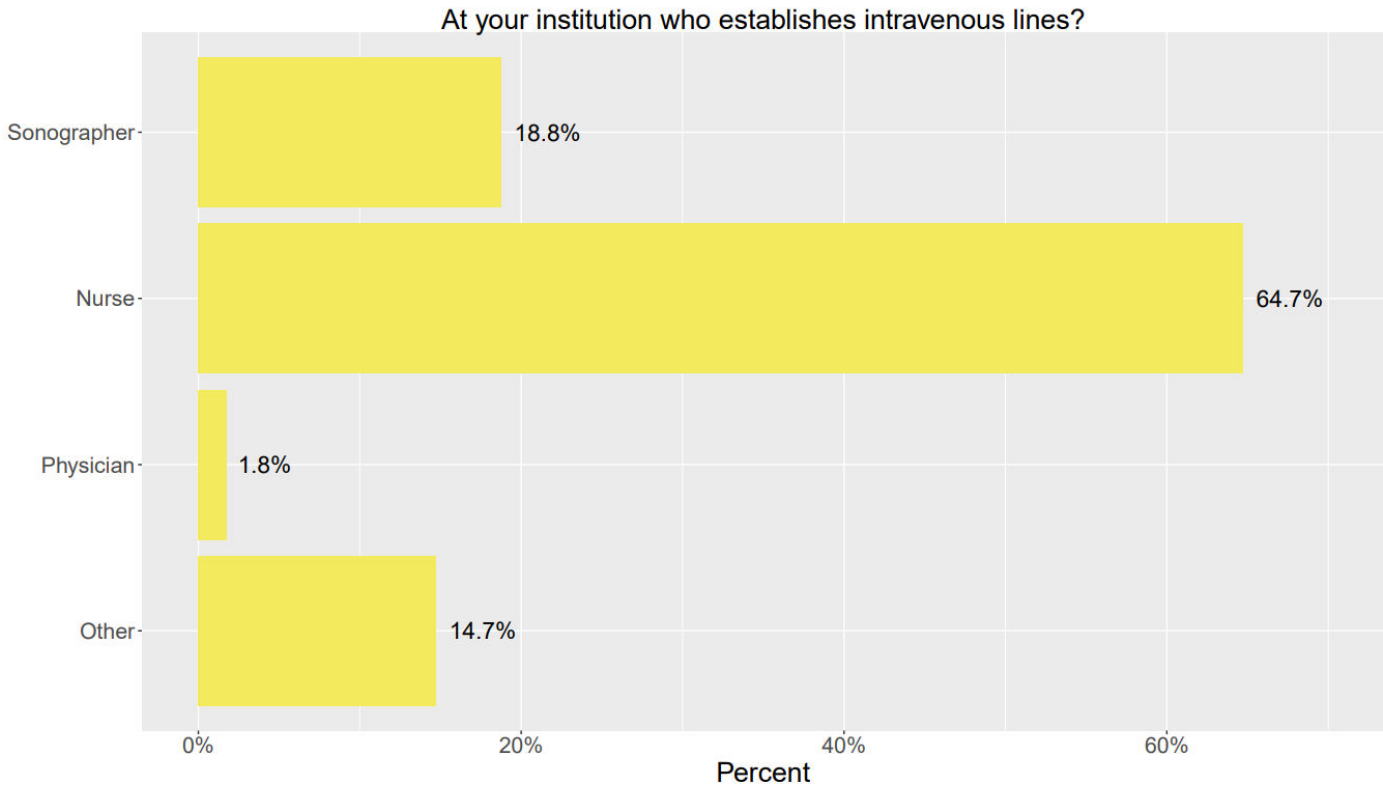
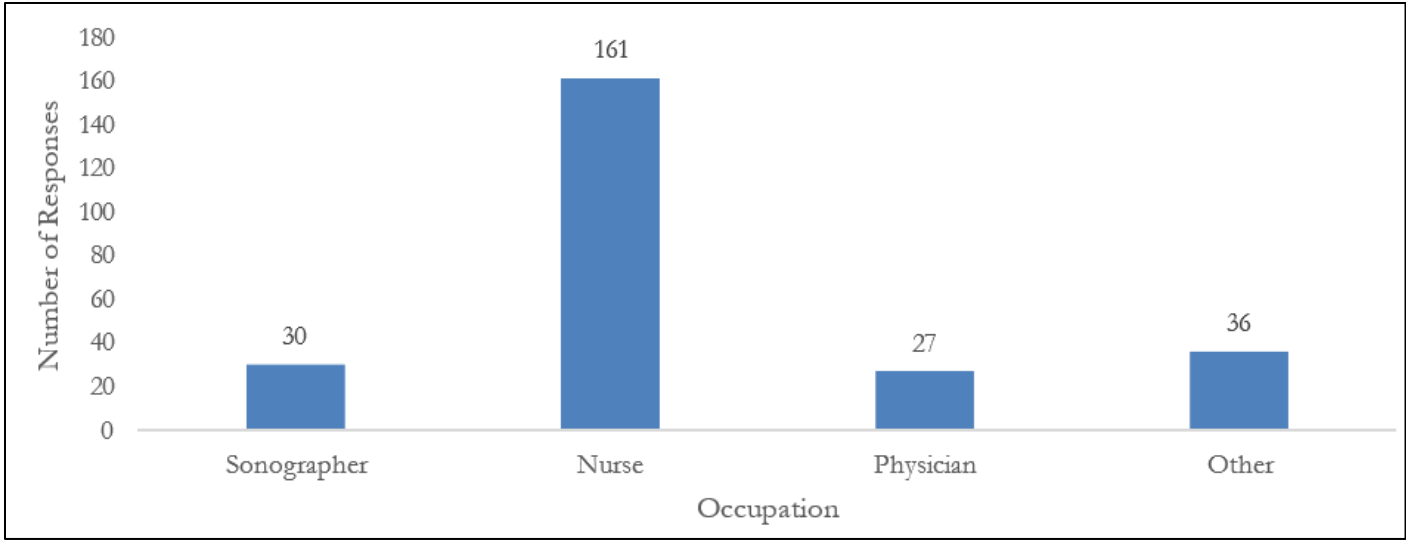


Figure 21: 2018 survey response for who establishes intravenous lines



Appendix G: Final Task and Domain Weighting Agenda

On the call, we will:

- Review demographic information from survey
- Review the panel's responses to the results of the survey and ask you to make final recommendations on the tasks and weightings for the content outline.

The meeting will be:

Thursday, February 1 at 8pm Eastern

What to do before the meeting:

- Review the two tabs of the attached spreadsheet:
 - Tasks to Review: This tab lists all the tasks that were on the practice analysis survey.
 - Yellow highlighted tasks: There are six tasks that are highlighted in yellow. These came back lower in importance than the other tasks. Consider if they are worth keeping on the outline. Feel free to use the Comments column to write your thoughts out. We will discuss on the call.
 - All tasks: Please review all the tasks one more time. We don't like to edit tasks too much after the survey, but if you see anything that needs to be edited, please also make a note and we will discuss on the call.
 - Domain Weighting to Review: This tab shows the new domain weightings derived from analysis of the survey. We have also included the old domain weightings for your reference. These might change slightly if we remove tasks based on our conversation during the call.

Appendix H: Final Content Outline and KSAs

Adult Echocardiography Examination Content Outline (Outline Summary)

#	Domain	Subdomain	Percentage
1	Anatomy and Physiology	• Normal Anatomy • Normal Physiology	15%
2	Pathology	• Abnormal Physiology and Perfusion • Postoperative Evaluation	40%
3	Clinical Care and Safety	• Clinical Care • Safety	11%
4	Measurement Techniques, Maneuvers, and Sonographic Views	• Measurement Techniques • Maneuvers • Sonographic Imaging Views	25%
5	Instrumentation, Optimization, and Contrast	• Instrumentation and Optimization • Contrast	9%

(Detailed Outline)

1	Anatomy and Physiology 15%
1.A	Normal anatomy
1.A.1	Assess great vessels (aorta, pulmonary arteries, etc.)
1.A.2	Assess cardiac anatomy and normal variants (e.g., chambers, false tendon, eustachian valve, Chiari network, etc.)
1.A.3	Assess pericardium
1.A.4	Assess valve structure
1.A.5	Assess vessels of arterial and venous return (e.g., venae cavae, hepatic veins, coronary sinus, pulmonary veins, etc.)
1.A.6	Assess wall segments (structure, nomenclature, etc.)
1.B	Normal physiology
1.B.1	Assess normal response to stress testing (e.g., blood pressure, wall augmentation, pharmacologic reaction, exercise type, etc.)
1.B.2	Assess normal systolic and diastolic function and left ventricular strain patterns
1.B.3	Assess normal valve function (e.g., gradient, pressure half-time, acceleration time, trivial regurgitation, etc.)
1.B.4	Identify phases of the cardiac cycle
2	Pathology 40%
2.A	Abnormal physiology and perfusion

2.A.1	Assess aortic and sinus of Valsalva abnormalities (e.g., aneurysm, dissection, prior repair, intramural hematoma, etc.)
2.A.2	Assess arrhythmias and conduction disturbances (e.g., electrocardiography [EKG] changes, flutter, fibrillation, ventricular tachycardia, etc.)
2.A.3	Assess cardiac masses (e.g., thrombi, tumors, etc.)
2.A.4	Assess abnormal diastolic function (e.g., grades, associated abnormalities, hemodynamics, etc.)
2.A.5	Assess endocarditis (e.g., complications, vegetations, associated findings, etc.)
2.A.6	Assess ischemic cardiac diseases (e.g., mechanical complications of myocardial infarction, etc.)
2.A.7	Assess abnormal left ventricle (e.g., true aneurysms, pseudoaneurysms, left ventricular hypertrophy, hyperkinesis, etc.)
2.A.8	Assess cardiomyopathies (e.g., dilated, hypertrophic, restrictive, etc.)
2.A.9	Assess segmental wall motion abnormalities (e.g., corresponding coronary arteries, abnormal rest and stress, etc.)
2.A.10	Assess abnormal left ventricle using strain (e.g., patterns, values, etc.)
2.A.11	Identify and assess abnormal systolic function
2.A.12	Assess aortic valve pathology (e.g., regurgitation, stenosis, valvular structure, etc.)
2.A.13	Assess mitral valve pathology (e.g., regurgitation, stenosis, valvular structure, etc.)
2.A.14	Assess pulmonic valve pathology (e.g., regurgitation, stenosis, valvular structure, etc.)
2.A.15	Assess tricuspid valve pathology (e.g., regurgitation, stenosis, valvular structure, etc.)
2.A.16	Assess pericardial disease (e.g., effusion, constrictive, restrictive, etc.)
2.A.17	Assess abnormal pulmonary artery (e.g., clot, dilatation, catheter, changes due to pulmonary hypertension, etc.)
2.A.18	Assess abnormal right ventricle (e.g., pulmonary hypertension, pulmonary embolism, etc.)
2.A.19	Assess abnormal arterial and venous return (e.g., venae cavae, hepatic veins, coronary sinus, pulmonary veins, etc.)
2.A.20	Assess abnormal structure and function of atria (e.g., volume, etc.)
2.A.21	Assess septal defects (e.g., patent foramen ovale, atrial and ventricular septal defects, etc.)
2.A.22	Identify and evaluate congenital heart defects (e.g., Ebstein anomaly, patent ductus arteriosus, tetralogy of Fallot, aortic coarctation, endocardial cushion defect, etc.)
2.A.23	Identify and evaluate connective tissue disorders (e.g., Marfan, Ehlers-Danlos, etc.)
2.B	Postoperative evaluation
2.B.1	Assess valve repair or replacement (e.g., normal and abnormal prosthetic valves, surgical or transcatheter valve procedures, etc.)
2.B.2	Identify and evaluate intracardiac devices (e.g., closure devices, assist devices, pacemakers, etc.)
2.B.3	Identify and evaluate post-surgical procedures for congenital heart diseases
3	Clinical Care and Safety 11%
3.A	Clinical care

3.A.1	Evaluate patient history and incorporate outside data (e.g., clinical assessment, physical history, other imaging modalities, etc.)
3.A.2	Prepare and monitor patient (e.g., positioning, EKG signal, blood pressure, fasting state, heart rate, etc.)
3.A.3	Identify and communicate critical findings
3.A.4	Practice universal precautions
3.A.5	Practice proper equipment cleaning and maintenance
3.B	Safety
3.B.1	Identify relative and absolute contraindications for echocardiographic procedures
3.B.2	Identify and manage medical emergencies
4	Measurement Techniques, Maneuvers, and Sonographic Views 25%
4.A	Measurement techniques and Maneuvers
4.A.1	Measure aortic valve (e.g., M-mode, planimetry, Doppler, left ventricular outflow tract measurement, etc.)
4.A.2	Measure mitral valve (e.g., M-mode, planimetry, Doppler, etc.)
4.A.3	Measure pulmonic valve (e.g., 2-D, Doppler, etc.)
4.A.4	Measure tricuspid valve (e.g., 2-D, Doppler, etc.)
4.A.5	Measure parameters of diastolic function
4.A.6	Measure great vessels and veins (e.g., dimensions, Doppler, etc.)
4.A.7	Measure atria (e.g., 2-D, M-mode, Doppler, etc.)
4.A.8	Measure left ventricle (e.g., 2-D, 3-D, M-mode, Doppler, etc.)
4.A.9	Measure pulmonary artery pressure
4.A.10	Measure right ventricle (e.g., 2-D, M-mode, Doppler, etc.)
4.A.11	Measure shunt ratios
4.A.12	Evaluate response to provocative maneuvers (e.g., Valsalva, cough, sniff, squat, etc.)
4.B	Sonographic imaging views
4.B.1	Obtain and optimize apical views
4.B.2	Obtain and optimize parasternal views (right and left)
4.B.3	Obtain and optimize subcostal views
4.B.4	Obtain and optimize suprasternal notch views
4.B.5	Obtain and optimize 2-D and 3-D transesophageal echocardiogram (TEE) images for valve assessment
5	Instrumentation, Optimization, and Contrast 9%
5.A	Instrumentation and optimization

5.A.1	Recognize imaging artifacts (e.g., 2-D, Doppler, etc.)
5.A.2	Utilize non-imaging transducer
5.A.3	Adjust console settings to achieve optimal Doppler recording
5.A.4	Adjust console settings to achieve optimal imaging display, including harmonics
5.A.5	Recognize critical findings and pathology on transesophageal echocardiogram (TEE)
5.B	Contrast
5.B.1	Utilize ultrasound enhancing agents (e.g., saline, contrast, etc.)

Knowledge, Skills, and Abilities:

The following is a list of the foundational knowledge, skills, and abilities required to complete the tasks listed in the content outline.

Ability to recognize and assess normal cardiac anatomy, variances, and function
Ability to recognize and assess abnormal cardiac structure and function
Ability to assess the great vessels and identify abnormalities
Ability to identify and assess normal and abnormal valvular structure and function
Knowledge of distinguishing features of various cardiomyopathies
Knowledge of electrophysiology and components of the cardiac cycle
Ability to recognize normal and abnormal responses to stress testing
Knowledge of characteristics of various congenital heart diseases and associated surgical repairs
Ability to recognize and evaluate postoperative anatomy and intracardiac devices
Ability to safely perform echocardiographic procedures and follow current protocols
Knowledge of how to obtain and evaluate cardiac measurements
Ability to obtain appropriate echocardiographic views
Ability to obtain and recognize transesophageal echocardiogram (TEE) images
Ability to manipulate ultrasound system settings and transducers to obtain diagnostic information
Ability to recognize critical findings and communicate findings to the physician
Knowledge of indications, contraindications, and proper use of ultrasound enhancing agents