Practice Analysis Report: Radiography - Effective January 2022

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, 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, 2021). Legislation and legal precedent also stress the importance of practice analysis in the development and validation of certification exams. The ARRT conducts a practice analysis for each discipline approximately every five years. Regular updates are important for professions that continually evolve due to advances in technology because they help ensure that the content specifications and other certification requirements reflect current practice.

This report describes the practice analysis for Radiography conducted from August 2019 to September 2020. The project sought to identify tasks currently required of the typical radiographer and determine what knowledge and cognitive skills are required to effectively perform those tasks.

To accomplish this task, ARRT hosted several meetings with a committee of subject matter experts (SMEs) to develop a survey of job tasks; evaluate survey results; and revise the content specifications, content outline, and clinical competency requirements. ARRT selected seven SMEs for this committee from across the United States and from a range of practice settings (e.g., hospitals, clinics, educational programs). All seven SMEs were certified and registered radiographers.

All statistical analyses were performed by trained statisticians employed by ARRT and meetings were primarily conducted by ARRT's Exam Development Coordinators with psychometric support provided by ARRT psychometric staff.

The ARRT Board of Trustees reviewed all changes to exam content and eligibility requirements before giving approval in January 2021. The first exam under the new content and eligibility requirements was administered in January 2022.

Task Inventory

Survey Development

ARRT begins the practice analysis process by revising the task inventory, which is a listing of clinical and supporting procedures related to practice. The committee reviewed the previous task inventory and content outline before creating an updated list of job tasks by adding, deleting, or rewording tasks as necessary to reflect changes in the profession.

The committee used the updated job task list to create a survey for distribution to individuals working in the profession. The first section of this survey consisted of 131 questions asking current radiographers how frequently they perform each task utilizing a six-point scale with the following options: *Never Perform, Yearly, Quarterly, Monthly, Weekly,* and *Daily*. Based on past research, ARRT uses a frequency scale with absolute anchors because data from scales like importance and criticality, which use subjective anchors, have inferior statistical properties (Babcock, Risk, & Wyse 2020). The data gathered by absolute anchor frequency scales also correspond well to medical imaging practice as defined by external data sources (Babcock & Yoes, 2013) and add value beyond advisory committee members' judgement without data (Wyse & Babcock, 2018).

To reduce the length and burden of the practice analysis survey, the committee identified tasks from the previous task inventory that they believed were so ubiquitous in practice that over 90% of respondents would report that they do perform the task. The following tasks were omitted from the survey and included in the new task inventory without further discussion:

- Verify the patient's identity
- Manage interpersonal interactions in an effective manner
- Follow environmental protection standards for handling and disposing of bio-hazardous materials (e.g., sharps, blood, and body fluids)
- Provide for the patient's safety, comfort, and modesty
- Notify appropriate personnel of adverse events or incidents
- Communicate relevant information to appropriate stakeholders
- Practice Standard Precautions
- Follow appropriate procedures when caring for patients with communicable diseases
- Recognize and communicate the need for prompt medical attention
- Evaluate the need for and use of protective shielding
- Take appropriate precautions to minimize radiation exposure to the patient
- Keep all unnecessary persons out of the immediate area during radiation exposure
- Take appropriate precautions to minimize occupational radiation exposure
- Advocate radiation safety and protection
- Describe the potential risk of radiation exposure when asked
- Wear a radiation monitoring device while on duty
- Operate radiographic unit and accessories, including: fixed unit
- Explain breathing instructions prior to making the exposure
- Position patient to demonstrate the desire anatomy using anatomical landmarks
- Modify exposure factors for circumstances such as involuntary motion, casts and splints, pathological conditions, contrast agent, or patient's inability to cooperate
- Select appropriate geometric factors (e.g., SID, OID, focal spot size, tube angle)
- Evaluate images for diagnostic quality

- Verify accuracy of patient identification associated with images
- Add electronic annotations on images to indicate position or other relevant information (e.g., time, upright, decubitus, post-void)
- Perform post-processing on images in preparation for interpretation
- Identify image artifacts and make appropriate corrections as needed
- Store and handle image receptor in a manner which will reduce the possibility of artifact production
- Recognize and report malfunctions in the imaging unit and accessories
- Recognize the need for periodic maintenance and evaluation of radiographic equipment affecting image quality and radiation safety (e.g., shielding, image display monitor, light field, central ray detector calibration)
- Perform routine maintenance on digital equipment, including: equipment cleanliness

The second section of the survey included 11 questions regarding the respondent's role and workplace such as hours worked, primary job title, and department composition.

In addition to the task survey, the committee also created a separate survey of 207 radiographic positions and projections that may be used in practice. The results from this survey formed the basis for Appendix A of the content specifications. The second section of this survey contained 9 questions regarding the respondents' role and workplace such as hours worked, primary job title, and department composition.

Survey Sample

Task Survey

ARRT staff drew a random sample of 2,400 radiographers from the ARRT database of certified and registered technologists according to the following criteria:

Inclusion Criteria:

1. R.T.s primary discipline was radiography
2. R.T. was actively employed as a radiographer
3. R.T. was employed full time
4. R.T. had 10 years or fewer work experience
5. R.T. worked in the USA

Exclusion Criteria:

1. R.T. had been sampled in one of the last two practice analyses
2. R.T. was sanctioned or on probation
3. R.T. was retired or dead
4. R.T. was missing data in any field required to determine eligibility

Additionally, to ensure that the survey was representative of entry-level practice, the random sample was stratified by years of experience in radiography: 60% of the sample was made up of those with 1-3 years of experience, 20% with 4-5 years of experience, and 20% with 6-10 years of experience.

ARRT's survey vendor mailed the survey in October 2019. A total of 644 recipients returned their survey by close in January 2020 for an absolute response rate of 26.8%. ARRT staff screened

responses to ensure that the surveys were correctly filled out by the intended population, retaining 594 for an effective response rate of 24.8%.

Position and Projection Survey

ARRT staff drew a random sample of 1,500 radiographers from the ARRT database of certified and registered technologists according to the same criteria as the task survey. Of the 1500 surveys sent, recipients returned 385 for an absolute response rate of 25.7%. ARRT staff screened responses to ensure that the surveys were correctly filled out by the intended population, retaining 380 for an effective response rate of 25.3%.

Analysis

Task Survey

ARRT psychometric staff first calculated the percentage of respondents who report performing the task and the percent who report performing the task daily or weekly (Table 1). ARRT allows tasks performed by 40% or more of respondents to be included on the task inventory without further discussion so that committees may focus on discussions most likely to impact task inclusion. However, committees still review all survey results and may choose to include tasks below the threshold or reject tasks above the threshold as they see fit based on their joint expertise.

ARRT psychometric staff next compared the percent of tasks performed by radiographers at different medical settings. Table 2 provides a summary of differences in radiographer tasks between different medical settings.

Finally, ARRT staff summarized results for the 11 items that covered the respondent's role and workplace (Tables 3 - 13).

Position and Projection Survey

ARRT staff summarized the proportion performing each position or projection (Table 14) as well as the results for the nine items that covered the respondents' role and workplace (Table 15-23).

Table 1.
Percent of technologists performing tasks

Item	Task	% Performing	% Daily/Weekly
1	Sequence imaging procedures to avoid affecting subsequent examinations (e.g., residual contrast material)	62.1	41.6
2	Evaluate the patient's ability to understand and comply with requirements for the requested examination	98.8	96.3
3	Obtain pertinent medical history	98.3	95.1
4	Explain and confirm the patient's preparation (e.g., diet restrictions, preparatory medications)	78.7	64.6
5	Review the examination request to verify information is accurate, appropriate, and complete (e.g., patient history, clinical diagnosis, physician's orders)	99.2	97.6
6	Explain the procedure instructions to patient, patient's family, or authorized representative (e.g., pre-procedure, post procedure)	94.8	91.1
7	Respond as appropriate to procedure inquiries from the patient, patient's family, or authorized representative (e.g., scheduling delays, exam duration)	94.8	90.8
8	Monitor the patient's auxiliary medical equipment (e.g., IVs, oxygen) during the procedure	80.2	65.8
9	Follow environmental protection standards for handling and disposing of hazardous materials (e.g., disinfectant, chemotherapy IV, radioactive implant)	76.9	66.8
10	Demonstrate and promote professional and ethical behavior (e.g., confidentiality, regulation compliance)	100.0	99.7
11	Verify informed consent as necessary	94.6	83.1
12	Recognize abnormal or missing lab values relative to the procedure ordered	64.5	49.4
13	Handle, label, and submit laboratory specimens (e.g., cerebrospinal fluid, synovial fluid)	53.2	30.0
14	Use positioning aids, as needed, to reduce patient movement and/or promote patient safety	98.3	91.5
15	Use proper body mechanics and/or ergonomic devices to promote personnel safety	98.8	98.0
16	Prior to administration of a medication other than a contrast agent, review pertinent information to prepare appropriate type and dosage	42.3	31.7
17	Prior to administration of a contrast agent, review pertinent information to prepare appropriate type and dosage	64.4	49.2
18	Prior to administration of a contrast agent, determine if patient is at risk for an adverse reaction	66.7	51.4
19	Use sterile or aseptic technique when indicated	82.7	63.7
20	Perform venipuncture	32.8	21.0
21	Administer contrast agents as required by the procedure	61.3	44.8
22	Assess the patient after administration of a contrast agent to detect adverse reactions	65.1	47.9
23	Obtain vital signs	46.4	25.4
24	Provide emergency care	67.5	30.5

Item	Task	% Performing	% Daily/Weekly
25	Clean and disinfect or sterilize facilities and equipment	94.1	91.7
26	Document required information on the patient's medical record (e.g., imaging procedure documentation, images, adverse events)	94.8	88.6
27	Screen female patients of childbearing age for the possibility of pregnancy and take appropriate action (e.g., document response, contact physician)	98.2	95.1
28	Set technical factors to produce optimal images and minimize patient dose	99.8	98.3
29	Document radiographic procedure dose	73.7	61.7
30	Take appropriate action to minimize fluoroscopy dose	70.0	57.8
31	Document fluoroscopy time	68.8	57.8
32	Document fluoroscopy dose	63.5	50.4
33	Evaluate individual occupational exposure reports to determine if values for the reporting period are within established limits	60.5	12.8
	Select appropriate radiographic exposure factors using the following:	---	---
34	a. Fixed kVp technique chart	74.5	65.6
35	b. Variable kVp technique chart	75.5	65.1
36	c. Calipers (to determine patient thickness for exposure)	25.0	13.6
37	d. Automatic Exposure Control (AEC)	89.4	86.0
38	e. Anatomically programmed technique	89.0	85.0
	Operate radiographic unit and accessories including:	---	---
39	a. Mobile unit	65.3	60.3
40	b. Tomosynthesis unit	7.4	3.2
	Operate fluoroscopic unit and accessories including:	---	---
41	a. Fixed fluoroscopic unit	58.6	41.7
42	b. Mobile fluoroscopic unit (e.g., C-arm, O-arm)	63.3	48.6
43	Use film-screen cassettes and automatic film processing	24.5	15.8
	Operate digital imaging devices and information technology systems including:	---	---
44	a. Computed radiography (CR)	58.9	39.5
45	b. Digital radiography (DR)	90.5	86.9
46	c. Picture archiving and communication systems (PACS)	97.3	95.9
47	d. Medical information systems (e.g., HIS, RIS, EMR, EHR)	93.1	91.1
48	Recognize and report malfunctions in the information technology systems (e.g., downtime procedures)	95.1	48.4
49	Remove radiopaque materials that could interfere with the image from the exposure field (e.g., clothing, jewelry)	99.5	98.8

Item	Task	% Performing	% Daily/Weekly
50	Use radiopaque anatomical side markers at the time of image acquisition	98.0	95.9
51	Select imaging accessories (e.g., grid, compensating filter, shielding) for the examination requested	98.7	96.6
52	Align central ray to body part and image receptor to demonstrate the desired anatomy	99.7	98.8
	Adapt procedures for:	---	---
53	a. Patient condition (e.g., age, size, trauma, pathology)	99.7	99.0
54	b. Location (e.g., mobile, surgical, isolation)	81.4	76.7
55	Respond appropriately to exposure indicator values	97.8	95.7
56	Determine corrective measures if image is not of diagnostic quality and take appropriate action	99.7	97.4
	Perform routine maintenance on digital equipment including:	---	---
57	a. Detector calibration	60.4	28.3
58	b. CR plate erasure	45.0	26.7
59	c. Test images	58.0	19.8
60	Perform CT quality control	24.5	15.7
	Perform the following diagnostic examinations:	---	---
61	Chest	96.0	89.1
62	Ribs	96.2	71.9
63	Soft tissue neck	89.0	40.0
64	Sternum	85.6	6.6
65	Sternoclavicular joints	73.1	6.8
66	Abdomen	92.9	83.6
67	Esophagus	61.3	34.9
68	Swallowing dysfunction study	55.6	38.8
69	Foreign body, airway or ingested	82.9	32.9
70	Upper GI series, single or double contrast	58.1	38.0
71	Small bowel series	58.5	30.8
72	Contrast enema (e.g., barium, iodinated), single or double contrast	52.5	15.8
73	Surgical cholangiography	44.8	20.1
74	ERCP	40.3	21.0
75	Cystography	46.1	19.4
76	Cystourethrography	38.3	13.3
77	Intravenous urography	26.8	6.3
78	Retrograde urography	40.0	16.9

Item	Task	% Performing	% Daily/Weekly
79	Hysterosalpingography	35.0	11.2
80	Cervical spine	97.6	89.3
81	Thoracic spine	98.2	83.5
82	Scoliosis series	73.7	37.3
83	Lumbar spine	98.2	91.5
84	Sacrum/coccyx	97.5	51.4
85	Sacroiliac joints	88.4	27.6
86	Pelvis/hips	97.8	91.0
87	Skull	88.7	29.1
88	Facial bones	85.1	19.8
89	Mandible	79.4	8.3
90	Zygomatic arch	45.8	2.4
91	Temporomandibular joints	53.5	3.7
92	Nasal bones	87.6	17.5
93	Orbits	76.4	18.2
94	Paranasal sinuses	70.7	17.4
95	Optic foramina	30.0	3.2
96	Mastoids	28.4	3.2
97	Toes	96.1	71.6
98	Foot	98.3	93.7
99	Calcaneus	96.8	53.3
100	Ankle	98.3	94.5
101	Tibia/fibula	97.8	88.4
102	Knee/patella	98.5	96.3
103	Femur	97.8	78.4
104	Fingers	97.8	87.6
105	Hand	98.3	95.1
106	Writs	98.2	94.7
107	Forearm	97.7	86.0
108	Elbow	98.1	81.6
109	Humerus	97.5	69.3
110	Shoulder	98.3	91.5
111	Scapula	92.5	33.2

Item	Task	% Performing	% Daily/Weekly
112	Clavicle	96.6	48.9
113	Acromioclavicular joints	74.3	12.4
114	Bone survey	70.6	18.7
115	Long bone measurement	46.0	10.2
116	Bone age	60.4	18.4
	Assist radiologist with the following invasive procedures:	---	---
117	a. Joint injection (arthrography)-fluoroscopic guided contrast injection	51.8	31.2
118	b. Myelography-fluoroscopic guided contrast injection	38.9	16.0
	Assist practitioners with the following fluoroscopic procedures:	---	---
119	a. Operative vascular imaging using mobile fluoroscopy	27.2	11.8
120	b. PICC line insertion	25.6	13.5
	Position patient and independently operate a CT scanner to produce the following diagnostic images:	---	---
121	a. Head without contrast	22.4	20.4
122	b. Head with contrast	21.0	13.3
123	c. Neck (cervical spine) without contrast	22.5	19.3
124	d. Chest without contrast	22.4	19.1
125	e. Chest with contrast	21.7	19.1
126	f. Abdomen without contrast	22.2	19.6
127	g. Abdomen with contrast	21.7	20.1
128	h. Pelvis without contrast	21.8	16.9
129	i. Pelvis with contrast	20.7	15.8
130	j. Computed Tomography Angiography (CTA)	21.0	17.9
131	Perform and analyze bone densitometry scans utilizing DXA equipment (e.g., lumbar, proximal femur, forearm)	14.7	11.8

Table 2.
Percent of tasks performed by radiographers at different clinical settings

Setting	Q20	Q60	Q121	Q122	Q123	Q124	Q125	Q126	Q127	Q128	Q129	Q130	Q131
Hospital < 100 Beds	63	65	79	72	79	79	77	79	77	76	72	76	31
Hospital 100-249	32	32	32	32	32	32	32	32	32	32	32	32	18
Hospital 250-500	16	19	19	17	19	19	17	18	17	17	15	16	9
Hospital >500	19	13	8	8	8	8	8	8	8	8	8	8	6
Clinic	33	13	3	3	3	3	3	3	3	4	3	3	7
Imaging Center	40	33	31	29	31	31	29	31	29	31	29	26	52

Key:
Q20: Perform Venipuncture
Q60: Perform CT quality control
Q121: Head without contrast
Q122: Head with contrast
Q123: Neck (cervical spine) without contrast
Q124: Chest without contrast
Q125: Chest with contrast
Q126: Abdomen without contrast
Q127: Abdomen with contrast
Q128: Pelvis without contrast
Q129: Pelvis with contrast
Q130: Computed Tomography Angiography (CTA)
Q131: Perform and analyze bone densitometry scans utilizing DXA equipment (e.g., lumbar, proximal femur, forearm)

Table 3.
How many years have you worked as a radiographer?

Response	Count	Percent
less than 1 year	18	3.1
1 - 3 years	245	41.7
4 - 5 years	150	25.6
6 - 10 years	139	22.7
more than 10 years	35	6.0

Table 4.
How many hours per week do you work as a radiographer?

Response	Count	Percent
less than 20 hours	4	0.7
20 to 30 hours	22	3.8
more than 30 hours	559	95.2

Table 5.
Which of the following best describes your primary work shift (select one)?

Response	Count	Percent
M-F days	400	68.1
M-F evenings	96	16.4
M-F overnights	38	6.5
weekends	44	7.5

Table 6.
Which of the following best describes your primary job role?

Response	Count	Percent
staff technologist	532	90.6
lead or chief technologist	25	8.9
program director, clinical coordinator, clinical instructor, or didactic instructor	0.0	0.0
manager	0.0	0.0

Table 7.
Estimate the percentage of your work time you spend performing the following:

	Count (Percent)				
	0%	1-25%	26-50%	51-75%	>75%
radiography	3 (0.5)	19 (3.2)	57 (9.7)	67 (11.4)	440 (75.0)
CT	398 (67.8)	38 (6.5)	35 (6.0)	34 (5.8)	26 (4.4)
MR	495 (84.3)	9 (1.5)	6 (1.0)	2 (0.3)	4 (0.7)
mammography	489 (83.3)	7 (1.2)	7 (1.2)	9 (1.5)	3 (0.5)
VI radiography	503 (85.7)	4 (0.7)	3 (0.5)	0 (0.0)	4 (0.7)
CI radiography	505 (86.0)	3 (0.5)	1 (0.2)	0 (0.0)	0 (0.0)
bone densitometry	437 (74.5)	53 (9.0)	19 (3.2)	10 (1.7)	6 (1.0)

Table 8.
Do you currently hold or are you currently pursuing ARRT certification in any of the following?

	Count (Percent)		
	Certified & Registered	In Progress	No
CT	58 (9.9)	80 (13.6)	431 (73.4)
MR	12 (2.0)	26 (4.4)	527 (89.8)
mammography	26 (4.4)	17 (2.9)	518 (88.3)
VI radiography	1 (0.2)	3 (0.5)	553 (94.2)
CI radiography	1 (0.2)	1 (0.2)	553 (94.2)
bone densitometry	11 (1.9)	18 (3.1)	530 (90.3)

Table 9.
Which of the following best describes the community in which you work?

Response	Count	Percent
urban/city	339	57.8
suburb	121	20.6
rural/small town	122	20.8

Table 10.
Which of the following best describes your primary place of employment? (select one)

Response	Count	Percent
hospital/medical center, less than 100 beds	75	12.8
hospital/medical center, 100 to 249 beds	70	11.9
hospital/medical center, 250 to 500 beds	106	18.1
hospital/medical center, more than 500 beds	88	15.0
physician group practice/clinic	149	25.4
free-standing imaging center	42	7.2
(other)	51	8.7

Table 11.
Approximately how many radiographers, including you, are employed in the facility where you work?

Response	Count	Percent
less than 6	161	27.4
6 - 10	74	12.6
11 - 15	88	15.0
more than 15	262	44.6

Table 12.
In the last year, has the number of approved FTE positions for radiographers at your facility changed?

Response	Count	Percent
number has increased	168	28.6
number has decreased	73	12.4
number has NOT changed	341	58.1

Table 13.
In the last year, has the number of radiographers employed at your facility changed?

Response	Count	Percent
number has increased	179	30.5
number has decreased	130	22.1
number has NOT changed	274	46.7

Table 14.
Percent performing each position/projection

Item	Position/Projection	Percent
	Skull	---
1	AP axial (Towne)	75.5
2	lateral	86.3
3	PA axial (Caldwell)	77.0
4	PA	66.6
5	submentovertex (full basal)	25.9
6	PA axial (Haas)	18.4
7	trauma cross-table (horizontal beam) lateral	28.6
8	trauma AP axial (reverse Caldwell)	23.0
9	trauma AP	30.2
10	trauma AP axial (Towne)	22.2
	Facial Bones	---
11	lateral	74.8
12	parietoacanthial (Waters)	74.5
13	PA axial (Caldwell)	67.6
14	modified parietoacanthial (modified Waters)	33.8
15	trauma acanthioparietal (reverse Waters)	15.6
	Mandible	---
16	axiolateral oblique	59.4
17	PA	53.7
18	AP axial (Towne)	50.5
19	PA axial	34.8
20	PA (modified Waters)	30.3
21	submentovertex (full basal)	21.2
	Zygomatic Arch	---
22	submentovertex (full basal)	18.9
23	parietoacanthial (Waters)	22.3
24	AP axial (modified Towne)	16.8
25	oblique inferosuperior (tangential)	16.0
	Temporomandibular Joints	---
26	axiolateral oblique (modified Law)	19.1
27	axiolateral (modified Schuller)	15.9
28	AP axial (modified Towne)	21.8
	Nasal Bones	---
29	parietoacanthial (Waters)	80.3
30	lateral	83.5
31	PA axial (Caldwell)	59.7
	Orbits	---
32	parietoacanthial (Waters)	58.3
33	lateral	55.1
34	PA axial (Caldwell)	50.3
35	modified parietoacanthial (modified Waters)	29.4
	Paranasal Sinuses	---
36	lateral, horizontal beam	52.3
37	PA axial (Caldwell), horizontal beam	51.6

Item	Position/Projection	Percent
38	parietoacanthial (Waters), horizontal beam	51.5
39	submentovertex (full basal), horizontal beam	19.3
40	open mouth parietoacanthial (Waters), horizontal beam	15.6
	Cervical Spine	---
41	AP axial	97.9
42	AP open mouth	94.4
43	lateral	98.4
44	cross-table (horizontal beam) lateral	56.3
45	PA axial obliques	40.6
46	AP axial obliques	81.6
47	lateral swimmers	92.6
48	lateral flexion and extension	89.2
49	AP dens (Fuchs)	69.7
	Thoracic Spine	---
50	AP	97.1
51	lateral, breathing	85.0
52	lateral, expiration	72.3
	Scoliosis Series	---
53	AP or PA	68.2
54	lateral	63.3
	Lumbar Spine	---
55	AP	98.7
56	PA	30.9
57	lateral	99.2
58	L5-S1 lateral spot	90.7
59	posterior oblique	43.5
60	anterior oblique	63.9
61	AP axial L5-S1	41.0
62	AP right and left bending	38.3
63	lateral flexion and extension	84.9
	Sacrum and Coccyx	---
64	AP axial sacrum	96.8
65	AP axial coccyx	96.6
66	lateral sacrum and coccyx, combined	95.3
67	lateral sacrum or coccyx, separate	36.3
	Sacroiliac Joints	---
68	AP axial	74.5
69	posterior oblique	37.3
70	anterior oblique	57.4
	Pelvis and Hip	---
71	AP hip only	91.8
72	cross-table (horizontal beam) lateral hip	71.4
73	unilateral frog-leg, non-trauma	94.4
74	axiolateral inferosuperior, trauma (Clements-Nakayama)	25.5
75	AP pelvis	98.9
76	AP pelvis, bilateral frog-leg	74.4
77	AP pelvis, axial anterior pelvic bones (inlet, outlet)	59.0
78	posterior oblique pelvis, acetabulum (Judet)	44.0
	Chest	---
79	PA or AP upright	96.6
80	lateral upright	96.0
81	AP lordotic	35.0
82	AP supine	70.7
83	lateral decubitus	53.2
84	anterior and posterior obliques	23.2

Item	Position/Projection	Percent
	Ribs	---
85	AP and PA, above and below diaphragm	96.3
86	anterior and posterior obliques	95.8
	Sternum	---
87	lateral	73.5
88	RAO	73.5
	Soft Tissue Neck	---
89	AP upper airway	77.2
90	lateral upper airway	81.0
	Abdomen	---
91	AP supine	91.5
92	AP upright	90.5
93	lateral decubitus	57.9
94	dorsal decubitus	22.9
	Esophagus	---
95	RAO	31.0
96	left lateral	28.1
97	Please answer this question 'No'	1.3
98	AP	30.5
99	PA	17.2
100	LAO	19.4
	Upper GI series	---
101	AP or PA scout	45.5
102	RAO	35.6
103	PA	27.7
104	right lateral	30.4
105	LPO	32.5
106	AP	37.7
	Small Bowel Series	---
107	PA scout	39.4
108	PA (follow through)	39.6
109	ileocecal spots	28.8
	Contrast Enema	---
110	left lateral rectum	31.2
111	left lateral decubitus	25.9
112	right lateral decubitus	24.5
113	LPO and RPO	29.4
114	PA	24.9
115	RAO and LAO	23.8
116	AP axial (sigmoid)	30.2
117	PA axial (sigmoid)	15.6
118	PA or AP post-evacuation	34.4
	Cystography	---
119	AP	27.3
120	LPO and RPO	18.6
121	lateral	15.0
122	AP axial	11.1
	Cystourethrography	---
123	AP voiding cystourethrogram female	18.5
124	RPO voiding cystourethrogram male	10.6
	Intravenous Urography	---
125	AP, scout, and series	12.9
126	RPO and LPO	10.6
127	post-void	12.2
	Retrograde Urography	---

Item	Position/Projection	Percent
128	AP scout	15.6
129	AP pyelogram	11.7
130	AP ureterogram	10.6
	Fingers	---
131	PA entire hand	81.8
132	PA finger only	90.8
133	lateral	98.4
134	medial and/or lateral oblique	97.6
135	AP thumb	96.8
136	medial oblique thumb	93.4
137	lateral thumb	97.4
	Hand	---
138	PA	99.5
139	lateral	99.5
140	lateral oblique	97.9
	Wrist	---
141	PA	99.5
142	lateral oblique	97.6
143	lateral	99.2
144	PA–ulnar deviation	83.4
145	PA axial (Stecher)	33.9
146	tangential carpal canal (Gaynor-Hart)	24.8
	Forearm	---
147	AP	99.5
148	lateral	99.5
	Elbow	---
149	AP	99.5
150	lateral	99.2
151	lateral oblique	90.7
152	medial oblique	70.6
153	AP partial flexion	58.4
154	trauma axial laterals (Coyle)	44.7
	Humerus	---
155	AP	98.9
156	lateral	98.9
157	neutral	55.4
158	transthoracic lateral	40.5
	Shoulder	---
159	AP internal and external rotation	98.7
160	inferosuperior axial (Lawrence)	50.8
161	posterior oblique (Grashey)	74.1
162	AP neutral	83.1
163	PA oblique (scapular Y)	94.2
164	supraspinatus outlet (Neer)	28.1
	Scapula	---
165	AP	87.6
166	lateral	87.8
	Clavicle	---
167	AP or PA	98.2
168	AP axial	97.9
169	PA axial	19.3
	Toes	---
170	AP, entire forefoot	81.2
171	AP or PA axial toe	82.6
172	oblique toes	92.9

Item	Position/Projection	Percent
173	lateral toe	95.0
174	sesamoids, tangential	24.3
	Calcaneus	---
175	lateral	95.0
176	plantodorsal, axial	82.9
177	dorsoplantar, axial	37.7
178	Please answer this question 'No'	2.4
	Foot	---
179	AP axial	99.2
180	medial oblique	97.9
181	lateral oblique	36.8
182	lateral	98.9
183	AP axial weight bearing	68.0
184	lateral weight bearing	68.1
	Ankle	---
185	AP	99.5
186	mortise	93.9
187	lateral	99.2
188	medial oblique	75.0
189	AP stress views	39.4
190	AP weight bearing	52.5
191	lateral weight bearing	52.2
	Tibia/Fibula	---
192	AP	99.2
193	lateral	99.2
	Knee/Patella	---
194	AP	98.1
195	lateral	98.4
196	AP weight bearing	79.5
197	lateral oblique	56.2
198	medial oblique	73.3
199	PA axial–intercondylar fossa (Holmblad)	22.4
200	PA axial–intercondylar fossa (Camp Coventry)	20.1
201	AP axial–intercondylar fossa (Béclère)	24.7
202	PA patella	36.6
203	tangential (Merchant)	52.1
204	tangential (Settegast)	36.4
205	tangential (Hughston)	16.6
	Femur	---
206	AP	97.9
207	lateral	97.6

Table 15.
How many years have you worked as a radiographer? (position/projection survey)

Response	Count	Percent
less than 1 year	9	2.4
1 - 3 years	153	40.3
4 - 5 years	107	28.2
6 - 10 years	89	23.4
more than 10 years	22	5.8

Table 16.
How many hours per week do you work as a radiographer? (position/projection survey)

Response	Count	Percent
less than 20 hours	3	0.8
20 to 30 hours	14	3.7
more than 30 hours	363	95.5

Table 17.
Which of the following best describes your primary work shift (select one)? (position/projection survey)

Response	Count	Percent
M-F days	275	75.5
M-F evenings	46	12.6
M-F overnights	17	4.7
weekends	26	7.1

Table 18.
Which of the following best describes your primary job role? (position/projection survey)

Response	Count	Percent
staff technologist	337	88.7
lead or chief technologist	37	9.7
program director, clinical coordinator, clinical instructor, or didactic instructor	4	1.1
manager	2	0.5

Table 19.
Which of the following best describes the community in which you work?

Response	Count	Percent
urban/city	203	53.8
suburb	93	24.7
rural/small town	81	21.5

Table 20.
Which of the following best describes your primary place of employment? (select one)

Response	Count	Percent
hospital/medical center, less than 100 beds	42	11.4
hospital/medical center, 100 to 249 beds	31	8.4
hospital/medical center, 250 to 500 beds	54	14.6
hospital/medical center, more than 500 beds	58	15.7
physician group practice/clinic	124	33.5
free-standing imaging center	21	5.7
(other)	40	10.8

Table 21.
Approximately how many radiographers, including you, are employed in the facility where you work?

Response	Count	Percent
less than 6	119	31.3
6 - 10	65	17.1
11 - 15	45	11.8
more than 15	151	39.7

Table 22.
In the last year, has the number of approved FTE positions for radiographers at your facility changed?

Response	Count	Percent
number has increased	117	31.0
number has decreased	31	8.2
number has NOT changed	229	60.7

Table 23.
In the last year, has the number of radiographers employed at your facility changed?

Response	Count	Percent
number has increased	137	36.1
number has decreased	76	20.1
number has NOT changed	166	43.8

Changes to Task Inventory

The practice analysis committee met in August 2020 to review the practice analysis survey data and determine whether any tasks should be dropped from or added to the task inventory. The committee also clarified the wording of several tasks.

The following tasks were removed:

- Calipers (to determine patient thickness for exposure)
- Use film-screen cassettes and automatic film processing
- Zygomatic arch

The following tasks were added:

- Handle, label and submit laboratory specimens (e.g., cerebrospinal fluid, synovial fluid)
- Select appropriate radiographic exposure factors using the following:
    - Automatic Exposure Control (AEC)
- Recognize and report malfunctions in the information technology systems (e.g., downtime procedures)
- Perform the following diagnostic examinations:
    - Soft tissue neck
    - Foreign body, airway or ingested
    - Sternoclavicular joints

The Board of Trustees approved the final task inventory in January 2021. The final task inventory may be found on the ARRT website: https://www.arrt.org/pages/arrt-reference-documents/by-document-type/task-inventories

Content Specifications and Clinical Competency Requirements

Changes to Content Specifications

The practice analysis committee updated the content specifications based on changes to the task inventory and the field. The committee considered the knowledge and cognitive skills required to successfully perform the tasks in the final task inventory and verified that those topics were covered in the content specifications, adding additional content as necessary. The committee also removed any topics that could not be linked to the updated task inventory.

The updated content specifications were then made available for public comment in September 2020 and the committee met again in November 2020 to discuss the comments before making any final adjustments.

The most notable changes from the previous version of the content specifications were:

- Patient Care
  - Added additional details to be more consistent with other ARRT primary disciplines
- Safety
  - Reorganized to be more consistent with the ARRT primary disciplines that include radiation safety
  - Removed genetic impact and shielding
- Image Production
  - Removed the image acquisition and evaluation chart selection of factors in the contrast section
  - Removed caliper measurement under technique charts
  - Added additional detail in the image receptors subsection
- Procedures
  - Removed zygomatic arch
  - Added sternoclavicular joints

In addition, the committee edited all sections of the content specifications for clarity and updated terminology to reflect current practice.

The Board of Trustees approved the final content specifications in January 2021. The final content specifications may be found on the ARRT website: https://www.arrt.org/pages/arrt-reference-documents/by-document-type/examination-content-specifications

Content Weighting

The practice analysis committee determined the number of items that should be assigned to each section of the exam through a process known as content weighting. First, the committee performed a bottom-up exercise where members individually estimated the number of unique items that should be included in each section. Second, the committee performed a top-down exercise where members individually estimated the relative proportion of the exam that should be dedicated to each section. Finally, ARRT staff provided the committee with summary values from the two exercises and the committee held a discussion to finalize their recommendation for the number of items assigned to each section (Table 24).

Table 24.
Number of Items per Section

Content Area	Number of Scored Items
Patient Care	**33**
Patient Interactions and Management (33)	
Safety	**50**
Radiation Physics and Radiobiology (21)	
Radiation Protection (29)	
Image Production	**51**
Image Acquisition and Evaluation (26)	
Equipment Operation and Quality Assurance (25)	
Procedures	**66**
Head, Spine, and Pelvis Procedures (18)	
Thorax and Abdomen Procedures (20)	
Extremity Procedures (28)	
Grand Total	**200**

Changes to Clinical Competency Requirements

The purpose of the clinical competency requirements is to document that individuals have demonstrated competence performing the clinical activities fundamental to a particular discipline. Competent performance of these fundamental activities, in conjunction with mastery of the cognitive knowledge and skills as documented by the examination requirement, provides the basis for the acquisition of the full range of procedures typically required in a variety of settings. Demonstration of clinical competence means that the candidate has performed the procedure independently, consistently, and effectively during the course of his or her formal education.

The practice analysis committee reviewed and updated the previous clinical competency requirements considering the final task inventory and content specifications. The updated clinical requirements were then made available for public comment in September 2020 and the committee met again in November 2020 to discuss the comments before making any final adjustments.

The most notable changes from the previous version of the clinical competency requirements were:

- Removed zygomatic arches from procedure list
- Removed sternoclavicular joints from procedure list
- Changed “orthopedic” to “upper or lower extremity” under mobile radiographic studies
- Combined upper and lower extremity in pediatric section
- Combined upper and lower extremity in geriatric section
- Added “hip or spine” to geriatric section

In addition, the committee discussed that certain imaging procedures are essential for candidates to demonstrate competence on real patients. They also used the survey data to make decisions of which procedures may be simulated. A column was added to the chart to show which procedures are eligible for simulation. Candidates may choose a maximum of ten procedures (approximately 20% of the total number of required procedures) to be simulated.

The Board of Trustees approved the final clinical competency requirements in January 2021. The final clinical competency requirements may be found on the ARRT website: https://www.arrt.org/pages/arrt-reference-documents/by-document-type/didactic-and-clinical-competency-requirements

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 an exam program to ensure that the content of the exam and the eligibility requirements remain relevant with current practice. This study noted significant changes to the field of radiography, and thanks to the efforts of all involved it assures that the ARRT Radiography exam program will continue to be an excellent assessment of radiographers wishing to demonstrate their qualifications by seeking certification and registration.