Engaging the Medical Imaging Department in New Technology Applications Training: A Comparative Study of Competency Levels

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Abstract

In busy radiology departments, dedicated time often is not scheduled to allow technologists to fully engage in new equipment applications training as prescribed by a vendor. Incomplete training may adversely affect the level of competency achievable by the technologists responsible for operating the imaging equipment. This paper details the measurement of technologists' skill competencies after new equipment applications training. The study compares the technologists' competencies at institutions that followed vendor-prescribed training vs. those that did not.

Introduction

Radiologic technologists perform complex diagnostic procedures using state-of-the-art imaging equipment and must be adequately trained to ensure that the equipment is being used safely and effectively. To ensure quality patient care, high quality images must be presented to the radiologist for proper diagnosis. This level of patient care can only be provided if the medical imaging team maintains a current knowledge of new technologies and procedures.

Continuing education provides a mechanism for technologists to fulfill their responsibility to maintain competence and prevent professional obsolescence. Participation in continuing education demonstrates accountability to peers, physicians, health care facilities and the public. It also reinforces the Code of Ethics jointly endorsed by the American Registry of Radiologic Technologists (ARRT) and the American Society of Radiologic Technologists (ASRT).[1] It was for these reasons that the ARRT, on January 1, 1995, mandated continuing education for radiologic technologists.

The increasing importance of preventive care and diagnostic procedures has almost tripled exam volumes. Imaging and radiation therapy department managers report that personnel shortages are adversely affecting the quality of patient care being delivered.[2]

The radiologic sciences are entering a critical period when demand for radiologic technologists will exceed supply at an increasing rate until 2010, when shortages will escalate as a result of the baby boom generation entering retirement age.

At the same time, technological advances in the imaging sciences are changing the face of medicine. As a result, workplace demands in both the public and private sectors are changing significantly.[3-4] Radiologic science professionals are working in an environment that demands greater productivity, skills, knowledge and working hours without a commensurate increase in compensation.[4-5] In addition, many medical imaging professionals and radiation therapists in the clinical setting are not prepared to fully employ the cutting-edge technologies, services and productivity solutions being introduced by industry.[5] These trends are further exacerbated by the fact that managed care and capitation are demanding that department managers keep costs to a minimum.[6]

As a result, the radiologic technologist work force has to become more flexible to meet demands and acquire advanced education, critical-thinking skills and continuing education that is more relevant to the workplace.[6] To ensure that health care providers are safe practitioners and that they have demonstrated a level of competence necessary to function safely in the work environment, the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) implemented standard HR.3. The standard states, “Processes are designed to ensure that the competency of all staff members is assessed, maintained, demonstrated and improved on an ongoing basis.”[7]

According to Michael Ruthemeyer, “Radiology administration not only has regulatory requirements to evaluate competency, but also has a moral duty to insure that patients receive the best care possible. We should not cover up or ignore the blemishes that we all know exist. Instead, we should take them on, as professional and personal challenges to improve the competency of staff.”[7]

Most medical imaging equipment suppliers provide professionally developed training programs to provide customers with the level of knowledge required to produce high-quality images from their technology and equipment. As an added benefit to their customers, many vendors submit application-training programs to a Recognized Continuing Education Evaluation Mechanism (RCEEM) for continuing education credits. These continuing education programs are planned, organized and administered to enhance the knowledge, professional performance and skills that technologists use to provide quality patient care.[8]

The medical imaging equipment supplier is not, however, required to provide continuing education credit for applications training. Further, the applications training specialist, serving as the continuing education sponsor, has the right to deny a technologist access to the training program if the technologist has not been given ample time to participate fully in the program. The sponsor also has a responsibility to withhold credit from any technologist who fails to complete the program as designed. When the equipment vendor limits participation, it is based on program strategies and expected learning outcomes. The ASRT fully supports continuing education sponsors in assigning credit only to technologists who complete a continuing education program as approved.[9]

Despite industry efforts, imaging department managers do not always allot the required time for imaging personnel to complete the applications training program prescribed by the vendor to ensure proper operation of newly installed equipment. This has been confirmed by internal reports from GE Medical Systems (GEMS) equipment applications specialists who estimate that they spend as much as 40% of their time waiting for technologists to return to the applications training session after being pulled away to perform patient exams. Because of the insufficient amount of time allowed for applications training on new equipment, the GEMS user support line receives more than 660 additional calls each year from customers requesting the application specialist to return to the site for “nonentitled” visits. A visit is termed “nonentitled” when it exceeds the originally agreed upon number of visits required to properly train the customers' technologists on the new equipment. Reasons for these visits may include training of new staff not present during initial training, the sites' inability to run the system properly, training for advanced features of the system or poor image quality resulting from insufficient training.

The authors hypothesized that radiologic technologists not given the opportunity to fully engage in a vendor-prescribed equipment applications training program are not adequately prepared to operate new imaging equipment at a level necessary to produce quality diagnostic medical images. Similarly, the authors believed radiologic technologists who are given the opportunity to fully engage in a vendor-prescribed, accredited applications training program demonstrate a higher skills competency level than technologists who do not.

Literature Review

Despite the fact that radiologic technologists are not always given ample opportunity to obtain the training necessary to operate workplace equipment properly, many are interested in staying current on new technologies. A 1997 national survey polled radiologic technologists about their primary continuing education (CE) objective. Fifty-eight percent said their primary continuing education objective was to earn CE credits in order to maintain certification; 19% reported a desire to keep current on new technologies, developments and practice; and 9% obtained CE to expand the knowledge of their primary area of practice.[10] This same research showed that 34% of the technologists surveyed said they rely on their employer/workplace for continuing education credits.[10]

Research into adult learning confirms that the generally accepted motivators of adult learning are the desire to learn in order to fulfill one's goals, to maintain one's present skills or to acquire new skills that enable one to keep up with changes in one's job.[11-13]

Other research demonstrates the benefits of employers providing training for their staff. The American Society for Training & Development (ASTD) reports that a company's investments in work force training can predict future financial performance.

ASTD researchers and their partners at Saba Software examined the average annual training expenditures of 575 firms. Taking a number of factors into account, ASTD found that a firm's education and training investment improves the power to predict its future total stockholder return (TSR) by 50%. ASTD researchers found a similar pattern when looking at gross profit margin. "It is clear that a firm's commitment to workplace learning is directly linked to its bottom line," said Mark Van Buren, Director of Research for ASTD.[14]

A similar study by ASTD and the Society for Human Resource Management found that training and development has risen to the top as one of the most important benefits organizations must offer to attract and retain talented employees. Seven companies, called Exemplary Practice Partners, were screened and chosen to participate in the study. In comparison with the ASTD Benchmarking Service database, which collects training investment data on more than 2,500 organizations worldwide, these 7 companies:

- Spent less per employee, but more as a percentage of payroll on employee training.
- Delivered training more often using learning technologies and less via the classroom.
- Spent more on technology as a percentage of the training budget.
- Utilized more outside resources to provide training.
- Spent less on outside providers of training.
- Engaged more often in the use of compensation practices, work practices, training practices and human performance management practices.

As a result, each of these 7 companies experienced lower turnover rates and higher employee satisfaction than the average company in its industry.[14]

In the hustle and bustle of a busy radiology department, the environment often can be counterproductive for learning. Maria Montessori, in her research of the learning environment, stressed the importance of allowing the learner the opportunity to become engaged in the learning.[15] Because the radiologic technologist often is interrupted during the applications training program, he or she may not have the opportunity to fully engage his or her attention on the training. "The essential thing," says Montessori, "is for the task to arouse such an interest that it engages the learner's whole personality."[16]

Despite the plethora of research available into adult learning, the authors found no information that specifically addressed the efficacy of new equipment applications training.

The ASRT, its Education and Research Foundation and GE Medical Systems (GEMS) advocate life-long learning and are dedicated to promoting work force development programs that provide radiologic technologists with the knowledge, resources and support they need to provide quality patient care. Concerned with elevating the competency levels of radiologic technologists, the organizations collaborated in 1999 to explore possible methods of fully engaging the medical imaging department in new technology applications training.

The purpose of this research was to compare the relationship between the competency levels of radiologic technologists who are given ample opportunity to fully engage in a vendor-prescribed applications training program vs. the competency levels of radiologic technologists who are not given adequate opportunity.

Instrumentation

The applications training curriculum used in this study was developed by GEMS specifically to teach the technologist how to operate new magnetic resonance (MR) imaging equipment. GEMS uses 3 sources for development of its training curricula: Management Training Consultants' "Proven Classroom Training Technique,"[17] "Evaluating Training Programs" by Donald L. Kirkpatrick[18] and "Evaluating the Impact of Training" by Scott B. Parry.[19]

Like most medical imaging equipment application training programs, the GEMS application-training curriculum uses a competency-based approach to instruction. This requires the student to learn to *do* something as opposed to just learning *about* something.[20] This is important in new equipment applications training because the user must be able to safely and effectively operate the equipment as opposed to simply being able to discuss the theory behind the technology.

In addition to the training curriculum, 4 customized data collection tools were developed for use in this research: a competency assessment tool, rules for administering the assessment, a demographic survey and an observation form.

Assessing learning is important because adult learners need to know what they have learned. Evaluation techniques provide that assessment.[21]   To effectively measure the success of the GEMS applications training program for MR, a competency learning assessment tool was developed by the authors, H.J., E.L. and J.S. The assessment measured basic, intermediate and advanced skills. Each skill was rated using the following scale:

1=No knowledge, unable to perform
2=Familiar with topic but unable to perform or explain
3=Familiar with topic, able to perform or explain parts
4=Understand topic, able to perform or explain with much prompting from trainer
5=Performed independently after prompt from trainer
6=Performed independently with slight hesitation
7=Able to perform independently with no hesitation
0=Not applicable

The relevance of the competency tests was validated by 2 GEMS applications trainers who agreed that the competencies listed on the test were in fact the competencies necessary for the technologist to safely and effectively operate the equipment.
A copy of the assessment is shown in Appendix A.

To ensure that each participating applications specialist administered the assessments consistently, authors G.A., E.L. and J.S. developed "Rules for Administering Competency Assessments." These guidelines directed the applications specialist to perform "one-on-one assessments," gave directions on how to deal with nonexistent features on certain equipment, provided information about who must fill out the assessment forms and more. The full list of guidelines is shown in Appendix B.

A short demographic survey also was developed to learn more about the technologists being assessed.   Information gathered through the questionnaire included education, years in current position, credentials and prior training. A copy of the survey is presented in Appendix C.

In the clinical medical imaging environment, there are a variety of factors that could impact the technologist's learning environment. The authors created an observation form to record such issues. Factors addressed in this form included the size of the training class, physician/manager interruptions, equipment availability and readiness, and patient load. A copy of the observations form is included in Appendix D.

Further preparations for the project included careful selection of personnel to administer the assessments. The applications training specialists chosen to participate in the project were GEMS senior applications specialists with 5 or more years of experience in the technical aspects of the equipment, as well as in the human aspects of adult learning. They were directed to administer the competency assessment using a uniform methodology to minimize variances. In addition, the specialists were tested on their evaluation of the competencies to further eliminate discrepancies and ensure clarity.

A pre-assessment of technologists' competency levels was performed for each of the technologists participating in the study; however, this data was not used in the analysis for the following reasons:

- Technologists participating in the study had significantly varying levels of experience. Experience levels ranged from "no prior knowledge of MR" to "some knowledge of MR but new to GE MR systems" to "extensive knowledge of GE MR systems." This wide range of experience levels resulted in "non-normal data" in the preassessment data set.
- The training curriculum was designed to bring all technologists to an equal level of competency, independent of prior experience and skill level.
- The purpose of this research was to determine the difference in skill competencies between technologists who follow a curriculum vs. those who do not, rather than assessing the differences between pretraining and post-training competencies.

Methodology

Prior to selecting the imaging sites to be assessed, the authors mapped out the process that GEMS follows to prepare customers for an applications training program. The process then was revised to include the steps needed to complete the competency assessments. The completed process map included the following steps:

(1) The applications specialist requests a training information package (TiP) to be sent to the customer. A guide to onsite training describes the curriculum and includes a suggested daily agenda. It also includes suggestions for the number of patients to be scheduled and preparation of the room for the training.
(2) The applications specialist calls the customer to explain the TiP program and answer questions. The specialist talks to the manager about the goals and objectives the site has for training, determines the number of technologists to be trained and the time and dates of the training. A follow-up call is placed to confirm the equipment readiness and the site readiness for applications training.
(3) The research project is explained to the customer, and the customer is asked if he or she is willing to participate in the assessment.
(4) Applications training is performed with or without the customer adhering to the prescribed curriculum.
(5) The competency of technologists at participating sites is assessed after completion of the applications training, regardless of whether they complied with the prescribed curriculum.

An abbreviated flowchart outlining this process is included in Appendix E.

Six Sigma, a well-known quality initiative that statistically examines products and processes, was the primary methodology used to conduct this research.[22]

It is widely recognized that the operational performance of an organization is largely determined by the capability of its processes. The Six Sigma process tells an organization how good its processes really are and allows organizations to draw comparisons between processes. The Six Sigma initiative guided the statistical measurements of the process under consideration — equipment applications training. It helped to establish the course of the research and gauge its progress by using a standard set of measurement tools to define the problem and help identify the best solution.

The applications training competency assessment was administered at the end of each training visit. The same assessment was used in each visit, and the technologists were assured complete anonymity and confidentiality.

Sampling

Sites chosen to participate in the study included both hospital and clinic facilities that had purchased new MR systems or an MR system upgrade that required a 4-day, onsite-training program. Ten hospitals and 8 clinics participated in the study. Each site had an average of 2.5 technologists participating in the training program, with a total of 53 from all sites assessed. Thirty-four technologists were allowed time for the recommended training curriculum and 19 were not. The authors agreed that a 90% confidence interval was sufficient to ensure a statistically sound sample size of competency scores. This confidence interval required a minimum sample size of 34 technologists.

Analysis

The competency scores of each technologist and each skill measured were recorded in a spreadsheet for analysis with the use of Minitab (Adobe Systems Incorporated, State College, Pa.). Competency scores were examined using descriptive statistics, normality tests, process capability, process mapping and cause-and-effect diagrams. The data was divided into 2 populations: sites that had fully engaged in the prescribed training curriculum and those that had not fully engaged in the prescribed training curriculum.

A “passing score” was determined to be a competency score greater than 5.5 for each of the 3 levels assessed — basic, intermediate and advanced. Each competency was rated on a 7-point Likert-type scale ranging from “no knowledge, unable to perform” to “able to perform independently, with no hesitation.”

Results

Of the technologists allowed to fully engage in the applications training process, 77% scored an average of 5.5 or higher on all 3 competency levels combined. Conversely, 58% of the technologists not permitted to fully participate in the applications training program scored less than 5.5. The statistics for competency scores less than 5.5 for each of the two populations are presented in Table 1.

The descriptive statistics reveal a significant difference between the mean and median scores of the group that was able to follow the curriculum (group Y) vs. the group that was unable to completely follow the curriculum (group N). Group Y achieved an average competency score of 5.99 — 15% higher than that of Group N. Similarly, the median score for Group Y was 6.42 vs. 5.06 for Group N. Table 2 details the descriptive statistics for the 2 groups.

The data was further analyzed to determine if there was any correlation between demographics of the technologists assessed and the final competency scores. Pearson's correlation was used for the analysis. A strong correlation, either direct or inverse, is shown when the correlation scores approach 1 or –1. As shown in Table 3, there is no correlation between technologist demographics and competency scores. It should, however, be noted there is a slight statistical difference for technologists who hold an advanced MR certification. This group scored higher on the competency tests than the group who did not hold an advanced certification.

A regression analysis was performed to determine if a combination of demographic factors affected the competency scores. The basic and intermediate competency scores were combined for this test. The analysis showed that 5 of the demographic factors analyzed (MR experience, number of interruptions during training, years in current position, education level and where MR was first learned) collectively contributed to 51% of the competency scores achieved. In other words, each of the factors on its own did not significantly affect competency scores. However, when added together, the 5 factors may have contributed to half of the score achieved by the participant.

In order for the 5 factors to contribute a statistically significant amount to the competency level, they would have to contribute to at least 70% of the scores. Results of the regression analysis are detailed in Table 4.

Lastly, a chi-square test was performed between the 2 populations with a resultant P-value of .010, proving a strong statistical difference between the scores of the technologists who were given ample opportunity to follow the training program vs. those who were not.

Limitations

The competency assessment tool was developed and revised with the assistance of senior MR applications specialists based on competencies expected to be mastered upon completion of the MR applications training program. It should be noted, however, that the tool was not tested with untrained technologists prior to its use in this study.

Discussion/Conclusion

The data analysis confirms the authors' hypothesis that radiologic technologists given the opportunity to fully engage in an applications training program score higher on an applications training competency assessment than those who are not permitted the same opportunity.

The current shortage of radiologic technologists and tight labor market, coupled with the introduction of new modalities, have stretched a thinning labor force even tighter, increasing the demand for highly trained competent technologists. These factors require administrators to use all avenues available to improve their departments and retain valuable employees. Adequate equipment applications training is just one avenue.

Ensuring the competence of a technologist with regard to a new technology means ensuring that the technologist can do the job correctly, do the job safely and recognize and solve minor problems without assistance.[7]

If imaging department administration introduces new technology into the workplace and does not allow technologists the opportunity to fully engage in a vendor-prescribed applications training program, there is a greater likelihood that the technologists will not possess the competency necessary to properly operate the equipment and patient care may be compromised.

Although the scope of this study did not allow for the collection and analysis of data on repeat rates due to the lack of competency, a recent study revealed a correlation between technologist competency levels and imaging repeat rates. In 1995 the Houston X-Ray Quality Society organized a committee to develop a standardized test to compare the competency levels of mammographers across 35 to 40 mammography facilities. The tests were run and compared over several years. When facilities correlated the results of the competency test with repeat rates, technologists who performed poorly on the technical factors portion of the test tended to have more repeats because of dark or light films than those who scored well on technical factors. Technologists who performed poorly on positioning tended to have more repeats due to positioning. Other areas of the test show similar correlation.[7]

The current study shows time dedicated to allowing the technologist to fully engage in learning new technology results in higher competency levels. This requires agreement between those receiving the training (clinical technologists and management) and those delivering the training (applications specialists and management).

The authors offer the following suggestions to increase the technologist's ability to fully engage in the training:

- The clinical site should preschedule "volunteer" patients for the training time. This allows for fewer interruptions in the training and allows the technologists to focus on the task at hand.
- Adequate time should be scheduled for the technologists to fully participate in the training program as prescribed by the vendor. By scheduling staff so that technologists can fully participate in the training program, managers demonstrate a commitment to staff improvement.
- Interruptions during the scheduled training program should be limited by notifying physicians and other department staff that the training technologists will be unavailable during the scheduled training hours.
- Newly trained technologists should spend as much time as possible on the new equipment so that the learned competencies may be retained.
- Encouragement and support of technologists in obtaining advanced MR certification assists in ensuring higher competency levels after completion of the new MR equipment training.

Further, a manager's dedication and commitment to staff training may go a long way toward employee retention, as well as ensuring patient safety, decreasing equipment downtime and retakes and positively affecting the imaging center's bottom line.

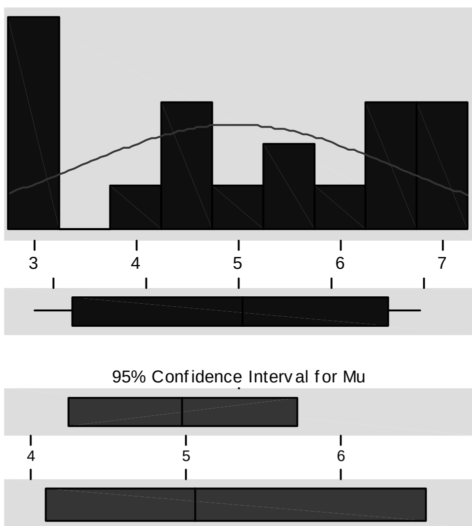
Table 1

Average Competency Scores Less than 5.5				
Population	*Number of Participants*	*Number of scores less than 5.5*	*Percentage of scores less than 5.5*	*Z Score*
Not fully engaged in curriculum	19	11	58%	0
Fully engaged in curriculum	34	8	23%	2.24

Table 2: Descriptive Statistics

Group N (Did not follow curriculum)

Descriptive Statistics



Variable: BQ & IQ Avg
Group: N

Anderson-Darling Normality Test

A-Squared:	0.632
P-Value:	0.084
Mean	4.97368
StDev	1.53244
Variance	2.34836
Skewness	-1.2E-01
Kurtosis	-1.48780
N	19
Minimum	2.80000
1st Quartile	3.22000
Median	5.06000
3rd Quartile	6.62000
Maximum	6.96000

95% Confidence Interval for Mu

4.23507 5.71229

95% Confidence Interval for Sigma

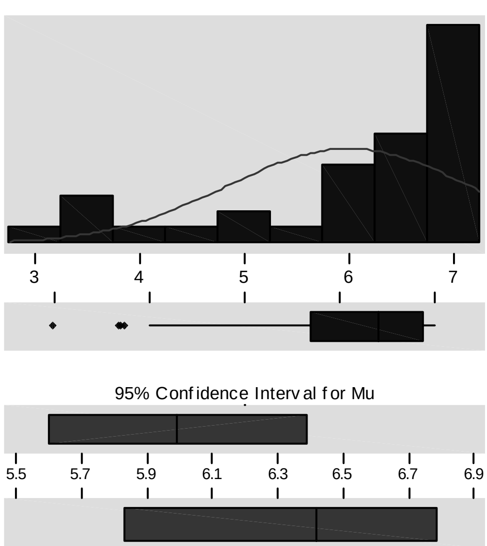
1.15793 2.26620

95% Confidence Interval for Median

4.10130 6.55088

Group Y (Followed curriculum)

Descriptive Statistics



Variable: BQ & IQ Avg
Group: Y

Anderson-Darling Normality Test

A-Squared:	2.592
P-Value:	0.000
Mean	5.99314
StDev	1.15130
Variance	1.32548
Skewness	-1.28365
Kurtosis	0.542975
N	35
Minimum	3.00000
1st Quartile	5.70000
Median	6.42000
3rd Quartile	6.88000
Maximum	7.00000

95% Confidence Interval for Mu

5.59766 6.38863

95% Confidence Interval for Sigma

0.93125 1.50843

95% Confidence Interval for Median

5.83657 6.78781

Table 3

Correlation of Demographics to Competency Level		
Technologist Demographics	*Basic Competencies*	*Intermediate Competencies*
Years as an R.T.	.344	.257
Years as a MR technologist	.262	.148
MR experience	.373	.328
Years in current position	-.445	-.351
*Education level**	No difference	No difference
*Attended GEMS Headquarters class**	No difference	No difference
*Hold advanced MR certification**	Some statistical difference	Some statistical difference
Where MR was learned	-.225	-.338
Patient volume during training	.281	.353
Percent time spent training	-.471	-.541
Percent of time equipment is ready for training	-.432	-.480
Management support for training	-.580	-.660
*Number of interruptions during training**	No difference	No difference

*Data is not continuous (or discrete) and therefore cannot be expressed numerically.

Table 4

Regression Analysis of Aggregated Demographics to Competency Scores				
Predictor	*Coefficient*	*StDev*	*T*	*P*
Constant	4.3164	0.3723	11.59	0.000
Time spent in MR	-1.7357	0.4122	-4.21	0.001
Number of Interruptions	-1.1332	0.4454	-2.54	0.023
Years in current position	-0.9628	0.5335	-1.80	0.093
Education level	-1.4269	0.4796	-2.98	0.010
Where M.R. was learned	1.0711	0.5120	2.09	0.055

R-Sq(adj) = 51.0%

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APPENDIX A

GE Medical Systems
Training in Partnership

Learning Assessment: MR

Technologist #_____________ Date _____/_____/____
Initial Turnover ___Revisit #1______ Revisit #2 ____
Pre-test______ Post test______
Assessment # ___________ Trained by ____________________

Evaluate each of the skills listed below using the following grading system
1= No knowledge, unable to perform
2= Familiar with topic but unable to perform or explain
3= Familiar with topic, able to perform or explain parts of
4= Understand topic, able to perform or explain with much prompting from trainer
5= Performed independently after prompt from trainer
6= Performed independently with slight hesitation
7= Able to perform independently, with no hesitation
0= Not applicable

Basic Skills

1. Power system	1	2	3	4	5	6	7
Power system up and down under normal and emergency conditions	❑	❑	❑	❑	❑	❑	❑
Locate emergency off switches	❑	❑	❑	❑	❑	❑	❑
Locate breaker switches	❑	❑	❑	❑	❑	❑	❑
Reboot system	❑	❑	❑	❑	❑	❑	❑
Power system up procedure, including correct order	❑	❑	❑	❑	❑	❑	❑

2. Table, Gantry and Magnet Functions	1	2	3	4	5	6	7
Locate table controls	❑	❑	❑	❑	❑	❑	❑
Locate gantry controls	❑	❑	❑	❑	❑	❑	❑
Exchange table accessories	❑	❑	❑	❑	❑	❑	❑
Know table weight limit	❑	❑	❑	❑	❑	❑	❑
Know diameter of bore	❑	❑	❑	❑	❑	❑	❑
Move the table in and out/ up and down	❑	❑	❑	❑	❑	❑	❑
Use of positioning light (internal/external)	❑	❑	❑	❑	❑	❑	❑
Describe procedures for magnet quench	❑	❑	❑	❑	❑	❑	❑
Perform emergency patient extraction	❑	❑	❑	❑	❑	❑	❑
Run Q/A	❑	❑	❑	❑	❑	❑	❑
Check cryogen level	❑	❑	❑	❑	❑	❑	❑

3. Patient Considerations	1	2	3	4	5	6	7
Describe the responsibilities of the technologist if a patient CODEs while in magnet	❑	❑	❑	❑	❑	❑	❑
For patient screening what are the contraindications to an MR exam?	❑	❑	❑	❑	❑	❑	❑
What is the proper attire for a patient having an MR exam?	❑	❑	❑	❑	❑	❑	❑
Name two ways to communicate with a patient	❑	❑	❑	❑	❑	❑	❑

4. Patient Scanning	1	2	3	4	5	6	7
Select protocol from protocol manager (head, spine, knee)	❑	❑	❑	❑	❑	❑	❑
Change parameter	❑	❑	❑	❑	❑	❑	❑
Demonstrate proper coil selection	❑	❑	❑	❑	❑	❑	❑

5. Theory	1	2	3	4	5	6	7
Explain why the 5 and 10 Gauss lines are important	❑	❑	❑	❑	❑	❑	❑
Explain T1 and T2	❑	❑	❑	❑	❑	❑	❑

6. Display/Film Images	1	2	3	4	5	6	7
Select exam from browser	❑	❑	❑	❑	❑	❑	❑
Demonstrate window leveling	❑	❑	❑	❑	❑	❑	❑
Next/prior images	❑	❑	❑	❑	❑	❑	❑

7. Archive	1	2	3	4	5	6	7
Initialize optical disk	❑	❑	❑	❑	❑	❑	❑
Store images to optical disk	❑	❑	❑	❑	❑	❑	❑

Intermediate

Patient Scanning	1	2	3	4	5	6	7
1. Demonstrate how to build protocols.	❑	❑	❑	❑	❑	❑	❑
Set-up a scan utilizing gantry angle, appropriate slice thickness, proper display field of view for lumbar spine	❑	❑	❑	❑	❑	❑	❑
Explain what will happen during the exam	❑	❑	❑	❑	❑	❑	❑
Prescribe and scan a PD/T2 FSE Brain	❑	❑	❑	❑	❑	❑	❑
Show how to perform a three-plane localizer	❑	❑	❑	❑	❑	❑	❑
Show how to prescribe slices manually and using the graphic Rx	❑	❑	❑	❑	❑	❑	❑

2. Theory	1	2	3	4	5	6	7
Explain TR	❑	❑	❑	❑	❑	❑	❑
Explain TE	❑	❑	❑	❑	❑	❑	❑
Explain TI	❑	❑	❑	❑	❑	❑	❑
Explain matrix	❑	❑	❑	❑	❑	❑	❑
Explain NEX	❑	❑	❑	❑	❑	❑	❑
Explain flip angle	❑	❑	❑	❑	❑	❑	❑
Explain FOV	❑	❑	❑	❑	❑	❑	❑

3. Display/Film Images	1	2	3	4	5	6	7
Perform the following:							
Measure distance	❑	❑	❑	❑	❑	❑	❑
Magnify	❑	❑	❑	❑	❑	❑	❑
ROI	❑	❑	❑	❑	❑	❑	❑
Multiple image display	❑	❑	❑	❑	❑	❑	❑
Set up the film composer then film and print an exam	❑	❑	❑	❑	❑	❑	❑

4. Archive	1	2	3	4	5	6	7
Remove and restore archived exams from system.	❑	❑	❑	❑	❑	❑	❑
Select a receiving station and network an exam to it.	❑	❑	❑	❑	❑	❑	❑

Advanced

1. Patient Scanning	1	2	3	4	5	6	7
Create projection image with IVI	❑	❑	❑	❑	❑	❑	❑
Build and explain a TOF MRA series using the protocol desktop	❑	❑	❑	❑	❑	❑	❑
Perform a manual prescan and explain fat saturation	❑	❑	❑	❑	❑	❑	❑
What pulse sequence is the best to reduce artifact with metal?	❑	❑	❑	❑	❑	❑	❑
Demonstrate how to position cardiac leads, position the patient, and scan using cardiac gating	❑	❑	❑	❑	❑	❑	❑

2. Theory	1	2	3	4	5	6	7
Explain factors that influence SNR	❑	❑	❑	❑	❑	❑	❑
Explain how to increase/decrease resolution	❑	❑	❑	❑	❑	❑	❑
What is the difference between a Spin echo and a Gradient echo?	❑	❑	❑	❑	❑	❑	❑
What is centric K-space filling?	❑	❑	❑	❑	❑	❑	❑
What’s the purpose of the 180-degree RF pulse?	❑	❑	❑	❑	❑	❑	❑
Explain phase and frequency	❑	❑	❑	❑	❑	❑	❑
Explain when to use a saturation pulse	❑	❑	❑	❑	❑	❑	❑

3. Display/Film Images	1	2	3	4	5	6	7
Reformat a series with batch reformat	❑	❑	❑	❑	❑	❑	❑
Demonstrate how to IVI/Reformat	❑	❑	❑	❑	❑	❑	❑
Demonstrate the various ways of calling up a series	❑	❑	❑	❑	❑	❑	❑
Explain how to perform MRVR	❑	❑	❑	❑	❑	❑	❑

APPENDIX B

Rules for Administering Competency Assessments

1) One-on-one (application specialist to technologist); no one else in the room observing.

2) Once a skill has been demonstrated and the technologist scores a "7," on the retest the technologist doesn't have to actually perform the task, but must explain in detail so that you know they know.

3) Make sure that your coding of the test remains consistent throughout the visits and re-visits. (See sample tracking sheet below.)

4) All skills must have a rating, so allow enough time to go through all the skills on the assessment.

5) If a feature doesn't exist on the system, cross the feature/specific skill off, designating N/A.

6) Assessments must be filled out by application specialists – do not give assessment to technologists or leave onsite.

7) The demographics sheet needs to be filled out by the technologist only once.

Sample Technologist Tracking Sheet

Location of Site ___________________________

Tech Name________________________________Tech #__________
Tech Name________________________________Tech #__________
Tech Name________________________________Tech #__________
Tech Name________________________________Tech #

APPENDIX C

GE Medical Systems
Training in Partnership

Demographics - MR

Technologist #____________________________ Date____/_____/____
Site Name: ____
Site Type______________________________ Bed Size__________________
Location: ____

1. Years as an RT __________
2. Years in MR ____________
3. Age:
   ____25 or younger
   ____26-35
   ____36-45
   ____46-55
   ____55+
4. Title ____
5. Years in current position ____
6. Credentials ____

7. Highest level of education completed (check all that apply):
   ____2-year program
   ____Associate degree
   ____Baccalaureate degree
   ____Master's degree
   ____Doctoral degree
   ____Advanced level certificate in MR
   ____Advanced level certificate in CT
   ____Advanced level certificate in CV
   ____Advanced level certificate in M
   ____Advanced level certificate in QM
   Other ____

8. Where did you learn MR?
   ____Formal training course ____Onsite applications specialist ____Co-worker

9. Did you attend the GE headquarters training class? _________

10. I have been scanning on the new equipment _____days/weeks/months prior to onsite applications training.

11. What percentage of your time is spent in MR? _____

12. If less than 100%, what other modalities do you work in? ______________

13. Do you work: ____ full time _____ part time ____ per diem?

14. On what shift do you practice more than half the time? ____Day _____Evening ____Night

APPENDIX D

Applications Observations of GE/ASRT Educational Research Project

Site Name ____
Site Location____
Applications Specialist _____________________________________
____Turnover ____Revisit 1 ____Revisit 2

Day 1 - Date __ /___/___

Patient load for today____
Percentage of time spent training____
Number of technologists trained ____
Number of technologists assessed ____
Number of doctor/manager interruptions ____________________________________
Equipment readiness ____
Camera/injector availability ____
How closely had management followed GE recommendations made in pre-training materials (i.e., scheduling requirements)? _____________________________________
____
How receptive were the technologists to taking the assessments? ____________________
Other comments *(use space to elaborate on above or for additional observations)*
____
____
____

Day 2 - Date __ /___/___

Patient load for today____
Percentage of time spent training____
Number of technologists trained ____
Number of technologists assessed ____
Number of doctor/manager interruptions____________________________________
Equipment readiness ____
Camera/injector availability ____
How closely had management followed GE recommendations made in pre-training materials (i.e., scheduling requirements)? _____________________________________
____
How receptive were the technologists to taking the assessments? ____________________
Other comments (*use space to elaborate on above or for additional observations)*
____
____
____
____
____

APPENDIX D

Applications Observations of GE/ASRT Educational Research Project continued

Page 2

Day 1 - Date __ /___/___

Patient load for today____
Percentage of time spent training____
Number of technologists trained ____
Number of technologists assessed ____
Number of doctor/manager interruptions ____
Equipment readiness ____
Camera/injector availability ____
How closely had management followed GE recommendations made in pre-training materials
(i.e., scheduling requirements)? ____

____
How receptive were the technologists to taking the assessments? _____________________
Other comments *(use space to elaborate on above or for additional observations)*

____

____

____

____

Day 2 - Date __ /___/___

Patient load for today____
Percentage of time spent training____
Number of technologists trained ____
Number of technologists assessed ____
Number of doctor/manager interruptions____
Equipment readiness ____
Camera/injector availability ____
How closely had management followed GE recommendations made in pre-training materials
(i.e., scheduling requirements)? ____

____
How receptive were the technologists to taking the assessments? _____________________
Other comments *(use space to elaborate on above or for additional observations)*

____

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