Background

According to the Certification Board of Nuclear Cardiology (CBNC) and other medical associations, nuclear cardiology is a subspecialty of cardiology in which radioisotopes are used in conjunction with a range of noninvasive nuclear imaging techniques to diagnose cardiovascular disease and to assess cardiac function after a heart attack or other major cardiac event. Nuclear cardiology procedures can be used to measure cardiac function during rest, exercise, or chemical stress, as well as for therapeutic purposes.

The practice area involves injecting a short-lived radioisotope into a patient’s vein and following the path of the radioisotope through the heart with the help of a scanning device (i.e., gamma camera), according to Yale-New Haven (Conn.) Hospital. Images show parts of the heart that are not getting enough blood. Radioisotopes are unstable isotopes of an element that decays by emitting particles or gamma radiation or x-radiation.

Practitioners of nuclear cardiology must have specialized knowledge of the workings of the cardiovascular system, risk factors associated with cardiovascular disease, clinical symptoms, and appropriate management of cardiovascular disease.

In the article "Practical Applications of Nuclear Cardiology," Robert Hendel, MD, a founding member of the American Society of Nuclear Cardiology (ASNC), wrote that nuclear cardiology has experienced substantial growth during the past decade because it gives clear assessments of patients who may have heart disease caused by a lack of blood supply to that part of the body. Hendel also noted that one of the most common procedures is single-photo emission computed tomography (SPECT) perfusion imaging, which involves injecting agents including technetium and thallium into the bloodstream.

In addition to SPECT, the University of Rochester (N.Y.) also includes the following common procedures in its nuclear cardiology program curriculum:

- Planar with technetium agents and thallium
- Electrocardiographic (ECG) gating of perfusion images for assessment of global and regional ventricular function (imaging protocols and stress protocols)
- Viability assessment, including reinjection and delayed imaging of thallium and metabolic imaging where available
- Equilibrium gated blood pool or “first pass” radionuclide angiography at rest and during exercise or pharmacologic stress
The list of common procedures is derived from a joint task force report published by the American College of Cardiology (ACC) and the ASNC, discussed below.

Less commonly used nuclear cardiology procedures include metabolic infarction imaging using single photon and/or positron emitting radionuclides, myocardial infarction imaging, and cardiac shunt studies.

According to the ACC Foundation (ACCF) task force, training of fellows in nuclear cardiology is divided into three levels:

- General (Level 1, two months): Makes trainee conversant with the field of nuclear cardiology for application in general clinical management of cardiovascular patients.
- Specialized (Level 2, four to six months): Provides trainee with special expertise to practice clinical nuclear cardiology.
- Advanced (Level 3, one year): Provides advanced training sufficient to pursue an academic career or direct a nuclear cardiology laboratory.

Physicians wishing to apply for certification in nuclear cardiology through the CBNC must meet and document established eligibility criteria, including board certification in cardiology, nuclear medicine, or radiology by an American Board of Medical Specialties (ABMS) or American Osteopathic Association (AOA) member board and completion of Level 2 nuclear cardiology training (minimum of four months), and pass a practice-based exam developed by experts and other specialists working in concert with psychometric and test development professionals.

For more information, please see the following Clinical Privilege White Papers:

- Practice area 126 – Cardiology
- Practice area 146 – Nuclear medicine
- Practice area 159 – Diagnostic radiology

Involved specialties

Nuclear cardiologists

Positions of specialty boards

CBNC

The CBNC grants certification in the specialty of nuclear cardiology. To be eligible, candidates must:

- Document Level 2 training in nuclear cardiology in accordance with the 2008 ACCF/ASNC Core Cardiology Training Symposium (COCATS) Guidelines in Nuclear Cardiology, including a minimum of 700 hours of which 80 hours is devoted to classroom and laboratory training in radiation safety. Training
must occur at a center that has an Accreditation Council for Graduate Medical Education (ACGME)- or AOA-accredited training program in cardiovascular disease, nuclear medicine, or radiology

- Hold a current unrestricted license to practice medicine in the United States
- Be board-certified in cardiology, nuclear medicine, or radiology by a certifying board recognized by either the ABMS or AOA

Positions of societies, academies, colleges, and associations

**ACC/ASNC**

In 2008, a joint committee composed of members from the ACCF and the ASNC revised the COCATS Guidelines in Nuclear Cardiology in a document titled *Task Force 5: Training in Nuclear Cardiology*. Here, the ACC sets forth its recommended training and competency standards for nuclear cardiologists. The document states that training in nuclear cardiology is best obtained in ACGME-approved training programs in cardiology, radiology, and nuclear medicine, and further recommends that training at all levels should include:

- Understanding of the indications and appropriate use of specific nuclear cardiology tests
- Safe use of radionuclides
- Basics of instrumentation and image processing
- Methods of quality control
- Image interpretation
- Integration of risk factors, clinical symptoms, and stress testing
- Appropriate application of the resultant diagnostic information for clinical management

According to the task force’s report, specialized training in nuclear cardiology consists of three levels and each level includes three components:

- Didactic program, including lectures and self-study plus radiation safety
- Interpretation of clinical cases
- Hands-on experience, including clinical cases and radiation safety

In addition, experience in the following nuclear cardiology procedures is recommended for all levels of training:

- Standard nuclear cardiology procedures
  - Myocardial perfusion imaging
    - SPECT with technetium-99m agents and/or thallium-201, with or without attenuation correction
    - Positron emission tomography (PET) with rubidium-82 and/or nitrogen-13 ammonia
    - Planar with technetium-99m agents and/or thallium-201
    - ECG gating of perfusion images for assessment of global and regional ventricular function
Nuclear cardiology

- Imaging protocols
- Stress protocols including exercise stress and pharmacologic stress
- Viability assessment including reinjection and delayed imaging of thallium-201 and/or metabolic imaging where available
  - Equilibrium radionuclide angioangiography and/or “first-pass” radionuclide angiography at rest
  - Qualitative and quantitative methods of image display and analysis
- Less commonly used nuclear cardiology procedures
  - Combined myocardial perfusion imaging with cardiac CT for attenuation correction or anatomic localization
  - Equilibrium radionuclide angioangiography and/or “first-pass” radionuclide angiography during exercise or pharmacologic stress
  - Metabolic imaging using single-photon and/or positron-emitting radionuclides
  - Myocardial infarct imaging
  - Cardiac shunt studies

**Level 1**
Level 1 training lasts a minimum of two months, during which the trainee gains familiarity with nuclear cardiology technology and its clinical applications in the general clinical practice of adult cardiology. During the two-month rotation, in addition to the didactic program, fellows should interpret a minimum of 100 nuclear cardiology cases. Fellows should also perform complete nuclear cardiology studies alongside a qualified technologist or other qualified laboratory personnel and should, under supervision, observe and participate in a large number of the standard procedures and as many of the less commonly performed procedures as possible. However, Level 1 training is not sufficient for the specific practice of nuclear cardiology.

**Level 2**
Level 2 training lasts four to six months, including a minimum of 700 hours of radiation safety experience in nuclear cardiology, and is required for residents who intend to specialize in nuclear cardiology. The didactic training may be scheduled over a 12- to 24-month period and should include in-depth details of all aspects of the procedures listed above. Regarding radiation safety, classroom and laboratory training needs to include extensive review of the following:
- Radiation physics and instrumentation
- Radiation protection
- Mathematics pertaining to the use and measurement of radioactivity
- Chemistry of byproduct material for medical use
- Radiation biology
- The effects of ionizing radiation and radiopharmaceuticals

In addition, there should be a thorough review of regulations dealing with radiation safety for the use of radiopharmaceuticals and ionizing radiation. This experience should total a minimum of 80 hours and be clearly documented.
Level 2 fellows should participate in the interpretation of all nuclear cardiology imaging data for the four- to six-month training period. It is imperative that the fellows have experience in correlating catheterization or CT angiographic data with radionuclide-derived data in a minimum of 30 patients, and a total of 300 cases should be interpreted under preceptor supervision from direct patient studies.

Fellows acquiring Level 2 training should have hands-on supervised experience in a minimum of 35 patients: 25 patients with myocardial perfusion imaging and 10 patients with radionuclide angiography. Such experience should include:

- Pretest patient evaluation
- Radiopharmaceutical preparation (including experience with relevant radionuclide generators and CT systems)
- Performance of studies with and without attenuation correction
- Administration of the dosage
- Calibration and setup of the gamma camera and CT system
- Setup of the imaging computer
- Processing the data for display
- Interpretation of the studies
- Generating clinical reports

Radiation safety work experience should total 620 hours and be acquired continuously during training in the clinical environment where radioactive materials are being used and under the supervision of an authorized user. Experience must include:

- Ordering, receiving, and unpacking radioactive materials safely and performing the related radiation surveys
- Performing quality control procedures on instruments used to determine the activity of dosages and performing checks for proper operation of survey meters
- Calculating, measuring, and safely preparing patient or human research subject dosages
- Using administrative controls to prevent a medical event involving the use of unsealed byproduct material
- Using procedures to safely contain spilled radioactive material and using proper decontamination procedures
- Administering dosages of radioactive material to patients or human research subjects
- Eluting generator systems appropriate for preparation of radioactive drugs for imaging and localization studies, measuring and testing the eluate for radionuclide purity, and processing the eluate with reagent kits to prepare labeled radioactive drugs

The program for Level 2 training must also provide experience in computer methods for analysis. This should include perfusion and functional data derived from thallium or technetium agents and ejection fraction and regional wall motion measurements from radionuclide angiographic studies.
**Level 3**
The same task force report states that fellows who are pursuing an academic career in nuclear cardiology or who wish to direct a nuclear cardiology laboratory are required to complete an additional year of training in nuclear cardiology. This can be part of a standard three-year cardiology fellowship. In addition to the Level 2 program, the Level 3 program should include advanced quality control of nuclear cardiology studies and active participation in ongoing laboratory or clinical research. The training period should include supervised interpretation of at least 600 nuclear cardiology cases. Hands-on experience should be similar to, or greater than, that required for Level 2 training. The fellow should be trained in most of the following areas:

- Qualitative interpretation of standard nuclear cardiology studies, including SPECT and/or PET myocardial perfusion imaging, ECG-gated perfusion studies, attenuation-corrected studies, gated-equilibrium studies, “first-pass,” and any of the less commonly performed procedures available at the institution
- Quantitative analysis of SPECT and/or PET myocardial perfusion and/or metabolic studies
- Quantitative radionuclide angiographic and gated myocardial perfusion analyses, including measurement of global and regional ventricular function
- SPECT and/or PET perfusion acquisition, reconstruction, and display
- ECG-gated SPECT and/or perfusion acquisition, analysis, and display of functional data
- Imaging of positron-emitting tracers using dedicated PET systems or hybrid PET/CT systems

**Specific Training in Cardiac Imaging of Positron-Emitting Radionuclides**

If the program has access to a positron imaging device, either PET or PET/CT, fellows may receive specialized training in cardiac imaging of positron-emitting radionuclides. Training may be concurrent with training in nuclear cardiology and provide basic knowledge of:

- Substrate metabolism in the normal and diseased heart
- Positron-emitting tracers for blood flow, metabolism, and neuronal activity
- Medical cyclotrons, radioisotope production, and radiotracer synthesis
- Principles of tracer kinetics and their in-vivo application for the noninvasive measurement of regional metabolic and functional processes
- Physics of positron decay
- Aspects of imaging instrumentation specific to imaging of positron emitters and the use of CT
- Production of radiopharmaceutical agents
- Quality control
- Handling of ultra-short-life radioisotopes
- Appropriate radiation protection and safety and regulatory aspects

As with nuclear cardiology, training in positron-emitting imaging is divided into three levels, each of which can be offered concurrently with the corresponding level of nuclear cardiology training.
**ACGME**

The ACGME does not address programs offering specialty or subspecialty training in nuclear cardiology. Instead, basic nuclear cardiology is a component of training programs in cardiology, radiology, and nuclear medicine.

**AOA**

At the time this white paper was written, the AOA no longer issues primary certification in nuclear medicine or a certificate of added qualifications in nuclear cardiology.

**Positions of accreditation bodies**

**CMS**

CMS has no formal position concerning the delineation of privileges for nuclear cardiology. However, the CMS Conditions of Participation (CoP) define a requirement for a criteria-based privileging process in §482.22(c)(6) stating, “The bylaws must include criteria for determining the privileges to be granted to individual practitioners and a procedure for applying the criteria to individuals requesting privileges.”

§482.12(a)(6) states, “The governing body must assure that the medical staff bylaws describe the privileging process. The process articulated in the bylaws, rules or regulations must include criteria for determining the privileges that may be granted to individual practitioners and a procedure for applying the criteria to individual practitioners that considers:

- Individual character
- Individual competence
- Individual training
- Individual experience
- Individual judgment

The governing body must ensure that the hospital’s bylaws governing medical staff membership or the granting of privileges apply equally to all practitioners in each professional category of practitioners.”

Specific privileges must reflect activities that the majority of practitioners in that category can perform competently and that the hospital can support. Privileges are not granted for tasks, procedures, or activities that are not conducted within the hospital, regardless of the practitioner’s ability to perform them.

Each practitioner must be individually evaluated for requested privileges. It cannot be assumed that every practitioner can perform every task, activity, or privilege specific to a specialty, nor can it be assumed that the practitioner should be
automatically granted the full range of privileges. The individual practitioner’s ability to perform each task, activity, or privilege must be individually assessed.

CMS also requires that the organization have a process to ensure that practitioners granted privileges are working within the scope of those privileges.

CMS’ CoPs include the need for a periodic appraisal of practitioners appointed to the medical staff/granted medical staff privileges (§482.22[a][1]). In the absence of a state law that establishes a time frame for the periodic appraisal, CMS recommends that an appraisal be conducted at least every 24 months. The purpose of the periodic appraisal is to determine whether clinical privileges or membership should be continued, discontinued, revised, or otherwise changed.

**The Joint Commission**

The Joint Commission has no formal position concerning the delineation of privileges for nuclear cardiology. However, in its Comprehensive Accreditation Manual for Hospitals, The Joint Commission states, “The hospital collects information regarding each practitioner’s current license status, training, experience, competence, and ability to perform the requested privilege” (MS.06.01.03).

In the introduction for MS.06.01.03, The Joint Commission states that there must be a reliable and consistent system in place to process applications and verify credentials. The organized medical staff must then review and evaluate the data collected. The resultant privilege recommendations to the governing body are based on the assessment of the data.

The Joint Commission introduces MS.06.01.05 by stating, “The organized medical staff is responsible for planning and implementing a privileging process.” It goes on to state that this process typically includes:

- Developing and approving a procedures list
- Processing the application
- Evaluating applicant-specific information
- Submitting recommendations to the governing body for applicant-specific delineated privileges
- Notifying the applicant, relevant personnel, and, as required by law, external entities of the privileging decision
- Monitoring the use of privileges and quality-of-care issues

MS.06.01.05 further states, “The decision to grant or deny a privilege(s) and/or to renew an existing privilege(s) is an objective, evidence-based process.”

The EPs for standard MS.06.01.05 include several requirements as follows:

- The need for all licensed independent practitioners who provide care, treatment, and services to have a current license, certification, or registration, as required by law and regulation
• Established criteria as recommended by the organized medical staff and approved by the governing body with specific evaluation of current licensure and/or certification, specific relevant training, evidence of physical ability, professional practice review data from the applicant’s current organization, peer and/or faculty recommendation, and a review of the practitioner’s performance within the hospital (for renewal of privileges)
• Consistent application of criteria
• A clearly defined (documented) procedure for processing clinical privilege requests that is approved by the organized medical staff
• Documentation and confirmation of the applicant’s statement that no health problems exist that would affect his or her ability to perform privileges requested
• A query of the NPDB for initial privileges, renewal of privileges, and when a new privilege is request
• Written peer recommendations that address the practitioner’s current medical/clinical knowledge, technical and clinical skills, clinical judgment, interpersonal skills, communication skills, and professionalism
• A list of specific challenges or concerns that the organized medical staff must evaluate prior to recommending privileges (MS.06.01.05, EP 9)
• A process to determine whether there is sufficient clinical performance information to make a decision related to privileges
• A decision (action) on the completed application for privileges that occurs within the time period specified in the organization’s medical staff bylaws
• Information regarding any changes to practitioners’ clinical privileges, updated as they occur

The Joint Commission further states, “The organized medical staff reviews and analyzes information regarding each requesting practitioner’s current licensure status, training, experience, current competence, and ability to perform the requested privilege” (MS.06.01.07).

In the EPs for standard MS.06.01.07, The Joint Commission states that the information review and analysis process is clearly defined and that the decision process must be timely. The organization, based on recommendations by the organized medical staff and approval by the governing body, develops criteria that will be considered in the decision to grant, limit, or deny a request for privileges. The criteria must be consistently applied and directly relate to the quality of care, treatment, and services. Ultimately, the governing body or delegated governing body has the final authority for granting, renewing, or denying clinical privileges. Privileges may not be granted for a period beyond two years.

Criteria that determine a practitioner’s ability to provide patient care, treatment, and services within the scope of the privilege(s) requested are consistently evaluated.

The Joint Commission further states, “Ongoing professional practice evaluation information is factored into the decision to maintain existing privilege(s), to
revise existing privileges, or to revoke an existing privilege prior to or at the time of renewal” (MS.08.01.03).

In the EPs for MS.08.01.03, The Joint Commission says there is a clearly defined process facilitating the evaluation of each practitioner’s professional practice, in which the type of information collected is determined by individual departments and approved by the organized medical staff. Information resulting from the ongoing professional practice evaluation is used to determine whether to continue, limit, or revoke any existing privilege.

**HFAP**

The Healthcare Facilities Accreditation Program (HFAP) has no formal position concerning the delineation of privileges for nuclear cardiology. The bylaws must include the criteria for determining the privileges to be granted to the individual practitioners and the procedure for applying the criteria to individuals requesting privileges (03.01.09). Privileges are granted based on the medical staff’s review of an individual practitioner’s qualifications and its recommendation regarding that individual practitioner to the governing body.

It is also required that the organization have a process to ensure that practitioners granted privileges are working within the scope of those privileges.

Privileges must be granted within the capabilities of the facility. For example, if an organization is not capable of performing open-heart surgery, no physician should be granted that privilege.

In the explanation for standard 03.01.13 related to membership selection criteria, HFAP states, “Basic criteria listed in the bylaws, or the credentials manual, include the items listed in this standard. (Emphasis is placed on training and competence in the requested privileges.)”

The bylaws also define the mechanisms by which the clinical departments, if applicable, or the medical staff as a whole establish criteria for specific privilege delineation.

Periodic appraisals of the suitability for membership and clinical privileges is required to determine whether the individual practitioner’s clinical privileges should be approved, continued, discontinued, revised, or otherwise changed (03.00.04). The appraisals are to be conducted at least every 24 months.

The medical staff is accountable to the governing body for the quality of medical care provided, and quality assessment and performance improvement (03.02.01) information must be used in the process of evaluating and acting on re-privileging and reappointment requests from members and other credentialed staff.
DNV

DNV has no formal position concerning the delineation of privileges for nuclear cardiology. MS.12 Standard Requirement (SR) #1 states, “The medical staff bylaws shall include criteria for determining the privileges to be granted to individual practitioners and a procedure for applying the criteria to those individuals that request privileges.”

The governing body shall ensure that under no circumstances is medical staff membership or professional privileges in the organization dependent solely upon certification, fellowship, or membership in a specialty body or society.

Regarding the Medical Staff Standards related to Clinical Privileges (MS.12), DNV requires specific provisions within the medical staff bylaws for:

- The consideration of automatic suspension of clinical privileges in the following circumstances: revocation/restriction of licensure; revocation, suspension, or probation of a DEA license; failure to maintain professional liability insurance as specified; and noncompliance with written medical record delinquency/deficiency requirements
- Immediate and automatic suspension of clinical privileges due to the termination or revocation of the practitioner’s Medicare/Medicaid status
- Fair hearing and appeal

The Interpretive Guidelines also state that core privileges for general surgery and surgical subspecialties are acceptable as long as the core is properly defined.

DNV also requires a mechanism (outlined in the bylaws) to ensure that all individuals provide services only within the scope of privileges granted (MS.12, SR.4).

Clinical privileges (and appointments or reappointments) are for a period as defined by state law or, if permitted by state law, not to exceed three years (MS.12, SR.2).

Individual practitioner performance data must be measured, utilized, and evaluated as a part of the decision-making for appointment and reappointment. Although not specifically stated, this would apply to the individual practitioner’s respective delineation of privilege requests.

CRC draft criteria

The following draft criteria are intended to serve solely as a starting point for the development of an institution’s policy regarding this practice area. The core privileges and accompanying procedure list are not meant to be all-encompassing. They define the types of activities, procedures, and privileges that the majority of practitioners in this subspecialty perform. Additionally, it cannot be expected or
required that practitioners perform every procedure listed. Instruct practitioners that they may strikethrough or delete any procedures they do not wish to request.

**Minimum threshold criteria for requesting privileges in nuclear cardiology**

**Basic education:** MD or DO  
**Minimal formal training:** Successful completion of four to six months training in an ACGME- or AOA-accredited postgraduate training program in cardiology, nuclear medicine, or radiology that included training in nuclear cardiology or training or experience equivalent to the training in a formal program such as the Level 2 training in the ACC/ASNC training guidelines.  
**Required current experience:** Demonstrated current competence and evidence of the performance of at least 30 cardiac nuclear scan interpretations during the past 12 months or completion of training in the past 12 months.

**References**

If the applicant is recently trained, a letter of reference should come from the director of the applicant’s training program. Alternatively, a letter of reference may come from the applicable department chair and/or clinical service chief at the facility where the applicant most recently practiced.

**Core privileges in nuclear cardiology**

Core privileges for nuclear cardiology include the ability to admit, evaluate, treat, and consult acute and chronically ill adult patients presenting with confirmed or suspected cardiovascular disease. Core procedures include:

- SPECT with technetium agents and thallium  
- PET with rubidium and nitrogen agents  
- Planar with technetium agents and thallium  
- ECG gating of perfusion images for assessment of global and regional ventricular function (imaging protocols and stress protocols)  
- Viability assessment, including reinjection and delayed imaging of thallium and metabolic imaging where available  
- Equilibrium gated blood pool or “first pass” radionuclide angiography at rest and during exercise or pharmacologic stress  
- Qualitative and quantitative methods of image display and analysis

**Special noncore privileges in nuclear cardiology**

If desired, noncore privileges are requested individually in addition to requesting the core. Each individual requesting noncore privileges must meet the specific threshold criteria governing the exercise of the privilege requested, including training, required previous experience, and maintenance of clinical competence. Noncore privileges include:

- Combined myocardial perfusion imaging with cardiac CT for attenuation correction or anatomic localization
Nuclear cardiology

• Equilibrium radionuclide angiography and/or “first-pass” radionuclide angiography during exercise or pharmacologic stress
• Metabolic imaging using single-photon and/or positron-emitting radionuclides
• Myocardial infarction imaging
• Cardiac shunt studies

Reappointment

Reappointment should be based on unbiased, objective results of care according to a hospital’s quality assurance mechanism. To be eligible to renew privileges in nuclear cardiology, the applicant must demonstrate current competence and evidence of the performance of at least 60 cardiac nuclear scan interpretations during the past 24 months based on results of ongoing professional practice evaluation and outcomes. In addition, successful completion of continuing education requirements that relate to nuclear cardiology and cardiac nuclear scan interpretation should be required. In addition, continuing education related to nuclear cardiology should be required.

For more information

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American College of Cardiology
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Website: www.cardiosource.org

American Osteopathic Association
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Fax: 312-202-8200
Website: www.osteopathic.org
American Society of Nuclear Cardiology
4340 East-West Highway, Suite 1120
Bethesda, MD 20814
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Website: www.asnc.org/

Centers for Medicare & Medicaid Services
7500 Security Boulevard
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Website: www.cms.hhs.gov

Certification Board of Nuclear Cardiology
101 Lakeforest Boulevard, Suite 401
Gaithersburg, MD 20877
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Fax: 240-631-8152
Website: www.cccvi.org/cbnc/index.cfm

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Healthcare Facilities Accreditation Program
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