

Program Improvement Using ASRT Clinical Refreshers

Heather Schmuck, EdD, R.T.(R)
Ryan Williams, MBA-HA, R.T.(R)

Education programs for the imaging sciences seek to cultivate and develop the next generation of imaging professionals. Programs should analyze whether their education methodology is producing graduates who are educationally prepared and clinically competent for practice in the profession. Through regular assessment of program effectiveness data, education programs can identify strengths and areas for improvement. By actively identifying areas of decreased performance, creating a plan of action, implementing an intervention, and tracking results, programs can determine the effectiveness of the intervention and refine further-action steps. This case study examines one program's efforts to effect positive change through analysis and improvement initiatives.

Program Effectiveness Data

As part of programmatic accreditation, the Joint Review Committee on Education in Radiologic Technology (JRCERT) sets standards related to program effectiveness data, with an emphasis on programmatic improvement.¹ Specifically, JRCERT Standard 6.2 states "the program analyzes and shares its program effectiveness data to facilitate ongoing program improvement."² As defined by JRCERT, program effectiveness data include a program's completion rate, pass rate on the national certification exam, and employment of its graduates.^{2,3} Each of these metrics seeks to identify a different facet of program success, and when combined, they identify the overall

achievement level of the program's mission. Programs also must make the data publicly available on their website.^{2,4} Although collecting and reporting these metrics is a clearly defined process, understanding what to do with the data and how to effect change in the data can be difficult.

Certification Exam Pass Rate

As part of the program effectiveness data, JRCERT requires programs to maintain a 5-year average for the certification exam pass rate.^{2,3} The certification exam pass rate comes from the program's graduates' first attempt on the American Registry of Radiologic Technologists (ARRT) certification exam for attempts made in the first 6 months after graduation.² Because programs can assist with job placement initiatives that affect the employment rate or implement additional measures to improve student retention that affect the program completion rate, the certification exam pass rate might be viewed by some as a direct reflection of the program's education quality.

Several factors can affect the certification exam pass rate. For example, students' lag time between graduation and attempting the exam, and variations in teaching pedagogy among a program's faculty can influence the average certification exam score for a program.⁵ These factors should be considered along with the statistical data on exam performance.

Examining the certification exam pass rate also should be multifaceted. Programs should understand

what the data mean in the aggregate and from a more specific perspective to identify patterns or trends in the data.⁶ Not only should programs evaluate performance on the exam, the composite results provided by the ARRT also should be reviewed. This information is readily available to each program director through the program directors' website and breaks down student performance in each content area on the certification exam.

Targeting Program Improvement

In this study, the program being assessed is a baccalaureate-level radiologic and imaging sciences radiography program in the Midwest. The program currently has a 100% job placement rate and 95% program completion rate. However, the certification exam pass rate has fluctuated during the past several years, ranging from its peak of 100% and dipping as low as 76%, with an average of 92.2%.⁷ Like other programs, this program receives annual reports of student performance outcomes on the content categories of the certification exam:

- patient interactions and management (patient care)
- radiation physics and radiobiology (safety)
- radiation protection (safety)
- image acquisition and evaluation (image production)
- equipment operation and quality assurance (image production)
- head, spine, and pelvis procedures (procedures)
- thorax and abdomen procedures (procedures)
- extremity procedures (procedures)

The program regularly reviews student performance internally in each of these categories, in addition to the overall exam pass rate. This information is then shared with communities of interest through yearly assessment and advisory committee meetings.

During internal review, the program collected data from the previous 6 years for performance on the certification exam at the programmatic and national levels. This data was populated into charts and converted into graphical representations for a more comprehensive review of the data and data trends (see **Tables 1 and 2**). When assessing the numerical data in chart form,

trends are not immediately visible. By including a trend line in the graphical representation, trends become more apparent (see **Figure**). The program compared students' performance on each of the content categories of the certification exam using this graphical data and identified the categories of declining performance on the exam. After assessing the categories for downward trends, the program chose extremity procedures as the area for targeted improvement.

Action Plan and Intervention

After identifying the targeted area, the program moved forward with creating an action plan and intervention to initiate change. To identify whether an intervention is effective at producing the desired results, a form of assessment must be integrated into the process. As part of the program's action plan, the faculty decided initially to use a mock exam before and after the ARRT certification exam to determine the effectiveness of the intervention. In addition, the intervention must be agreed on as the catalyst for the possible change in outcomes.

Implementing the Intervention

Based on the identified target of declining performance on the extremity procedures portion of the certification exam, the authors looked for resources that could be implemented with relative ease into an already intense curriculum. The program's curriculum includes 4 semesters in which students are enrolled in 3-credit-hour radiographic procedures courses, for a total of 12 credit hours. Through a donation from another organization, the program was able to purchase Clinical Refresher educational modules from the American Society of Radiologic Technologists (ASRT) that included online resources focused on reviewing upper and lower extremity examinations for these anatomical areas:

- clavicle
- distal lower extremities
- elbow
- forearm
- hand
- humerus
- pelvis

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Table 1

Program Performance on the Content Categories of the American Registry of Radiologic Technologists (ARRT) Certification Exam in Radiography

Year	Content categories, mean score							
	Patient interactions and management	Radiation physics and radiobiology	Radiation protection	Image acquisition and evaluation	Equipment operation and quality assurance	Head, spine, and pelvis procedures	Thorax and abdomen procedures	Extremity procedures
2017	8.4	8.6	8.0	8.2	8.0	9.0	8.5	8.5
2018	9.0	8.7	8.6	7.9	8.4	8.3	8.8	8.8
2019	8.9	8.2	8.1	8.5	8.1	8.5	8.8	8.7
2020	8.5	7.9	8.3	8.0	8.0	8.6	8.7	8.2
2021	8.7	8.4	8.2	8.3	8.4	8.7	8.4	8.5
2022	8.9	8.2	8.2	8.0	7.9	8.3	8.7	8.4
Program averages	8.7	8.3	8.2	8.2	8.1	8.6	8.7	8.5

Table 2

National Performance on the Content Categories of the ARRT Certification Exam in Radiography

Year	Content categories, mean score							
	Patient interactions and management	Radiation physics and radiobiology	Radiation protection	Image acquisition and evaluation	Equipment operation and quality assurance	Head, spine, and pelvis procedures	Thorax and abdomen procedures	Extremity procedures
2017	8.4	8.2	8.2	8.2	8.1	8.9	8.4	8.7
2018	8.6	8.3	8.5	8.2	8.0	8.1	8.1	8.8
2019	8.4	8.2	8.2	8.1	8.1	8.5	8.4	8.6
2020	8.4	8.4	8.3	8.3	8.2	8.4	8.3	8.5
2021	8.4	8.2	8.1	8.2	8.1	8.3	8.2	8.3
2022	8.5	8.3	8.3	7.9	7.9	8.2	8.2	8.5
National averages	8.5	8.3	8.3	8.2	8.1	8.4	8.3	8.6

- proximal lower extremities
- scapula
- shoulder
- wrist

These online videos were integrated into the learning management system and reviewed by students at their leisure as many times as necessary until the student felt comfortable with the material.

Assessing Performance

The program created a mock certification exam, to be taken before and after the actual certification exam, using a standard readily available to students through an assigned course textbook. The mock certification exam consisted of 200 standard questions that were meant to be representative of an actual certification exam and included questions from each of the content

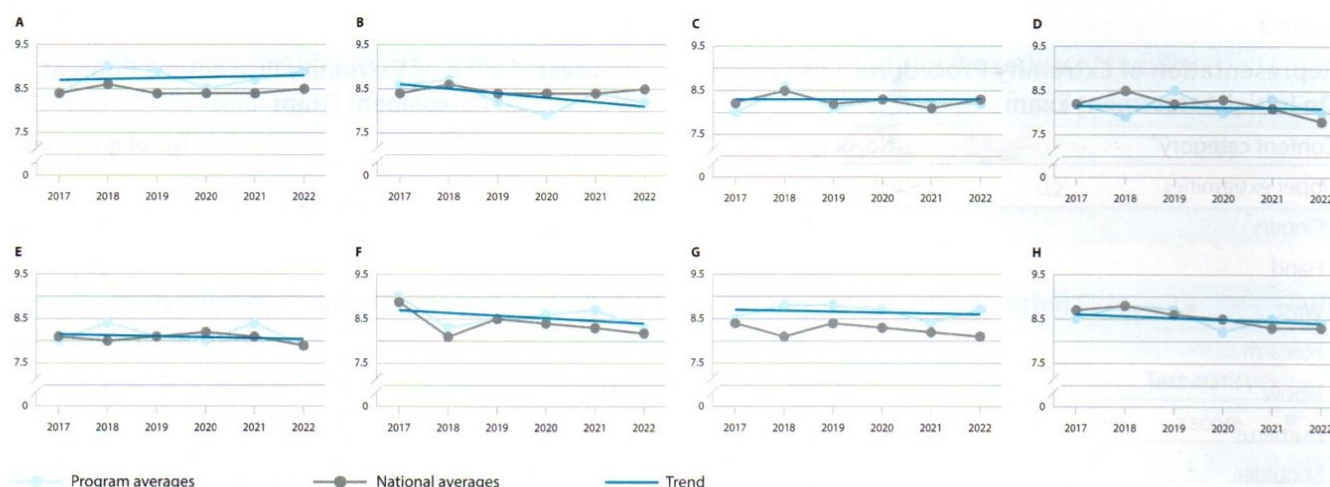


Figure. Program average scores compared with national average scores per year on the content areas of the American Registry of Radiologic Technologists certification exam. A. Patient interactions and management; B. Radiation physics and radiobiology; C. Radiation protection; D. Image acquisition and evaluation; E. Equipment operation and quality assurance; F. Head, spine, and pelvis procedures; G. Thorax and abdomen procedures; H. Extremity procedures. Figure courtesy of the authors.

categories. To develop an assessment exam that included only questions for extremity procedures, questions not related to extremity procedures were eliminated. This process left 30 questions on the assessment exam related to extremities.

Students completed the assessment exam as part of an extra-credit assignment with the knowledge that faculty would use results to develop course content for the next semester for additional review of extremity procedures before completion of the program's radiographic procedures curriculum. The intent was to use the ASRT Clinical Refresher modules as an intervention with requirements to review the assigned modules and then complete the assessment exam again after reviewing the modules.

After students completed this assessment, faculty collected the data and began analyzing the results. Although student performance indicated a need for additional instruction on extremities, results were not specific enough to aid faculty in determining what content needed to be reviewed. Most of the questions used were easily tied to specific extremity procedures. However, some areas of extremities noted on the ARRT Examination Content Specifications for radiography

were not represented on the assessment exam and thus could not be evaluated (see **Table 3**).⁸ This essentially negated the usefulness of this assessment; faculty recreated a better assessment exam.

Reassessing Performance

After the failed attempt at accurate assessment of student knowledge related to extremity procedures, faculty began creating a more robust assessment tool. Collectively, faculty agreed to use the 17 different categories of extremities from the ARRT to create a more accurate assessment of student knowledge.⁸ With the different categories identified, faculty used previous course unit exams covering each of the different categories of extremities to extract 5 questions representing each category of extremities. This resulted in an assessment exam with 85 questions to identify which extremity exams students might need to review (see **Table 4**).

Students were again offered an opportunity to voluntarily complete this revised assessment exam to help faculty develop content for their final radiographic procedures course. This assessment exam was offered at the beginning of the students' final radiographic procedures

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Table 3

Representation of Extremity Procedures Content On Initial Assessment Exam

Content category	No. of questions
Upper extremities	
Fingers	1
Hand	3
Wrist	2
Forearm	0
Elbow	4
Humerus	2
Shoulder	2
Scapula	4
Clavicle and acromioclavicular joints	1
Lower extremities	
Toes	0
Foot	2
Calcaneus	1
Ankle	1
Tibia and fibula	0
Knee	2
Patella	0
Femur and long bone measurement	1
Pelvis and hip ^a	2
Nonspecific and general exposure technique questions	2
Total questions	30

^a Pelvis and hip are part of the head, spine, and pelvis procedures content category of the ARRT Examination Content Specifications for radiography.⁷

course. All 15 students from the program cohort participated in this reassessment. Students then were assigned the ASRT Clinical Refresher modules loaded onto their course management website as an intervention for review of the various extremity procedures. No points were awarded for reviewing the modules. Finally, after all modules were marked as reviewed by a student, the student would have access to the post exam, which was identical to the exam taken before the modules, with questions randomized for each student.

Table 4

Representation of Extremity Procedures Content On Revised Assessment Exam

Content category	No. of questions
Upper extremities	
Fingers	5
Hand	5
Wrist	5
Forearm	5
Elbow	5
Humerus	5
Shoulder	5
Scapula	5
Clavicle and acromioclavicular joints	5
Lower extremities	
Toes	5
Foot	5
Calcaneus	5
Ankle	5
Tibia and fibula	5
Knee	5
Patella	5
Femur and long bone measurement	5
Total questions	85

Results and Discussion

Researchers reviewed results of student performance on the revised assessment exam before and after modules were completed. Descriptive statistics were conducted on the exam to identify means and distribution (see **Table 5**). After discovering the data distribution for the exam taken before the modules was moderately skewed, the researchers opted to perform the nonparametric equivalent of the *t* test known as the Wilcoxon signed rank test.⁹ This test was used to assess whether the median score for the exam taken after the modules was different from the median score for the same content before viewing modules (see **Table 6**). The median score for the exam taken after the modules indicated that a remediation program using the ASRT

Table 5

Descriptive Statistics of Exam Scores Before and After Completing Extremity Procedures Modules

Modules	Students, N	Minimum score	Maximum score	M (SD)	Skew	Kurtosis
Before	15	46	77	64.7 (9.0)	−0.7	−0.1
After	15	61	80	71.4 (4.8)	−0.2	0.6

Table 5

Results from Wilcoxon Signed Rank Test of Median Scores Before and After Completing Extremity Procedures Modules^a

Modules	Negative ranks			Positive ranks			Test statistics		
	Students, n	Mean rank	Sum of ranks	Students, n	Mean rank	Sum of ranks	Ties	z score	P ^b
Before – After	5	4.1	20.5	10	10.0	99.5	0	−2.2	.025

^a Median score before modules was 65.0 and after modules was 71.0.

^b $P < .05$

Clinical Refresher modules demonstrated a significant change in assessment outcomes between the premodule (median = 65.0) and postmodule (median = 71.0) scores among 1 cohort of radiologic technology students in a bachelor of science JRCERT-accredited program ($z = -2.2$, $P = .025$, effect size $r = -0.58$).

The significant difference ($P < .05$) indicates student performance improved on the exam after review of the ASRT Clinical Refresher modules. Students from the studied cohort have not yet graduated, so eventual performance on the ARRT certification exam will be evaluated later.

Although this study produced significant results, the small sample size might have affected the results. However, given the positive outcome from the intervention and resultant scores, faculty are hopeful for increased performance outcomes on the targeted extremity procedures section of the ARRT exam. Future research could expand on this initial study by repeating the same approach to increase the study population. In addition, a correlational study between the studied population in this study and eventual performance on the certification exam could yield additional information to potentially substantiate the effect of the educational intervention.

Conclusion

Radiologic and imaging sciences programs accredited by the JRCERT must collect, analyze, and publish

program effectiveness data. This data offers a glimpse into the overall quality of an education program. This study offers a method to examine program effectiveness data and provides a roadmap for implementing an action plan and intervention for programmatic improvement. Although gathering the required program effectiveness data is easy, interpreting the data can be more complex. By examining trends in data, programs can more readily identify opportunities for improvement initiatives. This action leads to improving student and program outcomes, which ultimately affects the future of the profession.

Heather Schmuck, EdD, R.T.(R), is clinical associate professor and clinical coordinator in the Radiologic and Imaging Sciences Department for the University of Southern Indiana in Evansville. She can be contacted at hmschmuck@usi.edu.

Ryan Williams, MBA-HA, R.T.(R), is assistant professor in the Radiologic and Imaging Sciences Department for the University of Southern Indiana.

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