



## **METHODOLOGY AND STRATEGY TO DEVELOP SUSTAINABLE PEDIATRIC CARDIAC PROGRAMS IN EMERGING COUNTRIES**

### **Background**

The development or improvement of a pediatric cardiac service is an enormous undertaking. Gift of Life International (GOLI) has the experience of starting or improving programs in El Salvador, Uganda, Jamaica, Romania, Dominican Republic, and The Philippines, among others. Our investment in a program is based upon strategic guidelines which include the following criteria: (1) supportive and invested government, (2) motivated and involved hospital administration, (3) established pediatric cardiac program and (4) existing in-country, non-governmental organization to support the program. Based upon how a prospective program stands up to these criteria, we make a decision whether to partner with or not with them.

Our model is to develop a local team with the capacity to provide reliable, sustainable care to children with congenital heart defect (CHD) based upon a strategic plan and action items which include, but are not limited to, the provision of: training, essential equipment upgrades, supplemental supplies and medications and an organizational structure for the pediatric cardiac service and support units.

### **Methodology and Strategy**

Our initial action item is to perform a site visit. The objective of this visit is to identify the strengths and weaknesses of the local facility and team. Posteriorly, a comprehensive report is delivered and discussed with the local authorities and team. Once our strategy is developed, we proceed to organize our medical teams to conduct the training visits.

We employ one of two approaches: either a one or two week visit. We send a team of experienced pediatric cardiac specialists to provide diagnostic services, surgery, diagnostic and interventional catheterizations, and post-operative care. The initial team consists of: a senior pediatric cardiac surgeon, a pediatric cardiologist, a pediatric cardiac anesthesiologist, a pediatric perfusionist, a scrub nurse, two pediatric intensivists, 6 pediatric cardiac ICU nurses, a respiratory therapist and 1 biomedical engineer. Depending on the site, we may need to add a Physician's Assistant or Registered Nurse First Assist or an extra pediatric intensivist for a more extended stay after the team departs. If we are going to provide cardiac catheterizations, we will also bring a pediatric interventional cardiologist, a second anesthesiologist and, eventually, a cath lab technician. The team will depart from their respective homes on the Saturday prior to the commencement of the visit and arrive on site either the same day or early Sunday. Sunday will serve as a patient review day and team organizational day (inventory of supplies and medicines, orientation and patient selection meetings, and introductions of visiting and local team.)

Surgeries and interventional cath procedures will begin on Monday. Our goal is to perform 2 surgeries and 3 to 4 cath cases per day. If we employ a two-week trip approach, the middle weekend is reserved for emergency cases. This will allow the ICU to decompress before week 2. A small team of 3 ICU personnel will remain on-site for

another five days after the last procedure (whether the one or two-week approach is employed). Depending upon case complexity and movement of the cases through the ICU, we anticipate on 15 to 18 children per treated per each week of our visit.

The patient's pathophysiology is used as a basis to teach the local team. Substantial skills are transferred through direct patient care. Additionally, didactic lectures (before and during the visit) and a comprehensive curriculum for Intensive Care Unit nurses are provided (Attached).

Depending upon several factors, our experience tells us it takes a minimum of 5 years to development an entirely new pediatric cardiac program. Those factors include, but are not limited to: presence of local personnel, infrastructure, turnover of personnel, support from the Government and Hospital Administration, training visits we conduct per year and available funding. Our experience shows a minimum of 3-4 training visits per year spaced every 3-4 months is necessary to ensure effective training.

### **Gift of Life International Medical Teams and Empowerment**

Our volunteers undergo very strict and thorough screening. They come from some of the best and most respected units in the world. Many have extensive experience working in teaching hospitals; therefore, teaching is second nature to them.

We believe it is essential to pair on corresponding shifts a visiting team member with his/her local counterpart. Our main skills transfer and educational efforts take place during patient screening, surgeries, cath procedures and post-operative care. Every department (anesthesia, perfusion, surgery, cardiology, ICU staff) will benefit from this approach.

Our first couple visits will allow us to make a more precise diagnosis of the strengths and areas in need of improvement relevant to the local team. We will then be positioned to customize our training approach for future visits.

Lectures will be developed prior to the commencement of or during the visit so to maximize the learning experience for the local team. The clinical workload is balanced to avoid too much pressure being put on the local team. We feel this helps create the best possible learning environment.

### **GENERAL OBJECTIVES BY SPECIALTY**

**Cardiology:** The visiting cardiologist will partner with the local cardiology team to review and confirm the diagnosis and anatomical details of each case before the patient is accepted for treatment. This includes the clinical examination and echo findings. We encourage the local senior cardiologists to incorporate junior trainees during our training visit. They benefit enormously from this exchange of knowledge and echo skills. The visiting cardiologist and the local cardiologists will also review other cases of interest for the local team, even if this patient is not included for treatment during the current visit. Follow-up for patients operated on during previous visits is part of the teaching process since it allows us to identify any medical issues or residual lesions that may need to be addressed. Additionally, this information is vital for Gift of Life International since we keep records of every patient operated on during our training visits. Many of the programs we are assisting do not perform procedures (surgeries and cath) regularly; therefore, certain routines and practices have yet to be implemented. Our cardiologist and the entire visiting team will explain the benefit to developing a culture of care. They will encourage the local team to adopt them from the beginning of the program. Some of these routines include ICU rounds, transesophageal echocardiograms in the operating room, follow-up and medication adjustment, follow-up schedule after discharge based upon the patient's diagnosis, and development of a patient database. In the cath

lab, the skills to perform diagnostic and interventional catheterization will be addressed. Clinical indications and best practices will be reviewed, with emphasis on interventional skills and troubleshooting.

**Pediatric Cardiac Surgeon:** With the experience and skills of the local surgeon used as a gauge, the visiting surgeon will be the principal surgeon or the first assistant in every case. The teaching will not be limited to the operating room. The screening process for patient selection, the discussion of surgical alternatives and risk versus benefits of any given surgical procedure, the post-operative management in conjunction with the ICU team are as important as the surgical skills transfer in the operating room. Most of our programs have some degree of cardiac surgical competence. Usually, it is adult experience that serves as a baseline to develop pediatric skills. How long it will take for a surgeon to develop competency in pediatrics, varies significantly. It depends, among other factors, on the frequency we visit each site, local surgeon's interest and skills, previous cardiac surgical experience, and the possibility for the local surgeon to dedicate full time to pediatric cardiac surgery. We will encourage and foster any initiative that involves a visiting or fellowship position overseas for the local surgeon, and for any other local team member. Consulting with our global cardiac network, we can facilitate this experience in the United States and other countries. Gift of Life International will facilitate this initiative, but it will not be responsible for the financing nor provision of funds to the applicants. Based upon the surgeon's skill and ability and without jeopardizing the patient's health, we will ensure he or she has the maximum exposure in the operating room to perform cases as the principal surgeon. This process will be accomplished gradually, and will be based on STAT Categories.

**Scrub Nurse/Technician:** Anticipation is the key skill set for a scrub nurse/tech. Accordingly, a basic understanding of the anatomical defects is needed. The visiting scrub nurse/tech will systematically review this subject with brief lectures based on the patient scheduled for surgery. This will allow the local scrub nurse/tech to understand the surgery and be ready with the right supplies, instruments, and sutures. Concepts of sterilization and sterility will also be reviewed in detail. Empowerment through education of the nurses and techs is fundamental for sound and fruitful teamwork in the operating room. A proper operating room table set up and a review of the content for a complete pediatric cardiac set of instruments will also be addressed during the training visit. A one-to-one working relationship between the local and the visiting scrub nurse/tech is fundamental for a smoothly run in the operating room.

**Anesthesia:** The main topics to address are physiology, pharmacology, and physiopathology of congenital heart diseases. These themes are most important for any anesthesiologist willing to work in pediatric cardiac surgery. Anesthesia will also participate during the patient selection process to have all the relevant information regarding the cases chosen for treatment. Ideally, no more than two local anesthesiologists should be working with the Gift of Life International anesthesiologist. This will optimize teaching and allow a proper assessment of the local team, who will ultimately be responsible for the care of these children once the local program becomes independent. As in all the specialties, consistency in the personnel assigned to anesthesia is paramount. Other topics, like basic anatomy, will also be reviewed. A comprehensive assessment and hands-on approach in central venous line insertion, arterial line insertion, and intubation will be performed. These are vital skills for any cardiac anesthesiologist. Specific topics of particular interest for the local team will be planned a trip in advance and must be proposed by the local team of anesthesiologist

**Perfusionist:** A clinical perfusionist is an individual qualified by professional credentialing and academic and clinical education to provide extracorporeal patient care services (American Society of Extracorporeal Technology). This definition that seems so clear is confusing and not fully comprehended in many developing countries. In some places, the person who is dedicated to working as a clinical perfusionist is a nurse with some experience in cardiac surgery or a physician. An initial assessment by the visiting perfusionist is paramount to plan how we will proceed with the training. Cardiac physiology, medications used during cardiopulmonary bypass (CPB), cardiac arrest, circulatory arrest, antegrade cerebral perfusion, and basic concepts of mechanical support will be reviewed in

detail during the training visits. We teach how to understand the CPB process, not only the technical aspect of the process. The visiting perfusionist will facilitate the creation of a checklist and a CPB registry sheet based on documents or formats already available in the hospital. A full assessment of the heart-lung machine's security features, how to use them, what do they mean, and the relevance in patient safety will be set up as the standard of care during any case undergoing CPB.

**Pediatric Cardiac Intensivist:** Most of the sites we assist may not have a cardiac intensivist or an Intensive Care Unit dedicated exclusively to cardiac patients. This is common since most of the places we visit do not perform a large number of pediatric cardiac cases that would justify having an intensive care unit only for cardiac patients. On the other hand, the resource pediatric intensivist is scarce, especially in developing nations. Therefore, a comprehensive assessment of the local intensivist/pediatrician working in the local ICU will be performed during the initial site visit. This information will help us to customize the teaching material and methodology to be used. Cardiac physiology, monitoring, mechanical ventilation, and cardiac medications are the main topics that will be addressed and taught during each training visit. Another aspect we emphasize during our stay is the concept of teamwork. We believe this is especially critical in the ICU environment where physicians and nurses must work as a cohesive team. The plan for each patient will be delineated during the morning round. Any change in the management will be discussed between the visiting and the local team. The local intensivist/pediatrician will participate in: the patient selection conference, the discussion of different treatment alternatives, the risks and benefits, and the pre and post-operative management of critically ill patients. How long it will take for a pediatric intensivist to develop some degree of competency in pediatric cardiac intensive care will vary. It depends on the variables already discussed in this document. We will encourage and foster any initiative of the local pediatric intensivist team to receive training overseas. We can facilitate this experience by consulting with our vast cardiac network around the world, but Gift of Life International does not directly finance associated costs. We will make sure that the local intensivist/pediatrician, based on his or her abilities and without jeopardizing patient safety, has the maximum autonomy to be the managing physician. This process will be accomplished gradually, and it will also be based on the patient's status.

**Intensive Care Unit Nurses:** This is the most heterogeneous group within any program. Different levels of training and baseline knowledge make it challenging to have a standardized approach to teach a large group of ICU nurses. To assess these differences and work in a consistent way to level the group, we have developed a comprehensive curriculum, including tests and constant evaluations. We deliver this curriculum in 12 months, assuming we plan four trips a year. This continuing education in pediatric cardiovascular nursing is detailed below.

## Continuing Education in Pediatric Cardiovascular Nursing

### Program Objectives

- ◆ Support and develop advanced nursing skills for the pediatric population with congenital heart defects.
- ◆ Foster a collaborative practice model, considering the inter-professional team systems of care.
- ◆ Contribute to the development of knowledge.
- ◆ Support clinical reasoning including comprehensive assessment, holistic analysis and interpretation of client data, and competence and confidence in clinical decision-making

### Learner Outcome

Each learner outcome is specifically designed to move the participants toward an overall increased knowledge of pediatric pathophysiology as it relates to the cardiovascular system.

- ◆ Demonstrate knowledge of pediatric congenital heart defects (CHDs)
- ◆ Adopt, apply and demonstrate safe medication administration using the 6 rights of medication administration.
- ◆ Demonstrate critical thinking by safely prioritizing and implement independent nursing interventions.
- ◆ Understand the different uses of invasive and non-invasive diagnostic procedures. Examine benefits and limitations.
- ◆ Examine and understand medical and surgical interventions commonly used in pediatric patients with a cardiovascular history.
- ◆ Identify main nursing consideration in both pre-operative and post-operative cardiac care.
- ◆ Increase knowledge of the most commonly used medication in children with congenital heart defects.

### Educational Strategies

There are a number of learning strategies that are used to improve participant's learning / knowledge. Without fully evaluating participant's learning styles, Gift of Life International will leverage knowledge from previous education programs and structure the learning program with the following strategies:

- Lecture-led and context based / problem solving clinical analysis.
  - Normal anatomy and physiology of the heart
  - Fetal and maternal circulation
  - Congenital Heart Disease, let's talk about it
    - acyanotic congenital heart disease
    - cyanotic congenital heart disease
    - obstructive heart disease
    - palliative corrective surgery versus surgery
  - Medication safety and administration
  - Pediatric assessment
  - Safety tour around the bedside
  - Nursing care in patients with congenital heart disease
  - Chest tubes
  - Nursing care in patients undergoing cardiac catheterization
  - Associated Infection Prevention in Health Care (IAAS) and CHD

- Pediatric emergency cardiovascular nursing care
  - Basic CPR and advanced
  - Nursing care in patients undergoing mechanical ventilation and ventilator associated pneumonia
  - Pressure lines and what they tell us
  - ABG / VBG interpretation
  - Oxygen therapy
  - Care of the newborn
  - Nursing care cardiovascular pharmacology and fluid
  - Peritoneal dialysis
- Direct and personalized assistance:
    - Direct patient care
    - Patient receiving operated post-cardiovascular surgery
    - Patient receiving post-cardiac catheterization
    - Care in hospitalized patients in the PICU
    - Prevention of hospital infections
- Case study problem-based learning tutorials:
    - Select patients from ICU will have their case, including progress in ICU and any complications, discussed in a group setting
    - Allow exploration of patient care and why we do things the way we do
    - Allow discovery of gaps in knowledge for further learning & relate to surgery/defect
- Webinars: The benefits of a Webinar are the ability to educate in the absence of GOLI's planned visits. It will allow for continued learning of theory, prepare for future training visits and will involve guest speakers.
- Individual and Small Group Projects:
    - Pharmacology
    - Cardiac Defects

### **Program Duration**

Twelve months – The months preceding the training visit will be used to establish educational needs, develop educational materials and prepare for program delivery. The time frame is expected to be long enough to build the foundational knowledge necessary for Registered Nurses to fully receive patients into care and independently care for children in the pediatric intensive care unit (PICU). Additionally, we strive to have a dedicated group of nurses assigned to the program to help ensure continuity of training.

### **Education Program Evaluation**

Success will be evaluated via the following methods:

#### **1. Theory Evaluation**

- Pre 'test'.

Rationale: In order to build on the participants knowledge, it is important to assess current theory.

Assessment: Participant's knowledge will be assessed based on accurate responses to a set of close-ended and open-ended questions.

- Post 'test'

Rationale: In order to build upon foundational concepts during the proposed dates participants are expected to demonstrate proficiency in these foundational concepts and their application.

Assessment: Participant's knowledge will be assessed based on accurate responses to a set of close-ended and open-ended questions.

Participants will have an opportunity to provide feedback

2. Practical Evaluation

- Receiving patient from the operating room (nurse ONE – Appendix A)
- Assisting with the receipt of a patient (nurse TWO – Appendix B)
- Providing advanced nursing care to PICU patients post- cardiac surgery
- Demonstrate nursing handover (Appendix C)
- Demonstrate check-list skills (Appendix D)
- Demonstrate safe practice
- Provide simulation exercises
- Preceptorship feedback

3. Participants are expected to maintain a portfolio that includes evidence of learning:

- Competency documents
- Clinical skills test CPR
- Case studies
- Log of lectures & problem-based tutorials attended

## Education Curriculum

### Syllabus

Class Topic	
Safety assessment	Bedside safety Medication safety Normal vital signs for children Normal lab results for children Physician availability Handover Transfer from ICU to Intermediate Unit
Pathophysiology and anatomy	Normal pediatric cardiovascular anatomy and pathophysiology Maternal and fetal circulation Components of cardiac output Normal conduction and ECG Cyanotic/acyanotic/obstructive heart disease
Nursing care in patients with CHD	See appendix D for patient assessment Preparing for a postop cardiac patient Post op care Overview an Fluid management Nutrition in the ICU Infection Control Chest Tube Management Pacemaker and basic concepts of pacing
Pulmonary care	See appendix D 'pulmonary assessment' Mechanical ventilation basics Care of ventilated child Non-Invasive Oxygen Therapy ABG Analysis Extubation & chest physiotherapy
Pharmacology	Commonly used medication Dosage Calculations Continuous Infusion Calculations Knowledge of delivery methods Medication action and reaction Emergency Drugs and Drug Sheet
Complications of cardiac post-operative	Low Cardiac Output Syndrome Electrolyte Instability Arrhythmias Bleeding Cardiac Tamponade Pulmonary hypertension Peritoneal dialysis
Neonatal Care	Thermoregulation Glucose control Nutrition
Emergency Resuscitation	Basic CPR PALS Defibrillator Crash trolley Emergency bedside chest opening



## Appendix A

Role of 'Nurse ONE' or receiving RN:

- A. Complete rapid assessment on arrival
  - Primary cardiorespiratory assessment
  - Observe and auscultate lung fields
  - Observe color
  - Check perfusion
  - Palpate upper and lower limb pulses, central and distal
  - Be conscious of vital signs, overall patient stability, and quantity of blood loss from chest tubes
- B. Receive handover from surgical team.
  - This is done in a time out fashion.
  - 'Nurse 2' will continue to complete transfer of patient (See Appendix B)
- C. Continue direct respiratory observation and continue pulse palpation until transfer of ECG, SaO<sub>2</sub> and pressures modules is transferred from transport monitor to PICU monitor.

The initial receipt of the patient typically takes 5-15 min depending on patient complexity.

## **Appendix B**

### Role of 'Nurse TWO'

The role of nurse two is to assist the receiving RN or 'Nurse ONE'.

- Attach and observe the monitor (ensure alarms set)
- Transfer all pressure and monitoring modules from transport monitor to PICU monitor
- Level and calibrate transducers.
- Attach suction to chest tube, mark amount in collection chamber. Monitor for active bleeding.
- Attach all electrical power to infusion pumps
- Complete ordered blood work
- Receive direction from 'nurse one'
- Listen to handover

The initial receipt of the patient typically takes 5-15 min depending on patient complexity.

## Appendix C

### Information Included in Nursing Handover

<p><u>Patient Information, Diagnosis, &amp; Status</u>          Name / Age / Weight / Allergies          Post Op Day # / Surgery / Diagnosis          Other Medical History          Bypass/Cross Clamp Time</p> <p><u>CARDIAC</u>          Auscultation (rate/range/rhythm)          Blood pressure/invasive (range)          CVP (range)          Temperature (max temp)          Pulses (good, weak, poor, where)          Perfusion (color, skin temp, cap refill)          Inotrope Infusions (name/dose/changes)          Chest tube (output for shift &amp; last 4hrs in mls total &amp; ml/kg/hr, &amp; description)          Pacing wires (quantity, location, status, pacer settings)          Blood products (type, amount)          Electrolyte replacements (frequency)          AM Labs</p> <p><u>RESPIRATORY</u>          Airway (NC, Mask, HFNC, ETT)          Ventilator Settings          Sats (range)          Blood Gas          Breath sounds          Nebulizations or meds          Cough          Suctioning (frequency, type)          Physiotherapy (frequency)          CXR</p>	<p><u>GU</u>          Urine Output (ml/kg/hr)          Total Fluid Balance          Diuretics (name, dose, frequency)          Foley/Diaper/Toilet</p> <p><u>GI</u>          Diet (PO frequency, type)          Nausea/ Vomiting (frequency, meds)          Stool (frequency, meds)</p> <p><u>NEURO</u>          Level of consciousness          Pain          Sedation          Infusions          PRNs (name, frequency)</p> <p><u>IV ACCESS &amp; MEDICATIONS</u>          IV access (locations)          Name / Dose / Frequency</p> <p><u>MUSCULOSKELETAL</u>          Moving in bed          Weakness          Out of bed/ walking</p> <p><u>SKIN</u>          Incision / wounds          Breakdown          Bath</p> <p><u>SOCIAL</u>          Family visits</p>
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**Appendix D**  
Pediatric Skills Checklist

- Safety assessment
- Bedside safety
- Medication safety
- Physician availability
- Handover

Patient assessment

Cardiovascular:

- Auscultation (rate, rhythm, volume)
- Blood pressure, invasive (arterial line)
- Heart sounds/murmurs
- Perfusion
- Chest tube
- Monitor output
- Maintenance & Safety
- Equipment & procedures
- Central venous pressure
- Crash cart
- 12 lead EKG machine
- Use of invasive monitoring
- Blood product administration
- Interpretation of lab results
- CBC/Diff
- Electrolyte imbalances
- Blood cultures
- Care of a child with:
  - Post cardiac surgery
  - Post interventional cardiac catheterization
  - Pacemaker (temporary / permanent)

Pulmonary:

- Breath sounds
- Rate and work of breathing
- Sputum (color/character)
- Interpretation of lab results
- Blood gases
- Equipment & procedures
- Airway management
- Assist with intubation
- Endotracheal tube suctioning
- In-line suction
- Open ET catheter suction
- Extubation
- Nasal airway/suctioning
- Oral airway/suctioning
- Chest physiotherapy
- Chest tube (assist with)
- Insertion
- Removal
- Set up
- Obtaining blood gasses
- ABG
- VBG
- O2 therapy
- Bag / mask  Nasal canula
- Nebulizer  Mask
- Blow by
- Ventilator
- CPAP  PS/PC
- PEEP  VS/VC
- Weaning off the ventilator

Patient assessment

Neurological:

- GCS
- LOC
- Analgesia
- Pain management
- Sedation
- Temperature
- Care of a child with:
  - Post interventional cardiac catheter
  - Pacemaker (temporary / permanent)

Gastrointestinal:

- Abdominal
- Auscultation
- Palpation
- Nutritional
- Genitourinary:
  - Assessment of fluid balance
  - Interpretation of lab results
  - Equipment & procedures
  - Collection of urine specimens
  - Peritoneal dialysis

Medication:

- Calculation of drugs delivered by continuous infusion
- Knowledge of delivery methods
- Dosage calculations
- Know emergency drug
- Medication action and reaction
- IV conscious medication
- Other:
  - Infection control
  - Allergic reactions
  - Discussing discharge
  - Skin Care