



Cardiovascular Magnetic Resonance (CMR) 2017-18 Job Task Analysis Summary Report

Inteleos Psychometrics Services
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Alliance for Physician Certification & Advancement (APCA)
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ACKNOWLEDGEMENTS

This study was completed through the work of many individuals at Inteleos, who worked together to construct the survey, administer the survey, and analyze the response data. Subject matter experts also volunteered many hours to draft and review materials before and after the survey was administered. Thanks is also due to the 393 members of the Society for Cardiovascular Magnetic Resonance (SCMR) and the American College of Nuclear Medicine (ACNM) from around the United States and other countries who took the time and interest to participate in the job task survey.

EXECUTIVE SUMMARY

The Alliance for Physician Certification & Advancement™ (APCA™) recognizes physicians' enduring commitment to the highest quality patient care through rigorous assessments and continual learning. APCA is responsible for the preparation of valid and reliable certification examinations in the field of medical imaging. Conducting job task analyses (JTAs) at the national and international levels facilitates APCA in evaluating the current practice expectations and performance requirements of a given specialty, in this instance, cardiovascular magnetic resonance (CMR). This JTA process was conducted on behalf of the Certification Board of Cardiovascular Magnetic Resonance (CBCMR) in support of its initial examination development.

The CMR JTA was designed to collect information on the practice of CMR imaging performed by physicians. The results were analyzed by Intelios staff and discussed by the JTA Working Group. Members of the JTA Working Group felt that four additional tasks were needed. A second “mini-survey” (i.e., Study 2) was developed, distributed and analyzed. The results from the second survey were discussed in context of both surveys by the JTA Working Group. These discussions and resulting decisions created the test content outline that will guide content distribution within the CBCMR Examination. The final content outline was approved by the JTA Working Group on May 2, 2018 via an electronic vote.

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 OF STUDY

The Alliance for Physician Certification & Advancement (APCA) recognizes that diagnostic medical imaging is a valuable tool in the healthcare industry. Successful mastery and demonstration of the knowledge and skills required to hold an APCA certification such as CBCMR will provide practitioners with an additional source of validation. This will support the veracity of the CMR studies that these practitioners perform.

METHODOLOGY

Study 1

Job Task Analysis Working Group

A JTA Working Group consisting of ten subject matter experts (SMEs) led this project. Additional information regarding the SMEs can be found in Appendix A.

Survey Questionnaire Development

In June 2017, APCA contracted with *The Caviart Group*, a certification and testing consulting group, to facilitate a kick-off meeting. During this meeting, the CBCMR JTA Working Group developed the task list and demographic items to include on the survey. The JTA Working Group reached consensus on a list of 85 tasks to be used in the survey. These tasks were divided into seven domains: (1) Examination Preparation; (2) Examination Performance; (3) Patient Protocols; (4) Study Interpretation; (5) Post-processing; (6) Findings Communication and Documentation; and (7) Perform New Tasks. All task statements and response options were relevant to physicians currently practicing CMR.

The task questions on the survey were validated by ten physician volunteers. Nine additional physician volunteers piloted the functionality of the survey. See Appendix A for the volunteer members of the JTA Working Group, Validation Panel, and Pilot Group.

Survey Process

Survey Administration Procedure

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 respondents (see Appendix B).

APCA sent the JTA survey (see Appendix C) to 994 physicians who are current members of the Society for Cardiovascular Magnetic Resonance or the American College of Nuclear Medicine. The survey was made available to the participants for two weeks between September 20th and October 3rd, 2017. All responses made by the participants were kept confidential.

After the data were analyzed, a call was held on November 1, 2017 with the JTA Working Group to discuss to results. After deliberation, which included item classification, the

JTA Working Group decided that additional tasks were needed. This led to the development and implementation of Study 2.

Study 2

Survey Questionnaire Development

Based on the results of from Study 1 and concerns from SMEs, four new tasks were written, and a second survey was launched, the “mini-survey”. The mini-survey contained only the four new tasks, which were: 1) Understand MR physics, 2) Understand physics and principles underlying pulse sequences, 3) Understand MR scanner hardware/instrumentation, and 4) Understand pulse sequences. Like Study 1, the four tasks were assigned to a domain, “Perform CMR Exams”.

Survey Process

In an effort to increase the response rate, the mini-survey was only distributed to the 294 participants who responded to at least part of the survey in Study 1. The mini-survey was made available to participants as a web-based survey through the survey platform Qualtrics®. An invitation to participate in the mini-survey was sent via email to the prospective respondents. The survey was made available to the participants between March 8th and March 20th, 2018. All responses were kept confidential.

Method of Data Analysis

Respondents were asked the following questions for each task on both surveys: 1) How frequently would you expect a physician newly certified in CMR to perform the 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 hierarchical method in which values on the importance scale outweigh or outrank all values on the frequency scale, with the exception of ‘Never’ (see Appendix E). Higher criticality values indicate

the most critical tasks for a physician newly certified in CMR. These criticality values were averaged for each task, rank ordered, and reviewed by the JTA Working Group. 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 (i.e., the domain weightings).

RESULTS

Response Rates

Study 1

A total of 393 (40% of those sampled) individuals responded to the survey. Of these, 322 (82% of respondents) reported that they currently perform CMR. 294 of the 322 participants responded to at least part of the task section of the survey. Of these 294 participants, 236 completed the demographics portion of the JTA survey.

Study 2

The mini-survey was sent to the 294 participants who responded to at least part of the task section of Study 1. 100 responded to the mini-survey for a response rate of 34%. Because Study 2 was a sample of Study 1 participants, the reported demographic information for Study 2 is less detailed than Study 1. Four demographic variables (i.e., gender, location, tenure, and practice setting) are presented in Appendix D and demonstrate that the mini-survey sample was proportionate to the Study 1 respondent population.

Demographic Results

Gender

Approximately 71% of the respondents were male and 27% were female (Figure 1). The remaining 2% of respondents selected “Other” or declined to respond.

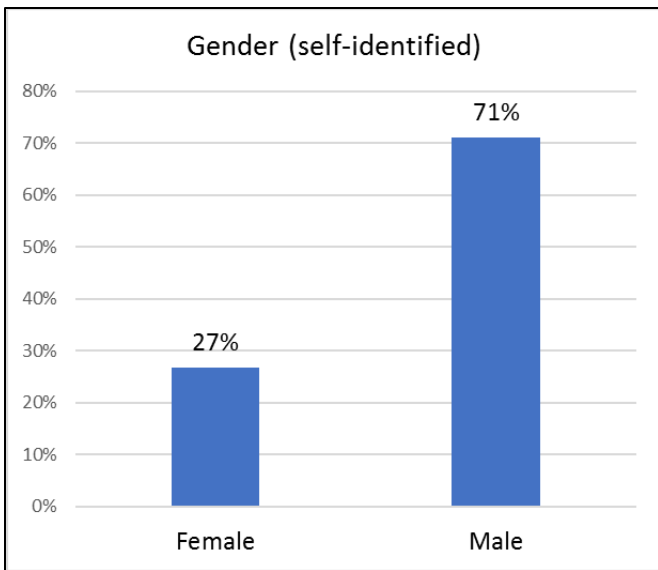


Figure 1

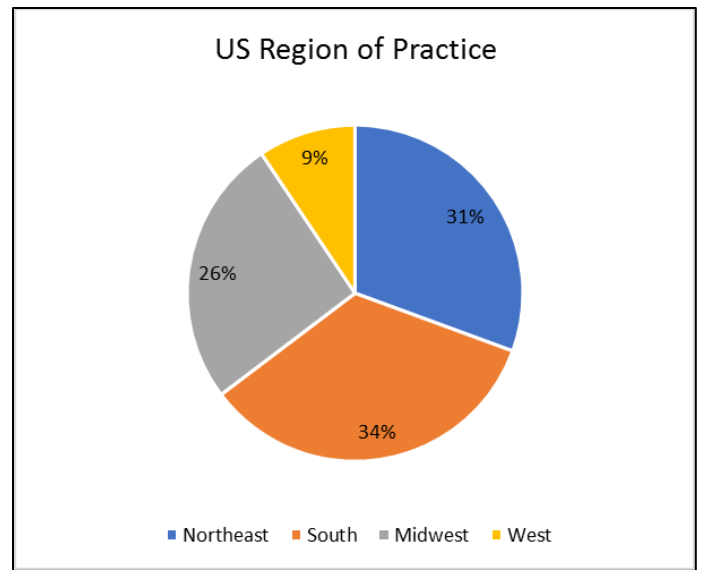


Figure 3

Location/Region of Practice

Of the respondents who reported the country in which they practice, 37% reported practicing in the United States and 12% in the United Kingdom, followed by Germany, Italy, and Japan. The remainder (37%), practiced in 36 other countries from every region of the world (Figure 2). Among US residents, over a third (34%) practiced in the southern region of the United States, the most populous region (as defined by the US Census Bureau) (Figure 3).

Work Experience

Approximately 67% of respondents had obtained enough training to direct their own lab, meaning they had achieved COCATS¹ Level III and had at least 12 months of training (Figure 4). Approximately 43% of respondents were practicing physicians for 11 to 20 years (Figure 5). However, 49% of respondents (about half) had been practicing CMR for less than 6 years post-training (Figure 6).

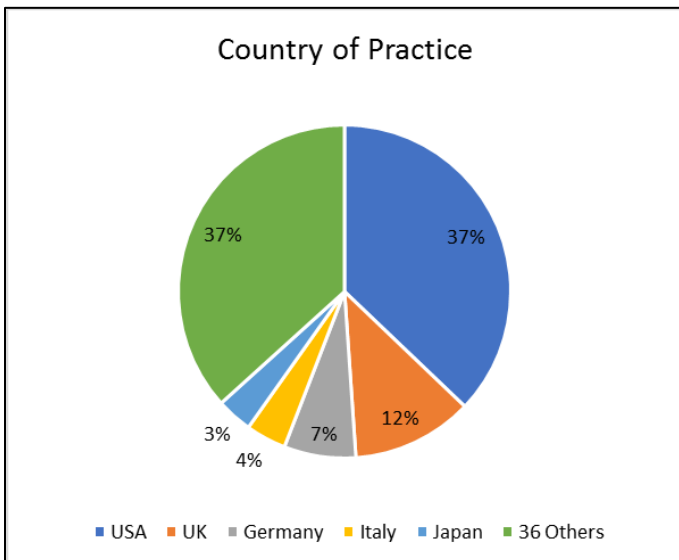


Figure 2

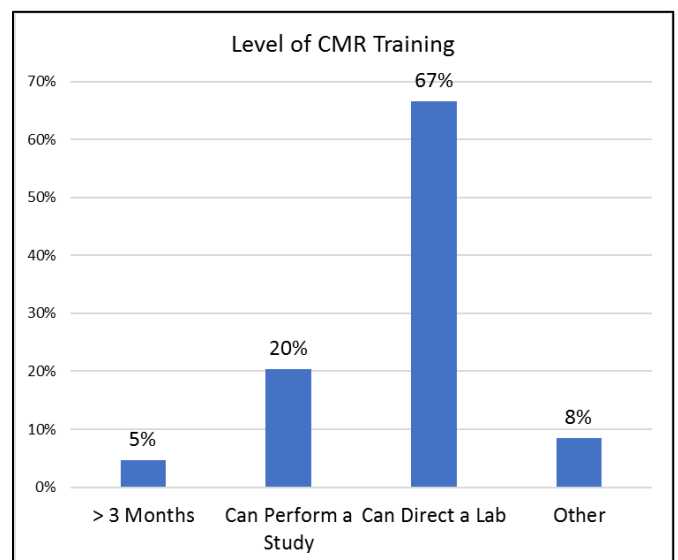


Figure 4

¹ American College of Cardiology (ACC) Core Cardiovascular Training Statement

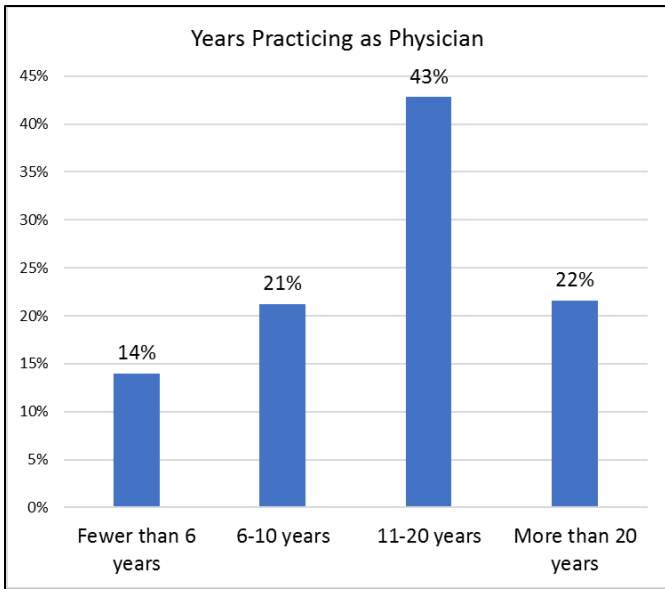


Figure 5

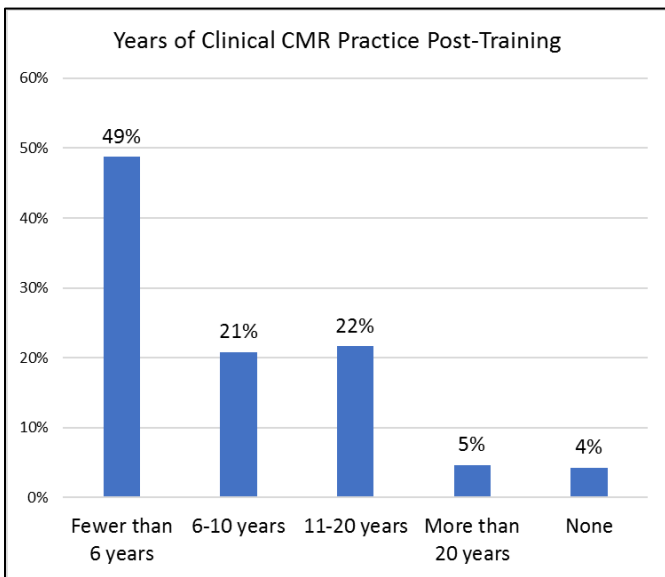


Figure 6

Work Environment

The respondents were asked to indicate the type of environment in which they perform most of their MR exams. The most common response (61%) was an academic or university setting (Figure 7). Other settings, such as Community based teaching /non-teaching, and government positions were much less common.

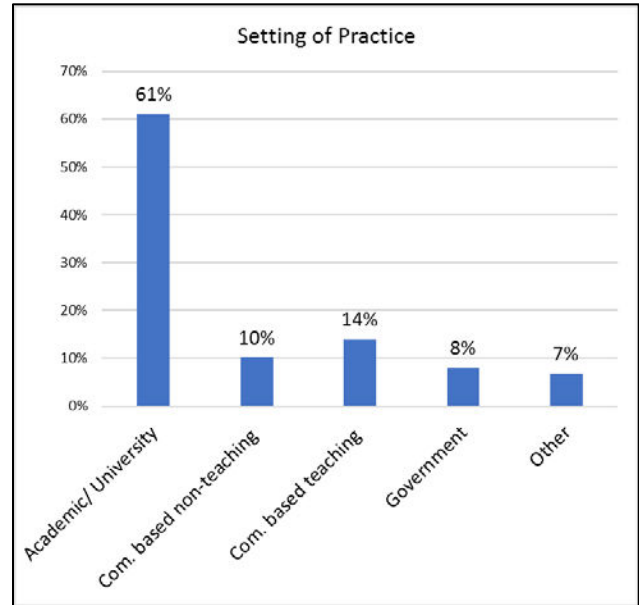


Figure 7

Respondents were asked what accreditations their laboratory held, and the most common response was 'None' at 46%, followed by 'ACR'² at 27% (Figure 8). They were also asked how many physicians were in their lab. Most respondents (39%) had 2 to 3 physicians in their lab (Figure 9).

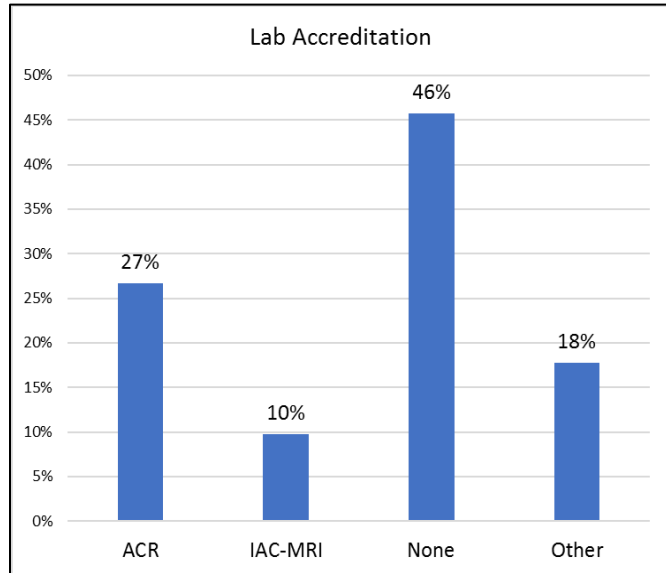


Figure 8

Respondents gave a variety of responses when asked how many CMR studies their lab performed annually, but the most common response was over one thousand studies performed annually by the lab (Figure 10). Individually, most respondents perform over 150 studies annually, with 32% performing between 150 and 300 annually CMR studies annually (Figure 11).

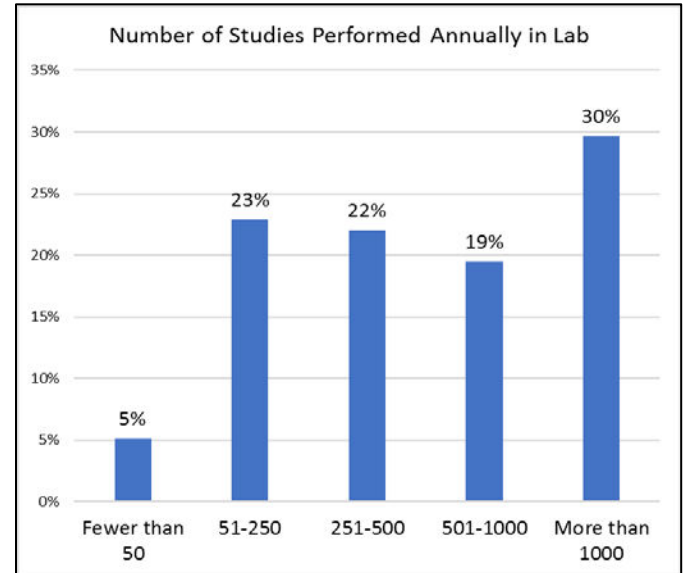


Figure 10

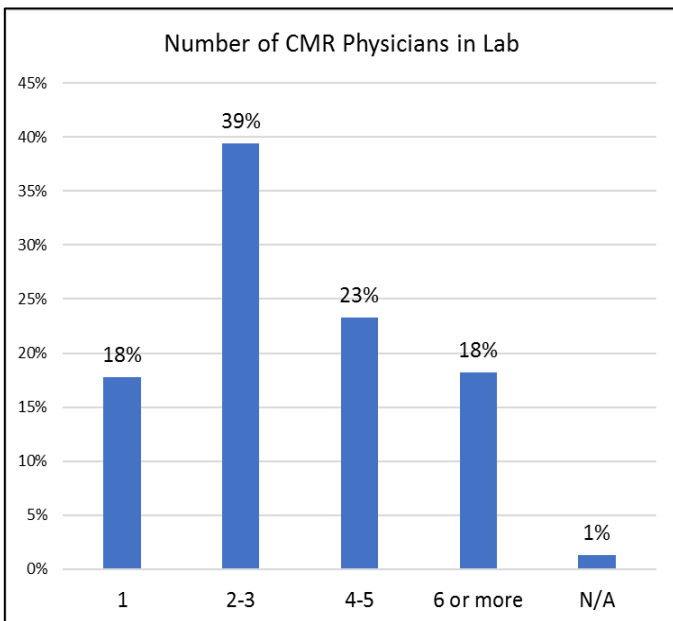


Figure 9

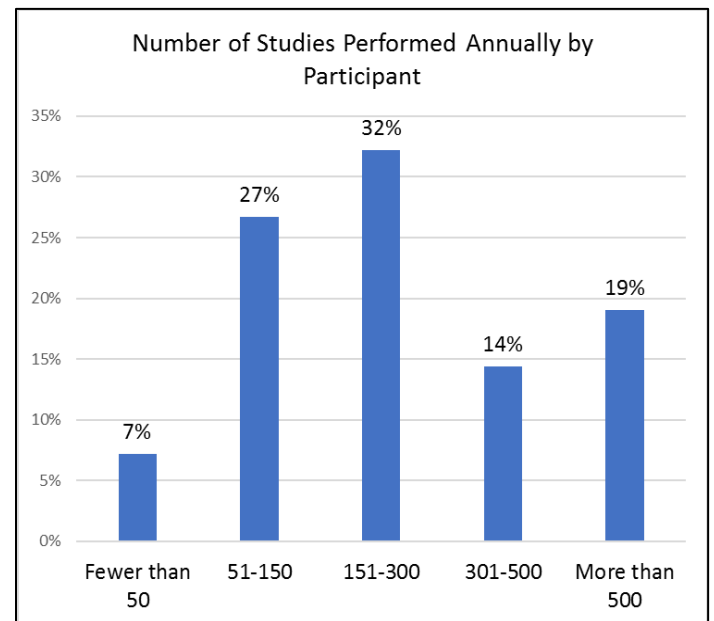


Figure 11

² American College of Radiology

Specialties and Certification

Respondents were asked to select all specialties within CMR they were trained in. The majority of respondents were trained in a single specialty, and about a quarter (27%) were trained in two specialties (Figure 12).

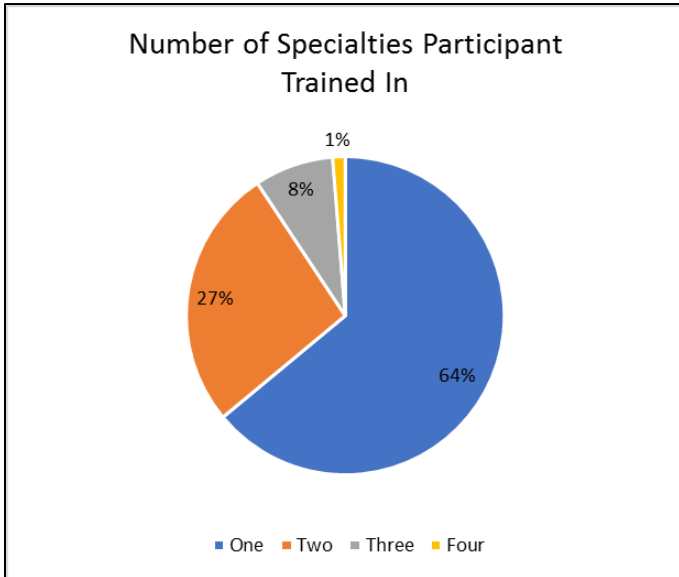


Figure 12

The most common specialty was cardiology, with 175 respondents selecting it as one of, or their only, specialty (Figure 13).

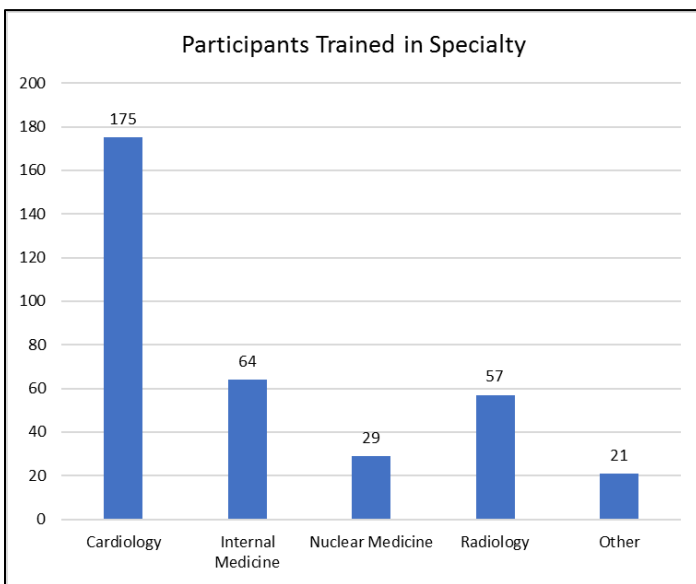


Figure 13

Respondents were also asked which Board Certifications they held. 42% held only one certification. A similar portion (31%) held two Board Certifications (Figure 14).

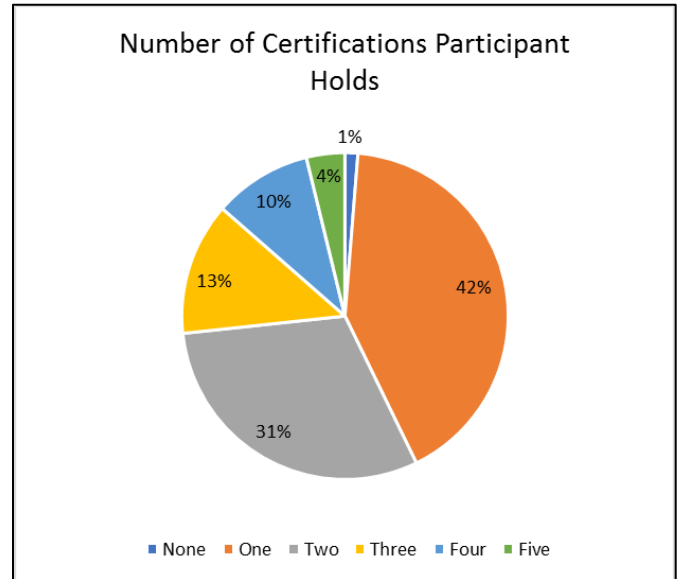


Figure 14

The most common Board Certification held was Cardiology, with 159 respondents selecting it as one of, or their only, Board Certification (Figure 15).

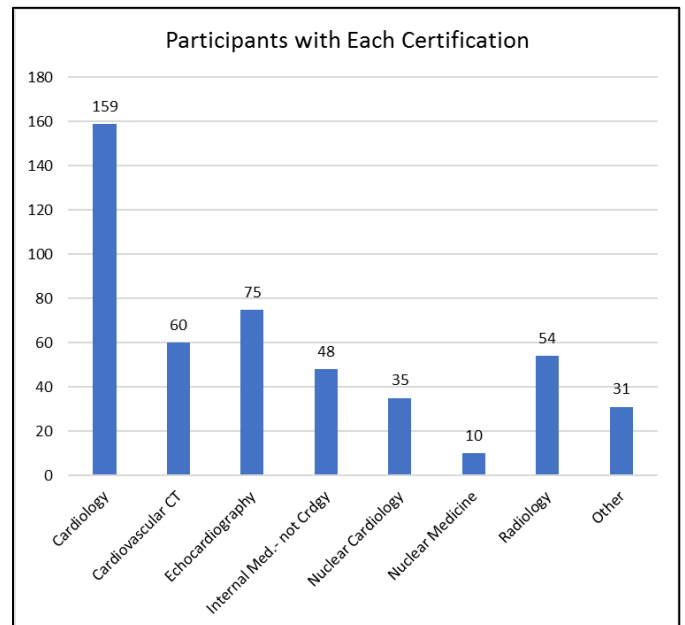


Figure 15

Other

The overall average percentage of studies performed at 3T was 27%. A little over a quarter (27%) of respondents reported not performing any studies at 3T, and about half (51%) of all respondents reported performing 10% or less of their studies at 3T. However, 18% of respondents reported performing more than half of their studies at 3T, with half of those respondents performing all of their studies at 3T (Figure 17).

Respondents were asked to break down their time by specific duties or tasks, detailing what portion of time (as a percent) was spent at each task. Each task was analyzed by the mean portion of time spent on that task among all respondents, including those who never did that task (red line/Mean), and by the mean portion of time spent on that task only among only respondents who performed that task (blue line/Adjusted Mean). Of the 16 tasks, the task that all respondents performed and had the most time spent on it among all respondents was Cardiac MR, with a reported Mean and Adjusted Mean time portion of 27%. The task General/Diagnostic Radiology (6% Mean, 32% Adjusted Mean) took up the large portion of time among respondents who performed that task, but wasn't performed by many respondents.

Additional common tasks were Echocardiography (12% Mean, 22% Adjusted Mean), General Adult Clinical Cardiology (14% Mean, 27% Adjusted Mean), and Research (9% Mean, 15% Adjusted Mean). The least commonly performed task among all respondents was Interventional Radiology (.66% Mean, 25% Adjusted Mean), which 6 respondents reported performing (see Figure 18).

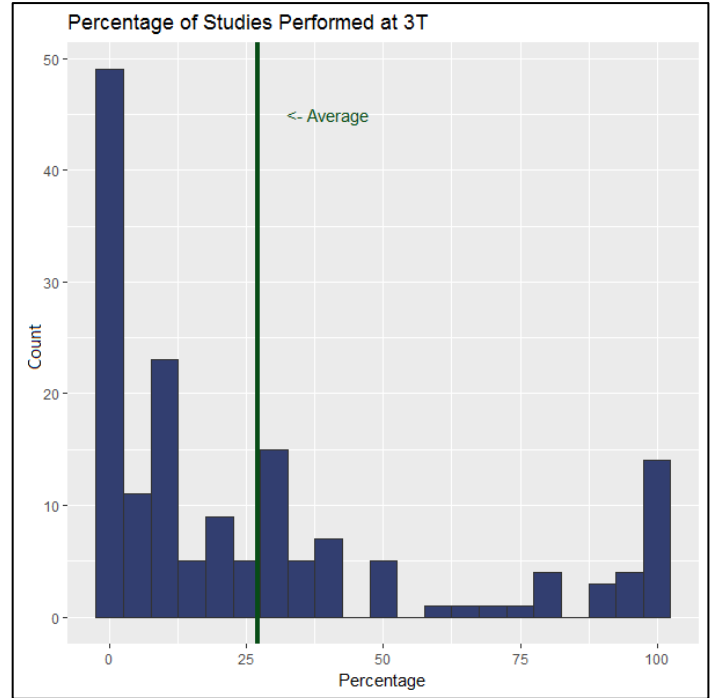


Figure 17

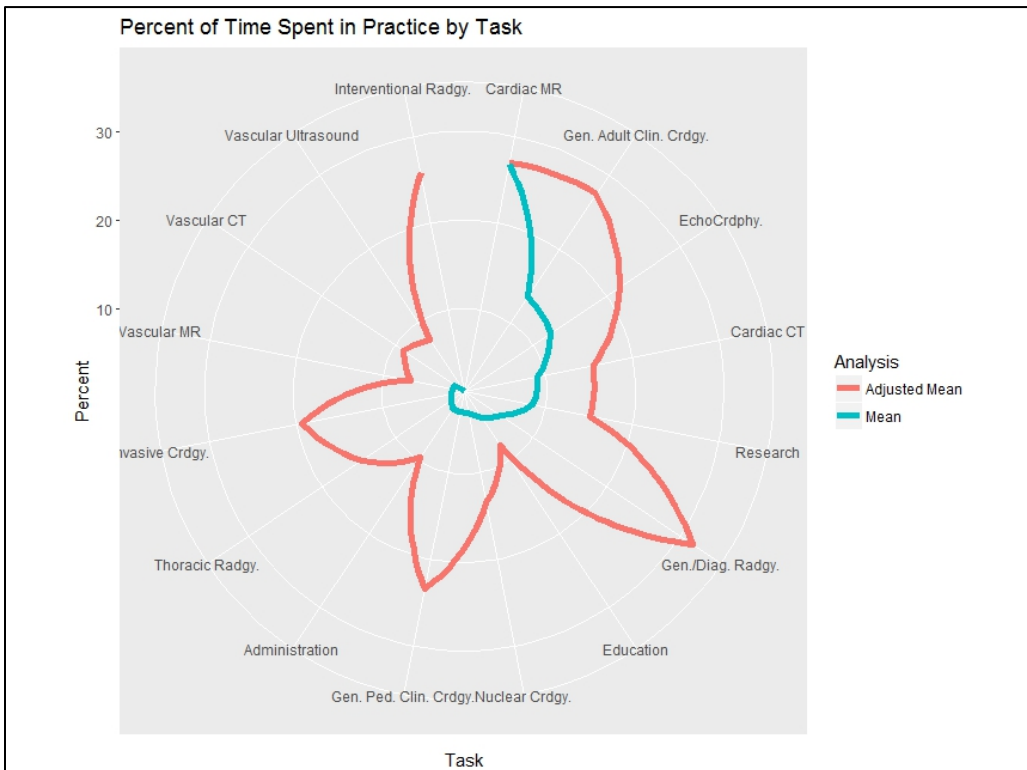


Figure 18

Task and Domain Weighting Results

For both Study 1 and Study 2 the overall criticality, importance, and frequency statistics were presented in rank order of criticality by domain based on the survey data to the JTA Working Group (see Appendix F for Study 1 and Appendix G for Study 2). Each task was re-evaluated for inclusion in the final list based on the JTA Working Group's opinion and criticality scoring from the survey participants. This was done after Study 1 and after Study 2. Appendix H contains earlier iterations of the number of tasks and domain weightings. Table H1 shows this data after the initial survey but prior to any discussion. Table H2 shows data after the initial discussion but prior to Study 2. After many hours of deliberation and discussion, the JTA Working Group combined redundant task and discarded tasks with low criticality ratings and/or other content issues. The number of tasks fell from 85 to 64. The criticality data was used to assign preliminary weightings to each domain. The JTA Working Group was given a small amount of flexibility to adjust the domain percentages from the original weightings. Table 1 contains their final recommendations based on the findings of Study 1 and Study 2. Appendix I contains the final detailed approved content outline. The Working Group also developed the knowledge and skills related to the respective content domains as shown in Appendix I.

Conclusion

Table 1 represents the overall number of tasks, criticality sum, and the resulting content weighting for each domain as recommended by the JTA Working Group. On May 2, 2018, the JTA Working Group unanimously approved the domain weightings and final content outline via an electronic vote. The detailed content outline is in Appendix I. This report was approved by the APCA Council on July 29, 2018. This content outline will be applied to the first administration of the CBCMR examination scheduled for 2019.

APPENDIX I: Final Content Outline

Cardiovascular Magnetic Resonance Examination Content Summary Outline

	Domain	Percentage
1	Prepare for cardiovascular magnetic resonance (CMR) exams	10%
2	Select and perform appropriate protocols for specific clinical scenario	17%
3	Perform CMR exams	18%
4	Interpret CMR exams: normal and abnormal anatomy, function, and physiology	13%
5	Interpret CMR exams: ischemic and nonischemic heart disease	19%
6	Interpret CMR exams: cardiac masses, congenital heart disease, and vascular disease	12%
7	Supervise and/or perform post-processing tasks	11%
Total		100%

Cardiovascular Magnetic Resonance Examination Content Detailed Outline

1. Prepare for cardiovascular magnetic resonance (CMR) exams 10%		Knowledge, skill and/or ability related to preparation for CMR exams
1.A	Review medical history, clinical information, and prior studies; consult with referring providers; and perform or direct pretest patient evaluation and education	Knowledge of clinical indications of CMR studies Knowledge of appropriate use criteria for CMR Knowledge of the advantages/disadvantages of CMR compared to other studies Knowledge of type of information provided by CMR studies Knowledge of other cardiovascular imaging modalities Knowledge of MRI safety and classification system Knowledge of appropriate patient preparation for various CMR studies Knowledge of cardiovascular pathophysiology Knowledge of indications/contraindications for contrast agents Knowledge of indications/contraindications for stress testing Knowledge of indications/contraindications for pharmacologic agents Knowledge of MR conditional devices Knowledge of the process for adjusting pulse sequences to image patients with MR conditional devices Ability to recognize need to adjust the programming of an MR conditional device Ability to integrate the most pertinent information from medical history to appropriately select, perform, and interpret CMR study Ability to evaluate the appropriateness of the ordered study Skill in identifying contraindications and recognizing potential risk
1.B	Evaluate clinical indications considering appropriate use criteria	
1.C	Screen for contraindications for magnetic resonance imaging (MRI), contrast, stress testing, pharmacologic agents, etc.	
1.D	Select an appropriate protocol to answer the clinical question	
1.E	Ensure any implanted devices (e.g., implantable cardioverter defibrillator [ICD], pacemakers) are in magnetic resonance (MR) conditional modes	
2. Select and perform appropriate protocols for specific clinical scenarios 17%		Knowledge, skill and/or ability related to appropriate protocols for specific clinical scenarios
2.A	Select and perform appropriate protocol for examinations for morphology and function	Knowledge of which techniques/protocol elements (e.g., pulse sequence, views) best address the clinical question Knowledge of MRI physics and instrumentation Ability to optimize techniques and protocol elements to the specific patient Ability to assess a variety of cardiovascular diseases using CMR
2.B	Select and perform appropriate protocol for examinations for viability and cardiomyopathy	
2.C	Select and perform appropriate protocol for stress examinations	
2.D	Select and perform appropriate protocol for tissue characterization (e.g., T1, T2, T2*) examinations	
2.E	Select and perform appropriate protocol for valvular examinations	
2.F	Select and perform appropriate protocol for examinations of the pericardium	
2.G	Select and perform appropriate protocol to examine masses	
2.H	Select and perform appropriate protocol for examination of implanted devices	
2.I	Select and perform appropriate protocol for examinations for simple congenital defects (e.g., atrial septal defect, ventricular septal defect)	
2.J	Select and perform appropriate protocol for examinations for complex congenital defects	
2.K	Select and perform appropriate protocol for coronary examinations	
2.L	Select and perform appropriate protocol for vascular examinations	
3. Perform CMR exams 18%		Knowledge, skill and/or ability related to performance of CMR exams
3.A	Monitor patient during study	Knowledge of required safety procedures in an emergency Knowledge of pharmacologic agents' mechanisms and the effects of these agents on the patient Knowledge of contrast agents, including how they work and their expected effects on patient and CMR study Ability to safely and effectively administer pharmacologic stress and other agents Ability to safely and effectively administer contrast agents Ability to recognize and manage adverse reaction to contrast or other pharmacologic agents Ability to recognize arrhythmias and determine their effect on image quality Ability to optimize gating Ability to modify protocol to differentiate normal variants from pathology Ability to identify and manage emergency situations Ability to ensure safety of patient and personnel in MR environment Ability to determine when to adapt or terminate study due to significant arrhythmias Ability to apply MR principles to optimize image acquisition Knowledge of MR physics (e.g., basics of spin precession, Larmor equation/frequency, basic MR relaxation properties T1, T2, T2*) Knowledge of physics and principles underlying pulse sequences (e.g. slice selection, frequency encoding, phase encoding, velocity encoding, saturation and inversion pulses, fat-saturation, gating modes, segmented vs. real-time acquisition) Knowledge of MR scanner hardware/instrumentation (e.g., superconducting magnet, magnetic field gradient coils, radiofrequency [RF] coils, implications of field strength on CMR exam) Knowledge of pulse sequences (e.g. gradient echo, spin echo, steady-state free precession, STIR, myocardial tagging, myocardial perfusion, late-gadolinium enhancement, MRA, flow imaging, parametric mapping (T1, T2, T2*), parallel imaging, common artifacts) Knowledge
3.B	Manage gating and recognize arrhythmias	
3.C	Oversee the activities of technologists/medical personnel according to institutional protocols	
3.D	Monitor scan quality and findings, and modify protocol as needed	
3.E	Troubleshoot scanning acquisition problems during study	
3.F	Follow safety guidelines (e.g., MRI safety, emergency situations, SAR)	
3.G	Administer contrast, pharmacologic agents, etc.	
3.H	Manage reactions to contrast, pharmacologic agents, etc.	
3.I	Understand MR physics	
3.J	Understand physics and principles underlying pulse sequences	

3.K	Understand MR scanner hardware/instrumentation	of implications of field strength (e.g., 1.5T or 3T) on CMR exam Knowledge of specific absorption rate (SAR) limits
3.L	Understand pulse sequences	
4.	Interpret CMR exams: normal and abnormal anatomy, function, and physiology 13%	Knowledge, skill and/or ability related to anatomy, function, and physiology interpretation
4.A	Assess significant extracardiac and extravascular findings	Knowledge of the spectrum of normal anatomy and physiology Knowledge of standardized reporting protocols Knowledge of SCMR (Society for Cardiovascular Magnetic Resonance) standardized reporting guidelines Knowledge of relevant CMR pathology-specific diagnostic criteria Knowledge of prognostic significance of CMR findings Knowledge of clinical implications of CMR findings Ability to synthesize prior clinical knowledge of the patient with CMR findings (qualitative and quantitative) to formulate a diagnosis Ability to recognize common normal anatomic and physiologic variants Ability to recognize and communicate findings that require immediate action Ability to identify and communicate critical findings Ability to generate differential diagnosis for CMR findings Ability to distinguish artifact from pathology Ability to diagnose pathology Ability to determine breadth of associated findings and information to be reported for specific diagnosis (e.g., aortic aneurysm and coarctation in bicuspid aortic valve)
4.B	Recognize scan artifacts and distinguish from pathology	
4.C	Recognize normal variants and distinguish from pathology	
4.D	Assess cardiac function	
4.E	Assess cardiac chambers	
4.F	Assess native/artificial valves	
4.G	Assess pericardium	
5.	Interpret CMR exams: ischemic and nonischemic heart disease 19%	Knowledge, skill and/or ability related to ischemic and nonischemic heart disease interpretation
5.A	Assess for ischemia (stress testing)	All knowledge and skills associated with Domain 4, plus the following: Knowledge of imaging features of ischemic heart disease/ischemic cardiomyopathy Knowledge of imaging features of nonischemic cardiomyopathies Ability to distinguish ischemic from nonischemic cardiomyopathy Ability to distinguish between different nonischemic cardiomyopathies
5.B	Assess ischemic cardiomyopathy and viability	
5.C	Assess nonischemic cardiomyopathy	
5.D	Assess dilated cardiomyopathy/noncompaction cardiomyopathy	
5.E	Assess iron-overload cardiomyopathy	
5.F	Assess amyloid cardiomyopathy	
5.G	Assess infiltrative cardiomyopathy	
5.H	Assess cardiac sarcoidosis	
5.I	Assess myocarditis	
5.J	Assess hypertrophic cardiomyopathy	
5.K	Assess arrhythmogenic right ventricular cardiomyopathy (ARVC)	
6.	Interpret CMR exams: cardiac masses, congenital heart disease, and vascular disease 12%	Knowledge, skill and/or ability related to cardiac masses, congenital heart disease, and vascular disease interpretation
6.A	Assess cardiac masses (e.g., tumor, thrombus)	All knowledge and skills associated with Domain 4, plus the following: Knowledge of common cardiac masses Knowledge of common and complex congenital defects Knowledge of thoracic and abdominal vascular anatomy Ability to diagnose common congenital abnormalities Ability to differentiate thrombus from other masses
6.B	Assess for simple congenital defects (e.g., atrial septal defect, ventricular septal defect)	
6.C	Assess for complex congenital defects	
6.D	Assess thoracic aorta	
6.E	Assess abdominal aorta	
6.F	Assess pulmonary artery	
6.G	Assess pulmonary veins	
6.H	Assess coronary anatomy/anomalies	
6.I	Assess vascular anatomy/anomalies	
7	Supervise and/or perform post-processing tasks 11%	
7.A	Supervise and/or perform quantification of morphology, volume, and function	Ability to quantify morphology, volume, and function Ability to quantify velocity and flow Ability to quantify vessel sizes (e.g., aorta, main pulmonary artery, pulmonary veins) Ability to quantify perfusion Ability to perform quantitative tissue characterization (e.g., T1, T2, extracellular volume [ECV]) Ability to quantify iron (e.g., T2*) Ability to perform quantitative LGE Ability to perform three-dimensional post-processing (e.g., MPR, MIP)
7.B	Supervise and/or perform quantification of velocity and flow	
7.C	Supervise and/or perform quantification of vessel sizes (e.g., aorta, main pulmonary artery, pulmonary veins)	
7.D	Supervise and/or perform quantification of perfusion	

7.E	Supervise and/or perform quantitative tissue characterization (e.g., T1, T2, extracellular volume [ECV])
7.F	Supervise and/or perform quantification of iron (e.g., T2*)
7.G	Supervise and/or perform quantitative late gadolinium enhancement (LGE)
7.H	Supervise and/or perform three-dimensional post-processing (e.g., multiplanar reformat [MPR], maximum intensity projection [MIP])