Peer Review File

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Reviewer A

The authors' have written a review entitled Fostering Sustainable Pediatric Cardiac Workforces Around the World in the Post Pandemic era. Since the paper focuses on the developing world, I would suggest editing the title to say, "in the developing world" instead of "around the world". You could also say Fostering a Sustainable Pediatric Cardiac Workforce…. This paper covers an important topic. Please consider the following suggestions: CHANGES DONE

Line 49-52 Communicable diseases still cause significant mortality in low- and mid-income countries (LMICs), but increasingly, the burden of non-communicable diseases (NCD) such as CHD and rheumatic heart disease, has increased creating great strain on fragile healthcare systems. CHANGES DONE

Line 53, say unprecedented COVID-19 pandemic…since this possibility has been discussed for many years. CHANGES DONE

Line 59, It might take …. pandemic (delete). At present, only 1% of developing world has been vaccinated against COVID-19 with the poorest countries not expected to receive vaccine until 2023. https://www.nature.com/articles/d41586-021-01762-w CHANGES DONE

Line 61, this intervening time provides a crucial opportunity to apply "frugal innovation" by training and equipping local teams and policy makers. CHANGES DONE

Line 62, we employed a Gap and SWOT analysis to identify the steps needed to work towards children's heart care in the developing world all while using lessons learned from the COVID-19 pandemic. Line 101, be consistent with usage of term COVID-19. At the beginning of paper, may want to say COVID-19 pandemic due to SARS-CoV-2. CHANGES DONE

Line 79, …72% of the overall mortality due to RHD. It is estimated that about 1.3 million children are born with CHD every year in the world (need ref primary data source) (1) CHANGES DONE

Line 80-81, …do not have access to cardiac surgery also need reference (1) CHANGES DONE

Line 84, Hence, mortality from congenital and acquired heart disease… CHANGES DONE

Line 101, COVID-19 pandemic… CHANGES DONE

Line 105, inadequate instead of diluted care… Is there a reference for this? CHANGES DONE

Line 110-112 Prior to the pandemic, a number of priorities …; I would list the specific targets from SDG 3.2 and 3.4 https://sdgs.un.org/goals/goal3 CHANGES DONE

Line 119 and 120, We can only imagine many of these children will be those with CHD. We have an estimate of this number -don't have to imagine. May want to cite estimate from GBD focusing on CHD. Next sentence, you mention DALY but no further mention in paper. You can list estimated DALYs due to CHD from GBD paper.
From GBD 2017: 261,247 (list confidence intervals) number of deaths due to CHD; 22,223,897 (18,066,811-26,578,182) list confidence intervals) DALYs due to CHD
CHANGES DONE
https://www.thelancet.com/journals/lanchi/article/PIIS2352-4642(19)30402-X/fulltext

Line 123, Lessons from the pandemic. First paragraph is very short. May want to read this paper (https://www.sciencedirect.com/science/article/pii/S2414644721000038) and add a little more about "lessons" especially focused on LMICs. CHANGES DONE

Line 126, can learn from instead of can gain much CHANGES DONE

Line 129-130, …many had to work remotely to support themselves. CHANGES DONE

Line 131, provide a source for Zoom. How can this technology be used to collaborate for patient care and education? This is discussed later and CHANGES DONE

Line 135, Can this technology be used to help surgical units in the developing world become self-reliant? CHANGES DONE

Line 136 May want to combine these two sections into one -Lessons from the Pandemic? CHANGES DONE

Line 127-141, I was only able to access one the references for this paragraph. This should be fleshed out a little more. I didn't follow these statements. CHANGES DONE

Line 142, The future of surgical training has also been impacted by the COVID-19 pandemic. Need

to elaborate. Next sentences send a powerful message. CHANGES DONE

Line, 148, would delete first world and say developed world instead. CHANGES DONE

Line 150-151 -these two sentences are pretty obvious-delete- deleted CHANGES DONE

Line 155 I don't find this table that useful either delete or revise. May want to use some of ideas when creating Gap and/or SWOT analysis table/figure? We feel that in a snap shot this table is useful. Often readers will not read the whole text and may benefit from the table. Would like to keep the table. However, we modified it extensively based on many of your suggestions. So, thank you.

Line 157-168 The Gap analysis is very short. Gap analysis is structured tool to identify actions needed to get a future state. Would include a table summarizing GAP analysis. We chose to modify the table1.

First, you need to define scope "sustainable pediatric cardiac workforce". This can be subdivided into a number of subcategories. Workforce: Cardiac surgeons per population. Pediatric cardiac surgeons per pop. Various staff e.g., anesthesia, critical care, perfusion, biomedical engineer, cardiologist, RNs, consultants. Infrastructure e.g., hospitals, ICUs, equipment and training/maintenance, cardiac cath lab, broadband, handheld U/S device. Service Delivery Partnerships with centers in Europe, North America. Financing (including partnerships with industry). Health Information Technology. Governance/Advocacy. Can look at and reference this paper:
https://www.sciencedirect.com/science/article/pii/S0003497520312935?via%3Dihub

Another paper performed an advocacy stakeholder analysis.
https://journals.sagepub.com/doi/10.1177/2150135120955189?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%20%200pubmed
All the authors believe that the pandemic has changed how we even look at healthcare. There are hundreds of papers written in literature about how care of CHD needs to be done in LMICs. The authors themselves have written few. We felt it is not wise to repeat what has already been written extensively. It will be more recycling of information already in public domain. We believe that many of the standards were set based on pre pandemic conditions. We may be surprised how things maybe when we wrap up the pandemic and at that time we can look at the comparison. So respectfully, we did not want to talk about the past standards. The idea of this paper is to talk about what can be done NOW during the pandemic (essential and stay afloat) to prepare ourselves for the future. HOWEVER, WE INCLUDED THE ABOVE PAPERS YOU QUOTED HERE.

Lines 210—221 Actions to close gap (we have extensively modified our table and SWOT based on

your recommendations)

This section is unusually short which only addresses the COVID vaccine issue in LMICs. It discusses this issue in limited manner. There is no discussion of the actions need to create a sustainable pediatric cardiac workforce. Authors' need to discuss proposed actions within each subcategory.

Line 223 SWOT analysis (The SWOT has been extensively modified and we have incorporated all your suggestions. Some of the opportunities we have also included in the table. Thank you for taking time to do this).

The figure layout is good. Ideally, you are supposed to link your strengths with your opportunities. SWOT analysis is another way to organize your action plan. I found some of SWOT items listed a little generic. I listed some considerations for your SWOT figure in the context of COVID-19 pandemic. Traditionally, strengths and weaknesses are supposed to be under internal control, while opportunities and threats are external (environmental). Here, the COVID-19 pandemic is the primary externality. ALL CHANGES DONE

Strengths:

Virtual platforms now commonplace for education and collaboration.

Advocacy efforts continue to evolve (Cardiac Surgery Intersociety Alliance, WSPCHS, Children's Heart Link, World Heart Federation etc.)

Cape Town declaration and RHD action

IQIC started in 2007

Examples of sustainable partnerships with oversight

India has ability to perform low-cost cardiac surgeries at scale

COVID-19 pandemic led to improved surveillance and data systems

As of 2014, a survey identified 80 NGOs that provide mission trip for CHD surgery to LMICs (with reasonable outcomes) https://journals.sagepub.com/doi/10.1177/2150135113514458 Cost effectiveness of cardiac surgery in developing world estimated to be $171 per DALY https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2714503

Weaknesses:

Competing priorities

Lack of infrastructure

Lack of trained personnel

Limited funding

Broad band availability

Some limitations to virtual mentorship and training

Opportunities:

Global health considered shared responsibility (among wealthier countries)
Universal healthcare/healthcare system capacity building
Further expand telehealth for provider training and care of CHD patients e.g., CTSNET platform
Increased interest in medical field from younger generation
Standardized international cardiac surgery training track
Frugal innovation e.g., surgeon perform intraoperative epicardial echocardiogram on heart instead of using transesophageal echocardiography
Integrate public health into medical education
Embed or rotate trained cardiac surgeons to programs in developing world
Using hand-held U/S technology and artificial intelligence to diagnose rheumatic heart disease in the field with physician extenders
Expand partnerships with industry and/or public-private partnerships e.g., develop low-cost capital equipment and disposables
Penicillin availability for RHD secondary prophylaxis (and other critical medicines)
Efforts to reduce fertility rate (family planning) and to decrease maternal mortality in developing world
Threats:
Post COVID-19 economy
COVID-19 variants
COVID-19 vaccine access to LMICs
Vaccine misinformation; hesitancy
Mission trips curtailed by COVID-19 pandemic
Continued socioeconomic inequity/inadequate resource allocation
Healthcare workforce attrition/burnout (exacerbated by COVID-19 pandemic)
Areas with civil unrest or failed state
Political will or policy failure
Rise of preventable communicable diseases due to COVID-19 pandemic

Line 293-355 Possible actions for the next two years
These arguments could be listed under the action plan from the Gap analysis.

Line 356 -> Conclusion fully modified. Thank you
I think the conclusion should be polished a bit. I would say, our Gap and SWOT analysis creates an action plan with a lens on creating a sustainable pediatric cardiac workforce to move toward SDG 2030. The COVID-19 pandemic led to a significant widespread healthcare disruption; however, some innovations which came in part due to the pandemic can be leveraged to help reach our goals.

Reviewer B

I have reviewed your manuscript, " Fostering Sustainable Pediatric Cardiac Workforces Around the World in the Post Pandemic era." I have divided my comments/suggestions/issues into Minor and Major points below.

MINOR ISSUES

1. Lines 79-82; For individuals interested in the article these statements are well known. What is missing is the number of deaths that occur annually because of the disparities in pediatric cardiac care and surgery specifically. Added deaths

2. Lines 89-91; While a lack of standardized training and national criteria do exist they are not the reason for poor accessibility. Access is based upon multiple factors that training and national criteria have nothing to do with. Clarified

3. Lines 109-110; You have placed quotation marks around " the seemingly hopeless situation can be used to our advantage". Who are you quoting? removed

4. Lines 150-154; Public health is a major issue in LMIC and certainly a better knowledge would help diminish RHDz. However, you mention early screenings, for what exactly? The sentence removed

5. Lines 161-163; W0hy is it difficult to focus on specialized care, who is responsible for this lack of focus? The Ministry of Health, the Parliament, the Executive Branch of government? This statement is a commonly used platitude, you can do better. revised

6. Lines 170-171; Ideally you would have used a reference which had some surgical context. The referenced article deals exclusively with the pandemic response and how that can be improved. I fail to see the relevance of this statement or reference with regard to the future state of pediatric cardiac care in LMIC. Revised

7. Lines 235-237; This would be a good place to mention at least some of the current online sites that feature pediatric cardiac education. Done

8. Lines 289-292; What exactly is this review about, pediatric cardiac surgery in LMIC post-pandemic. This section is non-contributory. We feel that the so called "weaknesses" during the pandemic may work out to be our strengths and help with fast tracking ped cardiac surgery in LMIC. So we would like to keep this.

9. 284-285; Optimistic prediction, really the entire world is going to be vaccinated within the next years, please quote the source for this prediction or revise your statement. Modified

10. Lines 298-201; I agree with most of this but really, 3-D printing as a tool for education? How many LMIC have this technology? This is wishful thinking and a fantasy in most LMIC pediatric cardiac surgical programs. Agree but have been in LMIC where this is being used. But get your point and have deleted it. Again a case in point this paper may not be for universal application. Probably countries such as Pakistan, China, India and Indonesia which have more than 70% of mortality from RHD can use this strategy.

11. Lines 304-306; Ditto, reference to above unless the authors are handing out 3-D printers and software around the world to LMIC. Modified

MAJOR ISSUES

1. Lines 102-104; I agree with the first part of this sentence, however "take several years to resume safely" has already proven to be patently false and moreover "how soon many of these countries can vaccinate their population" means that no one will be traveling to develop/assist until that time is utter nonsense. Teams that have team members vaccinated and utilize PCR testing of patients and families can and currently do function at full capacity. I do not mean this to be critical, but you obviously do not know who Is doing what now. This section requires major revisions and without something more realistic I cannot advise publication. (Agree with some of the observations. One of the author is already travelling to LMIC with precautions. However, we agree there is a difference of opinion here and our senior author feels that the realistic chance would be many years. We beg to differ. I modified this section extensively. Hope will be pleasing to you)

2. Lines155-156; These refer to Table 1 which I will take point by point.

a. #1 Better antenatal screening; are you referring to fetal echo's, really who in Kinshasa or Lubumbashi does these? Did you really mean education in antenatal screening? Again a platitude. LMIC's have wide ranging facilities. Where possible isn't that the goal for improving Ante natal care. Having worked in LMIC's that has been the goal to train the few professionals. All LMIC's are not Kinshasa and Lubumbashi. Amazon basin is even more remote and worse off than the above. However, we are talking about "where possible". Nevertheless, having worked in Papua New Guinea, which has very few resources the two pediatric cardiologists travel around all the different islands with their laptop based ECHO and do fetal echo's where indicated. We cannot compare some of the Malanesian, Polynasian islands to Congo or Sudan or Amazon basin. There is wide disparity. So whatever we wrote is not specific to one region but LMIC's in general.

b. Triaging children with complex heart disease. This is already done in most LMIC, kids get triaged by default, if there is a local team they operate on what they can operate on, if not and a visiting team is coming then the complex kids are triaged for the visiting team. We have clarified it better in

the paper

Therefore, the question here is whether it is worth doing complex surgeries in Kinshasa and Lubumbashi. Who takes care post op and follow up. I have witnessed so many who die with lack of care post op following a surgical mission. When we talk of triaging, we also mean that visiting teams should triage patients. Is it worth doing a Nikaidoh or Norwood vs. doing children with simple lesions? We cannot save everyone but the goal is to save the ones who have a definite chance. There is good but also some bad out of "surgical safari's". This may be obvious but often is missed.

c. Need to discuss diagnosis and treatment honestly with parents and family. Are you insinuating that the locals are not? If this article is published and this statement stands you are going to upset a lot of surgeons and cardiologists in LMIC. If on the other hand you are discussing a visiting team then this is a complete insult to that team, really!

Very true and we understand your point of view and so, have modified the text to convey the message. What we mean was that the pandemic has helped us make hard decisions. Recently one of the author (JM) has helped in establishing COVID unit in sub urban India from ground up during the dreaded COVID second wave, which has helped treat hundreds of patients. So, many of these thoughts are based on first-hand experience of dealing with desperate families and it was a scenario of making a decision of who gets a ventilator etc. when resources were limited. In that context would you spend all resources of ICU on a Nikaidoh procedure or double switch which otherwise could be used for other patients with ASD's or VSD's.

d. Making realistic waitlists and optimizing medical therapy. Oh My, what do you think the locals are doing now, nothing? I am surprised by the neo-colonialistic attitudes exuded in this Table. You need to seriously rethink a number of these points. Sorry you feel this. One of the author went to PNG regularly. The local team would make a list of 200 potential patients for surgery. Many of them may be due to local compulsions (village head man's recommendation, local politician's recommendation etc). Many were inoperable and there is bad blood when they are refused surgery. One way to mitigate the same is training and training and more training. Yes we modified this but that was the idea of this point. WE have extensively modified the table based on many observations.

3. Lines 178-180; "Standardizing a method of triaging CHD patients….. of the congenital lesion. A proper referral system……..a resource limited state." This is another neo-colonial statement. The locals, both cardiologists and if the area is lucky enough to have a surgeon operating on children already have a referral system. But when referring a child outside the country requires funds the locals are severely constrained and only those who can raise/find funds get out. Rarely a charitable entity in the country the child is traveling to will assist in covering costs. Certainly at least 2 of these authors should know this and as such I am surprised by this line of statements.

Again, this is a statement, which is applicable for all. One can take offense to any statement made in this paper. This is not to hurt anyone. This statement is for referral within countries not for overseas referral. Again, there are various view points and we agree to differ. We have already made our point above. How can we best use the limited local resources? It is one starfish at a time. Cannot save everyone. A more pragmatic view rather than Neo-colonial statement. One of the author (JM)

has trained and worked for majority of his life in LMIC and has personally experienced this. However, we modified this in the text to clarify the same.

4. Lines 188-189; “Moreover, the common impression that heart surgery is very resource intensive and expensive is not unfounded.” Ok, so you have the first part of this sentence correct, but expense in the long-term is definitely refuted by a number of publications, which at least one of your co-authors was a co-author on financial expenses. Also it appears you are not familiar with Cardarelli et al. Yes again difference of opinion who you talk to and personal experiences. However, get your point and made some changes. Quoted the paper too.

JAMA Network Open. 2018;1(7):e184707.doi:10.1001/jamanetworkopen.2018.4707

I suggest you familiarize yourself with this publication and rework this statement. Quoted it

5. Lines 206-209; This section is unrealistic if you know the situation on the ground in LMIC for pediatric cardiac disease. There are few countries that have enough centers for the care of children with heart disease to create “Networks” within countries. Sure, India and China perhaps, but what about Nicaragua, there is 1 center, or Honduras, which has 1` center. These 2 countries are not alone, there are dozens that don’t even have 1 center, take a look at sub-Saharan Africa, which you have featured in this article.

As we said previously there is so much of diversity among LMIC’s. The situation in Bangladesh, Pakistan, and Myanmar is different to Dr Congo or many countries of the sub Saharan Africa. There is no one-size fit all. Some suggestions are applicable to few countries may not be applicable to others. Yes, many of the points may not be applicable to sub Saharan Africa. That is the reality. So where applicable the suggestions can be followed. We have clarified the same throughout the paper.