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September 28, 2020

Dr. Sophie Cook
The BMJ, Head of Scholarly Comment

Dear Dr. Cook,

Thank you very much for your positive response to our manuscript, "A Path to Net Zero for Healthcare" (BMJ-2020-060628), and for the feedback from the four reviewers. We found the suggestions to be extremely useful. The notes below outline each point you and the reviewers made and explains how we have addressed it. The most important point, we think, concerned the need for more critical analysis of barriers to systems change and how to overcome them. We have added a short section to the paper that we hope addresses this point. In doing so, our word count did rise to 3147, as we did not delete any other sections. However, we look forward to your feedback.

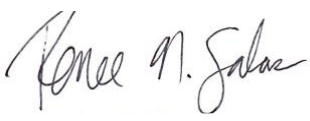
We look forward to working with you to finalize the tables and the graphic. As you know, the image we submitted was a placeholder; we trust that the BMJ graphics team can create a more compelling and informative image. As for the tables, we recognize that they are long, but we very much hope they can be retained in the full article rather than the appendix as we believe they are unique and will be of considerable interest to readers. We look forward to discussing further, if helpful.

Lastly, some other minor revisions were made throughout. Of note, there are three additional citations that are not currently available, but we would like to submit them for consideration:

- Possible location – cite with current reference 37: Hubbert, B., Ahmed, M. Kotcher, J., Sarfaty, M., Maibach, E. (2020) Recruiting health professionals as sustainability advocates. *Lancet Planetary Health*.
    - *Anticipated to be published this week*
- Possible location - cite at end of same sentence with reference 82: Maibach, E. Supporting communities of practice as a strategy to accelerate uptake of environmental science for climate action: TV weathercasters as a case study. *Environmental Research Letters*.
    - *Manuscript under review*
    - Dr. Maibach would like to let you know that if citing a paper under review is not allowed, he could post it at SSRN or elsewhere as a working paper if that is acceptable as he feels it is incredibly relevant.
- Possible location – cite with reference 57 in Box 2: National Health Service, Delivering a Net Zero NHS for Health.
    - *To be released 1 October 2020*

Thank you in advance for your consideration. We look forward to hearing from you and are more than happy to provide any further revisions as needed.

Sincerely,



Renee N. Salas, MD, MPH, MS

Editor comments:

The tables are important but long, we may choose to make these online only.

> **Yes, we apologize for the long tables as we got consumed by all that we could say. We discussed this as an author team and believe they are essential to communicate key points, and we believe that they provide information in a way that has not been previously published to our knowledge. One possible suggestion to decrease the real estate of Table 1 is to place the references as footnotes and remove the far-right column. We look forward to exploring options with you, if the manuscript is accepted.**

I am waiting to hear back from our infographics editor about the figure and also whether he could work some of these tables into an infographic. I will keep you informed on this but feel it's best if you start work on the revision and we can liaise about the infographic/figure options as we go through the process.

> **Thank you! We look forward to collaborating on this. We believe an effective infographic could be a very compelling part of the paper.**

Please make clear in the table why you have chosen to include these specialties and procedures - is it because these are the only ones where data are available or because these are the worst offenders?

> **Thank you for noting this. These are examples selected to demonstrate a range of methods and findings. We have added a notation to that effect to the Table title.**

We agree with one of the reviewers that as this is an analysis, it would be helpful to be more critical of this approach in places, considering some of the barriers to these proposed changes as you go along.

> **We appreciate this recommendation and have addressed it in two ways. First, we added a section called "Overcoming barriers to transformation." Second, we have enhanced the solutions shown in Table 2 with more detail and key references. We feel this is a substantial improvement, and hope it is responsive. Thank you for the wonderful feedback.**

Reviewer 1 comments:

This is a nicely conducted research and well written manuscript to propose a possible pathway towards net zero emission in health care facilities/services and, is primarily pertinent to high income countries or health care facilities in low-and middle-income countries located in big cities.

> **We greatly appreciate the positive assessment. Thank you.**

Major concern: While the specific areas or categories identified in the manuscript that could be targeted to attain net zero emission are clear, the manuscript could further benefit by detail explanation

of various intervention measures within these categories, to clearly guide concerned stake holders and actors on how it can be done.

> **We agree that more detail on potential solutions would be helpful. We believe this comment emphasizes the importance of including Table 2, which displays solutions, in the print version of the paper. In response to this comment, we enhanced Table 2 with additional detail (taking care not to expand the table unduly).**

The authors could further explain the trade-off between environmental and health benefit vs. economic burden or issues with transition management when undertaking specific intervention under each category. For example, the Swedish study on telemedicine clearly shows 40-70% reduction in carbon emission upon replacement of physical consultation with telemedicine appointment, making it a very strong yet a feasible solution. More discussion of evidence base or causal mechanism like these for each proposed category or intervention/solution would further explain, why it needs to be done and how it can be done and, is more likely to convince concerned authorities to adapt the proposed pathway. Having said that some of the points (such as green energy, proper management of food waste, energy sustainable building design) are covered in individual case study presented, solution like creating a culture that values sustainability remains poorly explained and doesn't show a casual mechanism, except for the proposition of chief sustainability officer. The authors could reduce information on the section- sources of carbon in health care setting (it has been widely discussed in available literatures) and use it to talk more about the proposed pathway, specifically.

> **We appreciate the suggestion of discussing the economic tradeoffs and causal pathway of each solution we mention. After exploring possible options, we were concerned this addition would greatly expand the length of the paper. Instead we have opted to explore key examples in the case studies (as noted by the reviewer) and to provide references for each solution (when available) to enable interested readers to pursue these issues. However, we look forward to continued discussions if these additions were not satisfactory. Thank you.**

Minor comment: It is likely to help, if authors could add a dedicated section and further explanations to emphasize the importance of preventive public health measures in reducing the burden of service seekers or patients in health care facilities, promoting healthy living and longevity.

> **We fully agree with the importance of primary prevention, and we address it in Table 2 (within a section) and in a full paragraph in the discussion that follows the Table. We hope that this addresses this topic in a satisfactory method given the space limitations.**

Reviewer 2 comments:

This is an important paper, and should, be published ASAP. It is concise clear and will help health systems understand how to best contribute to the resolution of the ecological emergency. It is also commendable in the approach suggested for health care systems in LMIC.

We appreciate the positive assessment. Thank you.

There are minor issues which need clarification.

- *In table 1 renal should be 3.006 tons/PERSON /year* **Corrected, thank you**
- *And M USD presumable means Million USD* **Changed M to million, thank you**
- *In the reduce overtreatment section of innovative model of care table it says "track and incentive accepted over treatment." Surely not.* **Corrected, thank you**
- *LINE 247 to 250. this para needs clarifying* **Clarified, thank you.**
- *page 18 Box 2 - Is there a conflict between this 57% quoted here and the 71% attributed to scope 3 in fig1?* **The 57% is a UK figure, while the 71% is global. But we have removed this figure from Box 2, obviating the need to explain. Thank you for catching that.**

And a couple of further thoughts.

a) *More could have been said about the potential of health care land for carbon sequestration. For instance tree planting and soil enhancement should take place in health care settings.*

We agree completely that sequestration is an important element in this "all hands-on deck moment." With respect, we believe this is a very minor opportunity since health care facilities are not major landowners, and in discussing solutions we have tried to focus on those with substantial impact given our strict word limitations. However, we look forward to exploring this further pending your review.

b) *In line 240 reduction of poverty is rightly mentioned, but the Closing of the inequality gap is arguably even more important.*

Agreed, thank you. We added this point to the paragraph on poverty.

c) *In advocating for local renewable energy generation, community ownership of same will provide further health benefits.*

Agreed. We added this point in Table 2. Thank you.

Reviewer 3 Comments:

This paper 'A Pathway to Net Zero for Health Care' focuses on the fact that health care is an energy-intensive sector and a substantial contributor to global GHG emissions. It highlights that the sector has lagged in efforts to reduce emissions and aims to 'chart a course to Net Zero emissions in health care'. With only a decade left to reduce emissions to half the 2010 level, the paper is timely and much needed in drawing global attention to the emergency.

We appreciate the positive assessment. Thank you.

The paper is well constructed in how it 'describes efforts to date, recounts the benefits of Net Zero operations, reviews available strategies, and identifies knowledge gaps'. It does a very good job of updating readers' knowledge on how the health care sector contributes to GHG emissions and the range of health sector activities which need to be included in these calculations together with some interesting examples of carbon footprint estimations undertaken across these activities, a global comparison of health sector carbon footprints by country, and a potential set of solutions from within and outside the health sector. The need to include the health care sector in discussions on carbon foot print reductions was first highlighted more than a decade ago, and this paper demonstrates very well, how the evidence base and the framework for a strategy have been strengthened, clarified and made much more authoritative since that time.

> **We appreciate the positive assessment. We hope that this will further inform the important and accelerating conversations on this topic.**

The paper could, however, be more critical in its approach to the pathway it recommends. This is, after all, an Analysis paper, and therefore needs to be bolder and more analytical. What are the barriers to change, what lessons have been learnt thus far, and how could change be industrialised [sic; assume this means "institutionalized" - HF), building on that learning? How would an appropriate balance be achieved globally, taking account of all the countries ranging from Iceland to India, so that there is equity of access to health care worldwide, while the health sector overall rapidly achieves its share of the emissions reductions by 2030 and 2050? What process has begun to explore this? The paper could be more impactful if the descriptive components could be matched by a greater focus on how change may be achieved.

> **We appreciate this wonderful suggestion, and we have added a section called "Overcoming barriers to transformation." We hope that this appropriately, yet concisely, addresses this important addition.**

Lastly, the involvement of health care workers in discussions on climate action is disappointingly limited even in the UK. The recent history of climate action illustrates how important it is to democratise knowledge, action and involvement to reimagine a new world and push for rapid transformational change. This group of experts is requested to consider how knowledge sharing can be accelerated and how health care workers and the public could become partners in demanding and leading the scale of change required to address the climate emergency.

> **We really appreciate this suggestion, as well. In the new section on overcoming barriers – per your wonderful previous suggestion, we have addressed the engagement of health professionals across the continuum - from training to workplace promotion of environmental performance.**

A minor observation is to recommend a spell check to ensure that words such as phacoemulsification are spelt correctly.

> **Thank you, spell check performed. We apologize for missing that.**

I am happy to recommend publication following revision.

Reviewer 4 comments:

This paper represents an excellent introduction to the issues, challenges and opportunities in net zero healthcare.

We appreciate the positive assessment. Thank you.

I have a few observations and suggestions. The diagram representing the breadth of Scopes 1,2,3 at the start is very heavy on Scope 3, it could highlight a little more detail under Scope 1 particularly energy use, fuel use and anaesthetic gases.

Thank you for this important point. Our rationale for the emphasis on Scope 3 emissions in the figure was to correspond to the preponderance of these emissions in health care, a consistent finding for which we cite evidence. In any event, we hope that this mock diagram will be redrawn with the assistance of BMJ staff – and we look forward to a collaborative path forward.

The early part of the paper gives good coverage of developed world health systems, and highlights the difference with the carbon intensity of health care per capita with India. It is good to see some exploratory text looking at the different challenges in LMICs. The coverage here though is maybe a little short. The authors could possibly do more to highlight the global health inequalities driven by climate change and the disproportionate impact on LMICs and their healthcare systems. Indeed coverage on adaptation is a little short. It is good to note the attention given to the need to integrate systemic action on energy supply and public health development in these countries and that this may sometimes come from collaboration with non-state actors. There are some excellent examples given where this has worked well.

We have added an acknowledgment of the disproportionate burden on LMICs in that section of the paper, together with an additional reference. Thank you for highlighting this important aspect and strengthening the paper.

Many major suppliers to developed world health systems will also supply to systems in LMICs. It may be worth highlighting the broader leverage available to developed world healthcare providers to drive down scope 3 emissions in suppliers and products also used in LMICs. An aligned approach could ensure that higher carbon products, such as high carbon anaesthetics and asthma medication are not just displaced from one national context to another.

A good point, and we have added it to the LMIC portion of the paper and to the second paragraph under Table 2. Thank you.

The example given on p18 lines 5-9 of the NHS use of food mastication seems out of place. There are many very good initiatives to reference, while food mastication is not really common practice. Maybe the authors could consider the 50m NHS investment in LED lighting, or the substantial recent NHS shift away from using Desflurane, backed by the NHS standard contract, NHS long term plan and close collaboration with the Association of Anaesthetists?

> **We have removed the food example. While we agree that desflurane is theoretically a wonderful example, we did not include it as it has not yet been publicly documented. If there is a source to utilize that we are not aware of, we are more than happy to include.**

The authors may want to consider highlighting the lack of access to good quality national level data and carbon conversion factors in all national contexts. For example the scope 3 conversion factors electricity grid factors readily available in the US and UK are not easily available in all countries. Similarly the availability of appropriately trained expertise on footprinting and delivery. These need to be purchased, putting LMICs and non-state actors at a disadvantage in footprinting, targeting and tracking action.

> **Agreed. We added these excellent points to the second paragraph under Table 2. Thank you.**

Overall this is a valuable paper that sets the scene well with some very useful practical examples. I would be keen to see it published.