

Advanced Cardiovascular Sonographer: A Proposal of the American Society of Echocardiography Advanced Practice Sonographer Task Force

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Echocardiographic examinations require a well-trained and competent sonographer to obtain proper anatomic and physiologic data to establish an accurate diagnosis for clinical decision-making and patient management. Although the formal education and training of cardiovascular sonographers are evolving, many entry-level and staff sonographers may not have sufficient practical or clinical knowledge of the necessary components of the echocardiographic study for the individual patient's clinical presentation. In many clinical settings, echocardiograms are read after the patient has left the laboratory. Thus, there is a role for a sonographer who can practice at an advanced level in a cardiovascular ultrasound laboratory to ensure a proper echocardiographic examination is performed on every patient. In this setting, an Advanced Cardiovascular Sonographer (ACS) would be able to review the indication for and quality of the examination. If additional images were needed, the ACS would assist the sonographer in obtaining these images, which would lead to the performance of a complete and fully diagnostic examination before the patient had left the echocardiography laboratory. In clinical practice, the quality of the examinations performed would improve, advancements in echocardiographic methods could be taught and incorporated into daily practice, and patients would be better served. The present report is a proposal from the American Society of Echocardiography Advanced Practice Task Force that identifies the potential of cardiac sonographers to achieve the ACS level. (*J Am Soc Echocardiogr* 2009;22:1409-13.)

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In many cardiovascular ultrasound laboratories, there are sonographer supervisors as well as "senior" sonographers. The role of the sonographer supervisor includes the provision of administrative

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guidance and management of departmental activities, whereas senior sonographers usually provide clinical and echocardiographic guidance. Both the supervisor and senior sonographers would be candidates for completing the necessary requirements for becoming an Advanced Cardiovascular Sonographer (ACS). This position would include a formal program with responsibilities such as the following: (1) teach staff sonographers who are less experienced with current technology how to assess cases that require the use of specific echocardiographic methods; (2) review studies that have been performed by staff sonographers; (3) provide in-service education for staff sonographers concerning new methods that are to be incorporated into the echocardiographic examination; and (4) ensure that the necessary echocardiographic data are obtained for the patient on the basis of the clinical history and presentation. These individuals would not practice independently but would always work under the supervision of one or more physician echocardiographers.

The scope of practice for the diagnostic medical sonographer was proposed by the Society of Diagnostic Medical Sonographers in 1993 and was subsequently endorsed by the American Society of Echocardiography (ASE); this scope of practice defines components of the comprehensive ultrasound examination, which includes patient history, performance of the procedure, and provision of a diagnostic

summary of findings. The scope-of-practice document also stresses that sonographers should engage only in practices they have been educationally prepared to perform or for which they have demonstrated clinical competency in subject matter or skill set.^{1,2}

The ASE has established guidelines for cardiac sonographer training and education that specifically define the role of the cardiac sonographer.³ According to this documentation, a cardiac sonographer should work under a supervising physician, and the supervising physician should be available to assist in the performance of an examination when it is "technically difficult, confusing, or nondiagnostic or when ancillary techniques or interventions are needed."³ Because the demand to perform patient studies has increased in cardiovascular laboratories, it has been proposed that an ACS could aid the physician by assisting staff sonographers in image acquisition in case of technically difficult imaging situations and with ancillary imaging or Doppler techniques. The ACS would review studies to determine whether they were complete for the patient's clinical situation, thereby allowing the patient to leave the laboratory before physician review of the study.

The ASE has defined the minimum standards for the practicing cardiac sonographer.⁴ This report states that the sonographer must be able to expand the echocardiographic examination as necessary to answer the clinical question posed by the case. Proper knowledge is required to integrate the patient's history, clinical presentation, and results of laboratory tests, cardiac catheterization, nuclear technology, cardiac computed tomography, and magnetic resonance imaging with the echocardiographic images.⁴ The report also emphasizes the importance of maintenance of competency, including a specific procedure volume of studies performed and continuing medical education requirements as set forth by the Intersocietal Commission on the Accreditation of Echocardiography Laboratories (ICAEL). All cardiac sonographers should also engage in peer-reviewed quality assurance practices and adhere to the sonographer scope of practice and the code of ethics.^{4,5} An ACS can help echocardiography laboratories meet all of these standards.

PREVIOUS EXPERIENCE: GENERAL SONOGRAPHY

An advanced practice role of sonographers has been evaluated in other disciplines of sonography. It has been suggested that there are 2 tiers of sonographers who perform sonography in the United States: those with standard skills and those with advanced skills.² Persutte² reported that sonographers are capable of practicing at advanced levels if they have had several years of instruction and interaction with a physician mentor and an extensive, closely supervised clinical education. However, it was also noted that advanced practice sonography is not applicable to all sonographers, especially if they have not had a physician mentor and a closely supervised clinical education experience.

PREVIOUS EXPERIENCE: CARDIOVASCULAR SONOGRAPHY

Another report evaluated the role of the cardiac sonographer and how it has met the characteristics of professional status.⁶ The criteria for professional status were defined as (1) rendering a unique and essential service; (2) providing a rigorous education and training program to prepare its practitioners; (3) achieving self-regulatory status for both the group and individual; and (4) establishing high standards for member selection. When these criteria were applied to the role of the cardiac sonographer, only some were met, but rigorous education and

Table 1 Prerequisites for Advanced Cardiovascular Sonographer designation

Prerequisite 1 ^a
ARDMS or CCI registry
5 y of full-time experience ^b
Demonstration of advanced scanning, interpretive, and interactive skills
Prerequisite 2
Bachelor's degree in any discipline
ARDMS or CCI registry
5 y of full-time experience ^b
Demonstration of advanced scanning, interpretive, and interactive skills
Prerequisite 3
Bachelor's degree in diagnostic medical sonography/ echocardiography/cardiovascular sonography
ARDMS or CCI registry
3 y of full-time experience ^b
Demonstration of advanced scanning, interpretive, and interactive skills

ARDMS, American Registry of Diagnostic Medical Sonographers; CCI, Cardiovascular Credentialing International.

^aThe pathway described in prerequisite 1 will be phased out of existence after 5 y from the date of this publication.

^bFull-time experience is defined as 35 h/wk for 48 wk.

training programs lacked consistent content and length.⁶ In the development of the ACS, the committee therefore recognized that entry-level sonographer education is often not uniform, and educational standards vary by accreditation status for individual educational programs. Thus, individuals who would assume the position of an ACS will need to attend an ACS educational program that includes a standardized core curriculum and clinical competency requirements (Table 1).

The idea for an ACS has been previously suggested. It has been reported in the literature⁷ and is in practice in some echocardiography laboratories. In 1999, Hall et al⁷ described a mid-level care provider for the field of diagnostic medical sonography, who would be called an ultrasound practitioner. In this proposal, the sonographer would be required to complete certain prerequisites and have a Master's degree with specific core and concentration courses, national board certification, and specific continuing medical education requirements.⁷ The current proposal from this task force, although supporting a high level of practice for individual sonographers via formal ACS training and certification, does not include the same level of functional autonomy that is incorporated into the nurse practitioner or physician assistant positions. As mentioned previously, ACSs would always practice under direct supervision of the physician echocardiographer(s) with whom they are partnering. An ACS is not expected to make diagnoses or to communicate preliminary study results to requesting providers; those duties are the responsibility of the supervising physician, who is ultimately responsible for the diagnostic echocardiographic service.

ACS models have already been instituted in some larger echocardiography laboratories. Before the establishment of the ACS, echocardiographers at these sites usually reviewed all echocardiography studies before patients left the laboratory to verify that all echocardiographic data necessary to answer the clinical question(s) had been obtained. As the number of cases per physician grew at these sites, it became impossible to maintain this model. Sonographers subsequently were trained to serve in an advanced practice cardiovascular sonographer role, working as a team with an echocardiographer and a group of staff sonographers. At some sites, sonographers with enough experience were simply advanced to this role. At other sites, the ACS model has included classes with subject matter similar to the first-year medical school cardiology curriculum and an internship under direct supervision by echocardiographers. Once implemented,

Table 2 Proposed curriculum for Advanced Cardiovascular Sonographer certificate

Advanced Cardiovascular hemodynamics/physiology and pathophysiology

Acquired heart disease in the adult

Surgical and medical options

New ultrasound technologies, including contrast agents

Comparative imaging analysis

Research methods and biostatistics

Pharmacology

Curriculum and instruction for the adult learner

Clinical internship

Proposed curriculum course descriptions:

Advanced Cardiovascular hemodynamics/physiology and pathophysiology

This course will discuss the fundamental principles of fluid mechanics and mass transport as applicable to physiologic and biological systems. The fluid mechanics coverage emphasizes blood flow in the cardiovascular system. Topics include Poiseuille flow, circulatory flow resistance, and Bernoulli's principle. In addition, the course will provide in-depth discussion of the autonomic nervous system, reflex arcs, and the renin-angiotensin system as they relate to cardiac function and dysfunction.

Acquired heart disease in the adult

This course will provide an understanding of a broad range of cardiovascular disease states acquired in the adult patient. The pathophysiology of and therapeutic strategies for the important cardiovascular diseases will be reviewed. Topics include but are not limited to heart failure (normal and abnormal ejection fraction), aortic stenosis and prostheses, mitral stenosis and prostheses, hypertrophic cardiomyopathy, aortic regurgitation, mitral regurgitation, and pericardial disease. The presenting signs and symptoms and both therapeutic and patient management strategies will be discussed.

Surgical and medical options

This course will provide in-depth discussion of medical and surgical treatments for various disease states of the adult patient.

New ultrasound technologies, including contrast agents

This course will discuss the implementation of contrast agents (when and how contrast should be added to the examination), three-dimensional imaging (protocols, disease states, when and how to perform such imaging), and strain imaging (when and how to perform it). This course should have an associated laboratory at which the ACS can perform these examinations and teach junior staff how to perform them. This course will cover the use of online and offline software for image processing. Contemporary advances in the field of transducer technology should be exploited to maximize image quality and clinical diagnosis.

Comparative imaging analysis

The student will be exposed to normal anatomy and pathology cases that combine diagnostic medical sonography, computed tomography, and magnetic resonance imaging. The student will gain an understanding of how diagnoses are made and patients are managed on the basis of findings from multiple imaging modalities.

Research methods and biostatistics

This course will discuss the basic principles of epidemiology and descriptive biostatistics as they apply to echocardiography. Topics include but are not limited to disease occurrence and recurrence, patterns and trends in a population, and interpretation of results. Participants will be asked to write a complete original manuscript with research methodology and defend their proposed strategy.

Pharmacology

This course will familiarize the ACS student with the pharmacology of drugs that affect the human cardiovascular system. The course will cover the autonomic nervous system and renin-angiotensin system and will include discussion of the responses of the cardiovascular system to antianginal drugs, antihypertensive agents, lipid-lowering drugs, and drug therapies used for treatment of coagulation disorders.

Curriculum and instruction for the adult learner

This course will familiarize the ACS student with the development of learning objectives, different styles of learning, construction of courses for the adult learner, and measurement of educational outcomes. Students will explore educational strategies used in ultrasound education. Students will participate in departmental education course development projects.

Other required training:

Clinical internship

The clinical internship for the adult learner will comprise a minimum of 288 hours. During the clinical internship, the participant will be required to complete the following to demonstrate competency in various areas: (1) Review and overread with the interpreting physician a minimum of 8 cases per week performed by practicing sonographers. (2) With the assistance of the physician, write preliminary reports and review them with the interpreting physician. These should be performed on a minimum of 8 cases per week. (3) Write quality assurance protocols and provide literature reviews of new technology. Participants will review their projects with the technical director and medical director of the laboratory and use this information to make 3 presentations at quality assurance/staff in-service meetings. This activity should follow ICAEL guidelines. (4) Throughout the training process, engage in overreading studies and critiquing of junior sonographer performance. This will consist of counseling, advising, providing feedback, and performing additional imaging to answer the clinical question after the clinical sonographer assigned to the case has completed his or her initial study.

sites have found that the ACS position allows for an increase in the number of studies supervised by physicians each day, while preserving the practice of having an individual (advanced sonographer) with high-level echocardiographic and clinical expertise review for each study while the patient is still available for additional imaging if needed. It is important to note that the role of the ACS at these sites is distinctly different from the role of the sonographer supervisor.

The role of the Adult Echocardiography ACS (based on prior education and experience) would be to (1) assist staff sonographers during echocardiographic examinations to ensure necessary echocardiographic data are obtained according to patient clinical history and presentation; (2) review studies and provide a preliminary report to the interpreting physician; (3) provide in-service education for staff sonographers on applications to be incorporated in echocardiographic

examinations; and (4) establish quality assurance measures to maintain the highest standard of care of a laboratory by closely monitoring sonographers' performance and training needs. The ACS works under direct physician supervision while applying clinical knowledge to ensure that the echocardiographic examination answers the appropriate clinical question. The ACS integrates knowledge of clinical practice roles with education, research methodology, management, leadership, and consultation (cited from ACS Task Force Standards and Guidelines). This individual would not be responsible for the day-to-day operation of the echocardiography laboratory as a Sonography supervisor or Technical Director would be.

According to the ICAEL (http://www.intersocietal.org/icael/pdfs/Standards/Adult_Org.pdf; accessed August 10, 2009),⁸ the responsibilities of the technical director or supervising sonographer include but are not limited to all laboratory duties delegated by the medical director, performance of echocardiograms, general supervision of the technical staff, delegation of specific responsibilities to technical staff or ancillary staff, daily technical operation (eg, staff scheduling, patient scheduling, laboratory record keeping), operation and maintenance of laboratory equipment, compliance of technical or ancillary staff, work with medical director and technical staff to ensure quality patient care, and technical training.

It is anticipated that many echocardiography laboratories, for a variety of reasons, would not hire an ACS in their practice. It is not the intent of this document to mandate use of the ACS position in all laboratories but rather to encourage the establishment of the ACS position within laboratories in which the ACS model is deemed appropriate.

RECOMMENDATIONS OF THE ADVANCED PRACTICE SONOGRAPHER TASK FORCE COMMITTEE

Proposed prerequisites are presented in Table 2. Training would consist of the following:

1. The didactic curriculum will consist of 3 academic semesters that incorporate courses in advanced hemodynamics/physiology, acquired heart disease, medical and surgical treatment, new ultrasound technologies, comparative imaging analysis, research methods and statistics, pharmacology, information technology, and curriculum and instruction for the adult learner.
2. Clinical internship will take place over 3 academic semesters and will include echocardiography study interpretation, with further imaging or Doppler evaluation as needed. These cases will be reviewed and critiqued by a supervising physician echocardiographer.
3. Clinical competencies will include development of a quality assurance protocol with the presentation of 3 quality assurance/staff in-service meetings and the provision of a literature review on new echocardiographic technology. The technical director and medical director of the laboratory will review clinical competencies. This requirement should follow ICAEL guidelines.
4. The staff sonographer's performance of echocardiographic studies will be monitored with written assessments that outline advice to the clinical sonographer assigned to the case for performing additional imaging or that detail the need for the ACS applicant to perform additional imaging to fully answer the clinical question(s) posed by the case.

The clinical training site should have the following qualifications:

1. Affiliation with an accredited cardiac educational program (such as CAAHEP program either in the cardiac learning concentration for diagnostic Medical Sonography or Noninvasive Cardiovascular technology program).^{9,10}
2. ICAEL accreditation.
3. Institutional affiliation with an accredited degree-granting organization.
4. Patient volume of at least 15 cardiac ultrasound examinations per day, with pre-reading independently performed on 5 of these studies by the ACS student and then for a second time in collaboration with the physician.

5. The number of students accepted by a program will be determined by the volume of examinations at clinical sites. CAAHEP guidelines recommend "each cardiac learning concentration major affiliate or clinical education center should perform a minimum of 800 patient examinations, including permanent records and reports, per year, per student equivalent." (CAAHEP DMS Standards and Guidelines, 2007, p. 3). The overall program volume of procedures should be representative of the range of cardiac procedures.⁸

The recognition of a sonographer as an ACS should also require a certification examination that is endorsed by a member organization. This could take the form of a national board certification examination by a known credentialing agency. Additional continuing medical education hours for an ACS would be mandatory and would comprise 36 hours every 3 years.

The next step in the development of the ACS is to legitimize the educational process and develop educational guidelines and standards to be administered by an accrediting agency, such as CAAHEP provides for entry-level diagnostic medical sonography and cardiovascular technology programs.^{8,9} Once formal educational program accreditation is in place, a core curriculum for the ACS will need to be written, similar to the ASE's core curriculum for sonographers and physicians. After program standards, guidelines, and curriculum have been developed, a credentialing examination must be offered to ensure that all individuals completing an accredited ACS program have acquired mastery of the knowledge needed to perform sonography at this advanced practice level. This examination would be administered similar to the National Board of Echocardiography for physicians. Once at this point, a request for proposal will need to be sent to certification organizations and an examination developed.

CONCLUSIONS

The need for ACSs has emerged because of the technologic advances, procedure volumes, and continued need for proper supervision in the field of echocardiography. The Advanced Practice Sonographer Task Force supports the development of an advanced practice clinical sonographer. This role, known as an ACS, would require completion of a recognized ACS educational program with specific educational requirements, including didactic instruction and a formal internship. An ACS could provide mentorship to entry-level and staff sonographers for maintenance of quality assurance, as well as the use of new technologic advances to ensure comprehensive echocardiographic examinations.

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