Resource Allocation and Decision Making for Pediatric and Congenital Cardiac Catheterization During the Novel Coronavirus SARS-CoV-2 (COVID-19) Pandemic: A U.S. Multi-Institutional Perspective

Brian H. Morray, MD[1]; Brent M. Gordon, MD[2]; Matthew A. Crystal, MD[3]; Bryan H. Goldstein, MD[4]; Athar M. Qureshi, MD[5]; Alejandro J. Torres, MD[3]; Shilpi M. Epstein, MD[6]; Ivory Crittendon, MD[7]; Frank F. Ing, MD[8]; Shyam K. Sathanandam, MD[9]

ABSTRACT: Background. The novel coronavirus (COVID-19) pandemic has placed severe stress on healthcare systems around the world. There is limited information on current practices in pediatric cardiac catheterization laboratories in the United States (US). **Objectives.** To describe current practice patterns and make recommendations regarding potential resource allocation for congenital cardiac catheterization during the COVID-19 pandemic. **Methods.** A web-based survey was distributed regarding case candidacy and catheterization laboratory preparedness. Centers were categorized based on the current degree of disease burden in that community (as of April 1, 2020). Data and consensus opinion were utilized to develop recommendations. **Results.** Respondents belonged to 56 unique US centers, with 27 (48.2%) located in counties with a high number of COVID-19 cases. All centers have canceled elective procedures. There was relative uniformity (>88% agreement) among centers as to which procedures were considered elective. To date, only three centers have performed a catheterization on a confirmed COVID-19 positive patient. Centers located in areas with a higher number of COVID-9 cases have been more involved in a simulation of donning and doffing personal protective equipment (PPE) than low-prevalence centers (46.7% vs 10.3%, respectively; *P*<.001). Currently, only a small fraction of operators has been reassigned to provide clinical services outside their scope of practice. **Conclusions.** At this stage in the COVID-19 pandemic, pediatric/congenital catheterization laboratories have dramatically reduced case volumes. This document serves to define current patterns and provides guidance and recommendations on the preservation and repurposing of resources to help pediatric cardiac programs develop strategies for patient care during this unprecedented crisis.

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The recent severe acute respiratory syndrome coronavirus 2 (SARS CoV-2) viral pandemic that originated in Wuhan, China in December 2019[1,2] has now spread to essentially every country in the world. Already, the coronavirus disease (COVID-19) pandemic has resulted in significant morbidity/mortality and at the same time has caused economic unrest, among other uncertainties. While COVID-19 predominantly involves the respiratory system, cardiac involvement in adults has been reported in many forms, including myocarditis, pericarditis, hypotension, low cardiac output, troponin leak, and arrhythmias — including fatal ventricular arrhythmias.[3,4] Recommendations for the management of COVID-19 positive patients in the cardiac catheterization laboratory (cath lab) have recently been published from members of the American College of Cardiology (ACC) and the Society for Cardiovascular Angiography and Interventions (SCAI) Emerging Leader Mentorship (ELM) program.[5,6] However, recommendations with regard to pediatric and adult congenital heart disease (ACHD) patients were not included in these documents.[7-10]

As of April 8, 2020, there are over 1.5 million confirmed COVID-19 positive cases worldwide, with over 395,000 confirmed cases in the United States. Hospital systems around the world have been overwhelmed by the volume of cases. To plan for a surge of patients, managing case priority, personnel, personal protective equipment (PPE), and critical medical supplies such as ventilators is crucial. To date, confirmed COVID-19 pediatric cases have occurred much less frequently and with less severity than the adult population. Adjustments to pediatric utilization of space and equipment are necessary to optimize the ability of the healthcare system to manage the influx of critically affected adults. We surveyed pediatric cardiac centers in order to: (1) better understand current practice patterns in pediatric and ACHD cardiac cath labs with respect to COVID-19; (2) assess institutional management and preparedness for COVID-19; and (3) investigate how centers are scaling back non-critical catheterization services to support the escalating demands on our local, national, and international systems. We further added commentary based on experiences from centers and regions impacted early and severely within the United States.

Table 1. Relative rates of procedures that have been delayed due to the COVID-19 pandemic.

Procedures	Centers Located in Counties With High Positive COVID-19 Rates (n = 27)	Centers Located in Counties With Low Positive COVID-19 Rates (n = 29)	*P*-Value
ASD device closure	100%	100%	NS
PDA device >6 months of age	96%	97%	NS
PDA device in premature infant	11%	4%	.03
Biopsy >6 months post transplant	89%	89%	NS
PVR for pulmonary insufficiency	100%	97%	NS
PVR for conduit stenosis	59%	52%	NS
Coarctation of the aorta stent	89%	72%	.05
Pre Glenn catheterization	85%	42%	<.01
Pre Fontan catheterization	100%	93%	NS
Post Fontan catheterization for symptoms	55%	55%	NS
PDA stent in neonate	3%	0%	NS
Arrhythmia ablation	100%	97%	NS
Pacemaker generator change	41%	35%	NS
AICD implantation	15%	10%	NS

Data presented as percentage of total cases.
ASD = atrial septal defect; PDA = patent ductus arteriosus; PVR = pulmonary valve replacement; AICD = automatic implantable cardioverter defibrillator.

Methods

A 21-question online survey (www.surveymonkey.com) was distributed by the pediatric cardiology members of the SCAI-ELM program to interventional pediatric cardiologists. The survey was distributed on March 30, 2020 and responses were collected through April 1, 2020. Data were analyzed on April 1, 2020. Demographic data, institutional practice patterns regarding case candidacy, changes to cath lab and staff preparedness, and perceived access to PPE were collected. Survey responses were individually reviewed for uniqueness based upon demographic data to ensure that no duplicate responses were included.

Statistical analysis. Multiple-choice responses and categorical data are presented as counts with percentages. Continuous data are presented as medians with ranges. To further evaluate practice-pattern variation between centers based on current disease burden (Johns Hopkins Coronavirus Resource Center), responses from those centers located in counties with more than 2000 COVID-19 positive cases were compared with those centers located in counties with less than 2000 confirmed cases (as of April 1, 2020). A Mann-Whitney U-test was used to compare responses between groups. *P*-values ≤.05 were considered statistically significant.

Results

The 21-question online survey was distributed to pediatric interventional cardiologists at 146 centers. The survey respondents originate from 85 centers (58% response), with 14 from outside the United States. Excluding duplicate responses, the study is made up of responses from 56 unique centers in the United States. Of the 56 centers, twenty-seven (48.2%) are located in counties with more than 2000 COVID-19 positive cases. The majority of responders are located in a free-standing children's hospital that share a campus with an adult medical center or hospital (48.2%), with the remaining located in a free-standing children's hospital independent of adult services (27%), or in a combined pediatric and adult cardiac cath lab (23.5%). The median number of total cardiac catheterization procedures (including electrophysiology) performed by the respondents is between 551-700 procedures/year (range, <100 to >700 procedures/year).

As of April 1, 2020, all 56 centers (100%) have canceled all elective procedures, with the majority of cancellations (62.5%) occurring prior to or in concert with recommendations on March 18th, 2020 from the Centers for Medicare & Medicaid Services (CMS) that all elective surgeries and procedures be delayed. There is relative uniformity (>90% agreement) among centers as to which procedures are considered elective and have been postponed for the current time (atrial septal defect closure; patent ductus arteriosus [PDA] closure in non-infants; pulmonary valve replacement [PVR] for insufficiency; pre-Fontan catheterization in a child; elective stent dilations; and radiofrequency ablation for re-entrant pathway currently medically controlled) as well as which procedures are considered urgent (>88% agreement) and have not been postponed (PDA stent in neonates; PDA device closure in premature infants; and implantable cardioverter defibrillator implantation).

There is less agreement among centers on whether to proceed with or postpone the following types of procedures: endomyocardial biopsy >6 months post heart transplant; pre-Glenn catheterization; coarctation stent implant in a teenager with hypertension; PVR for moderate to severe stenosis; symptomatic post-Fontan patient; and pacemaker generator change in a patient with <4 months of battery left. When centers are analyzed based on COVID-19 prevalence in their counties, those with greater prevalence of disease are more likely to delay the following types of procedures:

Table 2. Three important themes that have emerged for physicians performing congenital cardiac interventions during this pandemic.

Theme	Description	Outcomes
Medical resource preservation	Due to the limited availability of PPE in many United States hospitals, and the need to maintain critical medical equipment such as ventilators and hospital beds.	1. Utilization of a multidisciplinary committee to review all cases before scheduling.
		2. Postponement of elective procedures.
		3. Judicious utilization of PPE.
Minimizing exposure risk	To protect patients as well as the cath lab staff from exposure to COVID-19.	1. Establishing institutional flow algorithms for COVID+ and PUI patients brought to the cath lab.
		2. Increased testing for patients presenting to the cath lab.
		3. Simulation of donning and doffing PPE.
		4. Utilization of online meeting portals.
		5. Conversion of the lab to negative-pressure rooms with a prescribed number of air exchanges per hour as recommended by the CDC whenever possible, and terminal cleaning as necessary.
		6. Minimizing staff presence in the cath lab before and after airway manipulation.
		7. Pediatric interventional cardiologists working in rotations.
		8. Limiting the participation of trainees in cath lab procedures.
Resource reallocation and repurposing	As the pandemic worsens, resources including cath lab physicians and staff may be reassigned to perform other tasks within their field of expertise or even to provide clinical services outside their typical scope of practice.	1. Managing ACHD patients and other young adults in the children's hospital.
		2. Sharing of negative pressure labs, PPE, ventilators, and other equipment with disciplines such as interventional radiology and intensive care units.
		3. Appropriately utilizing the skills of pediatric interventional cardiologists, such as assisting the vascular access team in the hospital.
		4. Reassigning pediatric interventional cardiologists to provide clinical services in other areas, including adult intensive care units, to care for COVID-19 patients.

ACHD = adults with congenital heart disease; CDC = Centers for Disease Control and Prevention; PPE = personal protective equipment; PUI = person under investigation.

PDA device closure in premature infants (P=.03); pre-Glenn catheterization (P<.01); and coarctation stenting in a teenager with hypertension (P=.05) (Table 1).

Centers are relatively equivalent with regard to utilization of a multidisciplinary committee to review candidacy for potential upcoming cath lab cases (49% vs 58% at centers located in lower vs higher COVID-19 positive counties, respectively; P=NS). Most centers (65%) are only screening patients for COVID-19 prior to cardiac catheterization if they have symptoms consistent with a viral syndrome, with a minority screening all patients (15.7%) and some not testing at all (9.6%). The majority of responders (89.3%) feel that they have sufficient PPE to care for a COVID-19 positive or suspected positive patient (person under investigation [PUI], but only about one-third of centers (32.9%) have performed a simulation donning and doffing PPE. Centers located in counties with higher COVID-19 prevalence are more likely to have been involved in a simulation donning and doffing PPE than low-prevalence centers (46.7% vs 10.3%, respectively; P<.001). Few centers (10.8%) have converted one or more of their cath labs to a negative-pressure room for a potential COVID-19 positive patient or PUI, while the remainder are relying on standard air handling processes with terminal cleaning (28%), while 18.3% plan to convert to a negative-pressure room just prior to catheterization of a potential COVID-19 positive patient or PUI. A large number of centers (42.7%) have either not investigated, or are unable to convert to a negative-pressure room.

Active fellow participation in cardiac catheterization procedures during this time is divided between: all cases (23.8%); only emergent cases (15.5%); and no cases due to intentional exclusion (31%). Operator contact/exposure has been minimized in three-quarters of centers (76%) through changes to the work/call schedule, while less than one-half (47.6%) have altered their cath lab staff (nurse, technologist) work/call schedule. The majority of centers (48.5%) continue to pay cath lab staff as usual even if their hours are reduced, but over 50% of these centers believe that there

Table 3. Tier-level classification of common procedures performed on children and young adults with congenital heart disease based on the severity of the underlying condition.

Tier Level	Description	Examples of Lesions/Procedures
1A (urgent/emergent)	Any inpatient or patient transferred from another inpatient/outpatient setting, requiring an urgent cardiac catheterization procedure due to hemodynamic/impending hemodynamic compromise.	Pericardiocentesis; atrial septostomy for TGA; atrial septal decompression for HLHS; atrial septal decompression on ECMO; Impella (Abiomed) placement; thrombectomy for symptomatic PE with significant RV strain; coiling of AP collaterals/bronchial arteries due to hemoptysis.
1B (urgent/emergent)	Any inpatient awaiting a cardiac catheterization required prior to inpatient cardiac surgery OR in order to be discharged.	PDA/RVOT stenting for decreased pulmonary blood flow; balloon valvuloplasty of critical or severe AS/PS; perforation of PV for PA/IVS; PDA closure in premature infants; biopsy in OHT for acute rejection; surveillance after recent OHT.
2 (semi-elective)	Significantly symptomatic outpatients OR patients who are asymptomatic whose trajectories indicate that a delay in procedure (>30 days) could be detrimental.	Pulmonary vein stenosis and significant RV dysfunction; heart failure and a large PDA or muscular VSD/s; increasing aortic valve/pulmonary valve gradients that already meet the threshold for intervention; venous interventions to treat occlusions/stenoses to alleviate symptoms.
3 (elective)	Asymptomatic OR "mildly" symptomatic patients whose wait times would be longer than 1 month per routine.	Secundum ASD; PDA without significant heart failure; moderate pulmonary aortic valve stenosis; pulmonary valve dysfunction awaiting pulmonary valve replacement; presurgical catheterization (pre-Fontan catheterization); routine surveillance biopsy post OHT.

AP = aortopulmonary; AS = aortic stenosis; ASD = atrial septal defect; ECMO = extracorporeal membrane oxygenation; HLHS = hypoplastic left heart syndrome; OHT = orthotopic heart transplantation; PAIVS = pulmonary atresia with intact ventricular septum; PDA = patent ductus arteriosus; PE = pulmonary embolism; PS = pulmonary stenosis; PV = pulmonary valve; RV = right ventricle; RVOT = right ventricular outflow tract; TGA = transposition of the great arteries; VSD= ventricular septal defect.

will be reductions in staff pay forthcoming. Already, 14.5% of the centers are paying their staff a reduced wage (due to reductions in volume and hourly accrual). A small fraction of responders (10.8%) have been reassigned to provide clinical services outside their typical scope of practice, with reassignment discussed/planned in another 41.7%; physician reassignment has not been considered for the remainder (45.2%). To date, only three of the responding United States centers have performed a catheterization on a confirmed COVID-19 positive patient.

Discussion

Pediatric institutions around the United States are managing or preparing to manage patients with COVID-19. Thus far, the data suggest that the health impacts on pediatric patients are significantly reduced (<1%), relative to the adult and elderly population.[7-9] However, according to recent reports from China,[7] over 15% of children can be asymptomatic carriers of SARS CoV-2, and in some instances are significantly affected as well.[10-12] Patients with unrepaired or palliated congenital heart disease and those with residual lesions post repair constitute a high-risk group with known susceptibility to acute infectious viral illnesses. However, there is little published information on the impact of this disease on children or adults with congenital heart disease.[13] Given the extent of this pandemic, it is important for congenital cardiac programs to be prepared to face any number of unique patient-care scenarios that may arise during this period.

Several important themes emerged from this widely distributed survey: (1) the importance of techniques to preserve valuable medical resources, including PPE and ventilators; (2) minimization of potential COVID-19 exposure to hospital staff, patients, and families; and (3) resource reallocation and potential physician repurposing (Table 2).

Medical resource utilization and case selection. To date, there have been more than 320,000 reported cases of COVID-19 in the United States, and that number is rising daily. However, as of April 1, only 5% of responding pediatric centers have performed a catheterization in a COVID-19 positive (or suspected positive) patient. This inexperience with COVID-19 in the pediatric cath lab probably reflects a combination of low disease burden in children, a dramatic decrease in case volume following cancellation of elective procedures (including surgeries), and limited testing (particularly in asymptomatic children). In highly impacted endemic regions, such as New York City, practice patterns have shifted based on the assumption that all patients and/or family members are infected, even if asymptomatic. This strategy is necessary to protect medical staff and patients, but is impractical in regions with less burden of disease. Given the limited availability of PPE in many United States hospitals, and the need to maintain critical medical supplies such as PPE and ventilators, it is essential to postpone elective cases and perform only those that are deemed emergent or very urgent until the surge of patients begins to abate.

A number of factors drive case selection. From the survey data, there was general agreement about which cases should

and should not be performed during this time period. For a small number of case types, consensus was less clear, and appears to reflect COVID-19 disease burden in the region. Cardiac centers in a region with greater disease prevalence were more likely to delay urgent but not emergent case types. Some centers in endemic regions have been more likely to perform cases in patients in the intensive care unit (ICU) setting, in an effort to facilitate clinical progression and reduce ICU census (personal communication). There are no standardized guidelines for congenital cardiac case selection in the COVID-19 pandemic. We propose the following schema to facilitate case selection (Table 3). Patients may be grouped into tier levels as reflected by their disease state. Urgent/emergent procedures (tier 1A, tier 1B) must be performed in a timely fashion, while semi-elective procedures (tier 2) should be scheduled within 1-3 months and elective procedures (tier 3) may be postponed for >3 months. It is important to recognize that each patient is unique, and these categories are not a substitute for sound clinical judgment. Consensus decisions from a multidisciplinary clinical leadership team may be helpful in triaging case priority and timing. At present, only one-half of reporting United States programs employ a multidisciplinary committee to review case selection; experience from endemic regions suggests a benefit to this approach and we encourage more centers to engage this strategy. It is also important to recognize that both regional disease prevalence and pandemic duration will impact case selection and triage; for example, a tier 2 or tier 3 case can become a tier 1 case if untreated for a sustained period of time. Thus, development of a local system that facilitates continual, serial re-evaluation of patient candidacy is fundamental to maintaining best practices in a prolonged pandemic.

Given the ongoing need to manage critically ill newborns, it is important to develop and implement an action plan for emergent catheterization procedures performed on infants born to COVID-19 positive mothers. While vertical transmission has not been documented, there are reports of immunoglobulin M levels found in newborns born to COVID-19 positive mothers.[14-16] Therefore, it is prudent to assume that newborns will be exposed to the virus peripartum and should be treated as if infected until proven otherwise. Utilization of this strategy protects healthcare staff, but creates challenges to the parents, who will face postnatal restrictions in the ICU, in order to minimize COVID-19 spread. The American Academy of Pediatrics recently announced guidelines for COVID-19 positive mothers visiting the neonatal ICU, which further elucidates recommendations in this regard.[17]

Minimizing exposure risk. At the center level, preparedness for the COVID-19 pandemic is likely the product of multiple factors. The responses to this survey would suggest that many programs are not yet adequately prepared for a surge of COVID-19 positive patients. The availability of adequate PPE has been a widely discussed concern, particularly in heavily affected regions such as New York. As stated above, the decrease in elective case volume helps to conserve critical medical supplies. The majority of survey respondents indicated that they have adequate PPE available. However, a significant number of responding centers have not performed simulations to safely apply and remove PPE. In many centers, this apparent lack of preparedness may actually reflect a concerted effort to preserve PPE, rather than utilize scarce resources for simulation environments. Centers in high-prevalence regions were more likely to have performed these exercises, suggesting a just-in-time approach to training may be satisfactory, if not prioritized. Additionally, virtual simulation training with experienced observers on the frontlines has been instituted successfully in some hospitals as an alternative to utilizing PPE during simulations.

The availability of COVID-19 testing supplies is another "hot-button" issue, as many parts of the country have limited access to testing materials. Asymptomatic disease transmission is a valid concern in the pediatric community, yet only 15% of responding centers were screening asymptomatic patients prior to aerosol-generating procedures. This survey did not inquire about the decision-making process underlying the screening strategy. It seems likely that local disease prevalence, availability of testing supplies, and turnaround times are important factors in development and implementation of a screening strategy; such a strategy will likely change as regional disease prevalences change and testing kit availability and efficiency evolve.

Roughly 60% of respondents indicated that their cath lab had already made changes or was planning to make changes to air-handling procedures to accommodate COVID-19 positive or suspected patients. Airborne infection isolation rooms (AIIR) are negative-pressure rooms with a prescribed number of air exchanges per hour as recommended by the Centers for Disease Control and Prevention (CDC). Procedure rooms, cath labs, and operating rooms are typically maintained as positive-pressure rooms with a prescribed number of air exchanges per hour as recommended by CDC guidelines.[18] Care should be taken to consult with facilities management and infection prevention when preparing a procedural space to care for a COVID positive patient. The flow of air in a procedure room also has an impact on anesthesia practices when caring for a patient with COVID-19. The CDC and the American Society of Anesthesiologists (ASA) have produced guidelines to minimize risk to anesthesia providers and other staff.[19] Most respondents (60%) indicated that their centers are following some or all of those guidelines, while 30% noted that they had not yet encountered a case requiring them to follow those guidelines. In addition to appropriate PPE, many facilities have adopted the practice of minimizing staff presence in the cath lab before and after airway manipulation (5 to 30 minutes, depending upon several factors, including frequency of air exchange) to reduce exposure. A terminal clean of the room is typically then required.

The majority of those surveyed indicated that changes have already been made to physician and staff scheduling, in an effort to reduce exposure to patients and to each other. The survey did not inquire about the granular nature of those scheduling changes. Many institutions are splitting staff into two or more groups in an effort to preserve at least one unexposed group, in the event of an exposure to a group working in the hospital environment.[6,20] Notably, staff reassignment to other areas in the hospital may make it difficult to preserve unexposed staff. Many centers have already reduced the number of trainees or staff present during procedures to further limit exposure to positive or potentially infected patients. These types of practices are important to reduce the risk of exposure for the staff, but as the survey also demonstrates, this practice may create negative financial consequences for hourly paid staff members. Hospitals that are in a position to continue "normal" staff pay, despite reduced hours, may engender better morale and adherence to exposure-reducing practices in advance of the "all hands on deck" needs anticipated in most regions during COVID-19 surge conditions, as New York is encountering at the time of this publication.

Resource reallocation and potential repurposing. The epidemiology of this pandemic so far suggests that pediatric patients are not as severely impacted by this disease; thus, most pediatric institutions may not see the influx of infected patients that is occurring in adult centers around the country. Nevertheless, pediatric centers are preparing for an increase in volume of infected patients by decreasing the volume of elective cases and conserving medical supplies to the best of their ability. For subspecialists like pediatric interventional cardiologists, this raises the question of how best to utilize our clinical skills if the typical volume of patients with congenital heart is reduced (Table 2). Some institutions are choosing to limit the clinical exposure of these subspecialists, as there is a limited pool of physicians with that skill set, and depletion of that pool through illness could compromise the care of congenital heart disease patients.

Each pediatric institution will decide how best to serve the community. This may depend on geographic proximity and relationships with adult centers. Some may choose to extend the age limit of patients they will accept for admission or expand their services to accept pediatric patients from surrounding hospitals to free up those beds. In areas of high COVID-19 burden, such as New Orleans, ACHD patients may find themselves admitted to newly formed respiratory ICUs with fragmented care teams in order to limit exposure and PPE utilization. Whether or not this will have an effect on the outcomes of COVID positive adults with complex congenital heart disease, especially those with single ventricle physiology, is yet to be determined. Working with ACHD centers to move those patients to a pediatric cardiac center may help to preserve resources and open up space at adult centers, while allowing pediatric cardiologists to help manage a population of patients for which they are trained.

Where pediatric interventional cardiologists are deployed will likely depend on where resources are strained. Deployments to inpatient services, ICUs, or emergency departments are all possible. Utilizing additional skill sets, such as vascular access to aid vascular access teams, is another example of how pediatric interventional cardiologists can provide services outside of the cath lab.

Conclusions

In the current COVID-19 pandemic, pediatric institutions and congenital cardiac programs are being challenged to determine how best to help patients, families, and communities, given that the burden of symptomatic infection seems to be low in pediatric patients. A large wave of COVID-19 positive pediatric and congenital heart disease patients may or may not present. Thus, we are faced with a fundamental question: How can we, as pediatric and congenital interventional cardiologists, continue to care for patients who require intervention, while also being good stewards of limited medical resources and maintaining an appropriate level of preparedness when we are uncertain about how this pandemic will affect our discipline? The survey instrument and results detailed herein provide some insight, largely demonstrating that there is variability in the approach to these questions across pediatric and congenital cardiac centers throughout the United States. With these limitations in mind, the main considerations in the pediatric/congenital cardiac cath lab during the current COVID-19 pandemic should be:

(1) To ensure appropriate and safe delivery of care for any patient during the COVID-19 pandemic.
(2) To take appropriate measures to protect staff and take all necessary steps to mitigate the spread of the virus during the pandemic.
(3) To take appropriate precautions according to institutional/CDC guidelines when performing procedures on patients with confirmed COVID-19 infection or PUI.
(4) To determine which cases can be postponed according to institutional and state guidelines, and to consider employment of a multidisciplinary approach while doing so.
(5) To prepare for the possibility of having to care for non-cardiac pediatric patients with COVID-19 infections within a pediatric facility, should such a need arise.
(6) To prepare for the possibility of having to care for adults with COVID-19 infections, should adjacent or local adult hospitals reach full capacity.
(7) To utilize a dynamic approach to protocol development, with the need for serial updates based on evolving guidance from the CDC and other federal and state authorities.

(8) To maintain an open communication link between centers to share new experiences as the pandemic worsens.
(9) To develop institutional contingency plans if physicians and other healthcare workers contract the virus so that work-flow is minimized.

The needs of the congenital heart disease population and the available tools to support those needs are evolving constantly and will likely continue to do so as the COVID-19 pandemic progresses in the United States. Some areas of the country are heavily immersed in this crisis at the moment and can only do their best to react to a changing situation. For other areas of the country, there is an opportunity for preparation based on the lessons that centers both inside the United States and around the world have already learned. The goal of this document is to frame a discussion about how we can best prepare to care for patients with and without COVID-19 infection during this unprecedented crisis, with the understanding that the healthcare landscape is volatile at the moment and we must have the ability to quickly adapt to the needs of our population.

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From [1]the Division of Pediatric Cardiology, Seattle Children's Hospital, Seattle, Washington; [2]the Division of Pediatric Cardiology, Loma Linda University Children's Hospital, Loma Linda, California; [3]Columbia University Irving Medical Center – Morgan Stanley Children's Hospital of New York, New York, NY; [4]the Heart Institute, UPMC Children's Hospital of Pittsburgh, Department of Pediatrics, University of Pittsburgh School of Medicine, Pittsburgh Pennsylvania; [5]the Lillie Frank Abercrombie Section of Cardiology, Texas Children's Hospital, Department of Pediatrics, Baylor College of Medicine, Houston, Texas; [6]Cohen Children's Medical Center, Hofstra-Northwell, New Hyde Park, New York; [7]the Division of Pediatric Cardiology, Ochsner Children's Hospital, New Orleans, Louisiana; [8]the University of California Davis Children's Hospital, Sacramento, California; and [9]the University of Tennessee, Le Bonheur Children's Hospital, Memphis, Tennessee.

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Address for correspondence: Shyam K. Sathanandam, MD, Le Bonheur Children's Hospital, 848 Adams Avenue, Memphis, TN 38103. Email: shyam@uthsc.edu