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### Guidelines for Running an Optimised Telecardiology Service



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For paediatric cardiologists, telecardiology has become a valuable tool in diagnosing and triaging newborns with suspected congenital heart disease at remote hospital nurseries. The tele-echocardiography programme developed over 15 years ago at Children's Memorial Hospital, Chicago, IL, has spawned similar programmes both in the United States and internationally.

The continued success of this type of service has relied on several key points:

- Access of both hub and outreach sites to stable, low-cost telecommunications services and video-conferencing equipment;
- Easy to use technology for all hospital personnel participating in the programme;
- Appropriate echocardiography equipment;
- The commitment to training by outreach sites; and
- Continuous customer improvements.

A community hospital with 2,000 live births may need the tele-echocardiography service only 150 times per year. Hospital administration commonly resists purchase of complex technology with high capital and operational costs, which requires subsequent ongoing equipment upgrades. Therefore, the price point needs to be affordable and at a break-even point within the first few years.

#### Developing the Service

In 1994, the diagnosis of congenital heart disease was made in several inefficient ways, which prolonged the time to diagnosis:

- Transport of the patient to the paediatric hospital;
- Paediatric cardiologist or paediatric sonographer travel to the patient; and
- Echocardiogram sent to the paediatric cardiologist for interpretation.

In addition, sonographers who perform the studies at outreach sites are unfamiliar with specific paediatric scanning techniques and they have limited knowledge of congenital heart disease. Tele-echocardiography decreases the time to diagnosis and allows necessary life-saving treatment and better management of critically ill patients.

The concept of bedside real-time video conferencing at an affordable cost and with off-the shelf technology was pioneered at Children's Memorial through regional access to Integrated Service Digital Network (ISDN) telephone lines. The partnership with area hospitals was built on a 24/7 service model between cardiac sonographers, the paediatric cardiologist, and the referring physicians managing the patients. A critical component has always been the training of the remote hospital sonographers in techniques of paediatric cardiac scanning. This training is more than simple memorisation of the various types of congenital heart disease. It includes thorough interrogation of normal cardiac and abdominal situs with assessment of intra- and extra-cardiac connections using a segmental approach. This same scanning protocol continues to be used today.

#### Customer Service

Key components of the success of this service include easy to use equipment as well as the important relationships, which are developed between the hub and the outreach hospitals. With a pre-arranged page during the day or on-call, the tele-echo is scheduled. Then the

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performance of atele-echo during off hours involves the remote site sonographer taking the ultrasound system with the attached self-contained video conferencing unit to the patient's bedside. No additional outreach hospital staff support is needed. The sonographer dials the Children's Memorial Hospital paediatric cardiologist on-call at her home unit. After confirming the medical information, the echocardiogram is begun, with ongoing dialogue between the cardiologist and the sonographer to ensure that proper views are obtained. Severe heart disease is usually evident within the first few minutes. A complete study can be finished within 30 minutes. Using the results of the echocardiogram, management decisions are made by the referring neonatologist and the parents receive immediate feedback. A neonatal intensive care unit and a paediatric cardiologist may be many miles apart, yet, timely cardiac diagnosis is accomplished within 45 minutes of the sonographer arriving at the child's bedside, and appropriate treatment can be started.

### **Training for Success**

While in many parts of the world the echocardiogram is performed by physicians, in the US, the cardiac sonographers perform the transthoracic echoes. These skilled allied health personnel complete training and sit for examinations through the American Registry of Diagnostic Medical Sonography. The pass rate on these rigorous examinations for both physics and paediatric echocardiography is about 60%. It is also recommended that sonographers have ongoing exposure to at least 400 patients a year in order to maintain their skills.

Telecardiology resulted in decreased time to diagnosis, shorter ICU and hospital stay, and cost savings due to better ability to accurately triage the need for ambulance transport.

Since sonographers at our partner sites are usually skilled in adult echocardiography, but not in paediatric echocardiography, we provide specific on-site training in the mastery of our scanning protocol. Only those sonographers who have successfully completed this training may participate in tele-echocardiography and the on-call service. The videoconferencing provides the needed supervision.

### **Measuring the Benefits**

A multi-institutional study sponsored by the American Society of Echocardiography demonstrated that telecardiology resulted in decreased time to diagnosis, shorter ICU and hospital stay, and cost savings due to better ability to accurately triage the need for ambulance transport. In addition, therapy could be very specifically tailored to the individual needs of each infant. More than 1,000 cases were assessed in this study and the most significant success of telecardiology has been the lives saved due to the immediate diagnosis and interventional management. Since inception of the tele-cardiology programme at Children's Memorial Hospital, more than 12,000 tele-cardiology studies have been done.

Some patients diagnosed using this technology have had critical heart disease requiring immediate medical therapy and ambulance or helicopter transport to the hub tertiary care hospital. Such was the case with baby Matthew, who was being discharged from the normal newborn nursery when a heart murmur was heard. A tele-echocardiogram was done and critical pulmonary stenosis was discovered. Matthew required administration of the life saving medication, prostaglandin, and he was transported to Children's Memorial Hospital where his severely narrowed pulmonary valve was opened surgically. Matthew is now a normal 15-year old boy with no symptoms of heart disease. Had telemedicine not been available, Matthew may have died as a newborn infant due to insufficient blood flow to his lungs.

Telecardiology also enables the paediatric cardiologist to triage patients for different types of inpatient or outpatient care depending on the cardiac abnormality. In another case, a pair of twins was born to a mother at an outreach hospital. One twin was normal, but the other twin was a "blue baby". Telecardiology demonstrated that this baby had abnormal return of the venous blood from his lungs to the heart. Instead of returning to the left side of the heart, the pulmonary venous flow returned to the right side of his heart, causing him to have abnormally low oxygen levels in his blood. Because this baby was very small, an immediate operation would have been very risky.

Using tele-echocardiography, the paediatric cardiologist determined that it was safe for this baby to stay in the ICU at the outreach hospital so that he could feed and grow bigger. When the baby was the appropriate weight, he was transferred electively to Children's Memorial Hospital for repair of his anomalous pulmonary venous return. This management decision was also tremendously advantageous for the baby twins and their parents. Both babies remained in the same nursery and the parents were able to bond with both of them. Had one twin been transferred too early, the parents would have been required to split their time between two hospitals. Due to transportation difficulties, the parents would have had difficulty bonding with the twin with heart disease.

Finally, telecardiology is very effective in defining cases of mild heart disease, which can be very easily managed in an outpatient setting. For instance, if a small hole between the upper or lower chambers of the heart is found, the baby may be discharged with the mother and scheduled for routine follow up in an outpatient paediatric cardiology clinic. Prior to the advent of telecardiology, these babies may have been unnecessarily transported to the hub hospital for diagnosis or their discharge may have been delayed while waiting for an echocardiogram to be interpreted.

### **Conclusions**

In summary, telecardiology is a life saving technology for infants with congenital heart disease. With a modicum of outreach sonographer training and real time interaction between the sonographer and the hub hospital paediatric cardiologist, congenital heart disease can be diagnosed or ruled out. Time to diagnosis is decreased, improving the infant's chances of survival if heart disease is present, and expeditiously allaying parental anxiety if the heart is normal. Unnecessary costly transports and prolonged hospital stays are avoided. Since the distance between hub and spoke hospitals is irrelevant, telemedicine technology may also be an important solution to the diagnosis of congenital heart disease in remote parts of the globe without access to paediatric cardiology expertise. Thus, using this simple technology, outcomes for patients with congenital heart disease can be significantly improved not only locally but also throughout the world.

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