



# Cardiac Interventional Radiography

The purpose of structured education is to provide the opportunity for individuals to develop mastery of discipline-specific knowledge that, when coupled with selected clinical experiences, helps to document qualifications. The *Structured Education Requirements for Cardiac Interventional Radiography* is provided to assist candidates with these requirements.

Candidates for cardiac interventional radiography certification and registration must document at least 16 hours of structured education<sup>1</sup>. The activities must be earned within the 24-month period immediately prior to submission of an application for certification and registration. Structured education activities may be academic courses from an institution accredited by a mechanism recognized by the ARRT<sup>2</sup>, CE opportunities approved by a CE Approver, or a combination of the two.

Structured education documentation must include at least one CE credit or its equivalent in each content category listed below (i.e., Patient Care, Image Production, and Procedures). The remaining hours may be earned from any one or more of the content areas. Specific topics within each category are addressed in the content outline, which makes up the remaining pages of this document.

Content Category	Minimum Credit Hours
Patient Care (includes) <i>Patient Interactions and Management</i>	1
Image Production (includes) <i>Image Acquisition and Equipment</i>	1
Procedures (includes) <i>Diagnostic and Electrophysiology Procedures</i> <i>Interventional Procedures</i>	1
<b>Total</b>	<b>16</b>

## Acceptable Examples:

Example 1	Example 2	Example 3
Patient Care – 3 hours Image Production – 6 hours Procedures – 7 hours	Patient Care – 1 hour Image Production – 1 hour Procedures – 14 hours	Patient Care – 1 hour Image Production – 10 hours Procedures – 5 hours
TOTAL – 16 hours	TOTAL – 16 hours	TOTAL – 16 hours

1. If there is a structured education requirement document with a newer effective date, you may either use the new document or continue to use this document if you have completed at least one educational activity prior to the effective date of the new version. For more information log into your ARRT account and access [Earn Additional Credentials: Postprimary Pathway](#), where structured education is also reported.
2. Activities meeting the definition of an approved academic course will be awarded credit at the rate of 12 CE credits for each academic **quarter** credit or 16 CE credits for each academic **semester** credit. See the ARRT [Education Requirements for Obtaining and Maintaining Certification and Registration](#) document for additional information.



## Patient Care

### 1. Patient Interactions and Management

#### A. Patient Communication

1. preprocedure
  - a. explanation of procedure
  - b. explanation of radiation risk
  - c. preprocedure time-out
2. intraprocedure
3. postprocedure care instructions (\*e.g., discharge instructions)

#### B. Patient Assessment and Preparation

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 (e.g., 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 normalized 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. noninvasive blood pressure
  - e. intravascular pressure
  - f. pulse oximetry
  - g. capnography
  - h. level of consciousness (LOC)
2. monitor and maintain medical equipment
  - a. oxygen delivery systems
  - b. chest tubes
  - c. indwelling catheters
  - d. drainage bags
  - e. IVs
  - f. suction

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

(Patient Care continues on the following page.)



## Patient Care (continued)

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
- D. Contrast Administration
  1. types and properties of contrast agents
    - a. nonionic low osmolar
    - b. nonionic iso-osmolar
    - c. CO<sub>2</sub>
  2. indications and contraindications
- E. Medications
  1. types
    - a. anticoagulants
    - b. thrombolytics
    - c. vasoactives (e.g., constrictors, dilators)
    - d. emergency medications
    - e. other (e.g., analgesics, antiemetics, antihypertensives, antiarrhythmics, antiplatelets, moderate sedation medications)
  2. indications and contraindications
  3. safety and complications
  4. preparation
  5. reactions
- F. 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
- G. Handling and Disposal of Hazardous Materials
  1. biohazardous (e.g., sharps, blood)
  2. tissue samples
  3. chemotherapeutic agents
  4. radioactive material
- H. Emergency Care
  1. contrast reactions and complications
    - a. allergy type
      1. mild
      2. 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. dissection/perforation
    - n. access site management
    - o. bleeding (e.g., hemothorax, hematoma)
    - p. pneumothorax
    - q. flash pulmonary edema



## Image Production

### 1. Image Acquisition and Equipment

#### A. Data Acquisition and Processing

1. fluoroscopy
  - a. high/low dose rate
  - b. pulse rate
2. digital acquisition
  - 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/PACS

#### B. Automatic Pressure Injectors

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

#### C. Procedural Imaging Equipment\*\*

1. ultrasound unit
2. intravascular ultrasound (IVUS)
3. optical coherence tomography (OCT)
4. intracardiac echocardiography (ICE)

#### 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
  - 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

\*\*The cardiac interventional radiographer is expected to have the basic knowledge of this equipment and its operation.



## Procedures

### 1. Diagnostic and

#### Electrophysiology Procedures

##### A. Cardiac Diagnostic Procedures

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)
6. biopsy

##### B. Peripheral Angiography

1. femoral
2. carotid
3. renal
4. great vessel
5. radial
6. brachial
7. jugular
8. axillary
9. internal mammary

##### C. Hemodynamic Calculations

1. stroke volume measurement
2. valve area (e.g., Gorlin, Hakki)
3. shunt detection and calculation
4. cardiac output calculation and measurement
  - a. Fick
  - b. thermodilution
  - c. angiographic
5. flow reserve (e.g., FFR, IFR, RFR)

### FOCUS OF QUESTIONS

Questions for each section of the exam may address any of the following factors, as appropriate:

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

(Procedures continue on the following page.)



## Procedures (continued)

- D. 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

## FOCUS OF QUESTIONS

Questions for each section of the exam may address any of the following factors, as appropriate:

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

(Procedures continue on the following page.)



## Procedures (continued)

### 2. Interventional Procedures

- A. Percutaneous Intervention
  - 1. angioplasty
    - a. coronary
    - b. peripheral
  - 2. coronary atherectomy
    - a. directional
    - 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 pump (IABP)
  - 9. foreign body removal/retrieval
  - 10. catheter-based ventricular assist device
    - a. left ventricle
    - b. right ventricle
  - 11. intravascular lithotripsy
  - 12. extracorporeal membrane oxygenation system placement (ECMO)
  - 13. distal embolic protection device placement/retrieval

### FOCUS OF QUESTIONS

Questions for each section of the exam may address any of the following factors, as appropriate:

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

(Procedures continue on the following page.)



## Procedures (continued)

### B. Structural Heart Procedures

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

### FOCUS OF QUESTIONS

Questions for each section of the exam may address any of the following factors, as appropriate:

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