Guidelines for Pediatric Cardiology Diagnostic and Treatment Centers

This document describes the clinical and physical environment in which infants and children with heart disease can undergo accurate and safe diagnostic procedures and cardiac surgery. Guidelines in this statement are in concert with previous guidelines developed by the Intersociety Commission for Heart Disease Resources. These guidelines have been developed for use by health planning agencies and health service organizations to evaluate existing pediatric cardiac centers and to establish the need for the development of new centers.

Young patients with heart disease have identifiable needs that can only be adequately met by a team of experts with training and experience in the management of pediatric cardiovascular disease. Accurate anatomic diagnoses, hemodynamic and electrophysiologic assessments of acquired and congenital cardiovascular disease, and the treatment of these diseases are the responsibilities of a pediatric cardiologist in association with the primary physicians and other health professionals. There is a need for guidelines so each center can assess its performance and be assessed by peer review in the context of regional and national guidelines.

The purpose of this document is to recommend guidelines by which this evaluation can be accomplished and offer mechanisms by which the quality of pediatric cardiology care can be assured.

**Background**

*Pediatric Cardiology Patients.* To allow for continuity and expertise of patient care, the Section on Cardiology of the American Academy of Pediatrics believes that infants, children, and adolescents (from birth to age 21 years) with major heart disease should have access to the care of a pediatric cardiologist who, along with the child's primary physician, should provide a continuing care program for the patient.

*Pediatric Cardiologists.* A pediatric cardiologist should be qualified, by training and experience, in pediatrics and pediatric cardiology to provide evaluation, diagnosis, and preoperative and postoperative services to pediatric cardiology patients.

For those who complete their training after 1978, board certification in pediatrics and pediatric cardiology is recommended. All board-eligible pediatric cardiologists actively engaged in the subspecialty should become board-certified within six years of becoming eligible for the examination.

*Pediatric Cardiology Diagnostic Centers.* There should be pediatric cardiology diagnostic centers available throughout the nation for referral of all infant, child, and adolescent patients with heart disease who require the expertise represented in such a center.

A center is an institution or closely affiliated group of facilities providing pediatric cardiology care, including diagnosis and medical and surgical treatment, to a population with at least 30,000 live births per year. Appropriately equipped, staffed, and supported centers serving larger populations are preferable to multiple, minimum-sized centers. If multiple services already have been established in close proximity (e.g., within the same health planning district) to provide services for populations with 30,000 live births or less, the services should be consolidated into one center. If smaller centers have been established because of tradition, well-established patient referral lines, or patterns that serve a state or other well-defined large geographic area, these centers should be maintained and no other center established until the live births in the area reach 60,000 per year.

To coordinate the needs of infants at high risk, tertiary neonatal intensive care units and pediatric cardiology centers should be contained within the same health care facility. In these centers, the pediatric cardiologist should be consulted on all cardiac problems and be involved in making decisions about the care of infants with heart disease. Because the need for neonatal units is one per 10,000 live births and the need for pediatric cardiology centers is one per 30,000 live births, fewer cardiology than neonatology centers will be
required. Only institutions meeting the criteria for pediatric cardiac centers should care for newborn infants with cardiac problems. All infants requiring cardiac investigation and surgery in neonatal intensive care units not associated with a pediatric cardiology center should be transported to a pediatric cardiology center.

**Pediatric Cardiology Diagnostic and Treatment Team**

**Pediatric Cardiology Staff.** An approved pediatric cardiology diagnostic center, or one seeking approval, should be under the direction of a physician certified by the American Board of Pediatrics and the Sub-Board of Pediatric Cardiology. In established centers, physicians with long-recognized ability and experience in pediatric cardiology and with a high professional standing may direct centers if their clinical duties are totally within pediatric cardiology and if other members of the staff are certified by the Sub-Board of Pediatric Cardiology.

A center should have a minimum of two pediatric cardiologists to serve patient needs. A suggested ratio of pediatric cardiologists is one per 75 cardiac catheterizations or one per 1,000 patient visits per year. Centers with large outpatient, teaching, and research responsibilities will need additional manpower.

**Pediatric Cardiac Surgical Staff.** There should be at least two board-qualified cardiac surgeons on the staff of the hospital with a cardiac surgical program. One should be immediately available at all times. Approved training programs leading to board certification in cardiothoracic surgery are highly desirable in the conduct of an excellent cardiac surgical service, because they contribute to high standards of care and programs of productive, basic, and clinical research. However, absence of experienced resident coverage confers a special responsibility on both the hospital administration and the director of the program to assure that (1) there is adequate in-hospital professional staff coverage at all times, (2) the hospital support systems and services are sufficiently integrated to manage medical and surgical emergencies effectively, and (3) a physician member of the team familiar with the patient is always in the hospital.

The cardiac surgeon requires a full background in basic medical principles and surgical techniques, with special competence in cardiology (including cardiopulmonary anatomy, physiology, pathology, pharmacology, extracorporeal perfusion technique, and the interpretation of catheterization and radiographic data in infants, children, and adolescents). He/she should be able to direct a surgical team in the performance of all current cardiac surgical procedures applicable to the age group cared for, although special procedures in limited volume may be the province of a single member of the team. Cardiac surgeons should be certified by the American Board of Thoracic Surgery, and their training should include special emphasis in cardiovascular surgery in infants and children. One surgeon should have experience and a major interest in, and the primary responsibility for, the surgery of congenital heart disease. If the American Board of Thoracic Surgery develops a special certificate of competence in pediatric cardiovascular and thoracic surgery in addition to the standard cardiovascular and thoracic board examination, the center's surgeon should hold such a certificate.

**Other Pediatric Staff.** There should be physicians with recognized competence available to provide the necessary consultant services in pediatric hematology, nephrology, neurology, neonatology, allergy, endocrinology, surgery, urology, radiology, anesthesiology, and pathology. It is preferable that these physicians have their certificates of pediatric proficiency or board certification in their subspecialty if such certificates or boards exist.

**Nursing Staff.** Nurses specially trained in managing specific age groups with heart disease are essential. They include surgical, intensive care, and ward nurses. Frequent reassignment of nurses outside their area of special training is undesirable and should be discouraged. Basic skills are required to evaluate cardiac output, blood pressure, pulse volume, and pulse rate and rhythm, and to interpret the measurements of ECGs and other monitoring devices. Basic skills and training are also essential in the management (under the direct supervision of a physician) of the preoperative and postoperative complications associated with heart disease. Continuing in-service education should be incorporated into each nursing program.

**Medical Social Workers.** Qualified medical social workers, or the equivalent, should be available within the institution to assist the physicians in dealing with the anxiety, fear, and worry common in the patients' families when cardiac surgery is considered. The case worker should be familiar with state and federal programs for the support and rehabilitation of cardiac patients.

**Facilities**

The specific optimal criteria for hospital resources for the care of patients with heart disease described in the *Hospital Categorization Guidelines* of the Joint Commission on Accredita-
tion of Hospitals' are endorsed by the Section on Cardiology.

Inpatient Services. Comprehensive, specialized services for pediatric patients with heart disease may be provided in a children's hospital as well as in a pediatric cardiology department of category C hospitals designated by the Hospital Categorization Guidelines. These units should be capable of providing comprehensive diagnostic and therapeutic services of optimal quality, including cardiac surgery for children with all types of cardiovascular disease.

Ambulatory Services. There should be readily accessible pediatric cardiology ambulatory services available which are supervised by a pediatric cardiologist. Emergency service should be available on 24-hour call.

Cardiac Catheterization Laboratories. Personnel should be available on 24-hour call. The physician staff of a laboratory where cardiac catheterizations are performed should fulfill the qualifications for a pediatric cardiologist.

The nursing personnel should consist of the following:
1. A graduate nurse with special training in cardiovascular techniques and in the care of pediatric patients, or an individual with similar training and competence in cardiac laboratory techniques, should be a full-time member of the team.
2. Two or more additional personnel are essential to the performance of the catheterization procedure. These may include nurses, anesthesiologists, technicians, or individuals specially trained in operating monitoring and radiologic equipment.

The equipment necessary for catheterization laboratory includes the following.
1. There should be multiple-channel recording apparatus for the continuous display and recording of intracardiac pressure, ECGs, and other selected physiologic variables.
2. Equipment should be available to measure oxygen consumption and to determine the cardiac output in patients of all ages. In addition, densitometers and other equipment to detect shunts using indicator-dilution or hydrogen electrode techniques should be available.
3. Laboratories should have a hemoglobin-oxygen saturation analyzing technique that is periodically checked for accuracy by some standard. In addition, measurement of pH and blood partial pressure of carbon dioxide and oxygen should be available. The results of oxygen determinations should be immediately available while the catheter is in place. Laboratories in which infants are studied should be equipped with units requiring small samples of blood for analysis.
4. Radiologic equipment should include image intensification x-ray apparatus capable of video and cine recording. Biplane imaging, either cine or serial large-frame technique, is essential. Equipment that permits rapid injection of controlled amounts of radiopaque contrast material should be available.
5. Patient support devices should include resuscitation equipment and supplies available at all times for immediate use in the laboratory. The equipment should be periodically checked for reliable performance and include the following: a defibrillator, laryngoscopes with endotracheal tubes appropriate for all ages, an oxygen source, equipment for oxygen administration in assisted respiratory ventilation, a suction device, emergency drug facilities for insertion of a transvenous pacemaker, a body temperature monitoring device, and a warming device for infants.

Noninvasive Procedures. In a pediatric cardiac diagnostic center, electrocardiography, vectorcardiography, phonocardiography, and echocardiography should be available under the direction of a pediatric cardiologist.

Operating Room and Surgical Facilities. Operating room and surgical support facilities should be available and equipped as outlined in the report of the Intersociety Commission for Heart Disease Resources. Case Load. Case loads are essential to stimulate and maintain the quality of support necessary for safe and effective diagnostic procedures in cardiac surgery. The Intersociety Commission for Heart Disease Resources and the Joint Commission on Accreditation of Hospitals recommended that laboratories catheterizing only infants and children perform a minimum of 150 cardiac catheterizations per year, and that laboratories serving both adult and pediatric patients perform 350 cardiac catheterizations per year. The Section on Cardiology recommends that in centers serving all age groups, at least 150 cardiac catheterizations be done on patients in the pediatric range. A surgical case load of 200 operations per year should be performed in combined adult and pediatric programs; of these, at least 100 operations per year (three of four should use extracorporeal circulation) should be on pediatric patients. In programs serving only a pediatric population, at least 100 cardiac surgical procedures (three of four should use extracorporeal circulation) per year are required for the profes-
sional team to maintain a high level of skill and for reasonably efficient use of expensive equipment.

If a wide proliferation of cardiac surgical programs is developed without long-range considerations of cost, manpower, and the needs of a community, case loads in many centers might become small enough to interfere with cost effectiveness and quality of health care delivery. If case loads are low, cardiac surgeons, pediatric cardiologists, nurses, radiologists, and technicians may engage in activities not directly related to their specialty training. This represents costly and inappropriate use of trained personnel. Diagnostic facilities require expensive technical equipment that needs maintenance and updating. Because most of this equipment must be replaced every five to seven years, underutilization represents inappropriate and costly use of these physical resources.

Competing low volume programs in close geographic proximity drain case material from each other and make it difficult for any one hospital to develop adequate case loads. Multiple, underutilized units represent wasteful duplication of what are increasingly expensive capital resources at a time when the principal objective of medical care is to reduce costs through the cooperative arrangements and sharing of facilities. To assess the needs for additional pediatric cardiology and cardiac and surgical programs, the community inventory assessment suggested by the Intersociety Commission for Heart Disease Resources\textsuperscript{2} is endorsed by the Section on Cardiology of the AAP.

**Quality Control**

The purpose of guidelines is to foster quality care for pediatric patients with cardiac disease; therefore, care should be assessed by local, in-hospital review and outside peer review. The cost of this review probably will be borne by the center because the center will want to verify its clinical record. Specifically, yearly internal audits should be carried out using medical care evaluation studies with criteria such as those developed in this report for the AAP. Peer review of pediatric cardiology centers should be carried out every three years by a team of regionally appointed qualified nonaffiliated consultants, at least one of whom should be a board-certified pediatric cardiologist.

These reviewers should determine if the centers meet standards on the basis of review of an internal audit and a site visit of the activities of the center. The reviewers should also assess whether or not diagnostic and surgical results are acceptable by current standards. The findings of this review should be made available to the Joint Commission on Accreditation of Hospitals, the Office for Maternal and Child Health of the Bureau of Community Health Services, the Department of Health, Education and Welfare, health planning agencies, and health service areas.

If the reviewers find deficiencies, constructive recommendations should be made. Corrections of major deficiencies should be assessed by a similar review team within a designated period of time.

**Subcommittee on Standards**

**Section on Cardiology**

Ronald M. Lauer, M.D., Chairman; Ira H. Gessner, M.D.; Arno R. Hohn, M.D.; Saul J. Robinson, M.D.; Gerald L. Schiebler, M.D.

**Section Committee Members:** Arno R. Hohn, M.D., Chairman; George C. Emmanouilides, M.D.; Donald A. Girod, M.D.; Thomas P. Graham, Jr., M.D.; Charles E. Mullins, M.D.; Donald G. Ritter, M.D.; William B. Strong, M.D.

**REFERENCES**

1. *Hospital Categorization Guidelines: Optimal Criteria for Hospital Resources for the Care of Patients With Heart Disease, Cancer, Stroke, and End-Stage Kidney Disease.* Chicago, Joint Commission on Accreditation of Hospitals, 1974.
4. Ad Hoc Committee on Standards for Cardiac Diagnostic and Surgical Centers of the Council on Cardiovascular Disease in the Young: *Standards for Cardiac Diagnostic and Surgical Centers.* New York, American Heart Association, 1974.
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