

# Defining pediatric inpatient cardiology care delivery models: A survey of pediatric cardiology programs in the USA and Canada

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## Abstract

**Background:** The treatment of children with cardiac disease is one of the most prevalent and costly pediatric inpatient conditions. The design of inpatient medical services for children admitted to and discharged from noncritical cardiology care units, however, is undefined. North American Pediatric Cardiology Programs were surveyed to define noncritical cardiac care unit models in current practice.

**Method:** An online survey that explored institutional and functional domains for noncritical cardiac care unit was crafted. All questions were multi-choice with comment boxes for further explanation. The survey was distributed by email four times over a 5-month period.

**Results:** Most programs ( $n = 45$ , 60%) exist in free-standing children's hospitals. Most programs cohort cardiac patients on noncritical cardiac care units that are restricted to cardiac patients in 39 (54%) programs or restricted to cardiac and other subspecialty patients in 23 (32%) programs. The most common frontline providers are categorical pediatric residents ( $n = 58$ , 81%) and nurse practitioners ( $n = 48$ , 67%). However, nurse practitioners are autonomous providers in only 21 (29%) programs. Only 33% of programs use a postoperative fast-track protocol. When transitioning care to referring physicians, most programs ( $n = 53$ , 72%) use facsimile to deliver pertinent patient information. Twenty-two programs (31%) use email to transition care, and eighteen (25%) programs use verbal communication.

**Conclusion:** Most programs exist in free-standing children's hospitals in which the noncritical cardiac care units are in some form restricted to cardiac patients. While nurse practitioners are used on most noncritical cardiac care units, they rarely function as autonomous providers. The majority of programs in this survey do not incorporate any postoperative fast-track protocols in their practice. Given the current era of focused handoffs within hospital systems, relatively few programs utilize verbal handoffs to the referring pediatric cardiologist/pediatrician.

## KEYWORDS

inpatient cardiology, pediatric cardiology

## 1 | INTRODUCTION

The American Academy of Pediatrics (AAP) Guidelines for Pediatric Cardiology Diagnostic and Treatment Centers noted *young patients with heart disease have unique medical problems that can best be met by a team with training and expertise in the management of such patients*.<sup>1</sup> In the current era, most children with congenital heart disease survive to adulthood.<sup>2</sup> These patients account for 300 000 annual hospital admissions in the United States.<sup>3</sup> In the United States and Canada,

there are approximately 123 identified pediatric cardiology programs that provide care to these patients.<sup>4-6</sup>

In the past three decades, there was a surge in the number of cardiac intensive care units (CICU) dedicated to pediatric patients with heart disease or more accurately, congenital heart patients.<sup>7,8</sup> Most CICUs now have dedicated multispecialty personnel, as this has become the standard of care. There is also an emergence of intensive care medical societies (e.g., Pediatric Cardiac Intensive Care Society, www.PCICS.org) that have created continued medical education efforts



FIGURE 1 Representation of responders in North America

and training guidelines specific to this unique patient cohort.<sup>9</sup> A recent report from a single center demonstrated favorable process-of-care outcomes with the implementations of a dedicated noncritical cardiac unit (a.k.a., step-down unit) for congenital heart disease patients.<sup>10</sup> The design of such in-hospital medical services for noncritical cardiology inpatients, however, is largely undefined.

## 2 | OBJECTIVE

We sought to poll North American Pediatric Cardiology Programs to better understand the various inpatient care models for noncritical cardiac care units that are in current practice.

## 3 | METHODS

There were 123 self-identified Pediatric Cardiology Programs in the United States and Canada as listed in Congenital Cardiology Today (2014) Congenital Cardiac Care Providers in North America at Hospitals That Offer Open Heart Surgery for Children ([www.CongenitalCardiologyToday.com](http://www.CongenitalCardiologyToday.com)).<sup>4</sup> A 25-question survey was created and distributed to these programs. All questions were multi-choice with comment boxes for further explanation. The survey was distributed electronically via SurveyMonkey to identified cardiology chiefs. The survey was distributed four times over a 5-month period. The protocol was approved by the institutional review board at Baylor College of Medicine (Houston, Texas). The responses were reviewed in aggregate and are presented descriptively.

### 3.1 | Definitions

The noncritical cardiac care unit (NCCU) is the physical site where cardiology inpatients reside outside of the intensive care unit

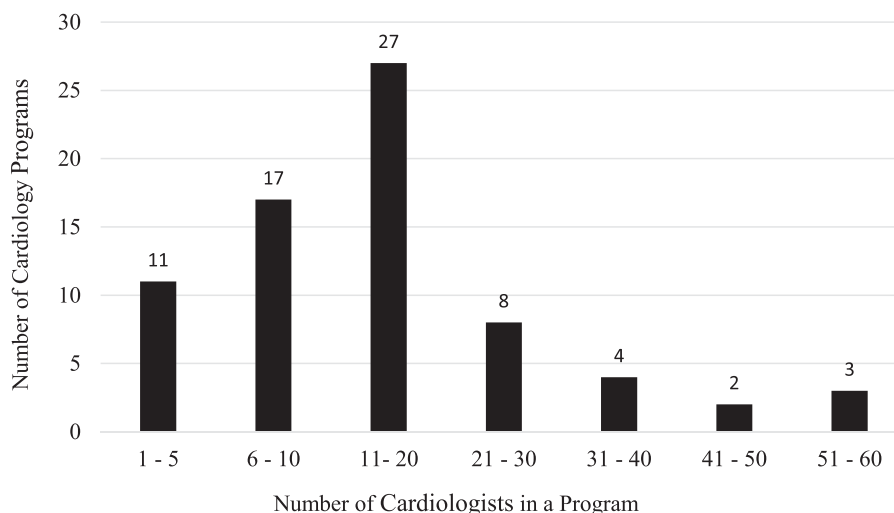
(e.g., pediatric intensive care, neonatal intensive care, cardiac intensive care). NCCUs are called other aliases such cardiac ward, cardiac floor, or cardiac step-down unit. We further subdivided NCCUs as either: Acute Care Unit—having a level of acuity requiring basic monitoring and pulse oximetry or Intermediate Care Unit—having a level of acuity requiring continuous cardiorespiratory/telemetry monitoring. A Universal Care Unit has a level of acuity that ranges from acute to intensive care as the patient stays in one room during the hospitalization. The NCCU care team consists of the Attending Physician and Frontline Providers (FLP)—categorical pediatric residents, nurse practitioners (NP), and physician assistants (PA).

This survey focused on defining: (1) institutional domains: pediatric hospital—freestanding (FS) or within an adult hospital ± medical school affiliation, (2) manpower metrics—number of cardiologists in a program, role of the cardiologist, and FLPs, (3) NCCU descriptors—capacity, patient acuity profile, and (4) elements in care delivery—integration of surrogates of efficiency. We used questions in the form of clinical scenarios to define: (1) the role of the cardiologist (primary or consultant) in the management of a cardiology patient on the NCCU, (2) the patient acuity profile on the NCCU, and (3) the practices used in transitioning of care from the inpatient physicians to the outpatient pediatrician/cardiologist.

## 4 | RESULTS

The survey was distributed to 123 programs of which 75 (61%) were returned and analyzed. Of the 75 survey received, 72 were complete and 3 partially complete. The respondents ( $n = 72$ ) represented 35 states within the United States and 3 provinces in Canada ( $n = 3$ ) (Figure 1).

TABLE 1 Cardiology program size (n = 72)



### 4.1 | Institutional setting

Most programs (60%) exist in either a FS hospital with a medical school affiliation (n = 40) or a FS hospital without a medical school affiliation (n = 5). Other programs exist in adult hospitals with a medical school affiliation (n = 23) or without a medical school affiliation (n = 7).

The number of pediatric cardiologists in a program varied: 1-5 (n = 11), 6-10 (n = 17), 11-20 (n = 27), 21-30 (n = 8), 31-40 (n = 4), 41-50 (n = 2), and 51-60 (n = 3) (Table 1). An electronic medical record (EMR) system is used in all hospitals, the majority (72%) using EPIC™ (n = 34) and Cerner (n = 20) (Table 2).

### 4.2 | Programmatic definition of the NCCU

Most programs cohort noncritical cardiac patients on their NCCU. In 39 (54%) programs, the NCCU is restricted to cardiac patients. In 23 (32%) programs, the NCCU is restricted to cardiac patients and other subspecialty patients. In 10 (14%) programs, cardiac patients are admitted to either a general or an age-restricted inpatient floor.

A scenario was presented to define the level of patient acuity on the NCCU. *A 5-month-old boy is immediately postoperative from repair of complete atrioventricular canal defect. He is ready for transfer from the ICU. To which unit will he transfer?* He would transfer to an: Acute Care (n = 12, 16%), Intermediate Care (n = 22, 33%), or an Acute Care/Intermediate Care (n = 15, 21%). The patient will remain in their Universal Unit in 16 (22%) of hospitals. At six programs, the patient will be discharged home from the CICU and not be transferred to their NCCU.

### 4.3 | NCCU care providers

#### 4.3.1 | Attending cardiology coverage

In 46 programs (64%), a select group of cardiologists attends the NCCU service. All cardiologists attend the NCCU in 26 programs. There is a designated NCCU medical director in 53 (74%) of programs:

cardiology chief (n = 16), another cardiologist (n = 35), CICU Attending (n = 1), or a pediatric hospitalist (n = 1). Nineteen programs (26%) do not have a designated medical director.

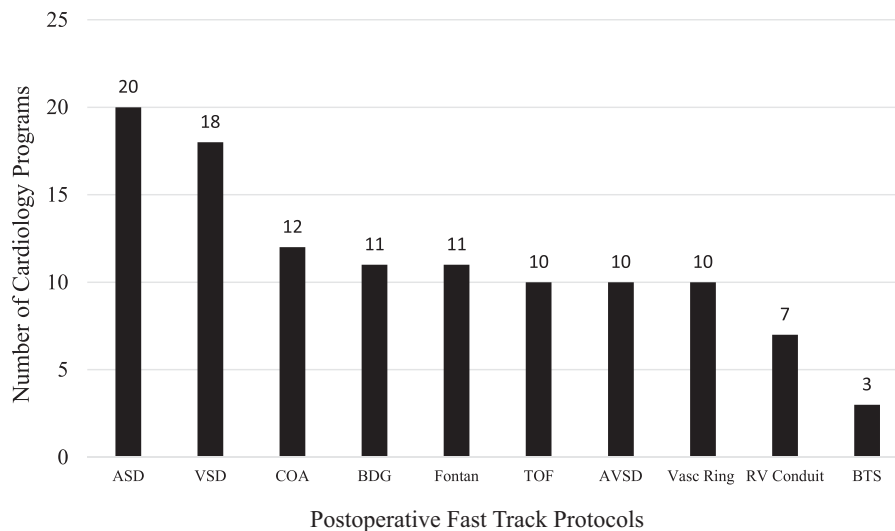
A scenario was presented to define the role of the cardiologist (Primary or Consultant). *Scenario: A child is immediately postoperative from homograft from the right ventricle to the pulmonary arteries. The child is ready to be transferred from the ICU to the NCCU.* In 43 CPs (60%), the cardiologist is the primary attending, and the cardiac surgeon is the consultant. In 25 programs (35%), the cardiac surgeon is the primary attending, and the cardiologist is the consultant. In others a cardiac intensivist (n = 3) or general pediatrician (n = 1) is the primary attending.

#### 4.3.2 | Frontline providers (FLP)

In 58 (81%) programs, categorical pediatric residents are the most common FLP group on the NCCU. Other FLPs are NPs (n = 48, 67%), PAs (n = 21, 29%), and Hospitalists (n = 14, 19%). In 21 (29%) programs, the

TABLE 2 Electronic medical record systems (n = 75)

EPIC	34
Cerner	20
MediTech	6
Sunrise	6
Internal System	2
Help2	1
Centricity	1
iConnect	1
Sorian	1
EPIC/Cerner	1
Meditech/Centricity	1
Eclipse/Crown	1

TABLE 3 Use of postoperative fast track protocols ( $n = 112$ )

NPs are autonomous providers. Sixteen (76%) of those programs that use NPs as autonomous providers have 20 or fewer cardiologists. All FLPs participate in night-call responsibilities, but categorical pediatric residents provide night-call in 45 (63%) programs. The other FLPs that provide night-call coverage are: Hospitalists ( $n = 14$ ), NPs ( $n = 9$ ), and PAs ( $n = 6$ ).

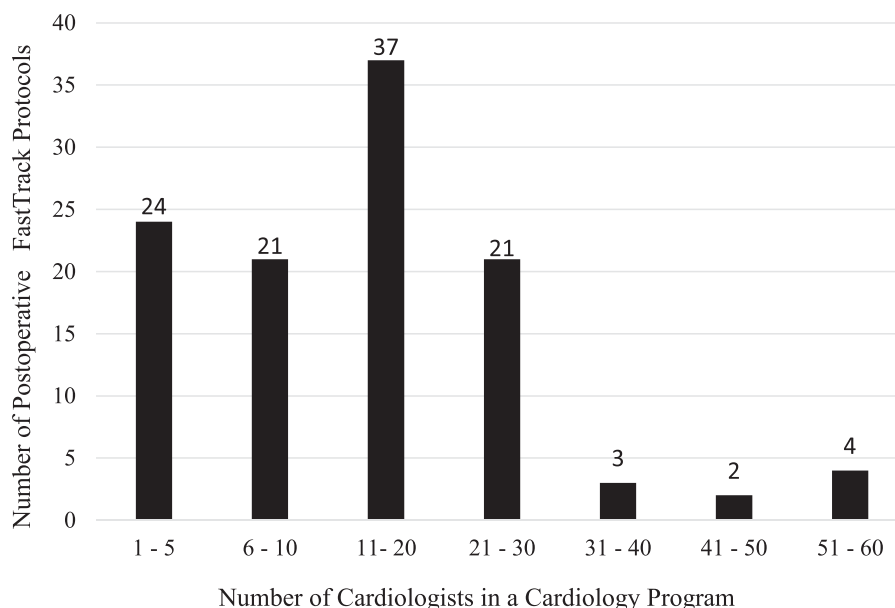
#### 4.4 | Resource utilization

Postoperative fast track protocols (PFTP) are care pathways aimed at reducing care variability and improving efficiency. Only 23 (32%) programs utilize one or more PFTPs. The most common PFTPs are used after ASD closure ( $n = 20$ ) and VSD closure ( $n = 18$ ) (Table 3). Only 2

programs use all PFTPs queried. The total number of PFTPs used by all programs was 112, of which 82 (73%) existed in programs with 20 or fewer cardiologists (Table 4). Forty-five programs (63%) utilize a postoperative feeding protocol. Twenty-five programs use feeding protocols for all neonates who had cardiac surgery, and twenty programs use feeding protocols only for neonates who had complex cardiac surgery.

#### 4.5 | Hospital discharge transition of care

A scenario was used to define the mode(s) of communication used to transition care to the referring cardiologist/pediatrician. *An infant with*

TABLE 4 Cardiology program size—use of postoperative fast track protocols ( $n = 112$ )

TGA/IVS is immediately postoperative arterial switch operation. She has progressed well and is ready for discharge. How would you transition her care to the referring cardiologist/pediatrician who live 3 hours from your hospital? The respondents selected the following mode(s): facsimile ( $n = 53$ , 72%), electronic mail ( $n = 22$ , 31%), and regular mail ( $n = 7$ , 10%). Eighteen programs (25%) use verbal handoffs to transition care to referring cardiologist/pediatrician.

## 5 | DISCUSSION

This survey is the first to describe the heterogeneity in North American NCCUs. Our survey reveals that most North American cardiology programs have developed, in some capacity, a dedicated NCCU. And most reporting programs (60%) exist in a FS children's hospital. There is however, wide variation in the hospital setting, and design of both the physical space housing the inpatients and medical management of these specialized patients, including the roles of FLPs and attending cardiologists. The survey was comprehensive in scope, and its information robust.

The treatment of cardiac disease is one of the most prevalent and costly pediatric inpatient conditions in the United States.<sup>11</sup> From 1997 to 2006, there was an increase in resource utilization in all pediatric complex chronic conditions, most notably for children with cardiac disease.<sup>12</sup> As such, it is imperative that care for the cardiac patient in the ICU and NCCU be efficient, safe, and cost effective.

Most programs in this survey cohort cardiac patients on an NCCU that is restricted to cardiac patients or cardiac and other subspecialty patients. This finding affirms the primary objective in the 1991 AAP guidelines—*Young patients with heart disease have unique medical problems that can best be met by a team (physicians and nurses) with training and expertise.*<sup>1</sup> A recent report noted lower rates of rapid response/code blue events when pediatric cardiac patients are admitted to an NCCU restricted to cardiology patients.<sup>10</sup> Similarly, the creation of dedicated pediatric cancer treatment centers lead to improved survival rates in children and adolescents with malignancies.<sup>13,14</sup>

In the current era, delivering care that is safe and efficient is very important. Incorporating PFTPs into care management seems an ideal strategy to address those challenges. Given the current era of cost savings, only 23% of programs in this survey utilize PFTPs. As early as 1984, Davis et al. noted decreased ICU and hospital lengths of stay after creating a postoperative protocol for children who had closure of atrial septal defects.<sup>15</sup> Subsequently, early extubation protocols after cardiac surgery in infants and children were deemed safe while decreasing ICU and lengths of stay and hospital costs.<sup>16–18</sup> Most recently, Lawrence et al used a PFTP in children who had surgical closure of atrial septal defects and ventricular septal defects and noted decreased length of stay compared with patients of the same age and cardiac diagnoses in the Pediatric Health Information System. As important, hospital costs also decreased.<sup>19</sup>

Neonates have feeding difficulties are cardiac surgery.<sup>20</sup> In this survey, postoperative feeding protocols for neonates and infants are used more frequently than PFTPs. These protocols are safe decrease

time to achieving goal caloric intake.<sup>21</sup> Targeted postoperative feeding protocols have been used to decrease the incidence of necrotizing enterocolitis in infants who had variations of the Norwood operation.<sup>21–23</sup>

In 2008, The Joint Commission, while acknowledging ineffective communication as a source of significant morbidity and mortality, added the implementation of a standardized approach to in-hospital “handoff” communications to its list of National Patient Safety Goals.<sup>24</sup> The transition of care from the inpatient care team to outpatient physicians is as important.

Based on this survey, we have identified the following opportunities to improve the continuum of care for pediatric cardiac care in the United States and Canada. Given the current era of focused handoffs within a hospital system, few programs (25%) utilize verbal handoff of a patient to the referring pediatric cardiologist/pediatrician. Most programs rely on written discharge summaries. Direct communication between hospital-based adult discharge physicians and primary care physician (PCP) occurs infrequently.<sup>25</sup> These deficits in communication at hospital discharge may adversely impact patient care.<sup>25</sup> Electronic medical record based solutions can lead to successful communication between the hospitalist and PCP.<sup>26</sup> Some healthcare organizations are using PCP portals—secure website that gives access to the health information record of mutual patients.<sup>27–29</sup> The referring providers and staff have real-time secure access to the patient's medical information, including clinic letters, discharge summaries, and test results.

The most common NCCU provider groups are categorical pediatric residents and NPs. The role of the NP has evolved over time on acute care and intensive care setting. While most programs in the survey utilize NPs on the NCCU, far fewer programs use them as autonomous providers. A survey of NPs who functioned as autonomous providers valued the challenge, and they noted autonomy to be a factor most predictive of their satisfaction.<sup>30,31</sup>

An initial challenge in completing this survey was identifying the cardiology programs that perform pediatric cardiac operations in the United States and Canada and more importantly the name and email address of the most appropriate representative to receive and complete the survey. There is no standard nomenclature system to describe the NCCU care capabilities or monitoring. The authors chose to use one system uniformly throughout the survey.

The responding programs in this survey are self-identified pediatric programs in North America. We did not attempt to narrowly define the term “free-standing” children's hospital be it physically, administratively, financially, or be it academically independent. The authors did not attempt to validate the reporting of the responders. The survey reflects a momentary state of a program. Its current state may not necessarily reflect their ultimate programmatic goal. We are indeed at the mercy of self-reporting.

The intent of this survey was to describe the different NCCU care models and not to define or present “the best” NCCU model. While the response rate for this survey met our expectations, we must acknowledge the breadth of information not garnered from programs that did not respond. Most importantly, our not having a program's



outcomes data to link to an NCCU model precludes any such speculation.

## 6 | CONCLUSION

The scope of this effort was to document the different care models used in the inpatient care of children with cardiac disease. Despite the inherent challenges in doing so, we hope this will be a stimulus for having meaningful and robust discussion to identify a uniform nomenclature to define the critical elements needed for inpatient cardiology care models. The expectation for the ideal care model is one that is efficient and safe as it documents the surrogate measures of quality and safety, such as timely discharge, acute resuscitative events, unplanned readmissions from home, readmissions to the ICU, and hospital acquired conditions.

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## CONFLICT OF INTEREST

None.

## AUTHOR CONTRIBUTIONS

Dr. Mott was involved with initially conceptualizing and designing the study and the survey tool. He drafted the initial manuscript and was responsible finalizing the revised drafts of the manuscripts. He approved the final manuscript as submitted.

Dr. Neish reviewed and revised the multiple drafts of this manuscript. He was also involved in the initial stages with conceptualizing the survey tool. He approved the final manuscript as submitted.

Ms. Challman helped with creating and designing the survey tool. She was the liaison to our institutional review board. She was solely responsible for querying the online database when there were requests or questions. She was very involved with editing the multiple drafts, and she approved the final manuscript as submitted.

Dr. Feltes was involved with the initial efforts at conceptualizing the survey and initial efforts at designing the survey tool. He was active in the revision of the multiple drafts of this manuscript. He approved the final manuscript as submitted. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of this work.

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