Author’s response to reviews

Title: Travel time to health facilities in areas of outbreak potential: maps for guiding local preparedness and response

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Author’s response to reviews:

October 10th, 2019
Dr. Lin Lee, DPhil
Chief Editor, BMC Medicine
Dear Dr. Lee,
Thank you for the opportunity to revise our manuscript “Travel time to health facilities in areas of outbreak potential: maps for guiding local preparedness and response” (BMED-D-19-01370) for BMC Medicine. We would also like to thank the reviewers for their time and feedback.
We have addressed the reviewers’ comments in our responses and incorporated related changes into the manuscript. Primary changes included expanding our description of the methods used to create the global friction surface, clarifying other methodological elements, and extending our description of the limitations related to where patients may seek care. We also updated all figures to incorporate north arrows and scale bars, and updated our graphical presentation of disputed territories to be more visually clear.
In re-running our analyses to include north arrows and scale bars for all plots, we observed that the code for identifying impact of new infrastructure/support on travel times was being evaluated for the entire national population (as seen in the manuscript for Ethiopia) rather than those at-risk for VHF specifically. We have updated our code to generate plots to show travel-time reductions relevant only to those at-risk, and have amended these plots and analyses in the manuscript and supplemental information, our code repertoire, and the results section of the manuscript. Similarly, we noted a discrepancy in the threshold used for Marburg binary classification in the uncertainty plots versus those in the main text, and have updated our code and results, most notably for travel time to nearest location at-risk in Botswana. These modifications did not substantially alter our findings or interpretation, but we wanted to flag this for attention as an explanation for the visual differences.
The list of datasets along with the code used for the analyses will be made publicly available on the Global Health Data Exchange (http://ghdx.healthdata.org/record/ihme-data/travel-time-health-facilities-vhf-outbreak-preparedness-africa) upon publication.
Thank you for your continued consideration of this manuscript.
Sincerely,
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Response to Reviews: “Travel time to health facilities in areas of outbreak potential: maps for guiding local preparedness and response” (BMED-D-19-01370)
Reviewer #1
The manuscript presents an accessibility study to health facilities in countries throughout SubSaharan Africa. It is mostly clear and easy to read. Comments follow.
Response: We apologize for the technical issue that seems to have occurred in the Word to PDF conversion process. We have included the text from the lines in question below for easier reference:

“Viral Hemorrhagic Fever Estimates

We used published environmental suitability maps of four VHF s (CCHF (31), Ebola virus disease (32), Lassa fever (33), and Marburg virus disease (34)) to define geographical variation in spillover potential (Figure 1). These maps utilize geotagged records of viral detections in human and animal populations with gridded covariate datasets to define an environmental profile which best captures the variation in observed detections. Using these reported locations, we can evaluate the local environmental conditions for all of Africa as compared to this theoretical optimal environment for viral presence and evaluate the potential for local zoonotic transmission.

We used the methods defined in Pigott et al. (2017) to derive data-driven threshold values, which are selected to optimize the tradeoff between accurate classification of known detections and background absences, to classify grid-cells (also referred to as locations) “at-risk” of transmission versus those “not-at-risk” (28,38). Given the inherent uncertainty associated with these models, we used different randomly generated dataset subsets to derive a range of threshold values. This allowed us to consider both a more conservative estimate (using a higher threshold at the 95th percentile) and a less conservative estimate (using a lower threshold at the 5th percentile) for all four VHF s in combination with the median estimate used throughout the subsequent analyses. Analyses conducted with these differing thresholds are presented in the supplemental information (pages 11-14 and GHDx).

Facility Data Source

To estimate travel time to health facilities, we used a list of over 95,000 public and private non-profit facilities in sub-Saharan Africa, published by WHO in 2019 (35).”

2. Ln. 186: "Given that reported locations", what locations are the authors referring to?
Response: This was an unfortunate typo. The locations mentioned refer to the geotagged records of viral detections mentioned in the sentence prior. We have amended the text to read as follows in line 186:

“Using these reported locations,”

3. Lns. 188-193: sentence is too long.
Response: Again, we apologize for the technical issue that seems to have occurred in the Word to PDF conversion process. Please see our response to comment 1 for the full text of this section from the Word document. The sentences cited by the reviewer are in fact several separate sentences, on lines 188-191, 191-193, and 193-196, respectively.

4. Lns. 196-197: incomplete sentence
Response: Please see our response to comment 1 for the full text of this section from the Word document, which does include a complete sentence here.

5. Lns. 197-200: repeated.
Response: Please see our response to comment 1 for the full text of this section from the Word document, which does not include the repeated text.
6. Lns. 224-233: the global friction surface is key to the calculation of accessibility. All the results are based on it. Can the authors please explain how the information between lines 226-229 was combined to produce the resulting summary surface?
Response: This analysis is reported elsewhere in more detail [by Weiss et al. 2018, reference 37]. However, we recognize the key role this plays in the analysis and that more detail would be of use. We have added the following text to replace the sentence “These datasets were then combined….” on lines 226-234:

“Infrastructure data, provided from a variety of sources including Open Street Map and Google, defining roads and railways were rasterized to identify which locations matched with these networks. For roads, associated metadata enabled tagging of routes with specific speeds; for railways and water crossings fixed speeds were assumed. For locations where no road infrastructure was present, speed of movement on foot was evaluated by cross-referencing specific land cover types (derived from MODIS MCD12Q1 imagery (42)), and a questionnaire-derived lookup table of speeds across each category (37). These speeds were also adjusted to account for topology using imagery-derived elevation assessments (43). Finally, all speeds were converted from kilometers per hour to minutes required to travel one meter.”

7. Analyses section: the way the authors describe the calculation of the travel times is by using grid cells as origin and destinations. However, the facilities are points. Where the facilities converted to grid cell? Or was the travel time calculated between grid and point? It is not clear?
Response: The pathing algorithm calculates the accumulated cost from one grid cell to any given point. For this analysis, the point data was the facility of interest. We have added the following nuance to the text on lines 242-245:

“For these analyses, cost was determined by the resistance and friction between a given grid-cell and every facility (represented as point data) in the country, based….”

8. Ln. 238: is one of these grid cells of the VHF surface? Not clear.
Response: We have added some text to clarify how this generalized statement can be specifically applied in our study on lines 241-242:

“… to find the shortest pathway from an origin grid-cell of interest (such as a suitable VHF location) to a destination (such as where a facility is present) and provide a cost…”

9. Ln. 246: what exactly is a "composite indicator"?
Response: This is referencing to the aggregation of four VHF rasters into a singular “any VHF” raster. We have clarified this in the text on lines 250-251:

“…were mapped country-wide for each VHF and for an aggregate raster of all VHFs indicating suitability for any of the four pathogens. We mapped…”

10. Lns. 251-252: not clear.
Response: We have rephrased this sentence accordingly on lines 257-261:
“We were also interested in understanding the proximity of all locations within a country to areas of VHF environmental suitability both within the same country, and in neighboring nations. To evaluate this, we estimated the travel time from every grid-cell within a country to the nearest at-risk grid-cell within the same country, as well as the nearest at-risk grid cell in adjacent countries within a 500-km buffer around the national borders. Due to challenges…”

11. Lns. 276-277: the calculation of these percentiles and what they represent should be explained previously.
Response: We have added the following text to the methods section in lines 245-246

“We also calculated country-specific percentile rank of hours of travel for each country.”

12. Lns. 343-348: sentence is too long.
Response: We have revised this sentence in line with the reviewer’s feedback (line 351).

13. All maps need north arrows and scale bars.
Response: We have added north arrows and scale bars to all maps.

Reviewer #2
This is a nicely written paper by a strong team. The paper assesses travel time to health facilities in some African countries, and how this information can be used in concert with maps of infectious disease outbreaks.

1. I am familiar with the approaches the team has developed in their paper (grid-based accessibility). The method they have developed is not new, but the application is novel. The sources of the data are accessible to other researchers, and the maps are informative. However, I feel the authors are missing some important components in modeling geographic access to health care. For instance, it is well known that individuals may not go to the closest hospital/health center for a myriad of reasons. Their symptoms may be so severe they have to seek expert care, and not the closest health post. Or there may be a shortage of staff at the nearest dispensary, etc... in other words, potential access (which is assumed in this paper) is not the same as revealed access....and so in reality the maps that are provided do not reflect the true travel (which will be much greater). In developed countries, people may also seek care at another, non-closest provider, due to insurance restrictions or because another specialist speaks the same language. Although these two papers are written in an urban context, we can see that individuals rarely seek the closest health facility Casas, I., Delmelle, E., & Delmelle, E. C. (2017). Potential versus revealed access to care during a dengue fever outbreak. Journal of Transport & Health, 4, 18-29. Casas, I., & Delmelle, E. (2019). Landscapes of healthcare utilization during a dengue fever outbreak in an urban environment of Colombia. Environmental monitoring and assessment, 191(2), 279.
I would like the authors to discuss this limitation.
Response: We thank the reviewer for this comment and agree that feasibility of travel is distinct from realized travel. This is a key limitation that it is necessary for readers to appreciate, particularly if intending to act on these estimates. We already have a large chunk of the manuscript (reviewer version lines 493-499) that include some of the issues raised by the
reviewer, and we have edited this section to include some additional reasons as referred to by the reviewer. We have also replaced references 58 and 59 with the Casas 2019 and Casas 2016 references provided, as these demonstrate the disconnect particularly well. Finally, we added a section on how existing comprehensive geospatial data can be used to provide further insights into this issue. Please see lines 498-515 shown below:

“First, geographic accessibility is just one facet of equitable care, and we currently lack the ability to assess other factors including quality of care and availability of relevant services. While global assessments of healthcare access and quality have been developed (22), implementing these principles at a local level, for multiple countries simultaneously, has not been addressed. Furthermore, the quantified travel times are not always the actual traveled route to care, as persons may pursue alternative paths to access a health facility, including cross-border travel (57), or chose an alternate facility aside from the closest facility (58,59), particularly during emergencies (60). In some instances, while a facility may be available, individuals could already be too ill to travel and are treated at home, or seek non-facility based forms of healthcare provisioning such as traditional healers (61). Understanding cultural drivers and barriers to treatment seeking are critical, whether misconceptions of treatment options (62), or fear and stigma associated with conditions (63), as well as recognizing the financial obstacles associated (10). While a comprehensive continental assessment of these factors is difficult, various geospatial data can be leveraged to act as an indicator of both likelihood to seek care as indicated by household surveys systematically performed across low and middle income countries (64) as well as meaningfully demonstrating actual route frequency, as tracked by mobile phones (65). With this in mind, these current estimates can act only as a general guide, and additional research is required to understand to what extent true humans behave compared to the travel patterns assumed in this study.