



# Cardiac -Interventional Radiography

The purpose of ~~The American Registry of Radiologic Technologists® (ARRT®) Cardiac-Interventional Radiography Examination~~ examination requirement is to assess whether individuals have obtained the knowledge and cognitive skills underlying the intelligent performance of the tasks typically required in ~~of~~ cardiac -interventional radiographyers at entry ~~level into the profession~~. The tasks typically performed were determined by administering a comprehensive practice analysis survey to a nationwide sample of cardiac -interventional radiographers<sup>1</sup>. An advisory committee then determined the knowledge and cognitive skills needed to perform the tasks on the task inventory and these are organized into the content categories within this document. ~~Every content category can be linked to one or more tasks on the task inventory.~~ The document is used to develop the examination. The Task Inventory for Cardiac Interventional Radiography may be found on the ARRT's website ([www.arrt.org](http://www.arrt.org)). ~~The results of the most recent practice analysis are reflected in this document.<sup>1</sup>~~

The ~~Examination Content Specifications for Cardiac Interventional Radiography~~ and attached content outline identifiesy the knowledge areas underlying performance of the tasks on the ~~Task Inventory for Cardiac-Interventional Radiography~~. ~~Every content category can be linked to one or more tasks on the task inventory.~~

The table below presents the ~~three~~ major content categories covered on the examination, ~~along with~~ the number of test questions in each major category are listed in bold and the number of test questions in each subcategory in parentheses. ~~The remaining pages of this document list the Specific topics addressed within each major content category are addressed in the content outline, which makes up the remaining pages of this document. The approximate number of test questions allocated to each topic appears in parentheses.~~

Content Category	Number of Scored Questions <sup>2</sup>
Patient Care	<b>3540</b>
Patient Interactions and Management	
Image Production	<b>3020</b>
Image Acquisition and Equipment	
Procedures	<b>8085</b>
Diagnostic and Conduction System Studies <del>(36)</del> 35)	
<del>Hemodynamics, Calculations, and Percutaneous</del> Interventional Procedures <del>(44)</del> 50)	
<b>Total</b>	<b>145</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> ~~Each~~ The exam includes an additional 25-40 unscored (pilot) questions. ~~On the pages that follow, the approximate number of test questions allocated to each content category appears in parentheses.~~



## Patient Care

### 1. Patient Interactions and Management (35)

#### A. Patient Communication

1. pre-procedure
  - a. explanation of procedure
  - b. informed consent
  - c. explanation of radiation risk
  - d. pre-procedure time-out
2. intra-procedure
3. post-procedure care instructions (e.g., discharge instructions)

#### B. Patient Assessment and Preparation

(\*e.g., normal and abnormal values, implication for imaging, equipment)

1. patient history
  - a. clinical notes
    1. medications
    2. allergies
  - b. prior imaging
2. interpersonal communication (e.g., patient care team, physician)
3. scheduling and screening
  - a. sequencing of imaging
  - b. pre/post procedure (contrast administration, NPO status)
4. patient education (e.g., preparation diet, medications)
5. consent
  - a. informed (e.g., written, verbal)
  - b. emergent (e.g., implied)
6. patient positioning (e.g., Velcro straps, padding, wedges, arm boards)
7. access assessment
  - a. vascular patency (e.g., ultrasound, Allen test, Barbeau test)
  - b. peripheral pulses (e.g., palpation, Doppler)
  - c. anatomical location (e.g. femoral artery/vein, radial artery, jugular vein)
  - d. imaging (e.g., ultrasound, fluoroscopy)
8. lab values (normal and abnormal values)
  - a. chemistry
    1. glucose
    2. blood urea nitrogen (BUN)
    3. creatinine
    4. electrolytes
    5. cardiac enzymes (e.g., troponin)

#### b. hematology

1. hematocrit
2. hemoglobin
3. platelet count
4. white blood count (WBC)

#### c. coagulation

1. prothrombin time (PT)
2. partial thromboplastin time (PTT)
3. international normalization ratio (INR)
4. activated clotting time (ACT)

#### d. arterial blood gas

1. pH
2. PaCO<sub>2</sub>
3. HCO<sub>2</sub>

#### C. Patient Monitoring

##### 1. physiologic monitoring

- a. temperature
- b. ECG
- c. respiration
- d. non-invasive blood pressure
- e. intravascular pressure
- f. pulse oximetry
- g. capnography
- h. level of consciousness (LOC)

##### 2. monitor and maintain medical equipment

(e.g., IVs, oxygen) used during a procedure

- a. oxygen delivery systems
- b. chest tubes
- c. in-dwelling catheters
- d. drainage bags
- e. IVs
- f. suction

##### 3. documentation

- a. radiographic exposure factors
- b. contrast administration parameters
- c. fluoroscopy time
- d. cumulative dose or air kerma (e.g., mGy)
- e. dose area product (DAP) (e.g., mGy-cm<sup>2</sup>)
- f. physiologic monitoring
- g. medications
- h. complications
- i. implantable devices

\* e.g., This is used here and in the remainder of this document to indicate examples of the topics covered, but not a complete list.

(Patient Care continues on the following page)



D. Contrast Administration

1. types and properties of ~~nonionic~~ contrast agents
  - a. ~~nonionic low-osmolar~~
  - b. ~~nonionic iso-osmolar~~
  - c. ~~C02~~
2. indications and contraindications

E. Medications

1. types ~~and administration routes~~
  - ~~a. narcotics~~
  - a. anticoagulants
  - b. thrombolytics
  - c. vasoactives (constrictors, dilators)
  - d. emergency medications
  - e. other (e.g., analgesics, antiemetics, antihypertensives, antiarrhythmics, antiplatelets)
  - ~~f. platelet inhibitors~~
  - ~~g. beta blockers~~
  - ~~h. calcium channel blockers~~
  - ~~i. coronary reperfusion~~
2. indications and contraindications
3. complications
4. preparation
5. reactions

F. ~~Infection Control and Prevention~~ Asepsis and Sterile Technique

1. disinfection and cleaning
  - a. medical asepsis
  - b. sterile technique
    1. patient preparation
    2. procedural tray (e.g., sterile supplies)
    3. maintenance of sterile fields
    4. scrubbing
- ~~2. CDC isolation precautions~~
  - ~~a. transmission of infection~~
    1. ~~contact~~
    2. ~~airborne~~
    3. ~~droplet~~
  - ~~b. types of precautions~~
    1. ~~CDC Standard Precautions (formerly Universal Precautions)~~
    2. ~~transmission-based precautions (additional precautions)~~

G. Handling and Disposal of Hazardous Materials

1. biohazardous (e.g., sharps, blood)
2. tissue samples
3. chemotherapeutic and radioactive material

H. Emergency Care

1. contrast reactions and complications
  - a. allergic-type
    1. ~~minor~~mild
    2. ~~intermediate~~ moderate
    3. severe
  - b. adverse
    1. nephrotoxicity
    2. physiological responses (e.g., airway, hemodynamic, CNS)
  - c. treatment and medications
    1. types (e.g., steroids, antihistamines)
    2. indications and contraindications
2. symptoms and treatment of the following medical emergencies
  - a. cerebral vascular accident (CVA)/ transient ischemic attack (TIA)
  - b. embolism
    1. air
    2. thrombotic
  - c. thrombosis
  - d. respiratory arrest
  - e. myocardial infarction
  - f. congestive heart failure
  - g. cardiac arrhythmias
  - h. vasovagal response
  - i. anaphylaxis
  - j. hypotensive/hypertensive episodes
  - k. shock (e.g., cardiogenic, hypovolemic, septic)
  - l. cardiac tamponade
  - m. ~~aortic~~ dissection and perforation
  - n. access site management
  - o. bleeding (hemothorax, hematoma)
  - p. pneumothorax
  - q. perforation/dissection
  - r. flash pulmonary edema



## Image Production

### 1. Image Acquisition and Equipment (30)

#### A. Angiography

##### A. Data Acquisition and Processing

###### a. ~~modes~~

1. fluoroscopy
  - a. high/low dose rate
  - b. pulse rate
2. digital acquisition ~~angiography (cine-)~~
  - a. exposure technique
  - b. frame rate
3. roadmapping
  - a. digital subtraction
  - b. field of view (e.g. magnification, collimation)
  - c. compensating filters (e.g., wedge, soft)
  - d. 3D imaging
4. projections/positions
5. post processing (e.g., reconstruction)
6. archiving

##### B. Automatic Pressure Injectors

1. parts
2. function and safety
3. operation
4. cleaning

##### C. Procedural Equipment ~~Intracardiac Imaging~~

1. ultrasound unit
- ~~4-2.~~ intravascular ultrasound (IVUS)
- ~~2-3.~~ optical coherence tomography (OCT)
- ~~3-4.~~ flow reserve (e.g., FFR, IFR, RFR)
5. ablation (e.g., cryo, microwave)
- ~~4-—~~
- ~~5-6.~~ intracardiac echocardiography (ICE)
7. thrombectomy
8. thrombolysis
9. atherectomy
10. intra-aortic balloon pump (IABP)
- ~~6-11.~~ catheter based ventricular assist device
- ~~7-12.~~ extracorporeal membrane oxygenation (ECMO)
13. laser
14. lithotripsy (balloon or catheter)
15. manifold/pressure transducers (adjust, calibration)

### D. Radiation Protection

#### 1. patients

- a. collimation (e.g., shutters, virtual collimation)
- b. magnification
- c. frame rates
- d. geometry (e.g., SID, OID, tube angle)
- e. pulsed or continuous
- ~~shielding~~
- f. last image hold
- g. dose rate

#### 2. personnel (ALARA)

- a. shielding
- b. monitoring devices
- c. occupational exposure reports
- d. promote radiation awareness

#### 3. quality control

- a. aprons
- b. role of dose calibration



## Procedures **(80)**

### CATEGORY

#### 1. Diagnostic and Conduction System Studies

- A. **Cardiac** Diagnostic Studies
  - 1. right and left heart hemodynamics
  - 2. angiography
    - a. coronary
    - b. bypass graft
    - c. pulmonary
    - d. aortography
    - e. ventriculography
  - 3. intracardiac echocardiography (ICE)
  - 4. flow reserve (e.g., FFR, IFR, RFR)
  - 5. intravascular imaging (e.g., OCT, IVUS)
- B. **Peripheral** Angiography
  - 1. femoral
  - 2. carotid
  - 3. renal
  - 4. great vessel
  - 5. radial
  - 6. brachial
  - 7. jugular
  - 8. axillary
  - 9. internal mammary
- C. ~~Hemodynamics and~~ Calculations
  - 1. ~~stroke ventricular~~ volume measurement
  - 2. ~~stenotic~~ valve area (e.g., Gorlin, **Hakki Method**)
  - 3. shunt detection and calculation
  - 4. cardiac output calculation and measurement
    - a. Fick
    - b. thermodilution
    - c. angiographic
  - 5. ~~fractional~~ flow reserve (e.g., FFR, IFR, RFR)

### FOCUS OF QUESTIONS

- 1. Anatomy and Pathophysiology
- 2. Indications for Procedure
- 3. Contraindications for Procedure
- 4. Image Analysis and Utilization
- 5. Access Methods
- 6. Equipment and Devices Used
  - A. Types (e.g., sheaths, catheters, guidewires, needles)
  - B. Indications for Use
- 7. Closure Devices, Puncture Site Pressure and Dressing (e.g., manual, external, permanent, non-permanent, surgical glue)
- 8. Complications
  - A. Recognition
  - B. Treatment
- 9. Ultrasound Guidance
- 10. Interventional Suite and Hybrid OR



## Procedures (continued)

### BD. Conduction System Studies

#### Electrophysiology

1. arrhythmia detection
2. arrhythmia ablation
  - a. atrial fibrillation
  - b. atrial flutter
  - c. ventricular tachycardia
3. cardioversion
4. implants
  - a. pacemaker
    1. permanent insertion
    2. temporary
    3. leadless
  - b. internal cardiac defibrillator (ICD) insertion
  - c. biventricular pacemaker
  - d. lead extraction
5. pacemaker, temporary insertion

### FOCUS OF QUESTIONS

1. Anatomy and Pathophysiology
2. Indications for Procedure
3. Contraindications for Procedure
4. Image Analysis and Utilization
5. Access Methods
6. Equipment and Devices Used
  - A. Types (e.g., sheaths, catheters, guidewires, needles)
  - B. Indications for Use
7. Closure Devices, Puncture Site Pressure and Dressing (e.g., manual, external, permanent, non-permanent, surgical glue)
8. Complications
  - A. Recognition
  - B. Treatment
9. Ultrasound Guidance
10. Interventional Suite and Hybrid OR

(Procedures continues on the following page.)



## Procedures (continued)

### CATEGORY

#### 2. ~~Hemodynamics, Calculations, and Percutaneous Interventional~~ Procedures

- A. Percutaneous Intervention
  - 1. angioplasty
    - a. coronary
    - b. peripheral
  - 2. coronary atherectomy
    - a. directional (~~peripheral~~)
    - b. rotational
    - c. laser
    - d. orbital
  - 3. peripheral atherectomy
    - a. directional
    - b. rotational
    - c. laser
    - d. orbital
  - 4. stent placement
    - a. coronary
    - b. peripheral
  - 5. thrombectomy
    - a. mechanical
    - b. pharmacological
    - c. aspiration
  - 6. inferior vena cava (IVC) filter placement/retrieval
  - 7. pericardiocentesis
  - 8. intra-aortic balloon counterpulsation pump (IABP)
  - 9. ~~removal of~~ foreign body removal/retrieval ~~ies~~
  - 10. ventricular assist device implantation
    - a. left ventricle
    - b. right ventricle
  - 11. intravascular lithotripsy (e.g., shockwave)
  - 12. extracorporeal membrane oxygenation system placement (ECMO)
  - 13. distal embolic protection device placement/retrieval

### FOCUS OF QUESTIONS

- 1. Anatomy and Pathophysiology
- 2. Indications for Procedure
- 3. Contraindications for Procedure
- 4. Image Analysis and Utilization
- 5. Access Methods
- 6. Equipment and Devices Used
  - A. Types (e.g., sheaths, drainage catheters, guidewires, needles)
  - B. Indications for Use
- 7. Closure Devices, Puncture Site Pressure and Dressing (e.g., manual, external, permanent, non-permanent, surgical glue)
- 8. Complications
  - A. Recognition
  - B. Treatment
- 9. Ultrasound Guidance
- 10. Interventional Suite and Hybrid OR



## Procedures (continued)

### B. Structural Heart Procedures

1. patent foramen ovale/atrial septal defect closure
2. ventricular septal defect closure
3. transcatheter aortic valve implantation (TAVI/TAVR)
4. valvuloplasty
5. transcatheter mitral valve repair
6. atrial appendage closure device implantation

### FOCUS OF QUESTIONS

1. Anatomy and Pathophysiology
2. Indications for Procedure
3. Contraindications for Procedure
4. Image Analysis and Utilization
5. Access Methods
6. Equipment and Devices Used
  - A. Types (e.g., sheaths, drainage catheters, guidewires, needles)
  - B. Indications for Use
7. Closure Devices, Puncture Site Pressure and Dressing (e.g., manual, external, permanent, non-permanent, surgical glue)
8. Complications
  - A. Recognition
  - B. Treatment
9. Ultrasound Guidance
10. Interventional Suite and Hybrid OR