



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 education¹. 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 ARRT², CE opportunities approved by a RCEEM or RCEEM+, 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, Safety, 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 Conduction System Studies</i> <i>Hemodynamics, Calculations, and Percutaneous Intervention</i>	1
Total	16

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 access the online clinical experience tool, 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 *Continuing Education Requirements* document for additional information.



Patient Care

1. Patient Interactions and Management

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

B. Patient Assessment and Monitoring (*e.g., normal and abnormal values, implication for imaging, equipment)

1. physiologic monitoring
 - a. temperature
 - b. ECG
 - c. respiration
 - d. non-invasive blood pressure
 - e. intravascular pressure
 - f. pulse oximetry
2. access assessment
 - a. vascular patency
 1. peripheral pulse (e.g., palpation, Doppler)
 2. Allen test
 3. Barbeau test
 - b. anatomical location
 1. femoral
 2. radial
 3. brachial
 4. axillary
 5. jugular
 6. subclavian
 - c. imaging (e.g., ultrasound, fluoroscopy)
3. lab values
 - a. chemistry
 1. glucose
 2. blood urea nitrogen (BUN)
 3. creatinine
 4. electrolytes
 5. enzymes
 - 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. PaCO₂
 3. HCO₂
4. monitor and maintain medical equipment (e.g., IVs, oxygen) used during a procedure
 5. documentation
 - a. radiographic exposure factors
 - b. contrast administration parameters
 - c. fluoroscopy time
 - d. cumulative dose or air kerma (mGy)
 - e. dose area product (DAP) (mGy-cm²)
 - f. physiologic monitoring
 - g. medications
 - h. complications

C. Contrast Administration

1. properties of nonionic contrast agents
2. indications and contraindications

D. Medications

1. types and administration routes
 - a. narcotics
 - b. anticoagulants
 - c. thrombolytics
 - d. vasoactives (constrictors, dilators)
 - e. emergency medications
 - f. platelet inhibitors
 - g. beta blockers
 - h. calcium channel blockers
2. indications and contraindications
3. complications

* 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)

- E. Infection Control and Prevention
 - 1. disinfection and cleaning
 - a. medical asepsis
 - b. sterile technique
 - 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)
 - 3. handling and disposal of biohazardous materials
- F. Emergency Care
 - 1. contrast reactions and complications
 - a. allergic-type
 - 1. minor
 - 2. intermediate
 - 3. severe
 - b. adverse
 - 1. hemodynamic responses
 - 2. nephrotoxicity
 - 3. central nervous system (CNS) reactions
 - 2. treatment and medications
 - a. types (e.g., steroids, antihistamines)
 - b. indications and contraindications
 - 3. symptoms and treatment of the following medical emergencies
 - a. cerebral vascular accident (CVA)
 - b. embolism
 - c. thrombosis
 - d. respiratory arrest
 - e. myocardial infarction
 - f. congestive heart failure
 - g. cardiac arrhythmias
 - h. vasovagal response
 - i. anaphylaxis
 - j. hypotensive episodes
 - k. hypertensive episodes
 - l. cardiogenic shock
 - m. cardiac tamponade
 - n. aortic dissection



Image Production

1. Image Acquisition and Equipment

- A. Angiography
 - 1. data acquisition and processing
 - a. modes
 - 1. fluoroscopy
 - a. dose rate
 - b. pulse rate
 - 2. acquisition angiography (cine)
 - a. dose per frame (e.g., low, med, high)
 - b. frame rate
 - 3. roadmapping
 - 4. digital subtraction
 - 5. 3D imaging
 - b. compensating filters (e.g., wedge, soft)
 - c. electronic magnification
 - d. geometric magnification
 - e. collimation
 - 2. projections/positions
- B. Intracardiac Imaging
 - 1. optical coherence tomography (OCT)
 - 2. intravascular ultrasound (IVUS)
 - 3. intracardiac echocardiography (ICE)
- C. Archiving
- D. Quality Control
- E. Automatic Pressure Injectors
 - 1. parts
 - 2. function
 - 3. operation

F. 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. shielding
 - g. last image hold
 - h. dose rate
- 2. personnel (ALARA)
 - a. shielding
 - b. monitoring devices
 - c. occupational exposure reports
 - d. promote radiation awareness



Procedures

CATEGORY

1. Diagnostic and Conduction System Studies

- A. Diagnostic Studies
 - 1. pulmonary arteriography
 - 2. aortography
 - 3. coronary angiography
 - 4. internal mammary angiography
 - 5. saphenous vein graft angiography
 - 6. femoral angiography
 - 7. carotid angiography
 - 8. renal angiography
 - 9. ventriculography
 - 10. biopsy
- B. Conduction System Studies
 - 1. arrhythmia detection
 - 2. arrhythmia ablation
 - a. atrial fibrillation
 - b. atrial flutter
 - c. ventricular tachycardia
 - 3. cardioversion
 - 4. implants
 - a. pacemaker, permanent insertion
 - b. internal cardiac defibrillator (ICD) insertion
 - c. biventricular pacemaker
 - 5. pacemaker, temporary insertion

FOCUS OF QUESTIONS

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

- 1. Anatomy and Pathophysiology
- 2. Indications for Procedure
- 3. Contraindications for Procedure
- 4. Image Analysis and Utilization
- 5. Access Methods and Closure Devices
- 6. Equipment and Devices Used
- 7. Complications
 - A. Recognition
 - B. Treatment

(Procedures continues on the following page.)



Procedures (continued)

CATEGORY

2. Hemodynamics, Calculations, and Percutaneous Intervention

A. Hemodynamics and Calculations

1. ventricular volume measurement
2. stenotic valve area (Gorlin Method)
3. shunt detection and calculation
4. cardiac output calculation and measurement
 - a. Fick
 - b. thermodilution
 - c. angiographic
5. right and left heart hemodynamics
6. fractional flow reserve

B. Percutaneous Intervention

1. angioplasty
2. atherectomy
 - a. directional (peripheral)
 - b. rotational
3. stent placement
4. thrombectomy
 - a. mechanical
 - b. pharmacological
5. inferior vena cava (IVC) filter placement/retrieval
6. pericardiocentesis
7. intra-aortic balloon counterpulsation
8. removal of foreign bodies
9. ventricular assist device implantation
10. patent foramen ovale/atrial septal defect closure
11. transcatheter aortic valve implantation (TAVI/TAVR)
12. valvuloplasty

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