

# Pediatric and congenital heart disease during the COVID-19 pandemic: the triple threat

Salem T Argaw,<sup>1</sup> Maryam S Babar,<sup>2</sup> Dominique Vervoort <sup>3</sup>

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The COVID-19 pandemic has left an unprecedented mark on the world. As of April 2021, over 100 million people have been confirmed with COVID-19, leading to nearly 3 million deaths—and counting.<sup>1</sup> Children have been found to present with less severe COVID-19 symptoms than adults, with less than 1 death in 500 pediatric cases.<sup>2</sup> However, despite early assumptions that children's role in transmission was minimal, data suggest novel SARS-CoV-2 variants are more infective among children and may be important drivers of community spread.<sup>3</sup> Based on recent developments, the pandemic poses a triple threat to the pediatric and congenital heart disease (PCHD) burden as a result of COVID-19 infection and the collateral damage of the pandemic. This, inevitably, will have major socioeconomic implications at the individual and population levels.

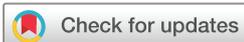
In the present article, we review the triple threat of the COVID-19 pandemic on the PCHD burden, concluding with opportunities to respond to the global burden of PCHD during and beyond the pandemic.

## DISEASE AND ECONOMIC BURDEN

The global burden of PCHD is substantial as more than seven million children live with cardiovascular disease.<sup>4</sup> Congenital heart defects (CHDs) are the most common major congenital anomaly, affecting one in every hundred live births; yet CHD has been largely neglected on the global public health agenda.<sup>5</sup> In upper middle-income and high-income countries, CHD has become a more obvious leading cause of under-5 mortality due to improvements in infectious disease care and other child health services.<sup>6</sup> In low-income and lower middle-income countries (LMICs), the prognosis for a child born with CHD is significantly worse compared with children born with CHD in high-income countries, and CHD will proceed to play an

increasing role in infant mortality as a result of the epidemiological transition away from communicable diseases.<sup>5</sup> Global disparities in access to care have been attributed to socioeconomic constraints. PCHD services are grouped under tertiary or even quaternary care in most LMICs and are only available at certain, centralized centers and/or are highly cost-prohibitive.<sup>7</sup>

In LMICs, more than 90% of children do not have access to the treatment they need or receive suboptimal treatment.<sup>5</sup> As a result, there are nearly 200 000 preventable child deaths from CHD every year.<sup>8</sup> Furthermore, over 30 million people live with rheumatic heart disease (RHD) worldwide, many of whom risk fatal complications without surgical care.<sup>7</sup> Every year, 300 000 children develop RHD while more than 10 000 children die from it due to the lack of available cardiac care.<sup>4</sup> Although CHD and RHD make up the largest portion of PCHD worldwide, children also can present with endomyocardial fibrosis, dilated or hypertrophic cardiomyopathy, endocarditis, myocarditis, pericarditis, or Kawasaki (-like) disease (KD). Failing to address gaps in access to care for children with heart disease impedes the potential of millions of children and substantially hinders improvements in countries' socioeconomic growth. These consequences are particularly important considering the vast burden of surgical PCHD. For example, up to 52% of the CHD burden could be addressed by surgical care<sup>9</sup>; yet most LMICs and many high-income countries lack sufficient access to pediatric cardiac surgical care. Some countries even lack any local care whatsoever.<sup>7</sup> As a result, governments spend millions to send patients abroad for surgical care. Investments into local CHD care could save millions each year, improve outcomes, promote patient care experiences, and strengthen local capacity.<sup>10</sup>



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<sup>1</sup>Feinberg School of Medicine, Northwestern University, Chicago, Illinois, USA

<sup>2</sup>Dubai Medical College, Dubai, UAE

<sup>3</sup>Department of Health Policy and Management, Johns Hopkins University Bloomberg School of Public Health, Baltimore, Maryland, USA

## Correspondence to

Dr Dominique Vervoort; vervoortdominique@hotmail.com

## ACCESS TO COMPREHENSIVE PEDIATRIC CARDIAC CARE

Several barriers exist in children's access to safe, timely, and affordable cardiovascular health services, both in high-income countries and in LMICs. In the USA, the high-cost burden associated with the diagnosis and treatment of PCHD weighs heaviest on families with insufficient health insurance.<sup>11 12</sup> Moreover, insurance restriction to in-network centers further complicates the ability of (especially lower income) Americans to access comprehensive PCHD services. In LMICs, acquired pediatric heart disease is especially associated with poverty, disproportionately affecting populations with the least access to cardiovascular care. In addition to the financial burden due to absence of widespread health insurance schemes and the pre-existing cardiology and cardiac surgery workforce and infrastructure shortages, many of the cardiologists in LMICs who treat children have not been sufficiently trained in PCHD.<sup>13</sup>

## IMPACT OF COVID-19 ON PCHD

The COVID-19 pandemic introduces three unique but underaddressed concerns for children with PCHD.

First, the pandemic halted many non-emergent and non-urgent surgical procedures while shifting outpatient care (eg, cardiovascular disease diagnosis and follow-up) to telemodalities. Although the decision to postpone surgery for CHD, for example, is easy for minor defects and not up for questioning in major defects, it is less concrete for those that fall in the middle, such as ventricular septal defects with early heart failure and shunt-dependent infants. Similarly, especially in LMICs where the RHD burden is highest, postoperative patients may have more difficulty obtaining periodic anticoagulation injections due to lockdowns, hospital measures, or fear of infection. Furthermore, the infection of one or even two staff surgeons may lead to a complete halt of a program due to the small number of pediatric cardiac surgeons per site. This is especially concerning in LMICs, where the pediatric cardiac surgical workforce is already scant and infection of surgeons may then lead to the complete loss of pediatric cardiac surgical services for an entire country or region.<sup>7</sup>

Second, it is clear that cardiovascular diseases are one of the most, if not the most, severe risk factors for a complicated COVID-19 disease course.<sup>14</sup> However, little is still known about the double burden of COVID-19 and CHD or RHD, both in adults and children. Initial reports hint that surgical treatment of children with PCHD can be complicated if COVID-19 positive, while the PCHD preoperative presentation may lead to more severe disease processes requiring palliation rather than salvation.<sup>15</sup> In addition, in LMICs large numbers of patients live with uncorrected or untreated CHD and RHD, for whom COVID-19 may become life-threatening.<sup>16</sup>

Third, there are reports of children suffering from more severe COVID-19 complications than previously thought due to the COVID-19-associated multisystem

inflammatory syndrome in children (MIS-C). While it is originally compared with KD, recent reports show that it presents with more prominent cardiac and gastrointestinal syndromes as well as with different laboratory parameters and demographical aggregation than KD.<sup>17 18</sup> Children presenting with MIS-C have demonstrated cardiac abnormalities by echocardiogram or laboratory parameters, including coronary artery aneurysms as seen in KD.<sup>18 19</sup> However, MIS-C is now more readily compared with the late-phase presentation of severe COVID-19 infection in adults characterized by a cytokine storm.<sup>17</sup> Although rare, some COVID-19-positive children and teenagers have been found to present with new-onset cardiac insults, myocardial injury, or dysfunction similar to those observed in adults with complicated COVID-19.<sup>20</sup> It remains crucial to reiterate that, overall, children remain only minimally affected by COVID-19, and that COVID-19 cardiovascular complications are rare in the overall pool of COVID-19-infected children. However, clinicians ought to maintain a high level of suspicion and to closely monitor children who present with severe COVID-19 symptoms.

## MOVING FORWARD

Time is of the essence to mitigate the impact of the pandemic on PCHD and to avoid exacerbation of longstanding disparities in global PCHD care. To do so, collective resilience and action are needed.

- ▶ Policymakers must respond to the economic impact of the pandemic on patients with PCHD and families. In countries without comprehensive health insurance, efforts are needed to improve access to and coverage of life-saving and life-changing PCHD health services. Here, the role of patient and family organizations in advocacy is critical, and policymakers must listen to the needs of their communities to ensure effective policies and health system interventions.
- ▶ Healthcare professionals must prepare to address the existing and likely growing backlog of PCHD cases, especially those with advanced disease. Similarly, continued research and monitoring of the impact of COVID-19 directly and the pandemic indirectly on patients with PCHD is vital to improve the planning and implementation of health programs targeting the PCHD community.
- ▶ Shared learning and information sharing on the impact of COVID-19 on children with PCHD as well as on navigating resource constraints will allow for effective collaboration and for efficient mitigation by cardiac centers around the world.<sup>21</sup> For example, low-cost, do-it-yourself innovations have enabled hospitals to manage personal protective equipment shortages during peaks of the pandemic.
- ▶ Investments in virtual platforms can ensure continuity of care and education despite the pandemic and can create opportunities to scale up in the long run in order to increase access to care and training.

These include, but are not limited to, telemedicine services (eg, tele-intensive care units), virtual education (eg, video lectures and virtual reality), and community health or at-home care (eg, remote vital sign monitoring).

The PCHD burden is likely exacerbated by the COVID-19 pandemic. Although children are minimally affected by COVID-19, the discontinuity of care and superinfection with COVID-19 in patients with pre-existing PCHD may increase the morbidity and mortality associated with PCHD. Further research is warranted to adequately investigate the relation between COVID-19 and PCHD. Additionally, hospitals, health workers, and policymakers should remain cautious of the growing gaps in access to PCHD care worldwide.

**Twitter** Maryam S Babar @msbsab99 and Dominique Vervoort @DVervoort94

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#### ORCID iD

Dominique Vervoort <http://orcid.org/0000-0002-3142-0388>

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