Practice Analysis and Content Specifications

for Quality Management

Final Report

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EXECUTIVE SUMMARY

Between August 2015 and July 2017, ARRT conducted a practice analysis for Quality Management (QM). This was the fifth practice analysis for QM. The practice analysis included the development of a task inventory survey that was sent to 3,780 Registered Technologists (R.T.s) that reported working in QM as their primary or secondary discipline of employment or who were certified and registered in QM. The 3,780 people represented the full population of R.T.s that may be working in QM and a larger survey sample than in previous QM practice analyses. Of the 3,780 people surveyed, 900 returned the survey (23.8% return rate) and 632 (16.7%) were retained for analysis. The response rate for the survey was comparable to recent ARRT surveys for other disciplines and the number of retained surveys exceeded the number previously retained in other QM practice analyses. The task inventory survey included 16 questions on equipment quality control (QC) for various imaging modalities, 131 job tasks on QC, Laws, Regulations, Standards, Guidelines, and Radiation Protection, and quality improvement (QI), and 15 demographic and work experience questions. The number of job tasks included in the survey was greater than previous QM practice analysis surveys and included some specific QC tasks in sonography, CT, MRI, and radiation therapy that had not been previously surveyed.

Analyses of the survey data showed that survey respondents had a variety of background characteristics and that they tended to have a range of job responsibilities with only part of their job responsibilities being QM related tasks. Additional analyses indicated that the number of job tasks above the 40% threshold that ARRT uses as a guideline for determining which tasks to include on the task inventory was dramatically less than in the past. After reviewing the survey results, the Practice Analysis Advisory Committee recommended that the QM task inventory consist of 64 tasks with 10 tasks in QC, 13 tasks in Laws, Regulations, Standards, Guidelines, and Radiation Protection, and 41 tasks in QI. The previous task inventory for QM included 105 job tasks with 50 tasks in QC, 15 tasks in Laws, Regulations, Standards, Guidelines and Radiation Protection, and 40 tasks in QI. These findings indicate that there were large changes in the QC portion of the task inventory due in part to increased transitions to digital equipment. Historically, QC has represented the biggest section of the task inventory and provided the strongest link to the imaging modalities covered in ARRT's mission statement. Further analyses showed that the QM results were notably different from other ARRT certification programs in that there were no tasks for which at least 80% of people surveyed reported responsibility (other ARRT certification programs typically have a large number of tasks for which at least 80% of people surveyed reported responsibility). The lack of tasks with at least 80% responsibility is important because it may indicate challenges with developing clinical requirements that people would be able to complete to qualify for the exam.

ARRT took additional steps to see if any tasks may had been inadvertently excluded from the task inventory survey or if there may be a subset of the population that may have greater responsibility for the job tasks than the full sample of survey respondents. These additional steps included having a special meeting with another committee of subject matter experts to discuss the task inventory survey and results as well as further statistical analyses of the survey data. Discussion at the special meeting suggested that there were no tasks that had not been surveyed that the subject matter experts felt that at least 40% of the people working in QM were responsible for. Results from the statistical analyses suggested that there were five latent groups who responded

to the survey and that no single group had a majority of people classified into it. In addition, results suggested that there were only 14 job tasks that had greater than 40% responsibility across the five groups. These findings indicate that —with the current use of digital imaging equipment — the job role of a person working in QM can look very different from the past, and that developing an exam that covers the job responsibilities of all the people working in QM is very difficult to do. It also suggests that it would be very difficult to develop clinical experience requirements that a large number of people could fulfill. It does not appear that there is a simple solution to increase the number of tasks on the task inventory and simultaneously define the job role of a person working in QM in a way that would represent the majority of people working in the field.

The Practice Analysis Advisory Committee recommended revised examination content specifications, structured education requirements, and clinical experience requirements based on the task inventory survey results and comments from the professional community. The documents had large changes compared to previous versions with especially big changes proposed for the examination content specifications. In particular, the Practice Analysis Advisory Committee recommended that the exam consist of 90 questions with 15 questions in QC, 25 questions in Laws, Regulations, Standards, Guidelines, and Radiation Protection, and 50 questions in QI. Previously, the examination consisted of 165 questions with 64 questions in QC, 40 questions in Laws, Regulations, Standards, Guidelines, and Radiation Protection, and 61 items in QI. The content of the QC questions also was narrower and focused only on digital equipment, where previously questions focused on analog equipment, fluoroscopy equipment, and digital QC. The changes to the exam imply that the construct assessed under the recommended exam content specifications is different than the construct assessed on prior QM exams and that the meaning of the QM credential would change if ARRT proceeded based on the recommendations. The changes also create challenges with offering the exam under a continuous testing paradigm. These challenges are mainly due to the low number of items on digital QC and a few other areas of the QM item bank in comparison to the number of items needed when considering the recommended changes. Also, QM is a low volume exam and it takes time to pilot new items and ensure that they are functioning appropriately before they can count towards an examinee's score under a continuous testing paradigm.

The Practice Analysis Advisory Committee also participated in a Hofstee and Beuk exercise to evaluate the passing standard used on the exam. After discussing the results of this exercise, the proposed changes to the exam, the amount of time since the last standard setting, and the historical exam pass rates the committee recommended that if the exam was offered that there was a need for an immediate standard-setting study.

The ARRT Board of Trustees reviewed the recommendations for changes based on the task inventory survey and recommended by the QM Practice Analysis Advisory Committee in January 2017 and decided not to approve the proposed changes. The Board of Trustees requested additional information on QM and the QM practice analysis project before making a final decision. After reviewing this additional information in the spring of 2017, the ARRT Board of Trustees decided to stop issuing new QM credentials after June 30, 2018 because the number of tasks defining QM has decreased substantially, and because QM no longer has a well-defined set of tasks that are universally applied in the workplace. The Board also noted that the profession primarily uses digital equipment now making many previous QC tasks obsolete. In addition, the QM practice analysis showed that 43 of the 105 tasks

covered on the QM exam are no longer common to QM practitioners and that many tasks that were common when ARRT introduced the QM credential in 1997 aren't specific to any particular radiologic discipline, and some aren't related to medical imaging, radiation therapy, or interventional procedures at all. Following this decision, ARRT sent out a series of communications informing various stakeholders of the Board of Trustees' decision and its implications.

CHAPTER 1

PROJECT BACKGROUND AND INTRODUCTION

The ARRT establishes the job relatedness of an examination via a practice analysis (also called a job analysis). Practice analyses document the role to be credentialed and the topics to be covered by the examination used in the credentialing decision as well as the degree of emphasis that each topic receives. The rationale for practice analyses is outlined in *The Standards for Educational and Psychological Testing* (American Educational Research Association, American Psychological Association, National Council on Measurement in Education, 2014) and in the National Commission for Certifying Agencies (NCCA) *Standards for the Accreditation of Certification Programs* (NCCA, 2014). Legislative activity and legal precedence also stress the importance of practice analysis in the development and validation of certification exams. ARRT has based its examinations on practice analyses since the 1980s with periodic updates. Regularly performing practice analyses is important for professions that continually evolve, due to advances in technology, because they help assure that the content specifications and other certification requirements reflect current practice. In ARRT's case, practice analyses inform the tasks that define the role being credentialed, the content of the certification exams, and the content of the continuing qualifications requirement assessments as well as the clinical requirements and structured education requirements for postprimary certifications that one must complete prior to taking the certification exams.

This report describes the practice analysis for Quality Management (QM) conducted between the dates of August 2015 and July 2017. The purpose of the overall project was to identify the tasks typically performed in the workplace and to determine the knowledge and cognitive skills required to effectively perform those tasks. There have been four prior practice analyses for QM. The first practice analysis was in 1996, the second practice analysis was in 2002, the third practice analysis was in 2008, and the fourth practice analysis was in 2012. Results from these prior practice analyses are discussed at various points throughout this report as they shed light into some of the results that were obtained in the current practice analysis and they show some of the challenges with identifying who the target audience is for the QM credential, some of the changes that have taken place in QM over time, and the diversity of people working in QM.

The ARRT Board of Trustees established a QM Practice Analysis Advisory Committee to carry out the QM practice analysis project. The QM Practice Analysis Advisory Committee was the same as the QM Exam Committee. The committee represented multiple perspectives in terms of geographic location and type of work experience (i.e., staff technologists, educators, administrators, and medical physicists). The responsibilities of this committee were to: (1) develop a survey instrument to collect information on the job tasks that a QM technologist is responsible for in the workplace; (2) review the results of the data collection and decide on the tasks that define the profession of the QM technologist; and (3) revise the content specifications that detail the content covered on the QM exam and the clinical experience requirements that specify the experiential requirements to take the exam. Based on the results of its deliberations, the Advisory Committee made recommendations to the Board of Trustees concerning the final composition of the task inventory, content specifications, and clinical experience requirements.

Projects such as this require a coordination of numerous activities. During the project a number of committee meetings were held, a survey was developed and administered, the survey data were analyzed, and decisions were made regarding revisions to the exam content and eligibility requirements. The time and task schedule for the QM practice analysis project is provided in Appendix A. The time and task schedule outlines the sixteen steps that were initially planned as part of the QM practice analysis project. In step fourteen, the ARRT Board of Trustees reviewed the recommendations for changes based on the practice analysis survey and recommended by the QM Practice Analysis Advisory Committee and decided not to approve the proposed changes to the QM content specifications and clinical experience requirements. The Board of Trustees requested additional information on QM and the QM practice analysis project before making a final decision. After reviewing this additional information in the spring of 2017, the Board of Trustees noted that — if the recommendations were to be approved — the new QM certification's clinical and examination requirements would be substantially reduced in comparison to the previous certification's requirements and they decided to discontinue offering new QM credentials after June 30, 2018. Therefore, steps fifteen and sixteen were not performed. This report describes the results of QM practice analysis project and some of the considerations that led to the decision to discontinue offering new QM credentials. The communications that ARRT has sent to notify stakeholders that new QM credentials will no longer be offered after June 30, 2018 are also provided.

CHAPTER 2

TASK INVENTORY

Development of Task Inventory Survey

The task inventory survey was developed between August 2015 and December 2015 by the Practice Analysis Advisory Committee with facilitation from ARRT staff. The Practice Analysis Advisory Committee held its first meeting in September 2015. Part of the meeting was devoted to the development of a task inventory survey. The survey consisted of tasks thought to be performed by those working in QM. A unique challenge for QM is that many of the people that work in this field have varying job responsibilities. Some people working in this field have job responsibilities primarily in quality control (QC), while others have job responsibilities primarily in quality improvement (QI), and still others have job responsibilities in both QC and QI. In addition, people with job responsibilities in QC may differ in the disciplines that they perform QC tasks for as well as the number and type of QC tasks that they perform. The time people spend working in QM may also differ across people with some individuals working full-time in QM, while others may spend only a small amount of their time performing QM tasks. The committee reiterated that the field of QM remained diverse and that there was not a single profile of a person working in QM. To capture the varying potential job profiles with QM components as well as the diversity of people working in QM, it was important that the QM task inventory survey be designed in such a way that the information collected could provide insight into the differences and diversity that exists in QM. To this end, the Advisory Committee suggested that the survey include a large number of tasks covering a wide range of job tasks in QC, QI, and Laws, Regulations, Standards, Guidelines, and Radiation Protection. The committee suggested surveying both general and specific QC tasks in various imaging modalities even though they believed that many of the tasks may only be the job responsibility of a small percentage of people working in QM. This included surveying specific QC tasks for several disciplines that had never been surveyed before such as sonography, CT, MRI, and radiation therapy. The goal of the committee was to try and survey any job tasks that they thought may be performed across the variety of settings and workplaces in which people work in QM to provide as complete a picture of the field as possible. A brief description of the survey developed by the Practice Analysis Advisory Committee is provided below. The full practice analysis survey can be found in Appendix B.

Format of Survey

The survey consisted of a one-page cover letter, a page with directions on how to use the responsibility scale to rate job tasks, a section on equipment QC, a section with the job tasks that needed to be rated, and a section with demographic and work experience questions. The survey was designed and administered via Survey Monkey using a dedicated webpage created for this purpose.

Section 1. The first major section of the survey consisted of 16 questions about equipment QC. The questions covered different imaging modalities for which people may have job responsibilities in related to performing equipment QC. Respondents were instructed to rate each task using the responsibility scale which had two scale points (not responsible and responsible).

Section 2. The second major section of the survey consisted of 131 job tasks in QC, Laws, Regulations, Standards, Guidelines, and Radiation Protection and QI. There were 72 job tasks related QC, 15 job tasks related to

Laws, Regulations, Standards, Guidelines, and Radiation Protection, and 44 job tasks related to QI. Respondents were instructed to rate each task using the responsibility scale which had two scale points (not responsible and responsible).

Section 3. The third major section of the survey consisted of 15 demographic and work experience questions. These included questions on the respondents' work place, experience, job duties, and demographic characteristics as well as how long it took them to complete the survey.

Survey Sample

The target population was defined as Registered Technologists (R.T.s) in the ARRT database who reported working in QM as their primary or secondary discipline of employment or who were certified and registered in QM. Individuals were also required to be currently working full or part-time as a certified and registered technologist, live in the United States, not be on CE probation or have an ARRT ethics sanction, and not have opted out of communications from ARRT. Ultimately, 3,780 technologists satisfied the above criteria. Of these 3,780 technologists, 1,094 were certified and registered in QM. There were 573 technologists that reported working in QM as their primary discipline of employment and 2,524 technologists that reported working in QM as their secondary discipline of employment. There were 3,373 that reported working full-time as a technologist and 407 that reported working part-time as a technologist. The Practice Analysis Advisory Committee suggested sending the survey to all 3,780 people to ensure that the broadest possible group of people who may be working in QM would have a chance to respond to the survey if they chose to do so. Therefore, the survey was sent to all 3,780 people that were identified using the above criteria.

The decision to send the survey to all 3,780 people is different from approaches that have been used for other ARRT disciplines and in prior practice analyses for QM. In other ARRT disciplines, the survey is usually sent to a stratified random sample of 1,000 to 1,500 people that have been identified based on the selection criteria. This approach works well to get a broad sampling of individuals who are working at entry-level in these other disciplines. However, it was felt that a stratified random sample of people working in QM may not capture the full range of people who may be working in this field. In prior practice analyses for QM, the survey has typically been sent to a random sample of 1,000 to 1,500 that have reported working in QM as their primary or secondary discipline of employment. There are two challenges with selecting such a survey sample. First, prior practice analyses have found that people that reported QM as their primary discipline of employment or that were certified and registered in QM tended to return the survey at much higher rates than those whose primary discipline of employment was not QM or who were not certified and registered in QM. These results suggest that by stratifying on these criteria one may get different response rates and potentially different survey responses. Second, it is possible that by focusing only on primary and secondary discipline of employment that there may be people that are certified and registered in QM who were not sent the survey. These people may be working in QM in some capacity and may provide useful responses about the job tasks of a typical person working in QM. Given the diversity of people working in QM, the committee felt that sending the survey to the full population of people who may be working in QM was the best approach to take.

Once the sample was determined, a postcard was mailed to all 3,780 technologists asking each person to respond to the survey. The postcard included the website address of the Survey Monkey survey and emphasized the importance of the survey. The initial postcard was mailed in early January 2016. For people that had an email address in the ARRT database (3,446 people), a follow-up reminder email was sent approximately two weeks after the initial postcard. A second follow-up reminder was sent to these same individuals approximately two weeks after the first follow-up reminder. For people that did not have an email address in the ARRT database (334 people), a follow-up reminder postcard was sent at the same time that the first follow-up reminder email was sent to individuals that had an email address. The text of the follow-up postcard and follow-up email was very similar. People without an email address did not receive a second follow-up reminder postcard. A copy of the initial and reminder postcards as well as the first and second follow-up email reminders can be found in Appendix C.

A total of 900 surveys were returned by February 15, 2016 (allowing 6 weeks for completion), for a response rate of 23.8%. Responses from those returning the survey were screened to assure that the surveys were correctly filled out, the responses were thoughtfully entered, and the surveys were from the intended population. In this case, the intended population was people who reported working in QM, reported some job responsibilities in QC and/or QI, and their survey responses could be linked back to a valid ARRT ID number of one of the 3,780 people in the survey sample. After completing the screening process, a total of 632 surveys were retained for an effective response rate of 16.7%. The total number of returned and retained surveys was much higher than in previous practice analyses for QM, while the response rate was somewhat lower. For example, in the 2012 practice analyses there were 332 returned surveys out of 1,000 surveys sent and 240 of those were retained for analysis. The higher total number of returned and retained surveys may be a function of sending the survey to much larger initial sample of people, while the lower overall response rate is consistent with recent trends for other ARRT disciplines where fewer surveys have tended to be returned overall. ARRT has also found lower response rates on some of its surveys that are only offered online.

Data Analysis

Survey Respondent Demographics

The first stage of the data analysis was to examine the demographic characteristics of the survey respondents that were retained for analysis. Appendix D provides summary tables of the demographic characteristics of the survey respondents based on the demographic questions contained in the task inventory survey and other demographic information in the ARRT database. One can see, as expected based on the screening criteria used, that 100% of survey respondents indicated that they had job responsibilities in QC and/or QI, which was the intended population of interest. Approximately 22.8% of the survey respondents reported working in QM as their primary discipline of employment, while 47.9% of the survey sample reported working in QM as their secondary discipline of employment. The most common credentials held by survey respondents were radiography at 97.2%, mammography at 40.8%, QM at 36.1%, CT at 19.6%, and MRI at 9.0%. These percentages add to more than 100% because some respondents held more than one credential. All other ARRT credentials were held by less than 5% of survey respondents. This suggests that there was a wide range of credentials held by survey respondents, but that most survey respondents were certified and registered in radiography. Consistent with prior QM practice analyses, it

appears that the retained surveys had a higher percentage of people who reported working in QM as their primary discipline of employment and who held the QM credential than the original survey sample. In total, 144 out of 573 people who reported working in QM as their primary discipline of employment (25.1%) were retained for analysis compared to 303 out of 2,524 who listed QM as their secondary discipline of employment (12.0%). Likewise, 228 out of 1,094 who held the QM credential were retained for analysis (20.8%) compared to 404 out of 2,686 who did not hold the QM credential (15.0%). These differences from the original sample are important to keep in mind as they may factor into some results that were obtained, but would seem to be expected.

Survey respondents were 71.4% female and had a variety of education levels with 38.1% having an associate's degree, 24.5% having a bachelor's degree, 13.3% having a master's degree, and 22.2% reporting a certificate or high school diploma as their highest level of education. Survey respondents also varied in their job titles and the training they received to work in QM. Most of the survey respondents worked as technologists in some capacity with 34.2% of survey respondents reporting job titles of a staff or senior technologist, 13.9% reporting job titles of supervisor of assistant chief technologist, and 11.9% reporting job titles of chief technologist. Roughly a quarter of survey respondents (25.3%) listed job titles of administrator or manager. The most common form of training that people received to work in QM was on the job training, which was reported by 78.8% of survey respondents. One-day workshops were reported by 9.3% of respondents, two-day workshops were reported by 20.7%, and other types of training were reported by 9.7% of respondents. Extended training and college courses were less common forms of training. Survey respondents as a group were quite experienced with 19.1% of respondents reporting six to ten years of experience, 25.8% of survey respondents reporting eleven to twenty years of experience, and 25.8% reporting more than twenty years of experience. These findings were consistent with those from the 2012 QM practice analysis, which also found that most people working in QM were quite experienced.

As expected, survey respondents reported working in a variety of places of employment. The most common place of employment was working in a hospital. A total of 8.5% of respondents reported working in hospitals with less than 100 beds, 17.2% reported working in hospitals with 100 to 249 beds, 14.6% reported working in hospitals with 250 to 500 beds, and 6.6% reported working in hospitals with more than 500 beds. Working in healthcare systems was also fairly common as 21.5% reported working in multisite healthcare systems. Working in physician offices/clinics or free-standing imaging were a little less common at 7.3% and 8.5%, respectively. There were some people that reported working as commercial representatives, in governmental agencies, and in other places of employment. These results suggest that there is some diversity in the places that people worked as a QM technologist. These findings are similar to those reported in the 2012 QM practice analysis which also found that people worked in a variety of places of employment with hospitals being the most common place of employment.

A majority of survey respondents reported working full-time (92.1%) compared to part-time (7.9%). This was also reflected in responses to the question about how many hours people worked as 84.2% of survey respondents reported working more than 30 hours a week. However, it was apparent from some of the additional questions about the hours people worked in various areas that spending a large amount of time in specific QC and QI activities was not very common. The most common number of hours worked in QC was one to ten hours, which was reported by 56.3% of survey respondents. Similarly, 50.3% of people reported working one to ten hours in QI

and 43.4% of people reported working one to ten hours with PACS. When asked about the number of hours worked in specific QC disciplines, the most commonly reported response category was not being involved in these activities as part of their job (see Table D.13). The one exception to this pattern was radiography and fluoroscopy QC where 36.7% of people reported not being involved in these activities and 38.1% of people reported being involved in these activities for one to ten hours a week. Having job responsibilities where a person worked more than 30 hours a week solely in QC, QI, or PACS activities was not the norm as reflected in the lower percentages reported for this response category. These results are consistent with feedback and remarks from the Practice Analysis Advisory Committee who indicated that the field of QM is diverse and there are a lot of people who are working in this field who may have a range of job responsibilities and may only perform QM activities as a portion of their job. The diversity of job responsibilities is also reflected in the average percentage of time that people reported spending working in different areas. On average, survey respondents reported spending 38.1% of their time imaging, 16.1% of their time in QC, 15.5% of their time in QI, 24.3% of their time in management, and 5.7% of their time on other job duties. Clearly, the average person working in QM has a number of areas that they may have responsibility for as part of their job. The average percentage of time reported in the current analysis is somewhat different than in the 2012 QM practice analysis where survey respondents reported spending 25.4% of their time imaging, 21.0% of their time in QC, 22.9% of their time in QI, 23.5% of their time in management, and 12.9% of their time in other activities. These differences may be a function of sending the survey to a wider sample of respondents or they may reflect some changes in the profiles of people working in QM. In discussion with the Practice Analysis Advisory Committee, the committee suggested that there had been some changes in QM since the last practice analysis. The biggest changes were more transitions from analog to digital equipment. Committee members indicated that these transitions had resulted in some previously performed QC tests becoming obsolete and other QC tests being built into the equipment. Committee members also noted that people working in QM were often not paid more if they had the QM credential and they observed changes in QM job descriptions in recent years. They also noted some challenges with finding positions that were solely focused on QM. Committee members also noted that people certified and registered in specific disciplines, such as radiography, mammography, CT, or MRI, may now be performing some of the QC tasks for those disciplines instead of people with a QM focus. In the next section, we examine the equipment QC data in more detail and in the following section we analyze data on the job tasks.

Analyses of Equipment QC Data

In this section, we examine the percentage of people that reported responsibility for the 16 different general questions on equipment QC in the first section of task inventory survey. ARRT's typical guideline for a task to be included in the task inventory is that at least 40% of people reported responsibility for the task. Appendix E provides a summary of these analyses. To aid in the interpretation of the results, tasks with less than 40% responsibility are highlighted in red. One can see that the only imaging modality where equipment QC had greater than 40% responsibility was digital radiography QC with 51.6% responsibility. The next highest percent responsibilities were mammography QC at 37.7% and fluoroscopy QC at 32.2%. Analog radiography QC fell dramatically and was only at 17.3% responsibility. All of the other equipment QC tasks for other imaging modalities were at less than 25% responsibility. These results suggest that equipment QC tasks were a lot less common than in the 2012 QM practice

analysis. In 2012, analog radiography QC was at 31.0%, digital radiography was at 66.7%, mammography was at 44.3%, and fluoroscopy was at 43.9%. These results also suggest there may be some potential challenges with including some previous equipment related QC tasks in the QM task inventory, content specifications, and clinical requirements as several tasks that were previously above the 40% guideline used by ARRT to include tasks on the task inventory were now below this threshold. However, it is possible that the issue may be related to the general tasks of equipment QC in these disciplines and not some of the specific QC tests. In the next section, we investigate some of the specific QC tests for various disciplines as many of these specific QC tests were included in the job tasks section of the task inventory survey.

Analyses of Job Task Statements

In this section, we examine the results of the analyses for the different job tasks. Appendix F provides a summary of the results. In table F.1, the results are presented for each of the specific job task statements. Similar to the analyses for the equipment QC, tasks with less than 40% are highlighted in red. One can see that very few of the QC-related job tasks were above the 40% threshold, while there were a greater number of job tasks that were above the 40% threshold in the Laws, Regulations, Standards, Guidelines, and Radiation Protection and QI sections. Table F.2 provides a summary of the tasks above the 40% threshold across the different sections. In the QC section, there were 7 digital radiography or mammography QC tasks above the 40% threshold, 1 equipment radiography or mammography QC task above the 40% threshold, and there were 3 other QC tasks that were above the 40% threshold. In the Laws, Regulations, Standards, Guidelines, and Radiation Protection section, there were 11 tasks above the 40% threshold, while in the QI section there were 39 job tasks above the 40% threshold. The total number of tasks above the 40% threshold is dramatically less than in any of the prior QM practice analyses, especially in the QC section.

Additional analyses were performed to examine whether there may be important differences in task responsibility based on whether a person reported working full versus part-time, whether someone was certified and registered in QM or not, whether QM was their primary discipline of employment or not, and whether QM was their secondary discipline of employment or not. The results of these analyses are presented in Tables F.3 to F.6. For all the analyses, task responsibility differences were tested for statistical significance using chi-square tests (see Agresti, 2007). Since multiple significance tests were performed, a Bonferroni (1936) correction was applied by dividing 0.05 by 131. In each table, significant differences are marked with a1 and are highlighted in yellow. There were no significant differences for any of the tasks based on whether a person reported working full versus part-time or whether QM was their secondary discipline of employment or not.

There were six tasks with statistically significant differences based on whether a person was certified and registered in QM or not. Five of the tasks dealt with QC and one of the tasks dealt with Laws, Regulations, Standards, Guidelines, and Radiation Protection. The five QC tasks dealt with mammography and bone densitometry related QC, while the Laws, Regulations, Standards, Guidelines, and Radiation Protection task dealt with MQSA guidelines. All of the tasks had greater percent responsibility for people who were certified and registered in QM. Two of QC tasks were well above the 40% threshold for the intended population and people who reported being certified and registered in QM, while three of the tasks were below the 40% threshold for the

intended population and were marginally above the 40% threshold for people certified and registered in QM. The committee discussed these results and recommended retaining the tasks above the 40% threshold for the intended population, but not retaining the tasks that were not above the 40% threshold. The MQSA guideline task was above the 40% threshold for people certified and registered in QM and the intended population and the committee recommended retaining this task.

There were 13 tasks that were significantly different based on whether a person reported working in QM as their primary discipline versus not. Ten of the tasks dealt with QC, one task dealt with Laws, Regulations, Standards, Guidelines, and Radiation Protection, and two of the tasks dealt with QI. All of the tasks had greater responsibility for people who reported working in QM as their primary discipline of employment. Of the ten QC tasks, seven of them dealt with fluoroscopy QC and three of the tasks dealt with digital radiography or mammography QC. Nine out of the ten tasks were below the 40% threshold for the intended population and people who reported working in QM as their primary discipline of employment. The patient dose for equipment QC task for radiography or mammography was above 40% threshold for people who reported QM as their primary discipline, but below the 40% threshold for the intended population. However, it was similar to a digital radiography or mammography QC task on patient dose that was above the 40% threshold for the intended population, so the committee felt that the task was covered by the digital QC task. Therefore, the committee recommended that none of the QC tasks with significant differences be retained in the final task inventory. The one Laws, Regulations, Standards, Guidelines, and Radiation Protection task dealt with NCRP and AAPM guidelines. The NCRP and AAPM guideline task was above the 40% threshold for people who reported working in QM as their primary discipline of employment, but below the 40% threshold for the intended population. The committee felt this task was critical to the discipline of QM and recommended retaining the task on the task inventory even though it was below the 40% threshold for the intended population. The two QI tasks dealt with ROC analyses and patient dose tracking and monitoring. The ROC analyses task was below the 40% threshold for people whose primary discipline of employment was QM and the intended population and was not retained in the final task inventory. Conversely, the patient dose tracking and monitoring task was above the 40% threshold for people whose primary discipline of employment was QM and the intended population and was retained in the final task inventory.

Revision of Task Inventory

The Practice Analysis Advisory Committee reviewed all of these results in April 2016 and recommended that all of the tasks above the 40% threshold be included in the final task inventory. They did recommend combining one digital QC task for radiography and mammography that dealt with evaluating phantom images with a similar task on the survey that asked about equipment QC for radiography and mammography that also dealt with evaluating phantom images. In addition, the committee recommended that two Laws, Regulations, Standards, Guidelines, and Radiation Protection tasks that were critical to patient safety be retained even though they were below the 40% threshold. The first task was the NCRP and AAPM guidelines task and the second task dealt with the Safe Medical Devices Act. The committee also recommended that two QI tasks that were below the 40% threshold be retained because these tasks were related to other tasks that were above the 40% threshold. The first task dealt with collecting data or overseeing data collection from patients using surveys, checklists, or other survey methods.

The second task dealt with engaging in formal process improvement models, including SWOT or FMEA. In total, the committee recommended that the final task inventory consist of 64 tasks. These 64 tasks included 62 tasks that had previously appeared on the task inventory and two new tasks that had not previously appeared on the task inventory. The two new tasks dealt with radiation protection and patient dose monitoring and tracking. The final task inventory recommended by the committee can be found in Appendix G.

The final recommended task inventory had several notable changes from previous approved task inventories. Table F.7 provides a summary of the number of tasks that were recommended on the final task inventory for each of the QM practice analyses. One can see that the current recommendations represented a dramatic reduction in the number of tasks on the task inventory, especially in the QC section of the task inventory. In the 2012 practice analysis, there were 105 tasks on the task inventory and 50 of the tasks dealt with QC. In the 2017 practice analysis, there were only 10 QC tasks recommended on the task inventory with no analog, equipment, or fluoroscopy QC tasks and fewer digital radiography or mammography QC tasks. Another trend since the inception of QM that can be seen in the results is an increase in the number of QI and Laws, Regulations, Standards, Guidelines, and Radiation Protection tasks over time. One can also see that the number of tasks on the task inventory is much less than in any previous practice analyses. This has big implications because it means there will be dramatic reductions to the content specifications and clinical requirements. A discussion of what these changes mean for the content specifications and clinical requirements is provided in the next chapter.

Another way that the task inventory for QM is unique is in the number of tasks that at least 80% of people reported responsibility for in comparison to other ARRT disciplines. Tasks that a lot of people reported responsibility for are important to consider because these tasks are often the ones that have higher numbers of repetitions in the clinical requirements or that may be mandatory clinical requirements. Table F.8 shows the number of tasks surveyed and the number of tasks with at least 80% responsibility for the most recent practice analysis survey in each discipline. It is important to note that in many disciplines the non-procedure tasks with at least 80% responsibility in some cases are not surveyed every practice analysis cycle because the committee often indicates that these tasks are not likely to fall below the 40% threshold and eliminating these tasks from the survey helps make the survey shorter. This implies that if all of the tasks for these other disciplines were included the number of tasks with at least 80% responsibility would probably be much higher. Even with this being the case, the results for the QM are very different than any other discipline. In QM there is not a single task that surveyed with at least 80% responsibility. The next lowest discipline was R.R.A, which had 17 tasks with at least 80% responsibility. Every other discipline had at least 30 tasks with at least 80% responsibility and a lot of the disciplines had even larger number of tasks than that. These results again highlight the diversity of job responsibilities in QM in that there are not any tasks that 80% of people surveyed reported responsibility for. These results may also help to explain some of the comments of the Practice Analysis Advisory Committee who indicated that certain activities on the clinical requirements may not be done by a lot of people and that it may be hard for some people to fulfill the clinical experience requirements.

Additional Steps Taken

An important question to ask is whether any tasks may have been missed by the task inventory survey that may fall within the job responsibilities of a person working in QM. In fact, the ARRT staff and the Practice Analysis Advisory Committee asked this very question after seeing the results of the current practice analysis. To address the possibility that tasks may have been missed on the task inventory survey, ARRT held a special meeting in September 2016 where an additional group of subject matter experts were shown the task inventory survey results and recommended changes for QM and asked if any tasks may have been missed or if other changes should be considered. This group of subject matter experts consisted of four of the members of Practice Analysis Advisory Committee plus seven other people that were certified and registered in QM and a medical physicist who worked regularly with QM technologists and had previously served on the QM Exam Committee. The group of subject matter experts reviewed the survey results and could not identify any tasks that were not included on the task inventory survey that they felt at least 40% of people working in QM would have responsibility. This group did offer some suggestions related to thinking about the discipline of QM in the future, including adding data analysis components to the exam, considering the possibility of adding portfolio type components for QM, coming up with more flexible ways that people may fulfill the clinical experience requirements, and thinking about giving CE credits for participating in QI projects. The group of subject matter experts did echo many of the sentiments of the Practice Analysis Advisory Committee in regards to the diversity of people working in QM, the range of job responsibilities that people working in QM have, and the reduction in number of QC tasks with the introduction of some of the new digital equipment. The discussion with this committee seemed to provide support to the recommendations made by the Practice Analysis Advisory Committee and seemed to indicate that the job tasks that may fall within the job role of someone working in QM had been included on the task inventory survey.

Another important question is whether there may be a subset of people from the intended population that may perform a greater number of tasks than the number identified using the full set of people. To answer this question, one can analyze the data using mixture Rasch models (Rost, 1990; 1991). Mixture Rasch models allow one to test whether there may be different latent groups of people that may be responding differently to the survey questions. In this case, the interest is in whether there may be different groups of people working in QM that may have different levels of responsibility for the job tasks that were surveyed. One would expect that this would be the case given that the Practice Analysis Advisory Committee and the group of subject matter experts indicated that there were various groups of people working in QM and these different groups often have differing job responsibilities. The first step in performing these analyses is determining the number of latent groups underlying the data. Table H.1 in Appendix H shows the AIC, BIC, and CAIC fit measures, which are common fit measures used to determine the number of groups underlying the data when fitting mixture Rasch models (Dallas & Willse, 2014; Willse, 2011). Results suggested that there were between three and five latent groups depending on the measure of fit used. We examined the solutions with three to five latent groups and found the five group solution to be the most interpretable. We also presented the three and five group models to the committee and the committee thought the five group model was a better fit.

To interpret the five class solution, we calculated the probability of each person being in each class, assigned each person to the class with the highest probability, and examined the tasks that greater than 40% of

people reported responsibility for in each class as well as the demographic characteristics of people in each class. The demographic questions of most interest were the medical imaging credentials that people held, the average percentage of time that people reported working in imaging, quality control (QC), quality improvement (QI), management, and other areas, and the job titles that people reported.

Table H.2 shows the number of tasks that at least 40% of people reported responsibility for the five latent classes. One can use the results from Table H.2 and those from Tables H.3, H.4, and H.5 that show the demographic characteristics to provide an interpretation to the latent classes. The first latent class appears to be mammographers who reported responsibility for a small number of digital radiography and mammography QC tasks, a small number of Laws, Regulations, Standards, Guidelines, and Radiation Protection tasks, and spent a small amount of time doing QI and a large portion of time imaging. The second latent class reported responsibility for all of the digital radiography and mammography QC tasks, almost all the radiography and mammography equipment QC, and all the fluoroscopy QC. They spent by far the greatest amount of time doing QC. The group reported responsibility for a moderate number of Laws, Regulations, Standards, Guidelines, and Radiation Protection tasks, a small number of QI tasks, and had the largest portion of people reporting job titles listed as other. The second group may be labeled as physicist assistants. The third class is the hardest to interpret. This class reported responsibility for all of the digital radiography and mammography QC tasks, and a moderate number of Laws, Regulations, Standards, Guidelines, and Radiation Protection tasks and QI tasks. A large percentage of people were staff technologists or lead/chief technologists who spent a lot time imaging. This class probably represents experienced technologists who work primarily in radiography and have some QC and management responsibilities as part of their job. The fourth class appears to be people that hold multiple credentials and often work in CT and MRI. They spent a majority of their time doing imaging, but also had some management responsibilities and as a group reported responsibility for nearly all of the QI tasks. If they were responsible for QC, it was in CT and MRI. The last class appears to be administrators and managers who focus on QI and management. This class reported responsibility for nearly all of the QI tasks and Laws, Regulations, Standards, Guidelines, and Radiation Protection tasks, but has very little responsibility for QC and spent the least amount of time doing imaging.

The presence of these five latent classes and the differences in the tasks that they reported responsibility for makes it hard to know who the target audience is for this credential, especially when one considers that no class had a majority of people classified into it. The group that reported responsibility for the most tasks only had 90 tasks at or above the 40% threshold. We more closely examined all 131 job tasks and found only 14 tasks that all five classes had at least 40% responsibility for. These findings indicate that —with the current use of digital imaging equipment — the job role of a person working in QM can look very different, and it suggests that developing certification requirements that cover the job responsibilities of all the people working in QM is very difficult to do. In addition to the difficulties in creating an exam, it also suggests that it is very difficult to develop clinical experience requirements that a large number of people would be able to fulfill. In fact, several of the Advisory Committee members mentioned challenges with satisfying the clinical experience requirements needed to qualify for the certification. The lack of a consensus on the job role of a person working in QM may also explain why many people working in QM do not hold the credential and why there is low volume of people that apply for the QM

credential. Each of these factors is important to consider when developing a credentialing program because the goal is for there to be an agreed upon job role, or at least a job role that the majority of people working in the field agree upon (Raymond, 2016; Raymond & Neustel, 2006). Clearly, with the transition from analog to digital imaging equipment the diversity in the field of QM has increased and it is hard to define the job role of a QM technologist in such a way that it can be applied across the variety of settings and workplaces. It does not appear that there is a simple solution to increase the number of tasks on the task inventory and simultaneously define the job role of a person working in QM in a way that would represent the majority of people working in the field.

If one defines the job role of QM using the 64 tasks recommended by the committee, the question becomes whether there is enough of a focus on medical imaging for the discipline of QM to fall within ARRT's mission. In particular, does defining QM such that there are only 10 QC tasks provide enough of a link to medical imaging that it makes sense to offer the QM credential? This question is especially important to consider given that previously the largest portion of tasks on the task inventory were QC related tasks. A similar question is whether offering the QM credential based on the recommended task inventory would change the meaning of credential from what the QM credential has represented in the past. These are some of the important questions needing to be addressed by the ARRT Board of Trustees as they considered the recommendations of the Practice Analysis Advisory Committee.

CHAPTER 3

EXAMINATION CONTENT SPECIFICATIONS AND CLINICAL REQUIREMENTS

Examination Content Specifications and Structured Education Requirements

Revising the examination content specifications (later referred to simply as "content specifications") is based on changes to the final task inventory, comments from the professional community, and judgment of the Practice Analysis Advisory Committee. A summary of comments from the professional community in response to the suggested changes can be found in Appendix I. A total of 42 people responded to a survey that was administered via Survey Monkey on the proposed changed and a summary of the results can be found in Appendix I.2. The professional community appeared to support most of the suggested revisions in the content specifications as the percent that agreed with the overall suggested changes was 61.8% and there were only three suggested changes that had less than 50% agreement. The three changes with less than 50% agreement were removing fluoroscopy QC (44.1% agreement), removing CT QC (42.4% agreement), and removing test instrumentation related QC (41.2% agreement) from the content specifications. The Practice Analysis Advisory Committee carefully reviewed the professional comments and data from the task inventory survey and decided that these changes were still warranted in the content specifications as the tasks related to these topics were below the 40% threshold and had decreased in responsibility compared to the previous task inventory survey in 2012. A final draft of the content specifications was completed after the task inventory had been finalized and approved and the comments from the community had been reviewed and discussed. For every activity in the task inventory, the Practice Analysis Advisory Committee was asked to consider the knowledge and skill required to successfully perform that task and verify that the topic was addressed in the content specifications. Similarly, topics that could not be linked to practice were not included on the final content specifications. The most notable changes from the previous version of the content specifications are:

- The following topics in the content specifications were reorganized and/or renamed. Rationale: Content was updated to correspond to the new universal content categories adopted by ARRT for all content specifications.
    - The content was restructured into three of the four major content sections: Patient Care, Safety, and Procedures.
    - Quality Improvement Management and Administration was renamed Patient Care and organized into two sections.
    - Topics concerning Laws, Regulations, Standards and Guidelines were moved to the new Safety section.
    - Topics concerning quality control were moved to the new Procedures section.
- Topics regarding radiation safety were added to the Safety section of the content specifications. Rationale: The tasks were added to the task inventory.

- American Association of Physicists in Medicine (AAPM) Report No. 151 was added and AAPM Report No. 74 was removed from the content specifications. Rational: AAPM replaced Report No. 74 with an updated Report No. 151.
- The following topics were removed from the content specifications. Rationale: The tasks to which the topics were linked were removed from the task inventory.
    - Topics regarding MIPPA were removed from the Safety section.
    - Topics regarding analog radiography were removed from the Procedures section.
    - Topics regarding computed radiography (CR) were removed from the Procedures section.
    - Topics regarding fluoroscopy were removed from the Procedures section.
    - Topics regarding bone densitometry were removed from the Procedures section.
    - Topics regarding computed tomography were removed from the Procedures section.
    - Topics regarding viewboxes were removed from the Procedures section.
    - Topics regarding laser printers were removed from the Procedures section.
    - Topics regarding test instrumentation were removed from the Procedures section.
- All areas of the content specifications were edited for clarity and to update terminology to reflect current practice.
- The number of items on the exam was reduced from 165 items to 90 items with 15 items in QC, 25 items in Laws, Regulations, Standards, Guidelines, and Radiation Protection, and 50 items in QI.

A copy of the recommended content specifications can be found in Appendix J.

The restructuring of the major content categories impacted the structured education requirements as the content categories of the structured education requirements were also retitled to follow the naming conventions in the universal content outlines adopted by ARRT. The structured education requirements document was also updated to include the new version of the content specifications. A copy of the recommended structured education requirements can be found in Appendix K.

The Board of Trustees reviewed the recommended content specifications at their January 2017 meeting. The Board decided not to approve the content specifications with the proposed substantial changes as recommended by the committee. The Board requested additional information on the proposed changes and the status of QM as a discipline before making its final decision. This additional information was provided to the Board in spring 2017. The decision was made at this meeting to discontinue issuing new QM credentials after June 30, 2018 but to allow existing QM credentials to be maintained. Staff was directed to communicate this decision to various stakeholder groups.

Clinical Experience Requirements

The purpose of clinical experience requirements is to verify that candidates have completed a subset of the clinical procedures within a modality. Successful performance of these fundamental procedures, in combination with mastery of the cognitive knowledge and skills covered by the certification examination, provides the basis for the acquisition of the full range of clinical skills required in a variety of settings. When establishing the clinical

experience requirements, the Practice Analysis Advisory Committee focused on those procedures in the task inventory typically performed by most QM technologists. The proposed changes to the clinical experience requirements were put out to the professional community for comment. A summary of these results is presented in Table I.3 in Appendix I. The community appeared to agree with most of the suggested revisions in the clinical experience requirements as the percent that agreed with the overall suggested changes was 71.9% and all the suggested changes to clinical requirements had 50% agreement or higher. A final draft of the clinical experience requirements was completed after the task inventory had been finalized and approved and the comments from the professional community had been reviewed and discussed. The most notable changes from the previous version of the clinical experience requirements are:

- Equipment quality control was removed from the clinical experience requirements. Rationale: Equipment quality control was removed from the task inventory.
- Analog systems were removed as an option in the general quality control procedures section. Rationale: Analog tasks were removed from the task inventory.
- Participate in development or revision of departmental emergency plans for natural and manmade disasters was added to the list of options under operational management. Rationale: The content is supported by a reworded task within the task inventory.
- Participate in development or revision of a departmental strategic plan (e.g., budget, personnel recruitment, marketing) was added to the list of options under operational management. Rationale: The content was a part of the task inventory not represented in the clinical requirements.
- All areas of the clinical experience requirements were edited for clarity and to update terminology to reflect current practice.

A copy of the recommended clinical experience requirements can be found in Appendix L.

The Board of Trustees reviewed the recommended clinical experience requirements at their January 2017 meeting. The Board decided not to approve the clinical experience requirements with the substantial changes as recommended. The Board of Trustees requested additional information on the proposed changes and the status of QM as a discipline before making its final decision. This information was provided to the Board in spring 2017. The decision was made at this meeting to discontinue issuing new QM credentials after June 30, 2018 but to allow existing QM credentials to be maintained. Staff was directed to communicate this decision to various stakeholder groups.

Implications of Proposed Changes

It is important to consider the implications of the proposed changes to the QM content specifications and clinical experience requirements. One of the most notable changes suggested in the QM content specifications was to change the number of exam items from 165 items to 90 items with 15 items in QC, 25 items in Laws, Regulations, Standards, Guidelines, and Radiation Protection, and 50 items in QI. These are big changes to the content specifications and the definition of the knowledge and cognitive skills that compromise QM in comparison to prior versions of the QM content specifications. In particular, the QM content specifications no longer contain many QC topics and the focus of the included QC topics is much narrower and primarily on digital QC content.

Table M.1 in Appendix M shows the content weights for the various QM content specifications since the inception of QM. One can see large changes in the content weights over time. It is clear that the content weights from the 2017 practice analysis are notably different than previous iterations. In prior versions of the content specifications, QC has made up the largest section of the exam, whereas in 2017 QC is the smallest portion of the exam. Since the QC part of the exam represents the biggest link to the other medical imaging credentials offered by ARRT, these changes are noteworthy and lead to questions on whether this version of the QM content specifications still represents the same knowledge and skills as previous versions. In psychometric terms, it appears that the construct being assessed by the revised version of the content specifications is somewhat different than in the past.

Another challenge is that QM is a low volume exam (i.e., few examinees) and that the focus of the content in QC section of the exam is now primarily related to digital content, whereas the exam has previously included a mixture of QC items that assess equipment, analog, fluoroscopy, and digital QC content. The narrowing of the focus of the items to only be digital QC items creates challenges in developing and maintaining the QM exam. ARRT found when it examined its QM item bank based on the proposed changes that the number of usable scored items (items with p-values between 0.4 and 0.9 and biserial correlations over 0.2) in the QC section of the exam was lower than the number of items suggested on the exam for the QC section. In addition, ARRT found that the number of items with usable statistics in the Laws, Regulations, Standards, Guidelines and Radiation Protection subsection and the Applications of QI subsections was not that much higher than the number of suggested items in the content specifications. Part of the reason for the low number of items in some areas is that the QM exam is a low volume exam and this means that it takes more time to acquire enough data on the items to be able to use them to count toward candidate scores. Also, some of the items that are piloted do not yield statistics that are within accepted ranges to be able to use them to count toward candidate scores even after enough data has been collected. Figure N.1 in Appendix N shows the total and first-time candidate volume for QM since its inception. One can see exam volumes of several hundred in the first three years that the exam was offered, and then exam volumes have typically been less than 50 examinees each year since 1999. In fact, the exam volume in all the years since 1999 does not total the exam volume from the first three years that the exam was offered. The drop in volume appears to coincide with the introduction of the clinical experience requirements as candidates were not required to complete clinical experience requirements prior to 1999. The low candidate volumes and lack of scored items with usable statistics create additional complications as one thinks about offering a QM exam based on the recommended content specifications because it means that a different test development model from the model that ARRT has typically used would be required to be able to offer the exam. In particular, it is clear that without items with statistics that the exam could not be offered under a continuous testing paradigm as scored items with usable statistics are required to be able to immediately score exams after the exams are administered. This would make QM unique from ARRT's other postprimary exams as the examination would be administered no more than once a year under the recommended content specifications proposed by the Practice Analysis Advisory Committee.

CHAPTER 4

EXAM PASSING STANDARD

Many factors go into deciding when to readdress the passing standard for an exam. The degree to which the content is changed based upon a practice analysis update is a major factor that goes into making the decision. It is clear that large changes have been made to the content of the exam compared to prior versions. The Practice Analysis Advisory Committee participated in a Hofstee (1981) and Beuk (1983) exercise to evaluate the passing standard. These methods provide a good starting point to see if a full standard-setting study would be needed. The Hofstee method asks panelists to respond to four questions: 1) What is the lowest acceptable percent correct cut score on the exam even if everyone passed?; 2) What is the highest acceptable percent correct cut score on the exam even if everyone failed?; 3) What is the lowest acceptable pass rate?; and 4) What is the highest acceptable pass rate? The Beuk method asks panelists to respond to two questions: 1) What is the ideal percentage correct cut score that should be required to the pass the exam? and 2) What is the ideal percentage of examinees that should pass the exam? The responses to these questions are then used in combination with data on actual exam performance to figure out possible cut scores. A challenge that can occur when implementing the Hofstee method is that it is possible that committee members may provide ratings that produce an undefined cut score because the bounds for the cut score that they suggest does not correspond with actual exam performance (see Wyse & Babcock, in press). A possible way to estimate a cut score when this happens is to extend the ratings beyond the bounds suggested by the committee members (see Wyse & Babcock, in press). The Hofstee ratings from the Practice Analysis Advisory Committee members produced an undefined cut score as committee members thought the cut score should be high and a large percentage of people should pass. These ratings did not match exam performance and required the modification suggested for such situations (see Wyse and Babcock, in press) to estimate a cut score. After modification, the Hofstee cut score was estimated at 66.1% correct. The Beuk cut score was estimated at 67.3% correct. These percentages were lower than the current passing standard on the exam.

The committee reviewed the results from this exercise and considered the proposed changes in content to the QM exam since the last standard setting was done in QM. It was noted that the last standard setting for QM was in 1997 and there have been large changes in content since the last standard setting. The committee also considered the pass rate on the exam over time. Appendix O provides a graph with these pass rates. One can see that the pass rate on the exam has been quite variable. In particular, the pass rate has ranged from 35% to 86% and has been between 35% and 59% over the last five years. Some of the variability in the pass rates is a function of the low candidate volumes and the diversity of candidates that take the QM exam each year. The variability may also be a function of changes in candidate preparation and knowledge over time. Based on these factors, the Practice Analysis Advisory Committee recommended that there was a need for an immediate standard setting if the QM exam was to be offered based on the recommended content specifications. The ARRT Board of Trustees reviewed and considered this recommendation as they made their decisions about QM.

CHAPTER 5

CONCLUSION

Numerous individuals contributed to this project, as committee members, document reviewers, or as survey respondents. Periodic practice analysis is a necessary step in the life cycle of a certification program to ensure that the content of the exam and the eligibility requirements remain relevant with current practice. Thanks to the efforts of the numerous individuals ARRT has the necessary information to develop and maintain its certification programs that promote high standards of patient care in medical imaging, interventional procedures, and radiation therapy.

This study found a number of significant changes to the field of QM. The ARRT Board of Trustees considered the recommended changes to the task inventory, content specifications, and clinical experience requirements as it made its final decision on the QM certification program. The Board decided to stop issuing new QM credentials after June 30, 2018 2018 but to allow existing QM credentials to be maintained because the number of tasks defining QM has decreased substantially, and because QM no longer has a well-defined set of tasks that are universally applied in the workplace. The Board also noted that the profession primarily uses digital equipment now which resulted in many previous QM tasks becoming obsolete. The most recent practice analysis showed that 43 of the 105 tasks covered on the QM exam are no longer common to QM practitioners and many tasks that were common when ARRT introduced the QM credential in 1997 aren't specific to any particular radiologic discipline, and some aren't related to medical imaging, interventional procedures, or radiation therapy at all.

In spring 2017, the ARRT issued a series of communications notifying the field of the ARRT Board of Trustees' decision. These communications included a general communication, a communication to people certified and registered in QM, a communication to people in the pipeline that were thinking of pursuing certification and registration in QM, a communication to QM item writers and committee members, a communication to people who had recently passed the QM exam, and a communication to people who had failed the QM exam. A copy of these communications can be found in Appendix P.

References

Agresti, A. (2007) *An introduction to categorical data analysis, 2nd ed.*, New York: John Wiley & Sons.

American Educational Research Association, American Psychological Association, & National Council on Measurement in Education. (2014). *Standards for educational and psychological testing*. American Educational Research Association: Washington, D.C.

Bonferroni, C. E. (1936). *Teoria statistica delle classi e calcolo delle probabilità*, Pubblicazioni del R Istituto Superiore di Scienze Economiche e Commerciali di Firenze.

Beuk, C. H. (1984). A method for reaching a compromise between absolute and relative standards in examinations. *Journal of Educational Measurement*, *21*, 147-152.

Dallas, A. D., & Willse, J. T. (2014). Survey analysis with mixture Rasch models. *Journal of Applied Measurement*, *15*, 394-404.

Hofstee, W. K. B. (1983). The case for compromise in educational selection and grading. In S. B. Anderson and J. S. Helmick (Eds.), *On educational testing* (pp. 109-127). Washington, DC: Jossey-Bass.

Institute for Credentialing Excellence. (2014). *NCCA accreditation*. Retrieved from http://www.credentialingexcellence.org/ncca.

Raymond, M. R. (2016). Job analysis, practice analysis and the content of credentialing examinations. In S. Lane, M. R. Raymond, & T. M. Haladyna (Eds.), *Handbook of test development* (2nd edition, pp. 144-164). New York: Routledge.

Raymond, M. R. & Neustel, S. (2006). Determining the content of credentialing examinations. In S. M. Downing & T. M. Haladyna (Eds.), *Handbook of test development* (pp. 181-223). Mahwah, NJ: Lawrence Erlbaum.

Rost, J. (1990). Rasch models in latent classes: An integration of two approaches to item analysis. *Applied Psychological Measurement*, *14*, 271-282.

Rost, J. (1991). A logistic mixture distribution model for polytomous item responses. *British Journal of Mathematical and Statistical Psychology*, *44*, 75-92.

Willse, J. T. (2011). Mixture Rasch models with joint maximum likelihood estimation. *Educational and Psychological Measurement*, *71*, 5-19.

Wyse, A. E., & Babcock, B. (in press). An investigation of undefined cut scores with the Hofstee standard-setting method. *Educational Measurement: Issues and Practice*.

Appendix A

Time and Task Schedule for QM Practice Analysis

Time and Task Schedule for
Quality Management Practice Analysis
August 2015 – July 2017

Steps	Approx. Date	Activity
1	August 2015	Staff compiles existing task inventory and other materials for Advisory Committee review.
2	August 2015	Advisory Committee reviews materials and makes notes regarding additions to task inventory and content specifications.
3	**September 16-18, 2015**	Advisory Committee meets to review and update task inventory and also discuss survey content and format.
4	October 2015	Staff prepares first draft of survey and mails to Advisory Committee for review. Advisory Committee members contact staff to discuss survey changes.
5	November 2015	Staff prepares survey copy and enters in Survey Monkey.
6	December 2015	Staff prepares postcards announcing the survey on Survey Monkey.
7	January 2016	Staff mails postcards and sends emails to large sample of Quality Management Technologists and those technologists who indicated QC as a primary or secondary discipline. • 1/04/2016: initial mailing and postcard sent • 1/20/2016: first follow-up reminder email blast/postcard • 2/02/2016: second follow-up reminder email blast
8	February/March 2016	Psychometrics Team analyzes data and prepares preliminary report.
9	**March 31-April 1, 2016**	Advisory Committee meets to 1) review survey results, 2) finalize new task inventory, 3) develop initial clinical competence requirements, 4) develop initial content specifications, 5) develop initial content weighting and 6) complete global weighting exercise.
10	July 2016	Board of Trustees approves the task inventory.
11	August 2016	Draft clinical requirements and content specifications posted to the ARRT website for the professional community review and comments.
12	September 2016	Staff collates comments from professional community.
13	*** September 14-16, 2016**	Advisory Committee meets to finalize content specifications and clinical requirements and perform item difficulty exercise.
14	January 2017	Board reviews and approves clinical experience requirements and content specifications.
15	***Spring 2017**	Exam Committee meets to assemble new test form and SSA form according to new content specifications.
16	July 2017	Exam forms with new content specifications are launched. New clinical experience requirements become effective.

(*indicates onsite committee meeting)

Appendix B

QM Task Inventory Survey

QUALITY MANAGEMENT
PRACTICE ANALYSIS QUESTIONNAIRE

Dear Registered Technologist:

The American Registry of Radiologic Technologists® (ARRT®) is revising the content specifications and clinical experience requirements for Quality Management (QM). It is our philosophy that an examination for certification and registration should be based on the job responsibilities of practicing technologists. The most effective way to ensure the exam reflects current practice is by asking professionals like you about the procedures they perform.

The ARRT has assembled a list of activities that may be performed by technologists working in QM. These activities appear on the practice analysis survey. The ARRT sent this survey to a carefully selected sample of people from across the country who may be working in QM in order to determine which procedures are performed in various practice settings. Because only a sample of people receive this survey, it is very important that those who receive it complete it. Your input is essential!

Instruction for completing the survey can be found on the next page. Please complete the survey and return it by February 15, 2016. It should take about 20 minutes to answer the questions. Your responses to this questionnaire are completely confidential. The ARRT will not release individual responses to anyone under any circumstances.

Thank you very much for assisting us with this project. Your participation will help ensure the integrity of the certification and registration process.

Respectfully,

Jerry B. Reid, Ph.D.
Executive Director

Please provide us with your ARRT ID # and email address. Be assured of the complete confidentiality of your responses. Individual responses will not be released to anyone under any circumstances.

ARRT ID #:
Email Address:

Introduction

Directions

Please read the definitions of quality control (QC) and quality improvement (QI) below and answer the question that follows.

Quality Control (QC) refers to the procedures for monitoring and maintaining the technical elements of imaging systems that affect image quality. Examples of QC procedures include film screen QC, digital image system QC, checking kVp accuracy, determining spatial resolution, assessing signal-to-noise ratio, etc.

Quality Improvement (QI) is the monitoring and evaluation of all aspects of patient care processes toward the goal of continuous improvement. One example of a QI activity is evaluating quality indicators and meeting with a team to discuss findings. Other examples including developing patient satisfaction surveys, writing or reviewing reports for regulatory agencies, or establishing QC policies and procedures.

Do your present job responsibilities involve performing activities related to QC or QI as described above?

□ Yes □ No

If you answered “No,” please end the survey and return the rest of the survey blank.

Section 1: General Survey

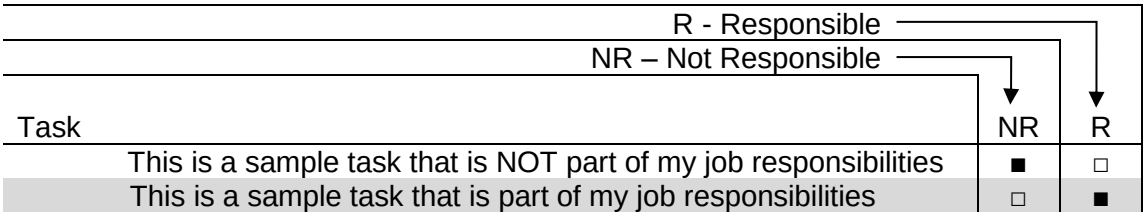
Directions

Please respond to all tasks and procedures (activities) as they apply to your personal practice and job responsibilities in medical imaging. If you are not personally responsible for performing, interpreting results, or analyzing data for a particular activity darken the circle labeled “Not Responsible” (NR). If you are directly responsible for performing, interpreting results, or analyzing data for a particular activity, darken the circle labeled “Responsible” (R).

Responsible	Responsible for performing, interpreting results, or analyzing data
Not Responsible	Not responsible for performing, interpreting results, or analyzing data

The sample below demonstrates how to mark your responses. Some tasks may be more difficult to rate than others — just provide your best judgment. We value your input.

SAMPLE



Equipment QC

For each type of equipment, please indicate whether or not you are responsible for QC on that type of equipment.

Task	NR (R – Not Responsible)	R (R - Responsible)
1. Analog radiography	□	□
2. Digital radiography	□	□
3. Fluoroscopy	□	□
4. Mammography	□	□
5. Bone Densitometry	□	□
6. Vascular Interventional Radiography	□	□
7. CT	□	□
8. MRI	□	□
9. Nuclear Medicine	□	□
10. PET/CT	□	□
11. PET/MRI	□	□
12. SPECT/CT	□	□
13. Ultrasound	□	□
14. Radiation Therapy	□	□
15. Conventional Tomography	□	□
16. Other (please specify)_____	□	□

Practice Activities

Task	NR (NR – Not Responsible)	R (R - Responsible)
Perform, interpret, or analyze the following analog radiography and/or mammography QC tests:		
1. Film screen QC	□	□
2. Processor QC	□	□
3. Darkroom QC	□	□
Perform, interpret, or analyze the following digital radiography and/or mammography QC tests:		
4. Cleanliness of image receptors.	□	□
5. Erasure of CR imaging plates.	□	□
6. Digital detector performance (e.g., sharpness, noise).	□	□
7. Testing of CR image systems.	□	□
8. Testing of DR image systems.	□	□
9. Visual inspection of digital radiographic equipment.	□	□
10. Evaluate the quality of phantom images.	□	□
11. Patient dose.	□	□
12. Image artifacts.	□	□
Perform, interpret, or analyze the following QC tests for radiographic and/or mammography equipment:		
13. AEC response.	□	□
14. Timer accuracy and reproducibility.	□	□
15. Beam quality (half-value layer).	□	□
16. Grid centering and uniformity of exposure.	□	□
17. Light field-radiation field congruency.	□	□
18. Spatial resolution.	□	□
19. mA linearity.	□	□
20. kVp accuracy and reproducibility.	□	□
21. Exposure output vs. kVp.	□	□
22. Evaluate the quality of phantom images.	□	□
23. Patient dose.	□	□
24. Entrance skin exposure (ESE).	□	□
25. Compression.	□	□
Perform, interpret, or analyze the following QC tests for fluoroscopic units:		
26. Automatic exposure rate control (AERC).	□	□
27. Five-minute timer.	□	□
28. Beam quality (half-value layer).	□	□
29. Beam limitation/collimation.	□	□
30. Low and high contrast resolution.	□	□
31. Evaluate the quality of phantom images	□	□
32. Patient dose.	□	□
33. Entrance exposure rate (EER).	□	□
34. Source to skin distance (e.g., C-arm spacers).	□	□
Perform, interpret, or analyze the following QC tests for MRI equipment:		
35. Center frequency.	□	□
36. Transmit gain.	□	□
37. Geometric accuracy.	□	□

Task	NR	R
R - Responsible; NR – Not Responsible		
38. Spatial resolution.	□	□
39. Contrast resolution.	□	□
40. Magnetic field homogeneity.	□	□
41. Slice position accuracy.	□	□
42. Slice thickness accuracy.	□	□
43. Image artifacts.	□	□
44. Visual inspection of equipment.	□	□
RF coils		
45. Signal-to-noise ratio.	□	□
46. Image intensity uniformity.	□	□
47. Percent signal ghosting.	□	□
Perform, interpret, or analyze the following QC tests for CT equipment:		
48. Water CT number.	□	□
49. Standard deviation.	□	□
50. Alignment light accuracy.	□	□
51. Spatial resolution.	□	□
52. Contrast resolution.	□	□
53. Image uniformity.	□	□
54. Noise.	□	□
55. CT number accuracy.	□	□
56. Patient dose.	□	□
57. Linearity.	□	□
58. Image artifacts.	□	□
59. Visual inspection of equipment.	□	□
Perform, interpret, or analyze QC tests for radiation therapy:		
60. Calibration board for isocenter.	□	□
61. System calibration of all stations.	□	□
Perform, interpret, or analyze QC tests for ultrasound:		
62. Penetration/Sensitivity/Depth of visualization.	□	□
63. Distance accuracy.	□	□
64. Image uniformity.	□	□
65. Fidelity of image display.	□	□
66. Visual inspection of equipment.	□	□
Perform, interpret, or analyze QC tests on the following:		
67. Bone densitometry units to include phantom scans to detect shift or drift (longitudinal QC).	□	□
68. Testing of digital display monitors (e.g., SMPTE test pattern).	□	□
69. Testing of viewboxes and viewing conditions	□	□
70. Testing of hard copy printers for digital systems.	□	□
71. PACS troubleshooting.	□	□
72. Shielding devices (e.g., gloves, aprons, table drapes).	□	□
Assure that department or facility is in compliance with the following recommendations, standards, or regulations:		
73. Occupational radiation exposure management (e.g., radiation monitoring badges).	□	□
74. Safe Medical Devices Act (SMDA).	□	□
75. National Commission on Radiation Protection and	□	□

Task	NR	R
Measurements (NCRP) and/or American Association of Physicists in Medicine (AAPM).		
76. Health Insurance Portability and Accountability Act (HIPAA).	□	□
77. Mammography Quality Standards Act (MQSA).	□	□
78. Modality specific accreditation (e.g., American College of Radiology [ACR], Intersocietal Accreditation Commission [IAC] or equivalent accreditation program).	□	□
79. Material Safety Data Sheets (MSDS).	□	□
80. Bloodborne pathogen procedures.	□	□
81. Medicare and other payer regulations.	□	□
82. Medicare Improvements for Patients and Providers Act (MIPPA)	□	□
83. Safety related staff education.	□	□
84. Onsite inspections.	□	□
85. Facility accreditation agencies (e.g., TJC, DNV, HFAP)	□	□
86. Federal regulatory bodies (e.g., FDA, OSHA)	□	□
87. State regulations.	□	□
QI Management and Administration:		
88. Instruct staff regarding quality control responsibilities and procedures.	□	□
89. Plan staff development workshops or seminars.	□	□
90. Conduct staff development workshops to provide feedback regarding performance improvement data.	□	□
91. Schedule equipment for maintenance or repair.	□	□
92. Follow-up evaluation of equipment after service is performed.	□	□
93. Recommend purchase specifications for imaging equipment or medical imaging products.	□	□
94. Provide technical information to architects, physicists, and others in the design of imaging facilities.	□	□
95. Review and update record keeping procedures of QI data.	□	□
96. Review reports and recommend action as necessary.	□	□
97. Prepare data summaries and statistical reports.	□	□
98. Review ROC analyses to compare diagnostic accuracy of different imaging procedures.	□	□
99. Arrange for data-driven corrective action.	□	□
100. Review and update quality policies and procedures.	□	□
101. Make recommendations for assigning QI or QC responsibilities to staff technologists.	□	□
102. Meet with other staff (e.g., administrators, radiologists, physicists) to discuss quality improvement programs and procedures.	□	□
103. Investigate incidents which may have quality or safety implications.	□	□
104. Report sentinel events.	□	□
105. Establish schedule and procedures for reject-repeat analysis program.	□	□
106. Identify and develop *logistic* quality indicators (e.g., patient waiting time, appointment availability).	□	□
107. Identify and develop *clinical* quality indicators (e.g., exam appropriateness, communication of critical findings).	□	□

Task	NR	R
108. Identify and develop *procedural* quality indicators (e.g., preprocedural time-out, correct patient/side/site),	□	□
109. Identify and develop quality indicators for high-volume, high risk, and problem-prone indicators.	□	□
110. Collect data based on *logistic* quality indicators (e.g., patient waiting time, appointment availability).	□	□
111. Collect data based on *clinical* quality indicators (e.g., exam appropriateness, communication of critical findings).	□	□
112. Collect data based on procedural quality indicators (e.g., preprocedural time-out, correct patient/side/site),	□	□
113. Collect data, or oversee data collection from patients using surveys, checklists, or other survey methods.	□	□
114. Collect data, or oversee data collection from staff using surveys, checklists, or other survey methods.	□	□
115. Collect QI data from department records or facility database.	□	□
116. Participate in risk and safety management activities.	□	□
117. Participate in patient dose tracking and/or monitoring programs.	□	□
118. Participate in project management teams.	□	□
119. Participate in primary source verification of professional credentials.	□	□
120. Participate in activities to help meet ISO 9000 standards.	□	□
121. Participate in efficient management strategies (e.g., Six Sigma, Lean Improvement Process).	□	□
122. Participate in strategic planning process.	□	□
123. Identify and solve problems using various QI tools (e.g., flowcharts diagrams, graphs, plots, and brainstorming).	□	□
124. Develop internal and external benchmarking.	□	□
125. Identify and develop action plans based on findings.	□	□
126. Engage in formal process improvement models (e.g., SWOT, FMEA).	□	□
127. Participate in development of departmental emergency plans for natural and manmade disasters.	□	□
128. Serve on radiation safety committee.	□	□
129. Develop and revise technique charts, including exposure ranges for digital systems.	□	□
130. Recommend and/or participate in HR hiring and staffing decisions.	□	□
131. Participate in CPT coding.	□	□

Section 2: Demographics and Work Experience

1. Is QM your primary discipline of employment?
   □ Yes □ No

2. Is QM your secondary discipline of employment?
   □ Yes □ No

3. Are you presently certified and registered in QM?
   □ Yes □ No

4. Which of the following best describes your primary place of employment?
   □ Hospital (less than 100 beds)
   □ Hospital (100-249 beds)
   □ Hospital (250-500 beds)
   □ Hospital (more than 500 beds)
   □ Health care system (multiple sites)
   □ Physician office / clinic
   □ Free-standing imaging center
   □ Governmental agency
   □ Commercial vendor
   □ Other_____

5. How many years have you worked as a QC or QI technologist?
   □ Less than 1 year
   □ 1 – 3 years
   □ 4 – 5 years
   □ 6 – 10 years
   □ 11 – 20 years
   □ More than 20 years

6. What type of training or education specific to QC or QI did you have to prepare for your entry-level role in QC or QI? (mark all that apply)
   □ On the job
   □ 1-day workshop or seminar
   □ 2 to 5 day workshop or seminar
   □ Extended training program (2+ weeks)
   □ 1 college course in QC/QI
   □ 2 or more college courses in QC/QI
   □ Other_____

7. How many hours per week do you work (on average)?
   □ Less than 10 hours
   □ 11 – 20 hours
   □ 21 – 30 hours
   □ More than 30 hours

8. How many hours per week (on average) are you involved in QC activities?
   □ Not involved in QC activities
   □ 1 – 10 hours
   □ 11 – 20 hours
   □ 21 – 30 hours
   □ More than 30 hours

9. How many hours per week (on average) are you involved in QI activities?
   □ Not involved in QI activities
   □ 1 – 10 hours
   □ 11 – 20 hours
   □ 21 – 30 hours
   □ More than 30 hours

10. How many hours per week (on average) are you involved in PACS activities?
   □ Not involved in PACS activities
   □ 1 – 10 hours
   □ 11 – 20 hours
   □ 21 – 30 hours
   □ More than 30 hours

11. How many hours per work (on average) are you involved in QC/QI activities for the following disciplines? Please indicate a response for each discipline.

General Radiography/ Fluoroscopy	Mammography	CT	MRI	Ultrasound	Imaging Informatics	Other
□ Not Involved in QC/QI activities for this discipline	□ Not Involved in QC/QI activities for this discipline	□ Not Involved in QC/QI activities for this discipline	□ Not Involved in QC/QI activities for this discipline	□ Not Involved in QC/QI activities for this discipline	□ Not Involved in QC/QI activities for this discipline	□ Not Involved in QC/QI activities for this discipline
□ 1- 10 hours	□ 1- 10 hours	□ 1- 10 hours	□ 1-10 hours	□1-10 hours	□ 1-10 hours	□ 1- 10 hours
□ 11 – 20 hours	□ 11 – 20 hours	□ 11 – 20 hours	□ 11 – 20 hours	□ 11 – 20 hours	□ 11 – 20 hours	□ 11 – 20 hours
□ 21 – 30 hours	□ 21 – 30 hours	□ 21 – 30 hours	□ 21 – 30 hours	□ 21 – 30 hours	□ 21 – 30 hours	□ 21 – 30 hours
□ More than 30 hours	□ More than 30 hours	□ More than 30 hours	□ More than 30 hours	□ More than 30 hours	□ More than 30 hours	□ More than 30 hours

12. Overall, about what percentage of time do you spend in each of the following general areas? Percentages should add to 100%.

Patient imaging _____%
QC (as defined earlier) _____%
QI (as defined earlier) _____%
Dept. management / admin _____%
Other _____ _____%
(specify)
Total **100 %**

13. How did you access this survey?
□ Typed in Web Address
□ Clicked on Survey Link
□ Scanned QR code

14. About how long did this survey take to complete?
□ less than 10 min
□ 10 -19 min
□ 20 – 29 min
□ 30 – 39 min
□ 40 min or longer

15. Do you have any other comments or suggestions?

Appendix C

Initial and Reminder Postcards and Emails

Initial Postcard

Immediate Attention Required: Request for your participation in a Short Survey about Your Job!

Dear Technologist:

You have been selected from certified and registered technologists who may be working in Quality Management to complete a short survey about your job. The survey is part of ARRT's process of developing exams and is called a practice analysis. It should take about 20 minutes to answer the questions.

To complete the survey go to:

http://www.surveymonkey.com/r/QMPASURVEY

The deadline to complete the survey is February 15, 2016.

Your participation in the survey is appreciated!

Reminder Postcard

Immediate Attention Required: Don't forget the survey!

Dear Technologist:

The ARRT mailed you a postcard a few weeks ago with the link to a survey to collect information on activities you do as a certified and registered technologist who may be working in Quality Management. We appreciate what you do every day at work and completing the survey helps us develop the most appropriate exam content and other requirements for current and future R.T.s.

Lost or misplaced the survey link?

Go to:

http://www.surveymonkey.com/r/QMPASURVEY

The deadline to complete the survey is February 15, 2016.

Already completed the survey? Thank you!

First Follow-Up Email Blast

Immediate Attention Required: Don't forget the survey!

Dear Technologist:

The ARRT mailed you a postcard a few weeks ago with the link to a survey to collect information on activities you do as a certified and registered technologist who may be working in Quality Management. We appreciate what you do every day at work and completing the survey helps us develop the most appropriate exam content and other requirements for current and future R.T.s.

Lost or misplaced the survey link?
Go to: http://www.surveymonkey.com/r/QMPASURVEY

Already completed the survey? Thank you!

The deadline to complete the survey is February 15, 2016.

Thank you for your participation in the survey. It helps ensure the integrity of the certification and registration process!

Respectfully,

Jerry B. Reid, Ph.D.
Executive Director

Second Follow-Up Email Blast

Dear Technologist:

A few weeks ago, the ARRT mailed you a postcard and sent you an email with the link to a survey to collect information on activities you do as a certified and registered technologist who may be working in Quality Management. The ARRT needs the input of people such as you to make informed decisions on the most appropriate exam content and other requirements for current and future technologists. If you have not already done so, would you please consider taking a few minutes to complete the survey?

To complete the survey go to:
http://www.surveymonkey.com/r/QMPASURVEY

If you have already completed the survey, thank you for taking time from your busy schedule to help us! We sincerely appreciate you telling us a little about what you do every day as it helps ensures that ARRT exams and requirements reflect the tasks that people like you typically perform as part of their job.

The deadline to complete the survey is February 15, 2016.

Respectfully,

Jerry B. Reid, Ph.D.
Executive Director

Appendix D

Survey Respondent Demographics

Table D.1: QC or QI Job Responsibilities

QC or QI Job Responsibilities	N	%
Yes	632	100.0%
No	0	0.0%
Total	632	

Table D.2: Primary Discipline of Employment

Primary Discipline	N	%
Yes	144	22.8%
No	453	71.7%
Missing	35	5.5%
Total	632	

Table D.3: Secondary Discipline of Employment

Secondary Discipline	N	%
Yes	303	47.9%
No	291	46.0%
Missing	38	6.0%
Total	632	

Table D.4: Credentials Held

Credentials	N	%
Radiography	614	97.2%
Nuclear Medicine Technology	28	4.4%
Radiation Therapy	13	2.1%
Sonography	1	0.2%
Magnetic Resonance Imaging	57	9.0%
Mammography	258	40.8%
Computed Tomography	124	19.6%
Quality Management	228	36.1%
Vascular Sonography	1	0.2%
Bone Densitometry	30	4.7%
Vascular-Interventional Radiography	6	0.9%
Breast Sonography	7	1.1%
Total	632	

Table D.5: Gender

Gender	N	%
Female	451	71.4%
Male	181	28.6%
Total	632	

Table D.6: Educational Level

Education Level	N	%
Certificate/High School	140	22.2%
Associate's Degree	241	38.1%
Bachelor's Degree	155	24.5%
Master's Degree	84	13.3%
Other	12	1.9%
Total	632	

Table D.7: Job Title

Job Title	N	%
Staff technologist or Senior Technologist	216	34.2%
Supervisor or Assistant Chief Technologist	88	13.9%
Chief Technologist	75	11.9%
Administrator or Manager	160	25.3%
Educational Program Faculty	9	1.4%
Educational Program Director	15	2.4%
Locum Tenens	1	0.2%
Commercial Representative	12	1.9%
Other	56	8.9%
Total	632	

Table D.8: Years of Experience

Years of Experience	N	%
Less than 1 year	20	3.2%
1 - 3 years	64	10.1%
4 -5 years	43	6.8%
6 - 10 years	121	19.1%
11 - 20 years	163	25.8%
More than 20 years	163	25.8%
Missing	58	9.2%
Total	632	

Table D.9: Type of Training

Type of Training	N	%
On the job	498	78.8%
1-day workshop or seminar	59	9.3%
2 to 5 day workshop or seminar	131	20.7%
Extended training program (2+ weeks)	45	7.1%
1 college course in QC/QI	27	4.3%
2 or more college courses in QC/QI	44	7.0%
Other	61	9.7%
Total	632	

Table D.10: Place of Employment

Place of Employment	N	%
Hospital less than 100 beds	54	8.5%
Hospital 100 - 249 beds	109	17.2%
Hospital 250 - 500 beds	92	14.6%
Hospital (more than 500 beds)	42	6.6%
Healthcare system (multiple sites)	136	21.5%
Physician office/clinic	46	7.3%
Free-standing imaging center	54	8.5%
Commercial vendor	12	1.9%
Governmental agency	9	1.4%
Other	41	6.5%
Missing	37	5.9%
Total	632	

Table D.11: Employment Status

Employment Status	N	%
Full-time	582	92.1%
Part-time	50	7.9%
Total	632	

Table D.12: Hours Worked Per Week

Number of Hours	N	%
Less than 10 hours	20	3.2%
11 - 20 hours	12	1.9%
21 - 30 hours	28	4.4%
More than 30 hours	532	84.2%
Missing	40	6.3%
Total	632	

Table D.13: Hours Worked Per Week in Various Areas

	QC		QI		PACS		Radiography and Fluoroscopy QC		Mammography QC		Computed Tomography QC		Magnetic Resonance Imaging QC		Sonography QC		Informatics QC		Other QC	
Number of Hours	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Not Involved in This	66	10.4%	103	16.3%	195	30.9%	232	36.7%	294	46.5%	360	57.0%	412	65.2%	415	65.7%	372	58.9%	318	50.3%
1 - 10 hours	356	56.3%	318	50.3%	274	43.4%	241	38.1%	201	31.8%	174	27.5%	141	22.3%	139	22.0%	143	22.6%	100	15.8%
11 - 20 hours	89	14.1%	85	13.4%	46	7.3%	40	6.3%	32	5.1%	21	3.3%	6	0.9%	4	0.6%	14	2.2%	18	2.8%
21 - 30 hours	23	3.6%	31	4.9%	33	5.2%	19	3.0%	11	1.7%	4	0.6%	3	0.5%	2	0.3%	12	1.9%	9	1.4%
More than 30 hours	59	9.3%	56	8.9%	45	7.1%	45	7.1%	36	5.7%	13	2.1%	8	1.3%	11	1.7%	20	3.2%	16	2.5%
Missing	39	6.2%	39	6.2%	39	6.2%	55	8.7%	58	9.2%	60	9.5%	62	9.8%	61	9.7%	71	11.2%	171	27.1%
Total	632		632		632		632		632		632		632		632		632		632	

Table D.14: Percentage of Time Spent in Different Areas

% of Time	Mean	Median	1st Quartile	3rd Quartile
Imaging	38.3%	25.0%	1.0%	80.0%
QC	16.1%	10.0%	5.0%	20.0%
QI	15.5%	10.0%	0.0%	20.0%
Management	24.3%	10.0%	0.0%	45.0%
Other	5.7%	0.0%	0.0%	1.0%
Total N	585			

Table D.15: Time to Complete the Survey

Time to Complete	N	%
less than 10 min	153	24.2%
10 - 19 min	355	56.2%
20 - 29 min	72	11.4%
30 - 39 min	10	1.6%
40 min or longer	4	0.6%
Missing	38	6.0%
Total	632	

Table D.16: Method of Accessing the Survey

Survey Access Method	N	%
Clicked on Survey Link	319	50.5%
Scanned QR Code	7	1.1%
Typed in Web Address	268	42.4%
Missing	38	6.0%
Total	632	

Appendix E

Analyses of Equipment QC Data

Table E.1: Percent Responsible for Equipment QC

	Nmiss	Ncount	%Resp
Analog Radiography (RAD) QC	20	612	17.3%
Digital Radiography (RAD) QC	14	618	51.6%
Fluoroscopy (FO) QC	23	609	32.2%
Mammography (MAM) QC	16	616	37.7%
Bone Densitometry (BD) QC	22	610	22.5%
Vascular-Interventional Radiography (VI) QC	25	607	12.5%
Computed Tomography (CT) QC	20	612	23.2%
Magnetic Resonance Imaging (MRI) QC	20	612	15.5%
Nuclear Medicine Technology (NMT) QC	25	607	10.5%
PET/CT QC	26	606	6.6%
PET/MRI QC	26	606	1.5%
SPECT QC	27	605	5.3%
Sonography (SON) QC	22	610	15.1%
Radiation Therapy (RTT) QC	24	608	3.0%
Conventional Tomography QC	25	607	6.9%
Other QC	173	459	13.3%

Table E.1 Note: Tasks with less than 40% responsibility are highlighted in red.

Appendix F

Analyses of Task Statements

Table F.1: Percent Responsible for Task Statements for Intended Population

Task Statement	Nmiss	Ncount	%Resp
1. Analog RAD MAM QC: Film screen QC	10	622	14.5%
2. Analog RAD MAM QC: Processor QC	10	622	21.5%
3. Analog RAD MAM QC: Darkroom QC	10	622	8.7%
4. Digital RAD MAM QC: Cleanliness of image receptors	6	626	58.1%
5. Digital RAD MAM QC: Erasure of CR imaging plates	9	623	38.0%
6. Digital RAD MAM QC: Digital detector performance (e.g., sharpness, noise)	6	626	55.1%
7. Digital RAD MAM QC: Testing of CR image systems	12	620	33.2%
8. Digital RAD MAM QC: Testing of DR image systems	12	620	43.2%
9. Digital RAD MAM QC: Visual inspection of digital radiographic equipment	4	628	61.6%
10. Digital RAD MAM QC: Evaluate the quality of phantom images	5	627	59.2%
11. Digital RAD MAM QC: Patient dose	4	628	47.9%
12. Digital RAD MAM QC: Image artifacts	2	630	70.0%
13. Equipment RAD MAM QC: AEC response	7	625	25.6%
14. Equipment RAD MAM QC: Timer accuracy and reproducibility	7	625	21.3%
15. Equipment RAD MAM QC: Beam quality (half-value layer)	5	627	17.7%
16. Equipment RAD MAM QC: Grid centering and uniformity of exposure	7	625	25.9%
17. Equipment RAD MAM QC: Light field-radiation field congruency	6	626	24.9%
18. Equipment RAD MAM QC: Spatial resolution	7	625	24.6%
19. Equipment RAD MAM QC: mA linearity	7	625	20.2%
20. Equipment RAD MAM QC: kVp accuracy and reproducibility	7	625	24.2%
21. Equipment RAD MAM QC: Exposure output vs. kVp	6	626	20.8%
22. Equipment RAD MAM QC: Evaluate the quality of phantom images	7	625	51.4%
23. Equipment RAD MAM QC: Patient dose	9	623	33.9%
24. Equipment RAD MAM QC: Entrance skin exposure (ESE)	6	626	18.8%
25. Equipment RAD MAM QC: Compression	6	626	34.8%
26. FO QC: Automatic exposure rate control (AERC)	10	622	16.4%
27. FO QC: Five-minute timer	15	617	18.2%
28. FO QC: Beam quality (half-value layer)	12	620	14.4%
29. FO QC: Beam limitation/collimation	11	621	19.0%
30. FO QC: Low and high contrast resolution	14	618	18.3%
31. FO QC: Evaluate the quality of phantom images	12	620	22.6%
32. FO QC: Patient dose	11	621	25.3%
33. FO QC: Entrance exposure rate (EER)	15	617	15.1%
34. FO QC: Source to skin distance (e.g., C-arm spacers)	15	617	16.9%
35. MRI QC: Center frequency	14	618	9.2%
36. MRI QC: Transmit gain	15	617	9.1%
37. MRI QC: Geometric accuracy	14	618	9.4%
38. MRI QC: Spatial resolution	14	618	10.0%
39. MRI QC: Contrast resolution.	14	618	10.4%
40. MRI QC: Magnetic field homogeneity	14	618	8.4%
41. MRI QC: Slice position accuracy	16	616	8.9%
42. MRI QC: Slice thickness accuracy	18	614	9.1%
43. MRI QC: Image artifacts	15	617	12.6%
44. MRI QC: Visual inspection of equipment	32	600	15.8%
45. MRI QC: RF Coils Signal-to-noise ratio	17	615	8.9%
46. MRI QC: RF Coils Image intensity uniformity	19	613	8.6%
47. MRI QC: RF Coils Percent signal ghosting	22	610	7.4%

48. CT QC: Water CT number	12	620	16.5%
49. CT QC: Standard deviation	12	620	16.0%
50. CT QC: Alignment light accuracy	15	617	14.4%
51. CT QC: Spatial resolution	13	619	15.8%
52. CT QC: Contrast resolution	14	618	16.0%
53. CT QC: Image uniformity	13	619	16.0%
54. CT QC: Noise	13	619	15.8%
55. CT QC: CT number accuracy	14	618	15.4%
56. CT QC: Patient dose	12	620	20.6%
57. CT QC: Linearity	15	617	13.8%
58. CT QC: Image artifacts	17	615	19.5%
59. CT QC: Visual inspection of equipment	35	597	21.1%
60. RTT QC: Calibration board for isocenter	26	606	1.7%
61. RTT QC: System calibration of all stations	22	610	2.1%
62. SON QC: Penetration/Sensitivity/Depth of visualization	16	616	6.3%
63. SON QC: Distance accuracy	16	616	6.3%
64. SON QC: Image uniformity	18	614	8.1%
65. SON QC: Fidelity of image display	17	615	8.0%
66. SON QC: Visual inspection of equipment	19	613	12.6%
67. Bone densitometry units to include phantom scans to detect shift or drift (longitudinal QC)	17	615	17.1%
68. Testing of digital display monitors (e.g., SMPTE test pattern)	15	617	42.5%
69. Testing of viewboxes and viewing conditions	16	616	34.7%
70. Testing of hard copy printers for digital systems	15	617	35.3%
71. PACS troubleshooting	14	618	41.9%
72. Shielding devices (e.g., gloves, aprons, table drapes)	19	613	52.0%
73. Occupational radiation exposure management (e.g., radiation monitoring badges)	14	618	51.5%
74. Safe Medical Devices Act (SMDA)	19	613	31.8%
75. National Commission on Radiation Protection and Measurements (NCRP) and/or American Association of Physicists in Medicine (AAPM)	21	611	33.6%
76. Health Insurance Portability and Accountability Act (HIPAA)	15	617	54.6%
77. Mammography Quality Standards Act (MQSA)	21	611	43.0%
78. Modality specific accreditation (e.g., American College of Radiology [ACR], Intersocietal Accreditation Commission [IAC] or equivalent accreditation program)	18	614	61.6%
79. Material Safety Data Sheets (MSDS)	14	618	49.8%
80. Bloodborne pathogen procedures	14	618	45.8%
81. Medicare and other payer regulations	17	615	27.2%
82. Medicare Improvements for Patients and Providers Act (MIPPA)	17	615	20.5%
83. Safety related staff education	15	617	61.4%
84. Onsite inspections	15	617	71.5%
85. Facility accreditation agencies (e.g., TJC, DNV, HFAP)	19	613	43.9%
86. Federal regulatory bodies (e.g., FDA, OSHA)	17	615	56.9%
87. State regulations	12	620	70.5%
88. Instruct staff regarding quality control responsibilities and procedures	22	610	75.9%
89. Plan staff development workshops or seminars	27	605	47.1%
90. Conduct staff development workshops to provide feedback regarding performance improvement data	22	610	47.0%
91. Schedule equipment for maintenance or repair	21	611	74.8%
92. Follow-up evaluation of equipment after service is performed	24	608	73.7%
93. Recommend purchase specifications for imaging equipment or medical imaging products	21	611	54.8%

94. Provide technical information to architects, physicists, and others in the design of imaging facilities	19	613	45.4%
95. Review and update record keeping procedures of QI data	20	612	72.5%
96. Review reports and recommend action as necessary	20	612	70.9%
97. Prepare data summaries and statistical reports	24	608	61.5%
98. Review ROC analyses to compare diagnostic accuracy of different imaging procedures	26	606	23.6%
99. Arrange for data-driven corrective action	24	608	47.0%
100. Review and update quality policies and procedures	29	603	70.5%
101. Make recommendations for assigning QI or QC responsibilities to staff technologists	21	611	66.3%
102. Meet with other staff (e.g., administrators, radiologists, physicists) to discuss quality improvement programs and procedures	19	613	75.0%
103. Investigate incidents which may have quality or safety implications	19	613	70.1%
104. Report sentinel events	25	607	61.8%
105. Establish schedule and procedures for reject-repeat analysis program	22	610	62.3%
106. Identify and develop logistic quality indicators (e.g., patient waiting time, appointment availability)	22	610	46.7%
107. Identify and develop clinical quality indicators (e.g., exam appropriateness, communication of critical findings).	22	610	49.8%
108. Identify and develop procedural quality indicators (e.g., preprocedural time-out, correct patient/side/site)	21	611	49.9%
109. Identify and develop quality indicators for high-volume, high risk, and problem-prone indicators	19	613	41.3%
110. Collect data based on logistic quality indicators (e.g., patient waiting time, appointment availability)	20	612	44.6%
111. Collect data based on clinical quality indicators (e.g., exam appropriateness, communication of critical findings)	22	610	45.7%
112. Collect data based on procedural quality indicators (e.g., preprocedural time-out, correct patient/side/site)	22	610	43.9%
113. Collect data, or oversee data collection from patients using surveys, checklists, or other survey methods	23	609	38.9%
114. Collect data, or oversee data collection from staff using surveys, checklists, or other survey methods	23	609	42.4%
115. Collect QI data from department records or facility database	24	608	52.5%
116. Participate in risk and safety management activities	25	607	60.0%
117. Participate in patient dose tracking and/or monitoring programs	21	611	49.8%
118. Participate in project management teams	23	609	58.8%
119. Participate in primary source verification of professional credentials	27	605	46.1%
120. Participate in activities to help meet ISO 9000 standards	28	604	17.2%
121. Participate in efficient management strategies (e.g., Six Sigma, Lean Improvement Process)	21	611	41.1%
122. Participate in strategic planning process	27	605	45.6%
123. Identify and solve problems using various QI tools (e.g., flowcharts diagrams, graphs, plots, and brainstorming).	22	610	58.5%
124. Develop internal and external benchmarking	24	608	41.0%
125. Identify and develop action plans based on findings	24	608	53.1%
126. Engage in formal process improvement models (e.g., SWOT, FMEA)	26	606	35.1%
127. Participate in development of departmental emergency plans for natural and manmade disasters	22	610	41.3%
128. Serve on radiation safety committee	25	607	41.7%

129. Develop and revise technique charts, including exposure ranges for digital systems	25	607	48.6%
130. Recommend and/or participate in HR hiring and staffing decisions	24	608	52.8%
131. Participate in CPT coding	28	604	34.3%

Table F.1 Note: Tasks with less than 40% responsibility are highlighted in red.

Table F.2: Summary of Task Statements with at Least 40% Responsibility

Type of Tasks	Total Number of Tasks	Tasks with at Least 40%
Analog QC for RAD or MAM	3	0
Digital QC for RAD or MAM	9	7
Equipment QC for RAD or MAM	13	1
FO QC	9	0
MRI QC	13	0
CT QC	12	0
RTT QC	2	0
SON QC	5	0
Other QC	6	3
Laws, Regulations, Standards, Guidelines, and Radiation Protection	15	11
QI	44	39
Total Number of Tasks	131	61

Table F.3: Percent Responsible for Full-Time versus Part-Time

Task Statement	Significant Difference	%Resp Full-Time	%Resp Part-Time
1. Analog RAD MAM QC: Film screen QC	0	14.1%	18.4%
2. Analog RAD MAM QC: Processor QC	0	21.3%	24.5%
3. Analog RAD MAM QC: Darkroom QC	0	8.2%	14.3%
4. Digital RAD MAM QC: Cleanliness of image receptors	0	58.8%	50.0%
5. Digital RAD MAM QC: Erasure of CR imaging plates	0	38.8%	29.2%
6. Digital RAD MAM QC: detector performance (e.g., sharpness, noise)	0	55.8%	46.9%
7. Digital RAD MAM QC: Testing of CR image systems	0	34.4%	18.8%
8. Digital RAD MAM QC: Testing of DR image systems	0	44.1%	32.7%
9. Digital RAD MAM QC: Visual inspection of digital radiographic equipment	0	62.3%	53.1%
10. Digital RAD MAM QC: Evaluate the quality of phantom images	0	60.3%	45.8%
11. Digital RAD MAM QC: Patient dose	0	49.1%	34.7%
12. Digital RAD MAM QC: Image artifacts	0	70.2%	67.3%
13. Equipment RAD MAM QC: AEC response	0	25.9%	22.4%
14. Equipment RAD MAM QC: Timer accuracy and reproducibility	0	21.7%	16.3%
15. Equipment RAD MAM QC: Beam quality (half-value layer)	0	18.0%	14.3%
16. Equipment RAD MAM QC: Grid centering and uniformity of exposure	0	26.4%	20.4%
17. Equipment RAD MAM QC: Light field-radiation field congruency	0	25.3%	20.4%
18. Equipment RAD MAM QC: Spatial resolution	0	25.5%	14.3%
19. Equipment RAD MAM QC: mA linearity	0	20.8%	12.2%
20. Equipment RAD MAM QC: kVp accuracy and reproducibility	0	24.8%	16.3%
21. Equipment RAD MAM QC: Exposure output vs. kVp	0	21.3%	14.3%
22. Equipment RAD MAM QC: Evaluate the quality of phantom images	0	52.3%	40.8%
23. Equipment RAD MAM QC: Patient dose	0	34.4%	27.1%
24. Equipment RAD MAM QC: Entrance skin exposure (ESE)	0	19.2%	14.3%
25. Equipment RAD MAM QC: Compression	0	35.0%	32.7%
26. FO QC: Automatic exposure rate control (AERC)	0	16.7%	12.8%
27. FO QC: Five-minute timer	0	18.9%	8.7%
28. FO QC: Beam quality (half-value layer)	0	14.7%	10.6%
29. FO QC: Beam limitation/collimation	0	19.3%	14.9%
30. FO QC: Low and high contrast resolution	0	18.7%	12.8%
31. FO QC: Evaluate the quality of phantom images	0	23.0%	17.0%
32. FO QC: Patient dose	0	25.8%	19.1%
33. FO QC: Entrance exposure rate (EER)	0	15.3%	12.8%
34. FO QC: Source to skin distance (e.g., C-arm spacers)	0	17.2%	12.8%
35. MRI QC: Center frequency	0	9.1%	10.6%
36. MRI QC: Transmit gain	0	8.9%	10.6%
37. MRI QC: Geometric accuracy	0	9.1%	12.8%
38. MRI QC: Spatial resolution	0	9.8%	12.8%
39. MRI QC: Contrast resolution.	0	10.2%	12.8%
40. MRI QC: Magnetic field homogeneity	0	8.2%	10.6%
41. MRI QC: Slice position accuracy	0	9.0%	8.5%
42. MRI QC: Slice thickness accuracy	0	9.2%	8.5%
43. MRI QC: Image artifacts	0	12.6%	12.8%
44. MRI QC: Visual inspection of equipment	0	15.8%	15.9%
45. MRI QC: RF Coils Signal-to-noise ratio	0	9.0%	8.5%
46. MRI QC: RF Coils Image intensity uniformity	0	8.7%	8.5%
47. MRI QC: RF Coils Percent signal ghosting	0	7.3%	8.5%
48. CT QC: Water CT number	0	16.6%	14.6%
49. CT QC: Standard deviation	0	16.1%	14.6%
50. CT QC: Alignment light accuracy	0	14.8%	10.4%
51. CT QC: Spatial resolution	0	16.1%	12.5%

52. CT QC: Contrast resolution	0	16.1%	14.6%
53. CT QC: Image uniformity	0	16.5%	10.4%
54. CT QC: Noise	0	16.1%	12.5%
55. CT QC: CT number accuracy	0	15.6%	12.5%
56. CT QC: Patient dose	0	21.0%	16.7%
57. CT QC: Linearity	0	14.1%	10.4%
58. CT QC: Image artifacts	0	19.7%	17.0%
59. CT QC: Visual inspection of equipment	0	21.2%	20.0%
60. RTT QC: Calibration board for isocenter	0	1.8%	0.0%
61. RTT QC: System calibration of all stations	0	2.3%	0.0%
62. SON QC: Penetration/Sensitivity/Depth of visualization	0	6.7%	2.2%
63. SON QC: Distance accuracy	0	6.7%	2.2%
64. SON QC: Image uniformity	0	8.6%	2.2%
65. SON QC: Fidelity of image display	0	8.4%	2.2%
66. SON QC: Visual inspection of equipment	0	13.4%	2.2%
67. Bone densitometry units to include phantom scans to detect shift or drift (longitudinal QC)	0	16.9%	19.6%
68. Testing of digital display monitors (e.g., SMPTE test pattern)	0	43.3%	31.9%
69. Testing of viewboxes and viewing conditions	0	34.4%	38.3%
70. Testing of hard copy printers for digital systems	0	35.4%	34.8%
71. PACS troubleshooting	0	43.0%	28.3%
72. Shielding devices (e.g., gloves, aprons, table drapes)	0	52.3%	48.9%
73. Occupational radiation exposure management (e.g., radiation monitoring badges)	0	51.6%	50.0%
74. Safe Medical Devices Act (SMDA)	0	32.5%	23.4%
75. National Commission on Radiation Protection and Measurements (NCRP) and/or American Association of Physicists in Medicine (AAPM)	0	33.6%	33.3%
76. Health Insurance Portability and Accountability Act (HIPAA)	0	55.1%	48.9%
77. Mammography Quality Standards Act (MQSA)	0	43.4%	38.6%
78. Modality specific accreditation (e.g., American College of Radiology [ACR], Intersocietal Accreditation Commission [IAC] or equivalent accreditation program)	0	61.0%	68.8%
79. Material Safety Data Sheets (MSDS)	0	49.7%	51.1%
80. Bloodborne pathogen procedures	0	45.4%	50.0%
81. Medicare and other payer regulations	0	27.8%	19.1%
82. Medicare Improvements for Patients and Providers Act (MIPPA)	0	21.3%	10.9%
83. Safety related staff education	0	61.7%	58.3%
84. Onsite inspections	0	70.9%	78.3%
85. Facility accreditation agencies (e.g., TJC, DNV, HFAP)	0	45.2%	27.7%
86. Federal regulatory bodies (e.g., FDA, OSHA)	0	57.0%	56.3%
87. State regulations	0	70.8%	66.7%
88. Instruct staff regarding quality control responsibilities and procedures	0	75.9%	76.1%
89. Plan staff development workshops or seminars	0	47.9%	37.0%
90. Conduct staff development workshops to provide feedback regarding performance improvement data	0	48.0%	34.8%
91. Schedule equipment for maintenance or repair	0	74.3%	80.4%
92. Follow-up evaluation of equipment after service is performed	0	73.3%	78.3%
93. Recommend purchase specifications for imaging equipment or medical imaging products	0	55.5%	46.7%
94. Provide technical information to architects, physicists, and others in the design of imaging facilities	0	46.2%	34.8%
95. Review and update record keeping procedures of QI data	0	72.4%	73.9%
96. Review reports and recommend action as necessary	0	70.8%	71.7%
97. Prepare data summaries and statistical reports	0	62.3%	51.1%
98. Review ROC analyses to compare diagnostic accuracy of different imaging procedures	0	24.1%	17.4%

99. Arrange for data-driven corrective action	0	48.0%	34.8%
100. Review and update quality policies and procedures	0	70.3%	73.3%
101. Make recommendations for assigning QI or QC responsibilities to staff technologists	0	67.4%	52.2%
102. Meet with other staff (e.g., administrators, radiologists, physicists) to discuss quality improvement programs and procedures	0	75.3%	71.7%
103. Investigate incidents which may have quality or safety implications	0	70.5%	65.2%
104. Report sentinel events	0	62.0%	58.7%
105. Establish schedule and procedures for reject-repeat analysis program	0	62.1%	64.4%
106. Identify and develop logistic quality indicators (e.g., patient waiting time, appointment availability)	0	46.8%	45.7%
107. Identify and develop clinical quality indicators (e.g., exam appropriateness, communication of critical findings).	0	50.7%	39.1%
108. Identify and develop procedural quality indicators (e.g., preprocedural time-out, correct patient/side/site)	0	50.6%	41.3%
109. Identify and develop quality indicators for high-volume, high risk, and problem-prone indicators	0	42.2%	30.4%
110. Collect data based on logistic quality indicators (e.g., patient waiting time, appointment availability)	0	45.4%	34.8%
111. Collect data based on clinical quality indicators (e.g., exam appropriateness, communication of critical findings)	0	46.6%	34.8%
112. Collect data based on procedural quality indicators (e.g., preprocedural time-out, correct patient/side/site)	0	44.7%	34.8%
113. Collect data, or oversee data collection from patients using surveys, checklists, or other survey methods	0	39.3%	34.8%
114. Collect data, or oversee data collection from staff using surveys, checklists, or other survey methods	0	43.0%	34.8%
115. Collect QI data from department records or facility database	0	53.8%	35.6%
116. Participate in risk and safety management activities	0	60.2%	56.5%
117. Participate in patient dose tracking and/or monitoring programs	0	50.6%	39.1%
118. Participate in project management teams	0	59.5%	50.0%
119. Participate in primary source verification of professional credentials	0	46.5%	41.3%
120. Participate in activities to help meet ISO 9000 standards	0	17.5%	13.3%
121. Participate in efficient management strategies (e.g., Six Sigma, Lean Improvement Process)	0	42.1%	28.3%
122. Participate in strategic planning process	0	46.8%	31.1%
123. Identify and solve problems using various QI tools (e.g., flowcharts diagrams, graphs, plots, and brainstorming).	0	59.4%	47.8%
124. Develop internal and external benchmarking	0	42.3%	23.9%
125. Identify and develop action plans based on findings	0	54.3%	39.1%
126. Engage in formal process improvement models (e.g., SWOT, FMEA)	0	36.4%	20.0%
127. Participate in development of departmental emergency plans for natural and manmade disasters	0	41.7%	37.0%
128. Serve on radiation safety committee	0	42.2%	34.8%
129. Develop and revise technique charts, including exposure ranges for digital systems	0	48.7%	47.8%
130. Recommend and/or participate in HR hiring and staffing decisions	0	53.9%	39.1%
131. Participate in CPT coding	0	34.8%	28.3%

Table F.3 Note: Tasks with statistically significant differences are marked with a 1 and highlighted in yellow.

Table F.4: Percent Responsible for QM Certified and Registered versus Not

Task Statement	Significant Difference	%Resp QM	%Resp not QM
1. Analog RAD MAM QC: Film screen QC	0	13.5%	15.0%
2. Analog RAD MAM QC: Processor QC	0	26.0%	19.0%
3. Analog RAD MAM QC: Darkroom QC	0	12.1%	6.8%
4. Digital RAD MAM QC: Cleanliness of image receptors	0	66.7%	53.4%
5. Digital RAD MAM QC: Erasure of CR imaging plates	0	41.7%	36.0%
6. Digital RAD MAM QC: detector performance (e.g., sharpness, noise)	0	63.7%	50.3%
7. Digital RAD MAM QC: Testing of CR image systems	0	39.5%	29.7%
8. Digital RAD MAM QC: Testing of DR image systems	0	53.3%	37.5%
9. Digital RAD MAM QC: Visual inspection of digital radiographic equipment	0	72.1%	55.7%
10. Digital RAD MAM QC: Evaluate the quality of phantom images	1	74.3%	50.6%
11. Digital RAD MAM QC: Patient dose	0	56.8%	42.9%
12. Digital RAD MAM QC: Image artifacts	0	81.5%	63.5%
13. Equipment RAD MAM QC: AEC response	0	27.8%	24.4%
14. Equipment RAD MAM QC: Timer accuracy and reproducibility	0	23.3%	20.1%
15. Equipment RAD MAM QC: Beam quality (half-value layer)	0	19.9%	16.5%
16. Equipment RAD MAM QC: Grid centering and uniformity of exposure	0	27.2%	25.2%
17. Equipment RAD MAM QC: Light field-radiation field congruency	0	28.3%	23.0%
18. Equipment RAD MAM QC: Spatial resolution	0	27.0%	23.3%
19. Equipment RAD MAM QC: mA linearity	0	20.5%	20.0%
20. Equipment RAD MAM QC: kVp accuracy and reproducibility	0	23.1%	24.8%
21. Equipment RAD MAM QC: Exposure output vs. kVp	0	21.2%	20.5%
22. Equipment RAD MAM QC: Evaluate the quality of phantom images	0	64.2%	44.1%
23. Equipment RAD MAM QC: Patient dose	0	39.7%	30.6%
24. Equipment RAD MAM QC: Entrance skin exposure (ESE)	0	23.0%	16.5%
25. Equipment RAD MAM QC: Compression	1	49.6%	26.5%
26. FO QC: Automatic exposure rate control (AERC)	0	14.2%	17.6%
27. FO QC: Five-minute timer	0	17.1%	18.7%
28. FO QC: Beam quality (half-value layer)	0	13.5%	14.9%
29. FO QC: Beam limitation/collimation	0	17.4%	19.9%
30. FO QC: Low and high contrast resolution	0	16.6%	19.2%
31. FO QC: Evaluate the quality of phantom images	0	22.9%	22.4%
32. FO QC: Patient dose	0	23.7%	26.2%
33. FO QC: Entrance exposure rate (EER)	0	15.3%	14.9%
34. FO QC: Source to skin distance (e.g., C-arm spacers)	0	16.1%	17.3%
35. MRI QC: Center frequency	0	7.6%	10.1%
36. MRI QC: Transmit gain	0	7.2%	10.1%
37. MRI QC: Geometric accuracy	0	7.6%	10.4%
38. MRI QC: Spatial resolution	0	9.0%	10.6%
39. MRI QC: Contrast resolution.	0	9.4%	10.9%
40. MRI QC: Magnetic field homogeneity	0	7.6%	8.9%
41. MRI QC: Slice position accuracy	0	7.2%	9.9%
42. MRI QC: Slice thickness accuracy	0	7.2%	10.2%
43. MRI QC: Image artifacts	0	11.7%	13.2%
44. MRI QC: Visual inspection of equipment	0	14.3%	16.7%
45. MRI QC: RF Coils Signal-to-noise ratio	0	7.2%	9.9%
46. MRI QC: RF Coils Image intensity uniformity	0	6.8%	9.7%
47. MRI QC: RF Coils Percent signal ghosting	0	6.4%	7.9%
48. CT QC: Water CT number	0	17.8%	15.7%
49. CT QC: Standard deviation	0	16.9%	15.4%
50. CT QC: Alignment light accuracy	0	14.7%	14.2%
51. CT QC: Spatial resolution	0	17.4%	14.9%
52. CT QC: Contrast resolution	0	17.4%	15.2%

53. CT QC: Image uniformity	0	17.0%	15.4%
54. CT QC: Noise	0	17.8%	14.7%
55. CT QC: CT number accuracy	0	16.1%	14.9%
56. CT QC: Patient dose	0	22.2%	19.7%
57. CT QC: Linearity	0	14.3%	13.5%
58. CT QC: Image artifacts	0	21.0%	18.7%
59. CT QC: Visual inspection of equipment	0	22.5%	20.3%
60. RTT QC: Calibration board for isocenter	0	0.9%	2.1%
61. RTT QC: System calibration of all stations	0	2.3%	2.1%
62. SON QC: Penetration/Sensitivity/Depth of visualization	0	7.1%	5.9%
63. SON QC: Distance accuracy	0	7.1%	5.9%
64. SON QC: Image uniformity	0	8.5%	7.9%
65. SON QC: Fidelity of image display	0	7.6%	8.2%
66. SON QC: Visual inspection of equipment	0	13.9%	11.8%
67. Bone densitometry units to include phantom scans to detect shift or drift (longitudinal QC)	1	25.4%	12.3%
68. Testing of digital display monitors (e.g., SMPTE test pattern)	0	54.7%	35.5%
69. Testing of viewboxes and viewing conditions	1	49.8%	26.1%
70. Testing of hard copy printers for digital systems	1	48.9%	27.6%
71. PACS troubleshooting	0	45.1%	40.1%
72. Shielding devices (e.g., gloves, aprons, table drapes)	0	55.1%	50.3%
73. Occupational radiation exposure management (e.g., radiation monitoring badges)	0	48.7%	53.0%
74. Safe Medical Devices Act (SMDA)	0	34.2%	30.4%
75. National Commission on Radiation Protection and Measurements (NCRP) and/or American Association of Physicists in Medicine (AAPM)	0	37.1%	31.5%
76. Health Insurance Portability and Accountability Act (HIPAA)	0	53.3%	55.4%
77. Mammography Quality Standards Act (MQSA)	1	59.8%	33.3%
78. Modality specific accreditation (e.g., American College of Radiology [ACR], Intersocietal Accreditation Commission [IAC] or equivalent accreditation program)	0	66.8%	58.6%
79. Material Safety Data Sheets (MSDS)	0	48.0%	50.9%
80. Bloodborne pathogen procedures	0	43.1%	47.3%
81. Medicare and other payer regulations	0	29.5%	25.8%
82. Medicare Improvements for Patients and Providers Act (MIPPA)	0	24.0%	18.5%
83. Safety related staff education	0	58.0%	63.4%
84. Onsite inspections	0	70.0%	72.3%
85. Facility accreditation agencies (e.g., TJC, DNV, HFAP)	0	44.4%	43.6%
86. Federal regulatory bodies (e.g., FDA, OSHA)	0	58.9%	55.8%
87. State regulations	0	70.2%	70.6%
88. Instruct staff regarding quality control responsibilities and procedures	0	71.6%	78.4%
89. Plan staff development workshops or seminars	0	47.3%	47.0%
90. Conduct staff development workshops to provide feedback regarding performance improvement data	0	47.1%	47.0%
91. Schedule equipment for maintenance or repair	0	72.0%	76.4%
92. Follow-up evaluation of equipment after service is performed	0	71.9%	74.7%
93. Recommend purchase specifications for imaging equipment or medical imaging products	0	55.6%	54.4%
94. Provide technical information to architects, physicists, and others in the design of imaging facilities	0	48.4%	43.6%
95. Review and update record keeping procedures of QI data	0	71.1%	73.4%
96. Review reports and recommend action as necessary	0	69.3%	71.8%
97. Prepare data summaries and statistical reports	0	62.2%	61.1%
98. Review ROC analyses to compare diagnostic accuracy of different imaging procedures	0	22.3%	24.3%
99. Arrange for data-driven corrective action	0	46.0%	47.7%

100. Review and update quality policies and procedures	0	69.4%	71.1%
101. Make recommendations for assigning QI or QC responsibilities to staff technologists	0	68.3%	65.1%
102. Meet with other staff (e.g., administrators, radiologists, physicists) to discuss quality improvement programs and procedures	0	70.2%	77.8%
103. Investigate incidents which may have quality or safety implications	0	68.9%	70.9%
104. Report sentinel events	0	58.0%	64.0%
105. Establish schedule and procedures for reject-repeat analysis program	0	66.4%	59.9%
106. Identify and develop logistic quality indicators (e.g., patient waiting time, appointment availability)	0	46.9%	46.6%
107. Identify and develop clinical quality indicators (e.g., exam appropriateness, communication of critical findings).	0	45.7%	52.2%
108. Identify and develop procedural quality indicators (e.g., preprocedural time-out, correct patient/side/site)	0	45.1%	52.7%
109. Identify and develop quality indicators for high-volume, high risk, and problem-prone indicators	0	39.1%	42.5%
110. Collect data based on logistic quality indicators (e.g., patient waiting time, appointment availability)	0	44.9%	44.4%
111. Collect data based on clinical quality indicators (e.g., exam appropriateness, communication of critical findings)	0	42.2%	47.8%
112. Collect data based on procedural quality indicators (e.g., preprocedural time-out, correct patient/side/site)	0	40.9%	45.7%
113. Collect data, or oversee data collection from patients using surveys, checklists, or other survey methods	0	38.2%	39.3%
114. Collect data, or oversee data collection from staff using surveys, checklists, or other survey methods	0	41.8%	42.7%
115. Collect QI data from department records or facility database	0	49.1%	54.4%
116. Participate in risk and safety management activities	0	54.7%	63.0%
117. Participate in patient dose tracking and/or monitoring programs	0	49.6%	49.9%
118. Participate in project management teams	0	54.7%	61.2%
119. Participate in primary source verification of professional credentials	0	46.2%	46.1%
120. Participate in activities to help meet ISO 9000 standards	0	14.0%	19.1%
121. Participate in efficient management strategies (e.g., Six Sigma, Lean Improvement Process)	0	42.2%	40.4%
122. Participate in strategic planning process	0	45.0%	46.0%
123. Identify and solve problems using various QI tools (e.g., flowcharts diagrams, graphs, plots, and brainstorming).	0	59.8%	57.8%
124. Develop internal and external benchmarking	0	44.2%	39.1%
125. Identify and develop action plans based on findings	0	50.4%	54.7%
126. Engage in formal process improvement models (e.g., SWOT, FMEA)	0	35.7%	34.8%
127. Participate in development of departmental emergency plans for natural and manmade disasters	0	36.9%	43.9%
128. Serve on radiation safety committee	0	37.9%	43.9%
129. Develop and revise technique charts, including exposure ranges for digital systems	0	51.1%	47.1%
130. Recommend and/or participate in HR hiring and staffing decisions	0	48.4%	55.4%
131. Participate in CPT coding	0	32.7%	35.2%

Table F.4 Note: Tasks with statistically significant differences are marked with a 1 and highlighted in yellow.

Table F.5: Percent Responsible for QM Primary Discipline versus Not

Task Statement	Significant Difference	%Resp Primary	%Resp Not Primary
1. Analog RAD MAM QC: Film screen QC	0	10.0%	15.8%
2. Analog RAD MAM QC: Processor QC	0	19.7%	22.2%
3. Analog RAD MAM QC: Darkroom QC	0	6.4%	9.2%
4. Digital RAD MAM QC: Cleanliness of image receptors	0	54.6%	60.3%
5. Digital RAD MAM QC: Erasure of CR imaging plates	0	38.4%	38.2%
6. Digital RAD MAM QC: detector performance (e.g., sharpness, noise)	0	64.1%	53.0%
7. Digital RAD MAM QC: Testing of CR image systems	0	44.9%	30.0%
8. Digital RAD MAM QC: Testing of DR image systems	0	55.6%	39.6%
9. Digital RAD MAM QC: Visual inspection of digital radiographic equipment	0	64.1%	61.6%
10. Digital RAD MAM QC: Evaluate the quality of phantom images	0	62.0%	59.4%
11. Digital RAD MAM QC: Patient dose	0	63.1%	43.6%
12. Digital RAD MAM QC: Image artifacts	0	71.1%	70.6%
13. Equipment RAD MAM QC: AEC response	0	34.5%	23.2%
14. Equipment RAD MAM QC: Timer accuracy and reproducibility	0	31.7%	18.8%
15. Equipment RAD MAM QC: Beam quality (half-value layer)	1	29.6%	14.4%
16. Equipment RAD MAM QC: Grid centering and uniformity of exposure	0	36.6%	23.0%
17. Equipment RAD MAM QC: Light field-radiation field congruency	0	36.2%	21.8%
18. Equipment RAD MAM QC: Spatial resolution	0	32.4%	22.7%
19. Equipment RAD MAM QC: mA linearity	0	31.7%	17.0%
20. Equipment RAD MAM QC: kVp accuracy and reproducibility	0	34.5%	21.2%
21. Equipment RAD MAM QC: Exposure output vs. kVp	0	32.4%	17.4%
22. Equipment RAD MAM QC: Evaluate the quality of phantom images	0	53.9%	51.4%
23. Equipment RAD MAM QC: Patient dose	1	50.0%	29.4%
24. Equipment RAD MAM QC: Entrance skin exposure (ESE)	1	34.5%	14.4%
25. Equipment RAD MAM QC: Compression	0	33.6%	36.1%
26. FO QC: Automatic exposure rate control (AERC)	1	28.9%	12.6%
27. FO QC: Five-minute timer	1	30.2%	15.1%
28. FO QC: Beam quality (half-value layer)	1	26.8%	10.8%
29. FO QC: Beam limitation/collimation	0	31.0%	16.0%
30. FO QC: Low and high contrast resolution	1	32.4%	14.3%
31. FO QC: Evaluate the quality of phantom images	0	35.2%	19.0%
32. FO QC: Patient dose	1	39.4%	21.8%
33. FO QC: Entrance exposure rate (EER)	1	29.8%	10.9%
34. FO QC: Source to skin distance (e.g., C-arm spacers)	1	28.9%	13.4%
35. MRI QC: Center frequency	0	10.6%	8.7%
36. MRI QC: Transmit gain	0	11.4%	8.3%
37. MRI QC: Geometric accuracy	0	11.3%	8.7%
38. MRI QC: Spatial resolution	0	12.8%	9.2%
39. MRI QC: Contrast resolution.	0	13.5%	9.4%
40. MRI QC: Magnetic field homogeneity	0	10.6%	7.6%
41. MRI QC: Slice position accuracy	0	12.1%	7.9%
42. MRI QC: Slice thickness accuracy	0	12.1%	8.1%
43. MRI QC: Image artifacts	0	16.3%	11.7%
44. MRI QC: Visual inspection of equipment	0	19.4%	14.6%
45. MRI QC: RF Coils Signal-to-noise ratio	0	11.3%	8.1%
46. MRI QC: RF Coils Image intensity uniformity	0	12.1%	7.7%
47. MRI QC: RF Coils Percent signal ghosting	0	9.3%	6.8%
48. CT QC: Water CT number	0	17.5%	16.6%
49. CT QC: Standard deviation	0	17.5%	15.9%
50. CT QC: Alignment light accuracy	0	17.5%	13.7%

51. CT QC: Spatial resolution	0	18.9%	15.2%
52. CT QC: Contrast resolution	0	18.9%	15.5%
53. CT QC: Image uniformity	0	18.9%	15.5%
54. CT QC: Noise	0	17.6%	15.7%
55. CT QC: CT number accuracy	0	17.5%	15.1%
56. CT QC: Patient dose	0	28.0%	18.8%
57. CT QC: Linearity	0	17.6%	12.8%
58. CT QC: Image artifacts	0	23.1%	19.0%
59. CT QC: Visual inspection of equipment	0	27.3%	19.6%
60. RTT QC: Calibration board for isocenter	0	0.7%	1.8%
61. RTT QC: System calibration of all stations	0	1.4%	2.3%
62. SON QC: Penetration/Sensitivity/Depth of visualization	0	9.9%	5.4%
63. SON QC: Distance accuracy	0	9.9%	5.4%
64. SON QC: Image uniformity	0	13.6%	6.7%
65. SON QC: Fidelity of image display	0	12.8%	6.7%
66. SON QC: Visual inspection of equipment	0	19.0%	11.0%
67. Bone densitometry units to include phantom scans to detect shift or drift (longitudinal QC)	0	14.2%	17.9%
68. Testing of digital display monitors (e.g., SMPTE test pattern)	0	48.3%	41.2%
69. Testing of viewboxes and viewing conditions	0	34.3%	35.2%
70. Testing of hard copy printers for digital systems	0	38.0%	35.0%
71. PACS troubleshooting	0	47.2%	40.3%
72. Shielding devices (e.g., gloves, aprons, table drapes)	0	65.2%	48.5%
73. Occupational radiation exposure management (e.g., radiation monitoring badges)	0	57.3%	49.7%
74. Safe Medical Devices Act (SMDA)	0	44.0%	28.1%
75. National Commission on Radiation Protection and Measurements (NCRP) and/or American Association of Physicists in Medicine (AAPM)	1	51.4%	28.8%
76. Health Insurance Portability and Accountability Act (HIPAA)	0	59.4%	53.3%
77. Mammography Quality Standards Act (MQSA)	0	43.7%	44.3%
78. Modality specific accreditation (e.g., American College of Radiology [ACR], Intersocietal Accreditation Commission [IAC] or equivalent accreditation program)	0	64.1%	61.0%
79. Material Safety Data Sheets (MSDS)	0	52.4%	49.4%
80. Bloodborne pathogen procedures	0	45.8%	45.8%
81. Medicare and other payer regulations	0	35.2%	25.2%
82. Medicare Improvements for Patients and Providers Act (MIPPA)	0	28.7%	17.9%
83. Safety related staff education	0	76.1%	57.4%
84. Onsite inspections	0	83.9%	68.0%
85. Facility accreditation agencies (e.g., TJC, DNV, HFAP)	0	58.0%	40.6%
86. Federal regulatory bodies (e.g., FDA, OSHA)	0	68.1%	54.4%
87. State regulations	0	85.3%	66.0%
88. Instruct staff regarding quality control responsibilities and procedures	0	82.5%	73.8%
89. Plan staff development workshops or seminars	0	60.6%	43.0%
90. Conduct staff development workshops to provide feedback regarding performance improvement data	0	61.1%	42.9%
91. Schedule equipment for maintenance or repair	0	69.7%	76.6%
92. Follow-up evaluation of equipment after service is performed	0	72.0%	74.2%
93. Recommend purchase specifications for imaging equipment or medical imaging products	0	57.6%	53.4%
94. Provide technical information to architects, physicists, and others in the design of imaging facilities	0	53.5%	42.8%
95. Review and update record keeping procedures of QI data	0	84.0%	68.8%
96. Review reports and recommend action as necessary	0	84.6%	66.2%
97. Prepare data summaries and statistical reports	0	75.7%	56.8%
98. Review ROC analyses to compare diagnostic accuracy of different	1	37.9%	19.1%

imaging procedures			
99. Arrange for data-driven corrective action	0	64.3%	41.2%
100. Review and update quality policies and procedures	0	81.4%	66.9%
101. Make recommendations for assigning QI or QC responsibilities to staff technologists	0	76.2%	62.8%
102. Meet with other staff (e.g., administrators, radiologists, physicists) to discuss quality improvement programs and procedures	0	87.5%	71.1%
103. Investigate incidents which may have quality or safety implications	0	84.0%	65.6%
104. Report sentinel events	0	64.3%	60.7%
105. Establish schedule and procedures for reject-repeat analysis program	0	72.0%	59.5%
106. Identify and develop logistic quality indicators (e.g., patient waiting time, appointment availability)	0	50.3%	45.7%
107. Identify and develop clinical quality indicators (e.g., exam appropriateness, communication of critical findings).	0	57.3%	47.2%
108. Identify and develop procedural quality indicators (e.g., preprocedural time-out, correct patient/side/site)	0	60.8%	47.1%
109. Identify and develop quality indicators for high-volume, high risk, and problem-prone indicators	0	54.9%	37.1%
110. Collect data based on logistic quality indicators (e.g., patient waiting time, appointment availability)	0	57.6%	40.3%
111. Collect data based on clinical quality indicators (e.g., exam appropriateness, communication of critical findings)	0	59.9%	40.7%
112. Collect data based on procedural quality indicators (e.g., preprocedural time-out, correct patient/side/site)	0	58.7%	39.2%
113. Collect data, or oversee data collection from patients using surveys, checklists, or other survey methods	0	47.9%	35.9%
114. Collect data, or oversee data collection from staff using surveys, checklists, or other survey methods	0	56.9%	37.6%
115. Collect QI data from department records or facility database	0	69.0%	47.3%
116. Participate in risk and safety management activities	0	73.4%	55.6%
117. Participate in patient dose tracking and/or monitoring programs	1	71.3%	42.7%
118. Participate in project management teams	0	72.7%	54.9%
119. Participate in primary source verification of professional credentials	0	54.2%	43.9%
120. Participate in activities to help meet ISO 9000 standards	0	22.7%	15.2%
121. Participate in efficient management strategies (e.g., Six Sigma, Lean Improvement Process)	0	52.1%	37.9%
122. Participate in strategic planning process	0	55.9%	42.8%
123. Identify and solve problems using various QI tools (e.g., flowcharts diagrams, graphs, plots, and brainstorming).	0	73.4%	53.7%
124. Develop internal and external benchmarking	0	56.6%	36.1%
125. Identify and develop action plans based on findings	0	66.2%	49.0%
126. Engage in formal process improvement models (e.g., SWOT, FMEA)	0	49.0%	30.6%
127. Participate in development of departmental emergency plans for natural and manmade disasters	0	51.4%	38.5%
128. Serve on radiation safety committee	0	53.9%	38.0%
129. Develop and revise technique charts, including exposure ranges for digital systems	0	63.6%	45.0%
130. Recommend and/or participate in HR hiring and staffing decisions	0	48.9%	54.1%
131. Participate in CPT coding	0	36.2%	33.3%

Table F.5 Note: Tasks with statistically significant differences are marked with a1 and highlighted in yellow.

Table F.6: Percent Responsible for Secondary Discipline versus Not

Task Statement	Significant Difference	%Resp Secondary	%Resp Not Secondary
1. Analog RAD MAM QC: Film screen QC	0	16.4%	12.5%
2. Analog RAD MAM QC: Processor QC	0	22.9%	20.4%
3. Analog RAD MAM QC: Darkroom QC	0	9.7%	7.3%
4. Digital RAD MAM QC: Cleanliness of image receptors	0	65.9%	51.2%
5. Digital RAD MAM QC: Erasure of CR imaging plates	0	39.2%	36.8%
6. Digital RAD MAM QC: detector performance (e.g., sharpness, noise)	0	60.8%	50.3%
7. Digital RAD MAM QC: Testing of CR image systems	0	34.4%	32.4%
8. Digital RAD MAM QC: Testing of DR image systems	0	46.1%	40.8%
9. Digital RAD MAM QC: Visual inspection of digital radiographic equipment	0	65.8%	58.3%
10. Digital RAD MAM QC: Evaluate the quality of phantom images	0	66.0%	53.8%
11. Digital RAD MAM QC: Patient dose	0	48.8%	47.6%
12. Digital RAD MAM QC: Image artifacts	0	74.3%	66.9%
13. Equipment RAD MAM QC: AEC response	0	27.4%	24.6%
14. Equipment RAD MAM QC: Timer accuracy and reproducibility	0	23.1%	20.8%
15. Equipment RAD MAM QC: Beam quality (half-value layer)	0	18.0%	18.3%
16. Equipment RAD MAM QC: Grid centering and uniformity of exposure	0	27.4%	24.6%
17. Equipment RAD MAM QC: Light field-radiation field congruency	0	25.3%	24.9%
18. Equipment RAD MAM QC: Spatial resolution	0	26.3%	23.9%
19. Equipment RAD MAM QC: mA linearity	0	21.5%	19.7%
20. Equipment RAD MAM QC: kVp accuracy and reproducibility	0	24.4%	24.6%
21. Equipment RAD MAM QC: Exposure output vs. kVp	0	21.0%	21.1%
22. Equipment RAD MAM QC: Evaluate the quality of phantom images	0	57.8%	46.0%
23. Equipment RAD MAM QC: Patient dose	0	33.6%	35.1%
24. Equipment RAD MAM QC: Entrance skin exposure (ESE)	0	17.3%	21.5%
25. Equipment RAD MAM QC: Compression	0	41.0%	29.8%
26. FO QC: Automatic exposure rate control (AERC)	0	14.7%	18.5%
27. FO QC: Five-minute timer	0	15.8%	21.9%
28. FO QC: Beam quality (half-value layer)	0	13.1%	16.4%
29. FO QC: Beam limitation/collimation	0	18.5%	21.0%
30. FO QC: Low and high contrast resolution	0	16.5%	21.1%
31. FO QC: Evaluate the quality of phantom images	0	24.2%	21.8%
32. FO QC: Patient dose	0	25.8%	26.6%
33. FO QC: Entrance exposure rate (EER)	0	14.9%	16.2%
34. FO QC: Source to skin distance (e.g., C-arm spacers)	0	16.5%	18.0%
35. MRI QC: Center frequency	0	9.7%	8.7%
36. MRI QC: Transmit gain	0	9.3%	8.8%
37. MRI QC: Geometric accuracy	0	10.0%	8.7%
38. MRI QC: Spatial resolution	0	10.3%	9.8%
39. MRI QC: Contrast resolution.	0	10.7%	10.1%
40. MRI QC: Magnetic field homogeneity	0	9.0%	7.7%
41. MRI QC: Slice position accuracy	0	9.7%	8.1%
42. MRI QC: Slice thickness accuracy	0	9.8%	8.4%
43. MRI QC: Image artifacts	0	13.4%	11.9%
44. MRI QC: Visual inspection of equipment	0	16.4%	14.9%
45. MRI QC: RF Coils Signal-to-noise ratio	0	9.8%	8.0%
46. MRI QC: RF Coils Image intensity uniformity	0	9.5%	8.1%
47. MRI QC: RF Coils Percent signal ghosting	0	8.5%	6.3%
48. CT QC: Water CT number	0	17.3%	16.3%
49. CT QC: Standard deviation	0	16.0%	16.7%
50. CT QC: Alignment light accuracy	0	15.1%	14.3%

51. CT QC: Spatial resolution	0	15.7%	16.7%
52. CT QC: Contrast resolution	0	15.4%	17.4%
53. CT QC: Image uniformity	0	16.1%	16.7%
54. CT QC: Noise	0	15.7%	16.7%
55. CT QC: CT number accuracy	0	16.1%	15.3%
56. CT QC: Patient dose	0	20.3%	21.9%
57. CT QC: Linearity	0	14.0%	14.0%
58. CT QC: Image artifacts	0	19.0%	20.8%
59. CT QC: Visual inspection of equipment	0	18.9%	23.9%
60. RTT QC: Calibration board for isocenter	0	1.3%	1.8%
61. RTT QC: System calibration of all stations	0	1.3%	2.8%
62. SON QC: Penetration/Sensitivity/Depth of visualization	0	7.3%	5.6%
63. SON QC: Distance accuracy	0	7.3%	5.6%
64. SON QC: Image uniformity	0	9.3%	7.4%
65. SON QC: Fidelity of image display	0	9.3%	7.0%
66. SON QC: Visual inspection of equipment	0	13.8%	11.9%
67. Bone densitometry units to include phantom scans to detect shift or drift (longitudinal QC)	0	20.6%	13.0%
68. Testing of digital display monitors (e.g., SMPTE test pattern)	0	46.8%	39.0%
69. Testing of viewboxes and viewing conditions	0	41.9%	28.0%
70. Testing of hard copy printers for digital systems	0	39.1%	32.5%
71. PACS troubleshooting	0	46.7%	36.9%
72. Shielding devices (e.g., gloves, aprons, table drapes)	0	55.2%	49.8%
73. Occupational radiation exposure management (e.g., radiation monitoring badges)	0	55.8%	46.7%
74. Safe Medical Devices Act (SMDA)	0	32.8%	30.9%
75. National Commission on Radiation Protection and Measurements (NCRP) and/or American Association of Physicists in Medicine (AAPM)	0	30.9%	37.6%
76. Health Insurance Portability and Accountability Act (HIPAA)	0	55.5%	53.8%
77. Mammography Quality Standards Act (MQSA)	0	49.0%	38.8%
78. Modality specific accreditation (e.g., American College of Radiology [ACR], Intersocietal Accreditation Commission [IAC] or equivalent accreditation program)	0	69.7%	53.6%
79. Material Safety Data Sheets (MSDS)	0	55.3%	44.5%
80. Bloodborne pathogen procedures	0	48.5%	42.6%
81. Medicare and other payer regulations	0	27.9%	27.0%
82. Medicare Improvements for Patients and Providers Act (MIPPA)	0	21.6%	19.1%
83. Safety related staff education	0	62.5%	61.0%
84. Onsite inspections	0	77.1%	66.2%
85. Facility accreditation agencies (e.g., TJC, DNV, HFAP)	0	47.2%	42.0%
86. Federal regulatory bodies (e.g., FDA, OSHA)	0	62.5%	52.4%
87. State regulations	0	74.6%	66.3%
88. Instruct staff regarding quality control responsibilities and procedures	0	82.1%	69.3%
89. Plan staff development workshops or seminars	0	49.7%	44.4%
90. Conduct staff development workshops to provide feedback regarding performance improvement data	0	49.5%	44.5%
91. Schedule equipment for maintenance or repair	0	84.2%	65.1%
92. Follow-up evaluation of equipment after service is performed	0	84.4%	62.2%
93. Recommend purchase specifications for imaging equipment or medical imaging products	0	58.4%	49.8%
94. Provide technical information to architects, physicists, and others in the design of imaging facilities	0	49.5%	40.9%
95. Review and update record keeping procedures of QI data	0	79.9%	64.5%
96. Review reports and recommend action as necessary	0	77.9%	62.8%
97. Prepare data summaries and statistical reports	0	65.7%	56.6%
98. Review ROC analyses to compare diagnostic accuracy of different	0	24.3%	22.6%

imaging procedures			
99. Arrange for data-driven corrective action	0	49.5%	43.6%
100. Review and update quality policies and procedures	0	77.0%	63.2%
101. Make recommendations for assigning QI or QC responsibilities to staff technologists	0	71.5%	60.0%
102. Meet with other staff (e.g., administrators, radiologists, physicists) to discuss quality improvement programs and procedures	0	79.5%	70.1%
103. Investigate incidents which may have quality or safety implications	0	73.6%	66.0%
104. Report sentinel events	0	67.3%	55.2%
105. Establish schedule and procedures for reject-repeat analysis program	0	70.5%	53.8%
106. Identify and develop logistic quality indicators (e.g., patient waiting time, appointment availability)	0	49.3%	43.6%
107. Identify and develop clinical quality indicators (e.g., exam appropriateness, communication of critical findings).	0	55.3%	43.3%
108. Identify and develop procedural quality indicators (e.g., preprocedural time-out, correct patient/side/site)	0	53.3%	46.9%
109. Identify and develop quality indicators for high-volume, high risk, and problem-prone indicators	0	43.2%	38.8%
110. Collect data based on logistic quality indicators (e.g., patient waiting time, appointment availability)	0	43.6%	44.8%
111. Collect data based on clinical quality indicators (e.g., exam appropriateness, communication of critical findings)	0	46.2%	43.9%
112. Collect data based on procedural quality indicators (e.g., preprocedural time-out, correct patient/side/site)	0	44.0%	43.3%
113. Collect data, or oversee data collection from patients using surveys, checklists, or other survey methods	0	38.5%	38.4%
114. Collect data, or oversee data collection from staff using surveys, checklists, or other survey methods	0	41.7%	42.4%
115. Collect QI data from department records or facility database	0	55.1%	49.3%
116. Participate in risk and safety management activities	0	58.4%	61.0%
117. Participate in patient dose tracking and/or monitoring programs	0	45.7%	53.3%
118. Participate in project management teams	0	60.9%	56.9%
119. Participate in primary source verification of professional credentials	0	51.5%	40.6%
120. Participate in activities to help meet ISO 9000 standards	0	16.4%	17.4%
121. Participate in efficient management strategies (e.g., Six Sigma, Lean Improvement Process)	0	39.1%	43.1%
122. Participate in strategic planning process	0	47.5%	43.9%
123. Identify and solve problems using various QI tools (e.g., flowcharts diagrams, graphs, plots, and brainstorming).	0	59.5%	56.9%
124. Develop internal and external benchmarking	0	42.0%	39.8%
125. Identify and develop action plans based on findings	0	55.1%	50.5%
126. Engage in formal process improvement models (e.g., SWOT, FMEA)	0	32.1%	37.5%
127. Participate in development of departmental emergency plans for natural and manmade disasters	0	42.1%	40.5%
128. Serve on radiation safety committee	0	44.5%	38.9%
129. Develop and revise technique charts, including exposure ranges for digital systems	0	52.8%	45.5%
130. Recommend and/or participate in HR hiring and staffing decisions	0	56.6%	48.6%
131. Participate in CPT coding	0	34.8%	32.8%

Table F.6 Note: Tasks with statistically significant differences are marked with a1 and highlighted in yellow.

Table F.7: Summary of Number Tasks on the Approved Task Inventory for Various Practice Analyses

	Practice Analysis				
Type of Tasks	1996	2002	2008	2012	2017
Analog QC for RAD or MAM	27	27	26	14	0
Digital QC for RAD or MAM	0	0	10	11	7
Equipment QC for RAD or MAM	14	15	13	13	0
FO QC	1	8	8	9	0
Other QC	2	2	2	3	3
Laws, Regulations, Standards, Guidelines, and Radiation Protection	9	8	8	15	13
QI	32	32	31	40	41
Total Number of Tasks	85	92	98	105	64

Table F.8: Summary of Tasks with at Least 80% Responsibility for Various Disciplines

Discipline	Number of Surveyed Tasks	Number of Tasks with at Least 80% Responsibility
Radiography (RAD)	149	81
Radiation Therapy (RTT)	143	83
Nuclear Medicine Technology (NMT)	118	51
Magnetic Resonance Imaging (MRI)	132	67
Sonography (SON)	89	38
Computed Tomography (CT)	123	79
Vascular-Interventional Radiography (VI)	123	58
Cardiac-Interventional Radiography (CI)	99	49
Mammography (MAM)	105	38
Bone Densitometry (BD)	61	39
Vascular Sonography (VS)	117	63
Breast Sonography (BS)	60	45
Registered Radiologic Assistant (RRA)	97	17
Quality Management (QM)	131	0

Appendix G

Recommended QM Task Inventory

Quality Management

Certification and registration requirements for quality management (QM) are based on the results of a comprehensive practice analysis conducted by The American Registry of Radiologic Technologists® (ARRT®) staff and the Quality Management Practice Analysis and Continuing Qualifications Requirements (CQR) Advisory Committee. The purpose of the practice analysis is to identify job responsibilities typically required of QM technologists at entry into the profession. The results of the practice analysis are reflected in this document. The purpose of the task inventory is to list or delineate those responsibilities. The task inventory is the foundation for both the clinical experience requirements and the content specifications.

Basis of Task Inventory

In 2016, the ARRT surveyed a large, national sample of QM technologists to identify their responsibilities. When evaluating survey results, the advisory committee applied a 40% guideline. That is, to be included on the task inventory, an activity must have been the responsibility of at least 40% of QM technologists. The advisory committee could include an activity that did not meet the 40% criterion if there was a compelling rationale to do so (e.g., a task that falls below the 40% guideline but is expected to rise above the 40% guideline in the near future).

Application to Clinical Experience Requirements

The purpose of the clinical experience requirements is to verify that candidates have completed a subset of the clinical procedures within QM. Successful performance of these fundamental procedures, in combination with mastery of the cognitive knowledge and skills covered by the QM examination, provides the basis for acquisition of the full range of clinical skills required in a variety of settings. An activity must appear on the task inventory to be considered for inclusion in the clinical experience requirements. For an activity to be designated as a mandatory requirement, survey results had to indicate the vast majority of QM technologists performed that activity. The advisory committee designated clinical activities performed by fewer technologists or which are carried out only in selected settings, as elective. The clinical experience requirements are available from ARRT's website (www.arrt.org) and appear in the *Quality Management Certification and Registration Handbook* also located on the ARRT website.

Application to Content Specifications

The purpose of the ARRT QM Examination is to assess the knowledge and cognitive skills underlying the intelligent performance of the tasks typically required of QM technologists at entry into the profession. The content specifications identify the knowledge areas underlying performance of the tasks on the task inventory. Every content category can be linked to one or more activities on the task inventory. Note that each activity on the task inventory is followed by a content category that identifies the section of the content specifications corresponding to that activity. The content specifications are available from ARRT's website (www.arrt.org) and appear in the *Quality Management Certification and Registration Handbook*.

	Activity	Content Categories Legend: PC = Patient Care, S = Safety, P = Procedures
	Perform, interpret, or analyze the following digital radiography QC tests (including mammography):	
1.	Cleanliness of image receptors.	P.1.A.1., P.1.A.5.
2.	Digital detector performance (*e.g., resolution, noise).	P.1.A.3.
3.	Testing of DR image systems.	P.1.A.
4.	Visual inspection of digital radiographic equipment.	P.1.A.1.
5.	Evaluate the quality of phantom images.	P.1.A.3.
6.	Patient dose.	S.1.C.
7.	Image artifacts.	P.1.A.5.
	Perform, interpret, or analyze QC tests on the following specialized units:	
8.	Testing of digital display monitors (e.g., SMPTE test pattern).	P.1.B.1.
9.	PACS troubleshooting.	P.1.B.2.
10.	Shielding devices (e.g., gloves, aprons, table drapes).	P.1.B.3.
	Assure that department or facility is in compliance with the following recommendations, standards, or regulations:	
11.	Occupational radiation exposure management (e.g., radiation monitoring badges).	S.1.C.2.
12.	Safe Medical Devices Act (SMDA) and Food and Drug Administration (FDA).	S.1.A.1.C.
13.	National Commission on Radiation Protection and Measurements (NCRP) and/or American Association of Physicists in Medicine (AAPM).	S.1.B.1., S.1.B.3.
14.	Health Insurance Portability and Accountability Act (HIPAA).	S.1.A.1.E.
15.	Mammography Quality Standards Act (MQSA).	S.1.A.1.B.
16.	Modality specific accreditation (e.g., American College of Radiology [ACR] or equivalent accreditation program).	S.1.A.1.F.
17.	Material Safety Data Sheets (MSDS).	S.1.A.1.D.2.
18.	Bloodborne pathogen procedures.	S.1.A.1.D.1.
19.	Safety related staff education.	PC.2.F., S.1.A., S.1.B., S.1.C.
20.	Onsite inspections.	PC.2.F.5., PC.2.F.7, S.1.A., S.1.B.
21.	Facility accreditation agencies (e.g., IAC, TJC, DNV).	S.1.A.1.F.
22.	Federal Regulatory Bodies (e.g., FDA, OSHA).	S.1.A.1.
23.	State regulations.	PC.2.F.5., PC.2.F.7., S.1.A.1.F.

	Activity	Content Categories Legend: PC = Patient Care, S = Safety, P = Procedures
	QI Management and Administration:	
24.	Instruct staff regarding quality control responsibilities and procedures.	PC.2.F.
25.	Plan staff development workshops or seminars.	PC.2.F.1.
26.	Conduct staff development workshops to provide feedback regarding performance improvement data.	PC.2.F.1.
27.	Schedule equipment for maintenance or repair.	PC.2.F.2.
28.	Follow-up evaluation of equipment after service is performed.	PC.2.F.2.
29.	Recommend purchase specifications for imaging equipment or medical imaging products.	PC.2.E.4., PC.2.F.6.
30.	Provide technical information to architects, physicists, and others in the design of imaging facilities.	PC.2.E.4., PC.2.F.
31.	Review and update record keeping procedures of QI data.	PC.2.F.5.
32.	Review reports and recommend action as necessary.	PC.2.F.
33.	Prepare data summaries and statistical reports.	PC.2.C., PC.2.D.
34.	Arrange for data-driven corrective action.	PC.2.D., PC.2.E.
35.	Review and update quality policies and procedures.	PC.2.E.2.
36.	Make recommendations for assigning QI or QC responsibilities to staff technologists.	PC.2.E.5., PC.2.F.4., PC.2.F.5.
37.	Meet with other staff (e.g., administrators, radiologists, physicists) to discuss quality improvement programs and procedures.	PC.1.A., PC.2.D.
38.	Investigate incidents which may have quality or safety implications.	PC.2.A., S.1.
39.	Report sentinel events.	PC.2.E.3.
40.	Establish schedule and procedures for reject-repeat analysis program.	PC.2.B.7., PC.2.C.
41.	Identify or develop logistic quality indicators (e.g., patient waiting time, appointment availability).	PC.1.A., PC.2.A.2., PC.2.B., PC.2.D.
42.	Identify or develop clinical quality indicators (e.g., exam appropriateness, communication of critical findings).	PC.1.A., PC.2.A.1., PC.2.B., PC.2.E.
43.	Identify and develop procedural quality indicators (e.g., preprocedural time-out, correct patient/side/site).	PC.1.A., PC.2.A.1.
44.	Identify and develop quality indicators for high-volume, high risk, and problem-prone indicators.	PC.1.A., PC.2.A.2., PC.2.B.
45.	Collect data based on logistic quality indicators (e.g., patient waiting time, appointment availability).	PC.2.A.2., PC.2.C.
46.	Collect data based on clinical quality indicators (e.g., exam appropriateness, communication of critical findings).	PC.2.A., PC.2.B., PC.2.C.
47.	Collect data based on procedural quality indicators (e.g., preprocedural time-out, correct patient/side/site).	PC.2.B., PC.2.C.

Activity		Content Categories Legend: PC = Patient Care, S = Safety, P = Procedures
48.	Collect data, or oversee data collection from patients using surveys, checklists, or other survey methods.	PC.2.B., PC.2.C.
49.	Collect data, or oversee data collection from staff using surveys, checklists, or other survey methods.	PC.1.D., PC.2.B.
50.	Collect QI data from department records or facility database.	PC.2.B.
51.	Participate in risk and safety management activities.	PC.2.A.2., PC.2.B., PC.2.C., PC.2.D., PC.2.E.3.
52.	Participate in patient dose tracking and/or monitoring programs.	PC.2.A.2.C., PC.2.B.8., S.1.C.1.
53.	Participate in project management teams.	PC.2.A., PC.2.B.3.
54.	Participate in primary source verification of professional credentials.	PC.2.B.2.
55.	Participate on efficient management strategies (e.g., Six Sigma, Lean Improvement Process).	PC.1.C.
56.	Participate in strategic planning process.	PC.1.A.
57.	Identify and solve problems using various QI tools (e.g., flowcharts, diagrams, graphs, plots, and brainstorming).	PC.1.A., PC.1.B.
58.	Develop internal and external benchmarking.	PC.2.D.
59.	Identify and develop action plans based on findings.	PC.2.E.
60.	Engage in formal process improvement models (e.g., SWOT, FMEA).	PC.1.C.
61.	Participate in development of departmental emergency plans for natural and manmade disasters.	PC.2.F.7.
62.	Serve on radiation safety committee.	PC.2.F.3., S.1.C.
63.	Develop and revise technique charts, including exposure ranges for digital systems.	PC.2.E.6.
64.	Recommend and/or participate in HR hiring and staffing decisions.	PC.2.E.5., PC.2.F.4.

Appendix H

Mixture Rasch Model Results

Table H.1: Mixture Rasch Model Fit Measures for QM Data

Numbers of Latent Classes	AIC	BIC	CAIC
1	71606	73549	73987
2	64938	68829	69706
3	62074	**67912**	**69228**
4	61312	69080	70831
5	**59391**	69124	71318
6	59506	71187	73820
7	Did Not Converge	Did Not Converge	Did Not Converge

Table H.2: Summary of Tasks with at Least 40% Responsibility for Different Latent Classes for QM Data

		Latent Class				
Type of Tasks	Total Number of Tasks	1	2	3	4	5
Analog QC for RAD or MAM	3	0	0	0	0	0
Digital QC for RAD or MAM	9	6	9	9	6	0
Equipment QC for RAD or MAM	13	2	12	2	2	0
FO QC	9	0	9	0	0	0
MRI QC	13	0	0	0	13	0
CT QC	12	0	0	0	12	0
RTT QC	2	0	0	0	0	0
SON QC	5	0	0	0	0	0
Other QC	6	5	2	2	4	0
Laws, Regulations, Standards, Guidelines, and Radiation Protection	15	5	8	8	12	14
QI	44	13	15	30	42	42
Total Number of Tasks	131	31	55	51	90	56
Total Number of People		153	70	146	92	164

Table H.3: Percentage of People Holding Different Credentials for Different Latent Classes

Latent Class	QM	RAD	MAM	NMT	RTT	SON	MRI	CT	BD
1	51%	100%	95%	0%	0%	0%	1%	9%	9%
2	40%	97%	20%	4%	4%	0%	6%	14%	4%
3	26%	99%	21%	2%	0%	0%	3%	10%	3%
4	34%	99%	20%	4%	1%	0%	36%	59%	5%
5	32%	93%	28%	10%	5%	0%	8%	4%	2%

Table H.4: Average Percentage of Time Spent Working in Different Areas for Different Latent Classes

Latent Class	% of Time Imaging	% of Time QC	% of Time QI	% of Time Management	% of Time Other
1	59%	18%	8%	11%	4%
2	32%	34%	14%	10%	10%
3	45%	15%	13%	21%	6%
4	40%	16%	14%	27%	4%
5	15%	7%	27%	44%	7%

Table H.5: Percentage of People with Different Job Titles for Different Latent Classes

Latent Class	Staff Technologist	Lead/Chief Technologist	Administrator or Manager	Other
1	61%	23%	10%	6%
2	44%	13%	9%	35%
3	36%	34%	12%	18%
4	29%	33%	32%	7%
5	12%	20%	56%	13%

Appendix I

Summary of Professional Comments

Table I.1: Demographics of Who Responded to Public Comment Survey

Job Title	N	%
QM Technologist	12	28.6%
Manager or Supervisor	9	21.4%
Educator	5	11.9%
Radiologist	4	9.5%
Other	12	28.6%
Total Number of Items	42	

Table I.2: Responses to Content Related Changes

Question	N	% Agree
Retitling Major Sections	38	68.4%
Retitling and Dividing QI into Two Sections	38	50.0%
Moving Laws, Regulations, Standards, and Guidelines to Safety Section	36	77.0%
Moving QC to Procedures	35	74.3%
Removing MIPPA	33	69.7%
Adding Radiation Protection	36	97.2%
Removing Analog QC	34	82.4%
Removing CR QC	35	51.4%
Removing FO QC	34	44.1%
Removing BD QC	36	63.9%
Removing CT QC	33	42.4%
Removing Viewboxes	35	85.7%
Removing Laser Printers	34	76.5%
Removing Test Instrumentation	34	41.2%
Overall Changes Made to Content Specifications	34	61.8%

Table I.3: Responses to Clinical Experience Requirement Related Changes

Question	N	% Agree
Removing Equipment QC	34	50.0%
Removing Analog QC	35	88.6%
Adding New QI Activities	34	94.1%
Overall Changes Made to Clinical Experience Requirements	32	71.9%

Appendix J

Recommended QM Content Specifications

Quality Management

The purpose of the quality management examination is to assess the knowledge and cognitive skills underlying the intelligent performance of the tasks typically required of quality management technologists at entry into the profession. The tasks typically performed were determined by administering a comprehensive practice analysis survey to a nationwide sample of quality management technologists.[1] The *Task Inventory for Quality Management* may be found on the ARRT's website (www.arrt.org).

The *Examination Content Specifications for Quality Management* identify the knowledge areas underlying performance of the tasks on the *Task Inventory for Quality Management.* Every content category can be linked to one or more tasks on the task inventory.

The table below presents the major content categories and subcategories covered on the examination. The number of test questions in each category are listed in bold and number of test questions in each subcategory in parentheses. Specific topics within each category are addressed in the content outline, which makes up the remaining pages of this document.

Content Category	**Number of Scored Questions[2]**
Patient Care	50
Concepts and Principles of Quality Improvement (17)	
Applications of Quality Improvement and Operational Management (33)	
Safety[3]	25
Laws, Regulations, Standards, Guidelines, and Radiation Protection (25)	
Procedures	15
Quality Control (QC) (15)	
Total	**90**

1. A special debt of gratitude is due to the hundreds of professionals participating in this project as committee members, survey respondents and reviewers.
2. The exam includes an additional 40 unscored (pilot) questions.
3. SI Units are the primary (principal) units of radiation measurement used on this examination.

Patient Care

1. Concepts and Principles of Quality Improvement (QI)

A. Foundations of QI
   1. customer focus
   2. planned, systematic evaluation
   3. process orientation
   4. data driven

B. Problem Solving Strategies
   1. define basic process components
      a. supplier
      b. input
      c. action (activity)
      d. output (outcome)
      e. customer
   2. identify process variables
      a. supplier
      b. input
      c. action (activity)
   3. identify quality characteristics
      a. output (outcome)
      b. customer

C. Process Improvement Models
   1. find, organize, clarify, understand, select (FOCUS)
   2. plan, do, check, act (PDCA)
   3. focus, analyze, develop, execute (FADE)
   4. strengths, weaknesses, opportunities, threats (SWOT)
   5. failure mode and effects analysis (FMEA)
   6. Six Sigma
   7. lean process improvement

D. Tools for Problem Identification and Analysis
   1. group dynamics (*e.g., focus groups, brainstorming)
   2. problem solving tools (e.g., flow charts, decision matrices, affinity charts, nine block grids)
   3. information analysis (e.g., histograms, Pareto charts, control charts, Shewhart charts)
   4. root cause analysis (e.g., fishbone diagrams)

*The abbreviation “e.g.,” is used to indicate that examples are listed in parentheses, but that it is not a complete list of all possibilities.

(Patient Care continues on the following page.)

Patient Care (continued)

2. Applications of Quality Improvement and Operational Management

A. Development of Indicators
   1. clinical and procedural quality indicators
      a. appropriateness of care
      b. continuity of care
      c. effectiveness of care
      d. efficacy of care
      e. efficiency of care
      f. respect and caring
      g. safety in the care environment (e.g., time-out, correct patient/side/site, fall prevention)
      h. timeliness of care
      i. cost of care
      j. availability of care
   2. Target Areas for Improvement
      a. high volume (e.g., chest x ray)
      b. high risk (e.g., angiography)
      c. problem prone (e.g., IV contrast use, dose creep)
      d. sentinel events

B. Data Collection Methods
   1. surveys and questionnaires
   2. facility database (e.g., staff credential verification and sentinel events)
   3. focus groups
   4. log entries
   5. record audits and reviews
   6. peer review
   7. reject/repeat analysis
   8. national and regional registries (e.g., dose reporting)

C. Data Analysis
   1. measures of frequency (e.g., counts, percents, rates and ratios)
   2. measures of central tendency (e.g., mean, median, mode)
   3. measures of variation (e.g., range, standard deviation, variance, reproducibility, validity, reliability, precision, accuracy)

D. Assessment of Outcomes
   1. identification of reference standards
      a. internal benchmarks (e.g., baseline performance, local customer expectations)
      b. external (e.g., government regulations, national norms, practice standards)
   2. comparison of outcomes to reference standards

E. Evidence Based Improvement Implementation
   1. action plans
   2. update policies and procedures
   3. incident response
   4. equipment evaluation/purchase recommendations
   5. staffing recommendations
   6. update imaging protocols

F. Operational Management
   1. staffing education
   2. maintenance and preventative maintenance
   3. committee membership and activities
   4. recommendation for staffing assignments
   5. maintain QC/QI documentation
   6. utilization and appropriateness management
   7. maintain policies and procedures

Safety

1. Laws, Regulations, Standards, Guidelines, and Radiation Protection

A. Laws and Regulations
   1. Food and Drug Administration (FDA)
      a. Code of Federal Regulations (CFR) TITLE 21, PART 1020
   2. Mammography Quality Standards Act (MQSA) CFR TITLE 21, PART 900
      a. general provisions
      b. documentation requirements (e.g., credentials, continuing experience and education, surveys, policies and procedures)
   3. Safe Medical Devices Act (SMDA) CFR TITLE 21, PART 807.92
      a. general provisions
      b. reporting procedures
   4. Occupational Safety and Health Administration (OSHA) CFR TITLE 29, PART 1910
      a. bloodborne pathogens/ CDC Standard Precautions
      b. material safety data sheet (MSDS)
      c. reporting procedures
   5. Health Insurance Portability and Accounting Act (HIPAA) CFR TITLE 45, PART 160
      a. general provisions
      b. reporting procedures
   6. Accreditation Agency Programs (e.g., ACR, IAC, TJC, DNV, CMS)

B. Standards and Guidelines
   1. National Council on Radiation Protection (NCRP) Recommendations
      a. Report No. 99, Sections 1, 6 and 7
      b. Report No.105, Sections 1, 2, 6, 7 and 8.4
      c. Report No.114
      d. Report No.147, Sections 1, 2 and 3
      e. Report No.160, Sections 3, 4.1-4.3 and 7
      f. Report No.168, Sections 3, 4, 5 and 6
      g. Report No. 172, exclude dental and nuclear medicine sections
   2. American College of Radiology (ACR) Technical Standards
   3. American Association of Physicists in Medicine (AAPM)
      a. Task Group 18
      b. Report No. 60
      c. Report No. 93
      d. Report No. 94
      e. Report No. 96
      f. Report No. 111
      g. Report No. 116
      h. Report No. 151
      i. Report No. 160
   4. American Society of Radiologic Technologists (ASRT) Practice Standards
   5. Conference of Radiation Control Program Directors (CRCPD) publications
   6. American Registry of Radiologic Technologists (ARRT) Standards of Ethics

C. Radiation Protection (e.g., Radiography, Fluoroscopy, Computed Tomography)
   1. patient dose tracking
   2. occupational dose management

Procedure

1. Quality Control

A. Digital Radiography*
   1. visual inspection of equipment
   2. exposure indicator value (e.g., EI, target exposure indicator (EIT), deviation index [DI])
   3. phantom tests to evaluate for contrast, spatial resolution and noise
   4. system malfunctions
   5. image artifacts

B. Ancillary Equipment Evaluation
   1. image display devices
      a. luminance
      b. ambient light (illuminance)
      c. spatial resolution
      d. contrast resolution/dynamic range
      e. digital display test pattern
         (e.g., SMPTE, AAPM TG-18)
   2. PACS (e.g., compression, file size, integrity of data transmission)
   3. radiation protection devices
      a. protective apparel
      b. shielding devices

* The questions in section A will focus on concepts that are common to both general radiography and mammography

Appendix K

Recommended QM Structured Education Requirements

Quality Management

The purpose of structured education is to provide the opportunity for individuals to develop mastery of discipline-specific knowledge that, when coupled with selected clinical experiences, helps to document qualifications. The *Structured Education Requirements for Quality Management* is provided to assist candidates with these requirements.

Candidates for quality management certification and registration must document at least 16 hours of structured education[1]. The activities must be earned within the 24-month period immediately prior to submission of an application for certification and registration. Structured education activities may be academic courses from an institution accredited by a mechanism recognized by the ARRT[2], CE opportunities approved by a RCEEM or RCEEM+, or a combination of the two.

Structured education documentation must include at least one CE credit or its equivalent in each content category listed below (i.e., Patient Care, Safety, Image Production, and Procedures). The remaining hours may be earned from any one or more of the content areas. Specific topics within each category are addressed in the content outline, which makes up the remaining pages of this document.

Content Category	**Minimum Credit Hours**
Patient Care (includes)	1
Concepts and Principles of Quality Improvement	
Applications of Quality Improvement and Operational Management	
Safety (includes)	1
Laws, Regulations, Standards, Guidelines, and Radiation Protection	
Procedures (includes)	1
Quality Control (QC)	
Total	**16**

Acceptable Examples:

Example 1	Example 2	Example 3
Patient Care – 5 hours Safety – 4 hours Procedures – 7 hours	Patient Care – 14 hours Safety – 1 hour Procedures – 1 hour	Patient Care – 1 hour Safety – 7 hours Procedures – 8 hours
TOTAL – 16 hours	TOTAL – 16 hours	TOTAL – 16 hours

[1] If there is a structured education requirement document with a newer effective date, you may either use the new document or continue to use this document if you have completed at least one educational activity prior to the effective date of the new version. For more information access the online clinical experience tool, where structured education is also reported.

[2] Activities meeting the definition of an approved academic course will be awarded credit at the rate of 12 CE credits for each academic **quarter** credit or 16 CE credits for each academic **semester** credit. See the ARRT *Continuing Education Requirements* document for additional information.

Patient Care

1. Concepts and Principles of Quality Improvement (QI)

A. Foundations of QI
   1. customer focus
   2. planned, systematic evaluation
   3. process orientation
   4. data driven

B. Problem Solving Strategies
   1. define basic process components
      f. supplier
      g. input
      h. action (activity)
      i. output (outcome)
      j. customer
   2. identify process variables
      a. supplier
      b. input
      c. action (activity)
   3. identify quality characteristics
      a. output (outcome)
      b. customer

C. Process Improvement Models
   1. find, organize, clarify, understand, select (FOCUS)
   2. plan, do, check, act (PDCA)
   3. focus, analyze, develop, execute (FADE)
   4. strengths, weaknesses, opportunities, threats (SWOT)
   5. failure mode and effects analysis (FMEA)
   6. Six Sigma
   7. lean process improvement

D. Tools for Problem Identification and Analysis
   1. group dynamics (*e.g., focus groups, brainstorming)
   2. problem solving tools (e.g., flow charts, decision matrices, affinity charts, nine block grids)
   3. information analysis (e.g., histograms, Pareto charts, control charts, Shewhart charts)
   4. root cause analysis (e.g., fishbone diagrams)

*The abbreviation “e.g.,” is used to indicate that examples are listed in parentheses, but that it is not a complete list of all possibilities.

(Patient Care continues on the following page.)

Patient Care (continued)

2. Applications of Quality Improvement and Operational Management

A. Development of Indicators
   1. clinical and procedural quality indicators
      a. appropriateness of care
      b. continuity of care
      c. effectiveness of care
      d. efficacy of care
      e. efficiency of care
      k. respect and caring
      l. safety in the care environment (e.g., time-out, correct patient/side/site, fall prevention)
      m. timeliness of care
      n. cost of care
      o. availability of care
   2. Target Areas for Improvement
      a. high volume (e.g., chest x ray)
      b. high risk (e.g., angiography)
      c. problem prone (e.g., IV contrast use, dose creep)
      d. sentinel events

B. Data Collection Methods
   1. surveys and questionnaires
   2. facility database (e.g., staff credential verification and sentinel events)
   3. focus groups
   4. log entries
   5. record audits and reviews
   6. peer review
   7. reject/repeat analysis
   8. national and regional registries (e.g., dose reporting)

C. Data Analysis
   1. measures of frequency (e.g., counts, percents, rates and ratios)
   2. measures of central tendency (e.g., mean, median, mode)
   3. measures of variation (e.g., range, standard deviation, variance, reproducibility, validity, reliability, precision, accuracy)

D. Assessment of Outcomes
   1. identification of reference standards
      a. internal benchmarks (e.g., baseline performance, local customer expectations)
      b. external (e.g., government regulations, national norms, practice standards)
   2. comparison of outcomes to reference standards

E. Evidence Based Improvement Implementation
   1. action plans
   2. update policies and procedures
   3. incident response
   4. equipment evaluation/purchase recommendations
   5. staffing recommendations
   6. update imaging protocols

F. Operational Management
   1. staffing education
   2. maintenance and preventative maintenance
   3. committee membership and activities
   4. recommendation for staffing assignments
   5. maintain QC/QI documentation
   6. utilization and appropriateness management
   7. maintain policies and procedures

Safety

1. Laws, Regulations, Standards, Guidelines, and Radiation Protection

A. Laws and Regulations
   1. Food and Drug Administration (FDA)
      a. Code of Federal Regulations (CFR) TITLE 21, PART 1020
   2. Mammography Quality Standards Act (MQSA) CFR TITLE 21, PART 900
      a. general provisions
      b. documentation requirements (e.g., credentials, continuing experience and education, surveys, policies and procedures)
   3. Safe Medical Devices Act (SMDA) CFR TITLE 21, PART 807.92
      a. general provisions
      b. reporting procedures
   4. Occupational Safety and Health Administration (OSHA) CFR TITLE 29, PART 1910
      a. bloodborne pathogens/ CDC Standard Precautions
      b. material safety data sheet (MSDS)
      c. reporting procedures
   5. Health Insurance Portability and Accounting Act (HIPAA) CFR TITLE 45, PART 160
      a. general provisions
      b. reporting procedures
   6. Accreditation Agency Programs (e.g., ACR, IAC, TJC, DNV, CMS)

B. Standards and Guidelines
   1. National Council on Radiation Protection (NCRP) Recommendations
      a. Report No. 99, Sections 1, 6 and 7
      b. Report No.105, Sections 1, 2, 6, 7 and 8.4
      c. Report No.114
      d. Report No.147, Sections 1, 2 and 3
      e. Report No.160, Sections 3, 4.1-4.3 and 7
      f. Report No.168, Sections 3, 4, 5 and 6
      g. Report No. 172, exclude dental and nuclear medicine sections
   2. American College of Radiology (ACR) Technical Standards
   3. American Association of Physicists in Medicine (AAPM)
      a. Task Group 18
      b. Report No. 60
      c. Report No. 93
      d. Report No. 94
      e. Report No. 96
      f. Report No. 111
      g. Report No. 116
      h. Report No. 151
      i. Report No. 160
   4. American Society of Radiologic Technologists (ASRT) Practice Standards
   5. Conference of Radiation Control Program Directors (CRCPD) publications
   6. American Registry of Radiologic Technologists (ARRT) Standards of Ethics

C. Radiation Protection (e.g., Radiography, Fluoroscopy, Computed Tomography)
   1. patient dose tracking
   2. occupational dose management

Procedure

1. Quality Control

A. Digital Radiography*
   1. visual inspection of equipment
   2. exposure indicator value (e.g., EI, target exposure indicator (EIT), deviation index [DI])
   3. phantom tests to evaluate for contrast, spatial resolution and noise
   4. system malfunctions
   5. image artifacts

B. Ancillary Equipment Evaluation
   1. image display devices
      a. luminance
      b. ambient light (illuminance)
      c. spatial resolution
      d. contrast resolution/dynamic range
      e. digital display test pattern (e.g., SMPTE, AAPM TG-18)
   2. PACS (e.g., compression, file size, integrity of data transmission)
   3. radiation protection devices
      a. protective apparel
      b. shielding devices

* The questions in section A will focus on concepts that are common to both general radiography and mammography

Appendix L

Recommended Clinical Experience Requirements

Quality Management

Candidates for certification and registration are required to meet the Professional Requirements specified in the *ARRT Rules and Regulations*. ARRT's *Quality Management Clinical Experience Requirements* describe the specific eligibility requirements that must be documented as part of the application for certification and registration process.

The purpose of the clinical experience requirements is to verify that candidates have completed a subset of the clinical procedures within a discipline. Successful performance of these fundamental procedures, in combination with mastery of the cognitive knowledge and skills covered by the examination, provides the basis for the acquisition of the full range of clinical skills required in a variety of settings.

The job responsibilities typically required of staff quality management technologists are delineated through a periodic practice analysis. This results in a "task inventory." An advisory committee then determines the number of clinical procedures required to demonstrate adequate candidate experience in performing the tasks on the inventory.

Candidates for Quality Management certification and registration must document performance of procedures according to the criteria noted below. Procedures are documented, verified and submitted when complete via an online tool accessible through My ARRT Info account on arrt.org. ARRT encourages individuals to obtain education and experience beyond these minimum requirements.

Completion of each procedure must be verified by an ARRT certified and registered technologist (post-primary certification not required), supervisor, radiation physicist or radiologist. The verification process is described within the online tool.

Specific Procedural Requirements

Candidates must complete requirements related to:

A. Digital Quality Control Procedures

B. Quality Improvement Activities

General Guidelines

- One imaging system may be used to address several procedures.
- Initiating and documenting corrective action is assumed in any of the situations in which it is appropriate.

A. Digital Quality Control Procedures

Perform and interpret each QC procedure the specified number of times.

Procedures	Number of Repetitions
Use phantoms or test tool image data to evaluate image quality (*e.g., spatial resolution, contrast resolution, artifacts, uniformity).	2
Inspect surface covering of image receptors/detector for cleanliness and environmental conditions.	1
Evaluate radiation protection devices visually and radiographically or fluoroscopically.	1
Perform reject-repeat analysis based on at least 250 patients.	1
Analyze exposure parameters (imaging or equipment testing protocols) effectiveness for optimal image quality and lowest possible patient dose.	1
Evaluate monitor performance (e.g., test patterns, luminance, contrast).	1
Evaluate ambient light (illuminance) in the reading area.	1
Perform test for image receptor uniformity and interpret results.	1
Perform test for image contrast evaluation and interpret results.	1
Assess whether displayed exposure indicator values (e.g., EI, EIT, DI) are within an acceptable range.	2
Evaluate PACS performance of at least five patients to include image quality, consistency, send/receive, and patient demographics.	1

B. Quality Improvement Activities

Complete at least one activity from each of the five categories listed below. Provide a brief synopsis or summary of each activity on the online documentation tool.

1. Staff Development
   - Plan and conduct a staff development learning activity regarding the implementation of new or revised quality control procedures.
   - Plan and conduct a staff development learning activity to provide feedback regarding performance improvement data or about some aspect of a total quality improvement program.
   - Analyze current staffing levels and project future staffing needs.
2. Regulatory Compliance
   - Complete all required institutional and governmental reporting related to an adverse, sentinel, or medical event.
   - Actively participate in an activity that documents departmental compliance with accreditation or other standards (e.g., prepare part of a report for TJC, DNV, IAC, MQSA, ACR or equivalent, HIPAA, participate in a regulatory audit).
   - Perform and document a radiation safety activity (e.g., compile personnel dosimetry reports for ALARA compliance, give a report on radiation safety activities at a radiation safety committee meeting or to the Radiation Safety Officer).
   - Audit material safety data sheets (MSDS) for relevance.
   - * The abbreviation "e.g.," is used to indicate that examples are listed in parentheses, but that it is not a complete list of all possibilities.

3. QC and QI Data Collection and Analysis
    - Develop and administer a survey for a supervisor (e.g., patient satisfaction survey for obtaining information on logistic or clinical indicators).
    - Analyze data and prepare a statistical report for a supervisor (e.g., histograms, tables summarizing data on logistic or clinical indicators).
    - Complete and document a mammography medical outcomes audit.
    - Participate in patient radiation exposure tracking and provide alerts for QA directed occurrences that exceed accepted reference levels.
    - Participate in the establishment of diagnostic reference levels (DRL) for routinely performed examinations and procedures.
4. QI Implementation
    - Develop a corrective action plan based on QC or QI data (e.g., reject-repeat analysis, patient turnaround time, review exam orders for appropriate clinical information to support medical necessity).
    - Conduct, document, and present the outcome of a focus group with patients or staff addressing some aspect of QC or QI.
    - Serve as a group leader for a meeting or activity to identify quality-related issues using QI problem-solving tools, such as flowcharts, fishbone diagrams, decision matrices, or brainstorming.
    - Lead or participate in a process improvement activity (e.g., Lean Process Improvement, Six Sigma, SWOT).
5. Operational Management
    - Participate in the development of an equipment maintenance schedule to include post-maintenance evaluation.
    - Participate in the development of purchase specifications for imaging equipment based on a needs assessment.
    - Participate in the development or revision of policies and procedures as a result of data obtained through data collection and analysis methods.
    - Participate in development or revision of departmental emergency plans for natural and manmade disasters.
    - Participate in development or revision of a departmental strategic plan (e.g., budget, personnel recruitment, marketing).

Appendix M

Content Weights

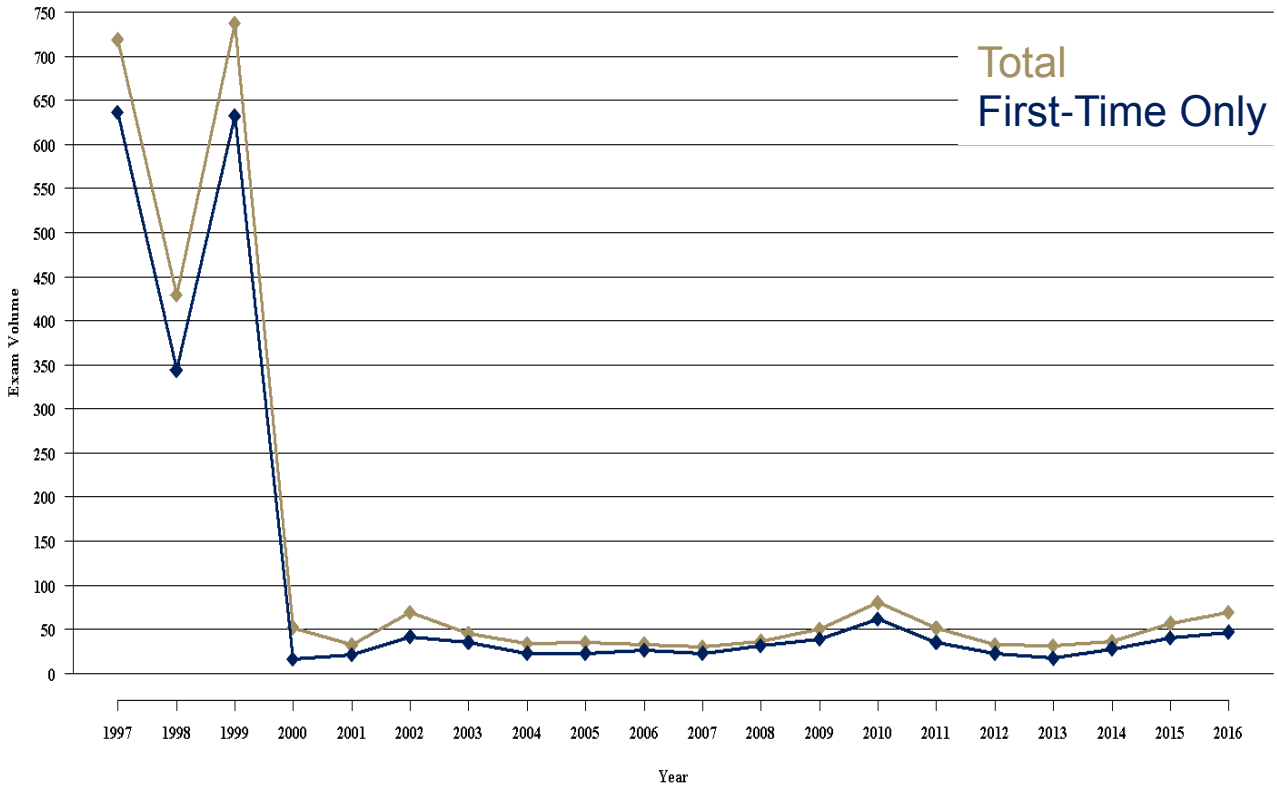
Table M.1: Summary of Content Weights in Content Specifications for Various Practice Analyses

	Practice Analysis				
Type of Tasks	1996	2002	2008	2012	2017
QC	77	93	93	64	15
Laws, Regulations, Standards, Guidelines, and Radiation Protection	21	28	28	40	25
QI	42	44	44	61	50
Total Number of Items	140	165	165	165	90

Appendix N

Exam Volume

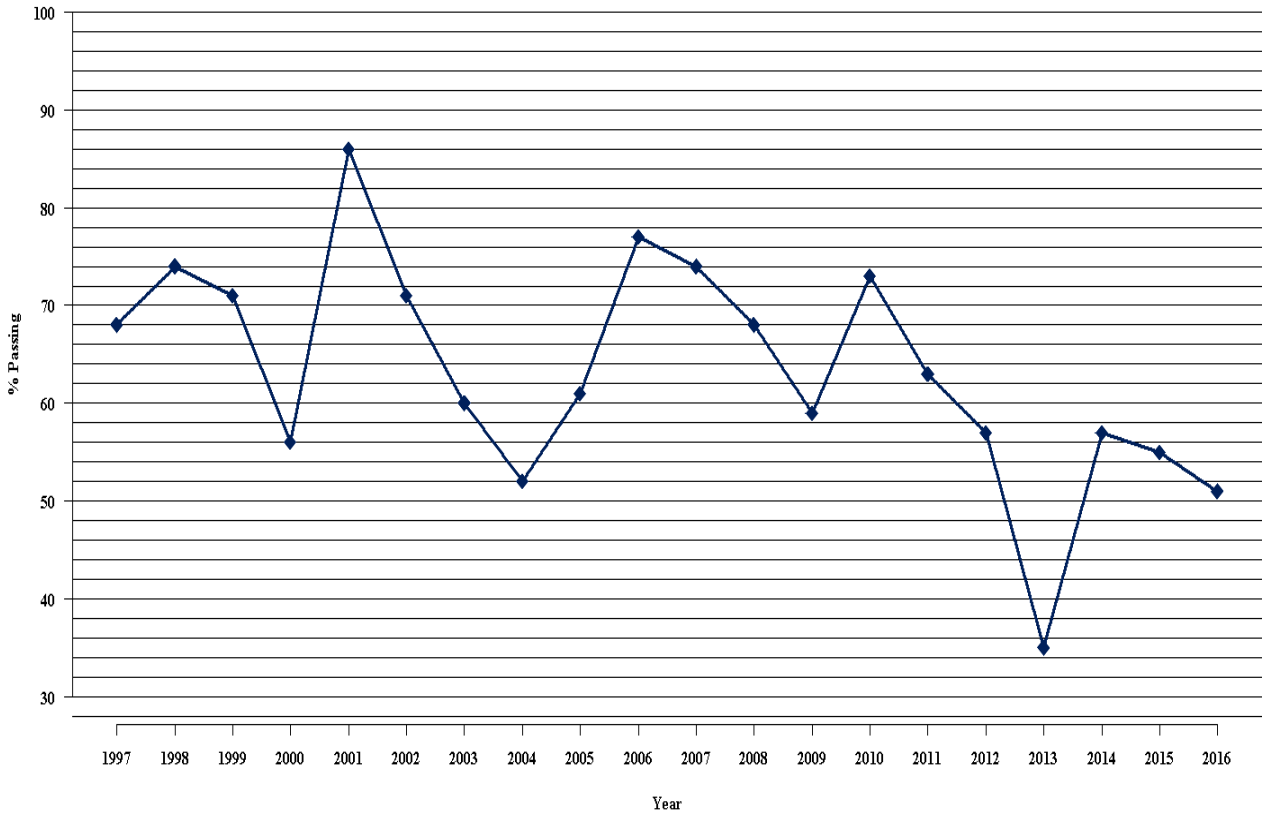
Figure N.1: QM Exam Volume over Time



Appendix O

Exam Pass Rates

Figure O.1: QM Exam Pass Rates over Time



Appendix P

Communications to Various Stakeholders

Announcement that ARRT would stop issuing new QM credentials

THE AMERICAN REGISTRY OF RADIOLOGIC TECHNOLOGISTS®

ARRT STOPS ISSUING NEW QM CREDENTIALS

What Does It Mean to You?

ARRT will stop issuing new Quality Management (QM) credentials on July 1, 2018. In May 2017, we mailed detailed information on this change to people who hold the QM credential or who have shown interest in pursuing it. If you already hold the QM credential, you may maintain it if you choose to do so. If you still want to earn the credential, you must complete all requirements—including passing the exam—no later than June 30, 2018.

WHY THE CHANGE?

Because the number of tasks has decreased significantly in QM, and because QM no longer has a well-defined set of tasks applied universally in the workplace, ARRT's Board of Trustees elected to stop issuing new QM credentials.

- The profession primarily uses digital equipment now, so many previous QM tasks have become obsolete.
- ARRT's most recent QM practice analysis showed that 43 of the 105 tasks covered on the QM exam are no longer common to QM practitioners.
- Many tasks that were common when ARRT introduced the QM credential in 1997 aren't specific to any particular radiologic discipline, and some aren't related to medical imaging, radiation therapy, or interventional procedures at all.

IF YOU HOLD THE QM CREDENTIAL

Once you've earned the QM credential, you can maintain it indefinitely by:

- Continuing to meet the requirements in ARRT Rules and Regulations, ARRT Standards of Ethics, and ARRT Continuing Education Requirements
- Renewing the credential each year
- Maintaining certification and registration in the appropriate supporting category
- Completing 24 biennial CE requirements

You won't have to complete Continuing Qualifications Requirements (CQR) for QM, although you'll have to complete CQR if you're an R.R.A. or if you earned any other credentials after Jan. 1, 2011. After July 1, 2018, if you don't comply with other ARRT requirements for maintaining certification and registration, you'll be able to reinstate your QM credential only up to the point at which you would have to re-examine. You won't be able to reinstate the QM credential after that because ARRT won't offer the exam after June 30, 2018.

IF YOU STILL WANT TO EARN THE QM CREDENTIAL

You'll have to:

- Complete any necessary requirements before you apply to take the QM exam.
- Apply online or postmark your reapplication to take the exam before June 1, 2018.
- Pass the QM examination on or before June 30, 2018.

If you have an ethics violation to report, processing your application will take longer. Be sure to report your violation within 30 days of its occurrence or when you renew, whichever comes first.

QUESTIONS? If you have questions about this change, please contact ARRT at 651.687.0048.

Letter to Certified and Registered Technologists with the QM Credential

May 10, 2017

To: R.T.s Who Hold the Quality Management (QM) Credential

Re: ARRT to Stop Issuing New QM Credentials After June 30, 2018

Because you're certified and registered in Quality Management (QM) with ARRT, we're writing to let you know about a decision that affects the future of the QM credential.

ARRT will stop issuing new QM credentials after June 30, 2018. Despite the change, **your credential will remain valid** as long as you continue to meet our requirements for maintaining certification and registration.

Nevertheless, the change will affect your certification and registration, particularly when it comes to Continuing Qualifications Requirements (CQR). This letter explains the reasons for the change and tells you what will be different in coming years.

Why the Change?
ARRT recently asked QM practitioners nationwide what tasks they commonly perform in their jobs. Because the profession has moved primarily to digital equipment, many previous QM tasks have become obsolete.

In fact, our survey showed that 43 of the 105 tasks the QM exam covers are no longer common to QM practitioners. In addition, some of the remaining tasks are no longer related to medical imaging, radiation therapy, or interventional procedures—and they aren't specific to any medical imaging discipline.

Because the number of tasks in QM has decreased significantly, and because QM no longer has a well-defined set of tasks applied universally in the workplace, ARRT's Board of Trustees elected to stop issuing new QM credentials.

Maintaining the QM Credential
Because you already hold the QM credential, you'll be able to maintain it indefinitely by:

- Continuing to meet the requirements in *ARRT Rules and Regulations, ARRT Standards of Ethics,* and *ARRT Continuing Education Requirements*
- Renewing the credential each year
- Maintaining certification and registration in the appropriate supporting category
- Completing 24 biennial CE requirements

Those tasks are the same ones you've been doing since you earned your QM credential. Differences occur in two areas: CQR and reinstatement.

Letter to People in the Pipeline that are Pursuing the QM Credential

May 10, 2017

To: R.T.s Interested in the Quality Management (QM) Credential

Re: ARRT to Stop Issuing New QM Credentials After June 30, 2018

Because you've shown an interest in earning ARRT's Quality Management (QM) credential, we're writing to let you know that ARRT will stop issuing new QM credentials after **June 30, 2018.** This letter explains our reasons for the decision—and lets you know what to do if you still want to earn the credential.

If you complete all requirements and pass the QM exam on or before June 30, 2018, you'll be able to maintain the credential indefinitely. You'll simply need to meet our requirements for maintaining certification and registration.

Why the Change?
ARRT recently asked QM practitioners nationwide what tasks they commonly perform in their jobs. Because the profession has moved primarily to digital equipment, many previous QM tasks have become obsolete.

In fact, our survey showed that 43 of the 105 tasks the QM exam covers are no longer common to QM practitioners. In addition, some of the remaining tasks are no longer related to medical imaging, radiation therapy, or interventional procedures—and they aren't specific to any medical imaging discipline.

Because the number of tasks has decreased significantly in QM, and because QM no longer has a well-defined set of tasks applied universally in the workplace, ARRT's Board of Trustees elected to stop issuing new QM credentials.

If You Still Want a QM Credential
If you still want to earn a QM credential, you may do so by meeting these deadlines:

- Complete any necessary requirements before you apply to take the QM exam.
- Apply online or postmark your reapplication to take the QM exam before **June 1, 2018**.
- Pass the QM exam on or before **June 30, 2018**.

Keep in mind that, if you have an ethics violation to report, processing your application will take longer. Be sure to report your violation within 30 days of its occurrence or when you renew, whichever happens first.

Letter to People Who Recently Passed the QM Exam

Congratulations on earning your Quality Management (QM) credential.

As you may know, ARRT will stop issuing new Quality Management (QM) credentials next year. Despite the change, **your credential will remain valid** as long as you continue to meet our requirements for maintaining certification and registration:

- Continuing to meet the requirements in *ARRT Rules and Regulations, ARRT Standards of Ethics,* and *ARRT Continuing Education Requirements*
- Renewing the credential each year
- Maintaining certification and registration in the appropriate supporting category
- Completing 24 biennial CE requirements

You won't be required to complete—or allowed to opt in to—Continuing Qualifications Requirements (CQR) for your QM credential. That's because ARRT won't be creating CQR materials for QM.

If, on or after July 1, 2018, you don't comply with ARRT requirements for certification and registration, you'll be able to reinstate your QM credential **only** up to the point at which you would have to re-examine. You won't be able to reinstate the QM credential after that because ARRT won't offer the exam after June 30, 2018.

Questions?
Keep in mind that discontinuing the issuance of new QM credentials doesn't mean ARRT no longer emphasizes the importance of quality initiatives. In fact, quality improvement is important to all of our disciplines and part of our exams.

To learn more about the change, visit the newsfeed in your online ARRT account. We published an article on the QM change on May 15, 2017. If you have questions about this change and how it affects you, contact ARRT at 651.687.0048.

Letter to People Who Have Failed the QM Exam

As you may know, ARRT will stop issuing new Quality Management (QM) credentials after **June 30, 2018.**

If you still have exam attempts remaining, you may reschedule and retake your QM exam on or before June 30, 2018. You'll have to postmark your reapplication **before June 1, 2018.**

If you pass the exam on or before June 30, 2018, you'll be able to maintain the credential indefinitely by meeting our requirements for maintaining certification and registration.

To learn more about the change, visit the newsfeed in your online ARRT account. We published an article on the QM change on May 15, 2017. If you have questions about this change and how it affects you, contact ARRT at 651.687.0048.

Letter to QM Committee Members and Item Writers

To: QM Item Writers
QM Committee Members

Thank you for all the work you've done with ARRT's Quality Management (QM).

I'm writing to let you know that ARRT's Board of Trustees has decided to stop issuing new Quality Management (QM) credentials on July 1, 2018. R.T.s who already hold the QM credential may maintain it if they choose to do so. R.T.s who still want to earn the credential must complete all requirements—including passing the exam—no later than June 30, 2018.

Why the Change
The change comes largely because of the work we've done on QM recently. When we asked QM practitioners nationwide what tasks they commonly perform, we found that because the profession has moved primarily to digital equipment, many previous QM tasks have become obsolete.

In fact, our survey showed that 43 of the 105 tasks the QM exam covers are no longer common to QM practitioners. In addition, some of the remaining tasks are no longer related to medical imaging, radiation therapy, or interventional procedures—and they aren't specific to any medical imaging discipline.

Because the number of tasks in QM has decreased significantly, and because QM no longer has a well-defined set of tasks applied universally in the workplace, ARRT's Board of Trustees elected to stop issuing new QM credentials.

What Next?
We're sending letters to all R.T.s who hold the QM credential and those who have shown an interest in the past by beginning work on or previously holding the credential. Those letters will go in the mail beginning May 10. We wanted you to have this information in advance—but please don't share it until we post the information publicly on May 24. I've attached copies of the letters we're sending, so you'll know all the details of the change.

Questions?
Keep in mind that discontinuing the issuance of new QM credentials doesn't mean ARRT no longer emphasizes the importance of quality initiatives. In fact, quality improvement is important to all of our disciplines and part of our exams. We've decided to stop issuing new QM credentials only because of the reasons cited above.

Again, we truly appreciate all of your efforts on behalf of ARRT. I'm happy to talk with you if you'd like to discuss anything related to this change.