



# Computed Tomography

The purpose of the examination requirement is to assess whether individuals have obtained the knowledge and cognitive skills underlying the intelligent performance of the tasks typically required in computed tomography for practice at entry level. The tasks typically performed were determined by administering a comprehensive practice analysis survey to a nationwide sample of computed tomography technologists.<sup>1</sup> The *Task Inventory for Computed Tomography* may be found on the ARRT's website ([www.arrt.org](http://www.arrt.org)).

The *Examination Content Specifications for Computed Tomography* and attached content outline identify the knowledge areas underlying performance of the tasks on the *Task Inventory for Computed Tomography*. Every content category can be linked to one or more activities on the task inventory.

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

<b>Content Category</b>	<b>Number of Scored Questions<sup>2</sup></b>
<b>Patient Care</b>	<b>22</b>
<i>Patient Interactions and Management (22)</i>	
<b>Safety<sup>3</sup></b>	<b>22</b>
<i>Radiation Safety and Dose (22)</i>	
<b>Image Production</b>	<b>50</b>
<i>Image Formation (28)</i>	
<i>Image Evaluation and Archiving (22)</i>	
<b>Procedures</b>	<b>71</b>
<i>Head, Spine, and Musculoskeletal (25)</i>	
<i>Neck and Chest (21)</i>	
<i>Abdomen and Pelvis (25)</i>	
<b>Total</b>	<b>165</b>

<sup>1</sup> A special debt of gratitude is due to the hundreds of professionals participating in this project as committee members, survey respondents, and reviewers.

<sup>2</sup> The exam includes an additional 30 unscored (pilot) questions.

<sup>3</sup> SI units are the primary (principal) units of radiation measurement used on the computed tomography examination.



## Patient Care

### 1. Patient Interactions and Management

- A. Patient Assessment and Preparation
  1. patient history
  2. interpersonal communication (e.g., patient care team, physician)
  3. scheduling and screening
  4. patient education
  5. consent (e.g., informed, oral, implied)
  6. positioning aids to eliminate motion artifacts and for patient safety (e.g., velcro straps, padding)
  7. patient monitoring
    - a. level of consciousness
    - b. fall prevention
    - c. vital signs
    - d. heart rhythm and cardiac cycle
    - e. oximetry
    - f. medical emergency
  8. ergonomics and patient transfer techniques
  9. management of accessory medical devices
    - a. oxygen delivery systems
    - b. chest tubes
    - c. in-dwelling catheters
  10. lab values
    - a. renal function (\*e.g., eGFR, creatinine, BUN)
    - b. other (e.g., d-dimer, LFT, INR)
  11. medications and dosage
    - a. current
    - b. pre-procedure medications (e.g., steroid, anti-anxiety)
    - c. post-procedure instructions (e.g., diabetic patient)
- B. Contrast and Medication
  1. contrast media types and properties
    - a. ionic, nonionic
    - b. osmolarity
    - c. barium sulfate
    - d. water soluble (iodinated)
    - e. air
    - f. water
    - g. other
  2. special contrast considerations
    - a. contraindications
    - b. indications
    - c. pregnancy
    - d. lactation
    - e. dialysis patients
  3. noncontrast medications (e.g., lidocaine, nitroglycerin)
  4. administration routes and dose calculations
    - a. IV
    - b. oral
    - c. rectal
    - d. intrathecal
    - e. catheters (e.g., central line, PICC line, Foley)
    - f. other (e.g., stoma, intra-articular)
  5. venipuncture
    - a. site selection
    - b. medical aseptic and sterile technique
    - c. documentation (e.g., site, amount, gauge, concentration, rate, and number of attempts)
  6. injection techniques
    - a. safety
    - b. manual
    - c. power injector options
      1. single or dual head
      2. single phase
      3. multi-phase
      4. flow rate
      5. timing bolus
      6. bolus tracking
  7. post-procedure care
    - a. complications (e.g., extravasation/infiltration)
    - b. documentation
  8. adverse reactions
    - a. recognition and assessment
    - b. treatment
    - c. documentation
  9. infection control

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



## Safety

### 1. Radiation Safety and Dose

- A. Radiation Physics
  - 1. x-ray production
  - 2. target interactions
    - a. bremsstrahlung
    - b. characteristic
  - 3. x-ray beam
    - a. frequency and wavelength
    - b. beam characteristics
      - 1. quality
      - 2. quantity
      - 3. primary versus remnant (exit)
    - c. inverse square law
    - d. fundamental properties of x ray
    - e. acquisition (geometry)
  - 4. photon interactions with matter
    - a. photoelectric
    - b. Compton
    - c. coherent (classical)
    - d. attenuation by various tissues

### B. Radiation Protection

- 1. minimizing patient exposure
  - a. kVp
  - b. mAs
  - c. pitch
  - d. collimation/beam width
  - e. filtration
  - f. gating
  - g. image reconstruction (e.g., iterative, retrospective, artifact suppression software)
  - h. detector efficiency
  - i. overranging
  - j. dose modulation techniques (e.g., SMART mA, auto mA, CARE dose, SURE Exposure)
  - k. dose notification/dose alert
- 2. shielding (e.g., lead apron)
- 3. patient considerations
  - a. positioning
  - b. removal of radiopaque materials and radiosensitive devices
  - c. communication (e.g., breathing instructions)
  - d. pediatric
  - e. adult (e.g., BMI)
  - f. pregnancy
- 4. dose measurements
  - a. absorbed dose (mGy)
  - b. effective dose (mSv)
  - c. CT dose index (CTDI) [mGy]
  - d. dose length product (DLP) [mGy-cm]
  - e. documentation
- 5. personnel protection
  - a. controlled access
  - b. education



## Image Production

### 1. Image Formation

- A. Components of a CT Unit
  - 1. gantry
    - a. tube
      - 1. x-ray production
      - 2. warm-up procedures
    - b. generator
    - c. detectors
      - 1. detector configuration
      - 2. detector collimation
    - d. data acquisition system (DAS)
    - e. slip rings
  - 2. array processor and host computer
- B. Imaging Parameters
  - 1. kVp
  - 2. mAs
  - 3. pitch
  - 4. collimation/beam width
  - 5. acquisition slice thickness
  - 6. x, y, z planes
  - 7. scan field of view (SFOV)
- C. Methods of Data Acquisition
  - 1. axial/sequential
  - 2. helical
  - 3. volumetric
  - 4. shuttle/continuous/cine
  - 5. dual energy/dual source
- D. Image Reconstruction
  - 1. filtered backprojection reconstruction
  - 2. iterative reconstruction
  - 3. prospective/retrospective reconstruction
  - 4. raw data versus image data
  - 5. reconstruction algorithm
  - 6. reconstruction slice thickness
  - 7. reconstruction interval
  - 8. interpolation
- E. Post Processing
  - 1. multi-planar reformation (MPR)
  - 2. 3D rendering (e.g., MIP, SSD, VR)
  - 3. quantitative analysis (e.g., distance, diameter, calcium scoring, ejection fraction)

### 2. Image Evaluation and Archiving

- A. Image Display
  - 1. pixel, voxel
  - 2. matrix
  - 3. image magnification
  - 4. display field of view (DFOV)
  - 5. window level (W/L), window width (W/W)
  - 6. cine loop/matrix
  - 7. geometric distance or region of interest (ROI) (e.g., mean, standard deviation [SD])
- B. Image Quality
  - 1. spatial resolution
  - 2. contrast resolution
  - 3. temporal resolution
  - 4. noise and uniformity
  - 5. quality assurance and accreditation
  - 6. CT number (Hounsfield units [HU])
  - 7. linearity
- C. Artifact Recognition and Reduction
  - 1. beam hardening or cupping
  - 2. partial volume averaging
  - 3. motion
  - 4. metallic
  - 5. edge gradient
  - 6. patient positioning (out-of-field)
  - 7. equipment artifacts
    - a. rings
    - b. streaks
    - c. tube arcing
    - d. cone beam
- D. Informatics
  - 1. hard/electronic copy (e.g., DICOM file format)
  - 2. archive
  - 3. PACS/MIMPS and electronic medical record (EMR)
  - 4. networking



## Procedures

### TYPE OF STUDY

#### 1. Head, Spine, and Musculoskeletal

##### A. Head

1. temporal bones/internal auditory canal (IACs)
2. orbits
3. sinuses
4. maxillofacial and/or mandible
5. temporomandibular joints (TMJs)
6. brain/cranium
7. brain perfusion

##### B. Spine

1. cervical
2. thoracic
3. lumbar
4. sacrum/coccyx
5. post myelography

##### C. Musculoskeletal

1. upper extremity
2. lower extremity
3. bony pelvis and/or hips
4. shoulder and/or scapula
5. arthrography

### FOCUS OF QUESTIONS

Questions about each of the studies listed on the left may focus on any of the following:

#### Anatomy and Physiology

- cross sectional anatomy
- pathological considerations/recognition
- landmarks
- vasculature

#### Factors

- imaging planes
- protocol considerations
- patient considerations (e.g., pediatric, geriatric, bariatric)
- post-processing presentations

#### Contrast Media

- indications
- scan/prep delay
- effect on images

#### Additional Procedures

- vascular (CTA, CTV) (e.g., PE, dissection, runoff, venogram)
- biopsies
- drainages
- aspirations
- trauma

(Procedures continue on the following page.)



## Procedures (continued)

### TYPE OF STUDY

#### 2. Neck and Chest

- A. Neck
  - 1. larynx/airway
  - 2. soft tissue neck
- B. Chest
  - 1. mediastinum
  - 2. lung
  - 3. heart
  - 4. airway
  - 5. chest wall
  - 6. low dose lung screening

#### 3. Abdomen and Pelvis

- A. Abdomen
  - 1. liver
  - 2. biliary
  - 3. spleen
  - 4. pancreas
  - 5. adrenals
  - 6. kidneys and/or ureters
  - 7. GI tract
- B. Pelvis
  - 1. bladder
  - 2. colorectal
  - 3. reproductive organs

### FOCUS OF QUESTIONS

Questions about each of the studies listed on the left may focus on any of the following:

#### Anatomy and Physiology

- cross sectional anatomy
- pathological considerations/recognition
- landmarks
- vasculature

#### Factors

- imaging planes
- protocol considerations
- patient considerations (e.g., pediatric, geriatric, bariatric)
- post-processing presentations

#### Contrast Media

- indications
- scan/prep delay
- effect on images

#### Additional Procedures

- vascular (CTA, CTV) (e.g., PE, dissection, runoff, venogram)
- biopsies
- drainages
- aspirations
- trauma