

PEER REVIEW HISTORY

BMJ Open publishes all reviews undertaken for accepted manuscripts. Reviewers are asked to complete a checklist review form (Error! Hyperlink reference not valid.) and are provided with free text boxes to elaborate on their assessment. These free text comments are reproduced below.

ARTICLE DETAILS

TITLE (PROVISIONAL)	National optimization of accessibility to emergency obstetric and neonatal care in Togo: a geospatial analysis
AUTHORS	Curtis, Andrew; Monet, Jean-Pierre; Brun, Michel; Bindaoudou, Issa Abdou-Kérim; Daoudou, Idrissou; Schaaf, Marta; Agbigbi, Yawo; Ray, Nicolas

VERSION 1 – REVIEW

REVIEWER	Schmitz, Michelle Centers for Disease Control and Prevention
REVIEW RETURNED	13-Dec-2020

GENERAL COMMENTS	<p>The paper, "National optimization of geographical accessibility to emergency obstetric and neonatal care in Togo", describes an AccessMod use case, informed by in-country workshops, to help compare the relative extent of estimated geographic access in Togo. It compares geographic access by assessing estimated population percentages within 1-2 hours of care, using various health facility systems. I commend the authors on this approach - as it extends the literature out to a nationally-representative use case. However, I have various logical, grammatical, and factual questions suggestions that, to me, involves some further work by the authors to resolve, and necessitates a manuscript revision.</p> <p>Title page</p> <p>[1.] Should Andrew Curtis's and Nicolas Ray's affiliation be capitalised as "GeoHealth Group"?</p> <p>[3.] Jean-Pierre's affiliation for the "Technical division" should also capitalised as "Technical Division"</p> <p>[5.] "Lome" should actually be accented to "Lomé".</p> <p>[6.] Marta Schaaf's affiliation is mentioned as belonging to "Brooklyn, USA". Brooklyn is a borough in New York City, and should be affiliated as such (i.e., "Brooklyn, New York, USA").</p> <p>Abstract</p> <p>Page 2, line 15: What is the "innovative methodology" described here? This isn't clear.</p>
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Page 2, line 19: There might be a more concise/informative way of saying “more limited network”. I eventually figured it out reading the paper, but it wasn’t clear in the abstract.

Page 2, line 27: What does “motorized” stand for here, given that “motorcycle-taxi” is then mentioned as another option? Are there cars showing up in this analysis? Can these three descriptions be mentioned as “walking/motorized-taxi scenario, motorcycle-taxi only, and walking only”?

Page 2, Results: Make sure to 1: add decimals to all percentages and remove spaces between numbers and “%” signs. This could help you with word counts.

Page 2, line 41: The whole sentence about uncertainties on speeds of travel on the roads is correct - but an uncertainty analysis was never described in the methods. Please mention an uncertainty analysis in the methods if you plan to include this sentence.

Page 2, Conclusion: Again, while this is a true sentence, I’m not sure if the conclusion sentence is exactly true. The wording of this abstract section suggests that geographic accessibility was used as the determining factor in downgrading the number of facilities in the reprioritized network. However, reading through the paper, it seems like that the downgrading of the number of facilities was done before any geographical accessibility was assessed. As I read this paper, geographic accessibility was instead compared between the 2013 and 2018 facility systems. Authors - please let me know if my reading was incorrect, and feel free to ask/suggest for possible revisions.

Strengths and limitations of this study:

Page 3, Line 5: What does the “national optimization of a network” mean here? I understand that the optimization was not done algorithmically, based on the description in the overall paper.

Page 3, Line 10: When the “associated uncertainty was accounted for”, the authors should probably just say an “uncertainty analysis assessing relative effect of speeds” was performed instead.

Page 3, Lines 17-18: I know that financial incentives are not described in the paper, but there seems to be a fair amount of description about bypassing.

Page 3, Line 23: This is a single-country analysis, and so the authors should write, “certain parts of the country”.

Introduction

Page 4, Lines 5-7: To an uninitiated reader, the phrase “SDG3” doesn’t give a ton of information - although SDG3 *is* the health goal. It could be reworded as, “Sustainable Development Goal 3 (SDG3) aims to better health outcomes for different at-risk

groups....". Additionally, periods are not needed after "SDG3.1." and "SDG3.2."

Page 4, Line 19: Write out "WHO" to be "World Health Organization", since this is the first instance of "WHO" mentioned.

Page 4, Line 23: "as after 2 hours," (add a comma)

Page 4, Line 31: What is the citation for "ease of use and minimal need for the input of spatial data layers"?

Page 4, Lines 38-39: Can delete, "where every minute of travel time is consequential" if word count is a major issue.

Page 4, Line 45: Is there a citation for the phrase, "and to model catchment areas of facilities"?

Page 4, Line 52: Can summarize citations as "[11-18]".

Data and Methods

Study Site and Context

Page 5, Line 24-28: As this is a BMJ Open submission, please make sure to use correct punctuation when separating out thousands. Additionally, "East", "West", "North" and "Southern" do not need to be capitalised.

Page 5, Line 28: Move Citation 21 to the end of the sentence.

Page 5, Lines 33-39: Wording is a little difficult to follow. Authors may want to reword these sentences.

Page 5, Line 52: Change to "...respectively, with 396..."

Page 5, Line 57 - Page 6, Line 10: I would have shown a little bit more of a description of the overall network. I would have also put a comparison here between facilities that were incorporated into the 2013 and 2018 frames, and tabulated the selection criteria into a table to show direct comparisons. Some questions for the authors to think about:

What were the most common reasons that a facility was omitted from the group?

Does this national network encompass both government and NGO facilities?

Page 8, Line 8: Instead of "over the period", I'd have written, "2016-2018".

Page 8, Line 13: Quick question for the authors: Were participants brought in from all over the country, and not just in Lomé? Given that the final travel speeds were apparently decided by consensus, there needs to be representation across the country, given that urban and rural speeds usually significantly differ.

Page 8, Line 20: I would have written the actual travel time scenario (i.e., “walking/motorcycle-taxi”) instead of “travel scenario 1”.

Page 8, Lines 38-50: This paragraph can be summarized in a table, or in a series of shorter sentences. There are a lot of run-on sentences in this paragraph right now.

Page 9, Line 17: I’m not sure if I’m following the subtraction/differences between the two sensitivity scenarios as described here. Is it basically just trying to find the ‘zones’ in which one scenario had more extensive travel?

Page 9, Line 40: Was this shapefile provided directly to the authors from the Direction de la Cartographie national et du cadastre? If so, please cite.

Page 9, Lines 45-48: Were there any adjustments made to the administrative boundaries to account for any post-2010 activity? I can’t speak for Togo, but I understand that in a few areas, administrative units have changed significantly in the last few years.

Page 10, Lines 3-8: Were the UN-adjusted population counts for 2013 and 2018 added/created by your team, or is this a feature of the Worldpop population density dataset? Additionally, as I’m reading this right now, your description of a uniform distribution insinuates that there is an equal probability that across the entire study area, women may want to deliver in an EmONC facility. Is that correct?

Results

Overall: make sure to denote the fact that you’re working with estimated access, not actual access.

Page 10, Line 26: Write “motorcycle-taxi” (i.e., don’t capitalise)

Page 10, Lines 32-40: Besides trying to clarify the language so that the scenarios are depicted in a clearer way, the authors may also want to describe relative percentage differences between the 2013/2018 scenarios here (e.g., there was a 30% decrease in the 2018 scenario compared to the 2013 scenario).

Page 10, Line 44: Hyphenate “one third”.

Page 10, Line 47: For the “difference of less than 4 percentage points”, are these 4 percentage points of the total population in total, or relative to each other?

Page 10, Lines 51-56: This section of the results can be more clearly written. Also, the authors don’t necessarily need to say that the area is unpopulated in the results; this may belong in discussion.

Page 10, Line 59: Are there no roads at all, or just paths? Based on the figures at the end of this manuscript, it looks like there's some type of path present.

Page 11, Table 1: Why is the walking-only scenario not shown in this table?

The regions are denoted in the table, but aren't shown on any maps - so it's hard to visualize what this looks like as well. Additionally, make sure that all entries in this table have 1 decimal point.

Page 11, Lines 44-49: May want to place this 'subtraction' description back in the methods when talking about the uncertainty analysis (around Page 9, Line 17).

Page 12, Line 10: In reference to the sentence, "Large differences in coverage are found between regions.", is there any heterogeneity in coverage between any of the regions? I'm assuming there is, and this may need to be mentioned (briefly) in the text.

Discussion

Page 12, Line 29: Say "motorcycle-taxi" instead of "taxi-moto", to keep consistent.

Page 12, Line 36: I noticed that there was a discussion for 'walking' in general. However, I'd assume that someone who's being carried, compared to someone who's walking, would move a little slower. I wouldn't necessarily mention being carried unless the authors did a carried-specific scenario.

Page 12, Line 40: What is defined as "low access to EmONC" in this case? Is it that very little of the population is within 1-2 hours of access, or something else? This is the first time that I'm seeing this indicator.

Page 12, Lines 43-48: Could rewrite as, "Access to EmONC is greater for urban populations, even with substantially decreased travel speeds, due to a higher density of both EmONC facilities and road networks in urban areas."

Page 12, Line 50: Once again, describe the difference between the 2013 and 2018 facilities.

Page 12, Line 51: What is defined as "good overall geographic accessibility"?

Page 12, Lines 59-60: What does "over the next short-term programmatic cycle" mean, and which programmatic cycle is being described? That observed by the MoH, UN, or something else?

Page 13, Lines 21-28: I like this conclusion sentence! However, I would also caution the authors that parenthetical statements can be eliminated, or written as another sentence.

Limitations

Page 13, Lines 36: Does this national network encompass both government and NGO facilities? Not clear - need to describe the network a little more.

Page 13, Lines 39-41: Would including this have been relevant to the paper? If this was clearly defined in the intro, there shouldn't be any implication that the person needs to expect this type of analysis.

Page 13, Line 48: "findings transport" should be "finding transport".

Page 14, Lines 12-15: It sounds like most experts came from Lomé to begin with - did I understand this correctly?

Page 14, Line 20: "Non-functional facilities" should have been described at the beginning.

Page 14, Lines 24-25: Are the authors claiming here that a national network of functional EmONC health facilities is needed to help decrease maternal mortality/morbidity?

Page 14: Line 32: Write "up-do-date" as "up-to-date".

Page 14, Line 36-38: Do you want to describe a "dedicated publication" specifically in this paper?

Page 14, Line 60: What is defined as "good availability" of the high-resolution geospatial datasets?

Bibliography - for Reference #18, the journal is actually, "Global Health: Science and Practice".

Figure legends

Figure 1: May want to describe what "GRUMP urban extents" stands for.

Figure 2: Is the walking scenario not being shown in the figure?

Figure 3: Define more clearly here that "landcover uncertainty" are off-road travel. Readers may get confused here.

Supplementary Material

Supplement 1: May want to add an extra column for English-language labels. Not sure how the journal editors feel about this, but this could be something that someone will pick up upon.

Supplement 2: So, this is the first mention I've seen of resampling spatial data - which I was under the impression wasn't the best approach to take. As I recall it, resampling is being used in this case to create a finer resolution for a raster - which is dangerous because it makes assumptions on the data. Better practice is to go to the most coarse resolution - so that you're not making

	<p>assumptions on the data. Is there any reason the authors chose to resample here?</p> <p>Supplement 3: What happened to non-asphalted primary roads?</p> <p>Supplement 4: Given that the prefecture was NEVER assessed or described for in this analysis, I'm kind of surprised that this analysis is being shown here. It also seems that the walking analysis will not be shown here - why is that not the case? Lastly, please make sure that all decimals are represented in this table, and that there's no rounding in this table.</p> <p>Supplement 5: I think the authors meant that the "first figure" is the left-hand side of the table, while the "second figure" is the right-hand side of the table? This could be more clearly described. Also, please fix the decimals in all of the numbers!</p>
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REVIEWER	Augusto, Orvalho Eduardo Mondlane University, Department of Community Health
REVIEW RETURNED	14-Feb-2021

GENERAL COMMENTS	<p>This is an important manuscript for Togo and many SSA countries. Very nice description of the methods.</p> <ol style="list-style-type: none"> 1. As many analyses of this kind do is failing to account for the seasonal disruptions to the road network. Which is becoming more common due to climate change. The authors mention this in the limitations but it should be said more earlier in the manuscript. The 20% uncertainty may not be enough to capture this. Was this discussed in the 2 workshops mentioned in page 9 line 6 to 33? 2. I believe there is a bit of confusion of figure labeling. For example, figure 1F mentioned in page 11 line 5, seems to be figure 1E. Can you check this. 3. The walking-only scenario is important. Yes, it may not have changed from 2013 to 2018. But please bring it from the supplements to somewhere on figure 2. 4. We discover that this study is for Togo first and may be applied to elsewhere in SSA in the methods. Please put some intro of Togo in the introduction as well.
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VERSION 1 – AUTHOR RESPONSE

Reviewer: 1
Dr. Michelle Schmitz, Centers for Disease Control and Prevention

Title page

[1.] Should Andrew Curtis's and Nicolas Ray's affiliation be capitalised as "GeoHealth Group"?

The manuscript was edited accordingly.

[3.] Jean-Pierre's affiliation for the "Technical division" should also be capitalised as "Technical Division"

The manuscript was edited accordingly.

[5.] "Lome" should actually be accented to "Lomé".

The manuscript was edited accordingly.

[6.] Marta Schaaf's affiliation is mentioned as belonging to "Brooklyn, USA". Brooklyn is a borough in New York City, and should be affiliated as such (i.e., "Brooklyn, New York, USA").

The manuscript was edited accordingly.

Abstract

Page 2, line 15: What is the "innovative methodology" described here? This isn't clear.

We added "based on obstetrical monitoring and geographical accessibility modeling" to the sentence to add more clarity to the "innovative methodology" we are mentioning.

Page 2, line 19: There might be a more concise/informative way of saying "more limited network". I eventually figured it out reading the paper, but it wasn't clear in the abstract.

We modified this sentence to read "smaller optimized" instead of "more limited network".

Page 2, line 27: What does "motorized" stand for here, given that "motorcycle-taxi" is then mentioned as another option? Are there cars showing up in this analysis? Can these three descriptions be mentioned as "walking/motorized-taxi scenario, motorcycle-taxi only, and walking only"?

The motorized scenario means taking a motorized vehicle (usually a car or a minibus, private or public) only on road, as opposed to the motorcycle-taxi scenario that uses a motorcycle everywhere. We are now clarifying that in the "Accessibility & population coverage modelling" section of the Methods, second paragraph: "The first scenario assumes that patients walk to the nearest road and then use a motorized mode of transportation (car, minibus or other motorized vehicle, either private or public), immediately available, to continue their journey. In the second scenario, patients use only a motorcycle-taxi to travel on- and off-road, with different speeds depending on the land cover."

Page 2, Results: Make sure to 1: add decimals to all percentages and remove spaces between numbers and "%" signs. This could help you with word counts.

The manuscript was edited accordingly.

Page 2, line 41: The whole sentence about uncertainties on speeds of travel on the roads is correct - but an uncertainty analysis was never described in the methods. Please mention an uncertainty analysis in the methods if you plan to include this sentence.

We added the following sentence to the “methods” part of the abstract, mentioning the uncertainty analysis undertaken: “We accounted for uncertainties on travel speeds, resulting in lower and upper bounds on reported output statistics.”

Page 2, Conclusion: Again, while this is a true sentence, I'm not sure if the conclusion sentence is exactly true. The wording of this abstract section suggests that geographic accessibility was used as the determining factor in downgrading the number of facilities in the reprioritized network. However, reading through the paper, it seems like that the downgrading of the number of facilities was done before any geographical accessibility was assessed. As I read this paper, geographic accessibility was instead compared between the 2013 and 2018 facility systems. Authors - please let me know if my reading was incorrect, and feel free to ask/suggest for possible revisions.

Thank you for this comment. You are correct, geographic modeling in this case is not the only determining factor in decreasing the number of EmONC facilities in the network, as it is also complemented by obstetrical activity and other pieces of information on each facility (this is now better described in the Methods section).

We changed the first sentence of the conclusion in the abstract that now reads: “By factoring in geographical accessibility modeling to our iterative EmONC prioritization process, the MoH was able to decrease the designated number of EmONC facilities in Togo by about 30% [...]”

Strengths and limitations of this study:

Page 3, Line 5: What does the “national optimization of a network” mean here? I understand that the optimization was not done algorithmically, based on the description in the overall paper.

We edited this sentence that now reads: “This is the first study presenting an improvement of a network of EmONC facilities, based on the characteristics of these facilities and on realistic physical accessibility modelling.”

Page 3, Line 10: When the “associated uncertainty was accounted for”, the authors should probably just say an “uncertainty analysis assessing relative effect of speeds” was performed instead.

The manuscript was edited accordingly.

Page 3, Lines 17-18: I know that financial incentives are not described in the paper, but there seems to be a fair amount of description about bypassing.

We are not sure if the reviewer expects us to change anything here. Bypassing is only mentioned one more time in the “limitations” section of the Discussion, so we decided to keep it as is.

Page 3, Line 23: This is a single-country analysis, and so the authors should write, “certain parts of the country”.

The sentence was edited accordingly.

Introduction

Page 4, Lines 5-7: To an uninitiated reader, the phrase “SDG3” doesn't give a ton of information - although SDG3 *is* the health goal. It could be reworded as, “Sustainable Development Goal 3 (SDG3)

aims to better health outcomes for different at-risk groups....". Additionally, periods are not needed after "SDG3.1." and "SDG3.2."

The manuscript was edited accordingly.

Page 4, Line 19: Write out "WHO" to be "World Health Organization", since this is the first instance of "WHO" mentioned.

The manuscript was edited accordingly.

Page 4, Line 23: "as after 2 hours," (add a comma)

The manuscript was edited accordingly.

Page 4, Line 31: What is the citation for "ease of use and minimal need for the input of spatial data layers"?

We updated the manuscript to include a citation for this sentence.

Page 4, Lines 38-39: Can delete, "where every minute of travel time is consequential" if word count is a major issue.

We decided to keep it.

Page 4, Line 45: Is there a citation for the phrase, "and to model catchment areas of facilities"?

We updated the manuscript to include a citation for this sentence.

Page 4, Line 52: Can summarize citations as "[11-18]".

The manuscript was edited accordingly.

Data and Methods

Study Site and Context

Page 5, Line 24-28: As this is a BMJ Open submission, please make sure to use correct punctuation when separating out thousands. Additionally, "East", "West", "North" and "Southern" do not need to be capitalised.

The manuscript was edited accordingly.

Page 5, Line 28: Move Citation 21 to the end of the sentence.

The manuscript was edited accordingly.

Page 5, Lines 33-39: Wording is a little difficult to follow. Authors may want to reword these sentences.

We agree that the wording here is hazardous at best. We have thus edited the text by (i) fractioning these lines in multiple distinct sentences and (ii) rewriting in a "non-parenthetical" form

Page 5, Line 52: Change to "...respectively, with 396..."

The manuscript was edited accordingly.

Page 5, Line 57 - Page 6, Line 10: I would have shown a little bit more of a description of the overall network. I would have also put a comparison here between facilities that were incorporated into the 2013 and 2018 frames, and tabulated the selection criteria into a table to show direct comparisons. Some questions for the authors to think about:

What were the most common reasons that a facility was omitted from the group?

Does this national network encompass both government and NGO facilities?

We have now added some more information mentioning that the network encompassed both government and NGO facilities, and on which criteria the decision were based. However, these criteria had no clear thresholds beyond which the selection was done (apart from the 30 deliveries/month). Rather, they guided the discussions among experts that decided by consensus the final set of facilities in each region. Therefore, we cannot really go into more details about the selection process.

Page 8, Line 8: Instead of "over the period", I'd have written, "2016-2018".

The manuscript was edited accordingly.

Page 8, Line 13: Quick question for the authors: Were participants brought in from all over the country, and not just in Lomé? Given that the final travel speeds were apparently decided by consensus, there needs to be representation across the country, given that urban and rural speeds usually significantly differ.

This is a good point, and we should have indeed indicated that experts from all regions were present. WE edited the text that now reads: " The thirty Togolese participants were technical experts from the MoH, the national Togolese Institute for Statistics, Economic and Demographic studies (INSEED), NGOs and UN agencies, and other key stakeholders (e.g., regional health director, monitoring expert) from all regions of Togo. The pool of experts discussed and agreed on the specifics of how women with obstetrical emergency typically travel when they need to reach an EmONC facility in Togo."

Page 8, Line 20: I would have written the actual travel time scenario (i.e., "walking/motorcycle-taxi") instead of "travel scenario 1".

The manuscript was edited accordingly.

Page 8, Lines 38-50: This paragraph can be summarized in a table, or in a series of shorter sentences. There are a lot of run-on sentences in this paragraph right now.

We agree with this comment and have thus modified the paragraph, rephrasing it in a simpler and clearer manner.

Page 9, Line 17: I'm not sure if I'm following the subtraction/differences between the two sensitivity scenarios as described here. Is it basically just trying to find the 'zones' in which one scenario had more extensive travel?

To make it clearer, we added the following sentences at the end of this paragraph, explaining the usefulness of the uncertainty maps: "In these uncertainty maps, pixel values indicate the extent of the uncertainty of travel time to the nearest EmONC facility, obtained by subtracting the travel time grid resulting from the "- 20%" travel speeds scenario by the one resulting from the "+ 20%" travel speeds scenario. This highlights the areas in the country where the travel time results are the most uncertain."

Page 9, Line 40: Was this shapefile provided directly to the authors from the Direction de la Cartographie national et du cadastre? If so, please cite.

Yes, the dataset was provided by the direction de la cartographie nationale et du cadastre. We modified the manuscript to cite this entity. We also did the same updates for the barriers to movement dataset and the admin boundary dataset.

Page 9, Lines 45-48: Were there any adjustments made to the administrative boundaries to account for any post-2010 activity? I can't speak for Togo, but I understand that in a few areas, administrative units have changed significantly in the last few years.

We did not modify the administrative boundary dataset, we used what we received from INSEED. Also, these boundaries are still the ones used today. To clarify this, we modified the sentence by "The most recent administrative boundaries at the prefectural, regional and national levels were created and made available by INSEED ..."

Page 10, Lines 3-8: Were the UN-adjusted population counts for 2013 and 2018 added/created by your team, or is this a feature of the Worldpop population density dataset? Additionally, as I'm reading this right now, your description of a uniform distribution insinuates that there is an equal probability that across the entire study area, women may want to deliver in an EmONC facility. Is that correct?

The yearly UN adjustments to population distribution is a feature of the Worldpop datasets, we didn't create it on our own. We thus mentioned it in the text.

We assumed a spatially uniform distribution of woman with obstetrical complications because we didn't have any information telling us otherwise. We clarified this in the text, the sentence now reads: " We assumed that the target population of women with obstetrical complications is uniformly distributed across the overall population."

Related to this, we also chose not to use the pregnancy distribution dataset provided by Worldpop, mainly because it was then available at a coarser scale (1km) than population data set at (100m) which was our working resolution.

Results

Overall: make sure to denote the fact that you're working with estimated access, not actual access.

We added "estimated physical access" and "estimations "in several places.

Page 10, Line 26: Write "motorcycle-taxi" (i.e., don't capitalise)

The manuscript was edited accordingly.

Page 10, Lines 32-40: Besides trying to clarify the language so that the scenarios are depicted in a clearer way, the authors may also want to describe relative percentage differences between the 2013/2018 scenarios here (e.g., there was a 30% decrease in the 2018 scenario compared to the 2013 scenario).

We agree that these lines could be presented with more clarity and have thus clarified the text in many places, separating more clearly the various description and adding relative % differences to the description as you suggested.

Page 10, Line 44: Hyphenate “one third”.

The manuscript was edited accordingly.

Page 10, Line 47: For the “difference of less than 4 percentage points”, are these 4 percentage points of the total population in total, or relative to each other?

The “4 percentage points” mentioned here are relative results in between the 2013 network and the 2018 network. But we agree that this isn’t clear in the text. We replaced this by “[...] within one or two hours is only marginally lower with the 2018 prioritized network.”

The relative differences in results are mentioned higher in the text, complying with your suggestion to add relative % differences between the two networks (comment for page 10, lines 32-40).

Page 10, Lines 51-56: This section of the results can be more clearly written. Also, the authors don’t necessarily need to say that the area is unpopulated in the results; this may belong in discussion.

The manuscript was edited accordingly. The sentence on unpopulated areas was moved down to the discussion part of the paper.

Page 10, Line 59: Are there no roads at all, or just paths? Based on the figures at the end of this manuscript, it looks like there’s some type of path present.

There is indeed one secondary road (that becomes a track) cutting through the middle of this mountainous region, but no other roads other than the one just mentioned. We changed the sentence to read “almost no roads” for more clarity.

Page 11, Table 1: Why is the walking-only scenario not shown in this table?

The regions are denoted in the table, but aren’t shown on any maps - so it’s hard to visualize what this looks like as well.

Additionally, make sure that all entries in this table have 1 decimal point.

We have added the walking only scenario outputs to table 1. Decimal points were also added to all entries for consistency. Regions are shown in Figure 1, panel I

Page 11, Lines 44-49: May want to place this ‘subtraction’ description back in the methods when talking about the uncertainty analysis (around Page 9, Line 17).

The manuscript was edited accordingly. The “subtraction” description was integrated in the paragraphs explaining the methods behind the uncertainty analysis (page 9).

Page 12, Line 10: In reference to the sentence, "Large differences in coverage are found between regions.", is there any heterogeneity in coverage between any of the regions? I'm assuming there is, and this may need to be mentioned (briefly) in the text.

We added a brief description in order to illustrate the differences in coverage in between the regions.

Discussion

Page 12, Line 29: Say "motorcycle-taxi" instead of "taxi-moto", to keep consistent.

The manuscript was edited accordingly.

Page 12, Line 36: I noticed that there was a discussion for 'walking' in general. However, I'd assume that someone who's being carried, compared to someone who's walking, would move a little slower. I wouldn't necessarily mention being carried unless the authors did a carried-specific scenario.

When we asked experts to define travel when motorized transport isn't available, we asked participants "what is the average speed for a pregnant woman walking or being carried?". We thus assumed that both ways of traveling result in the same travel speed. Indeed, we assumed that the slower pace at which a pregnant woman in search of emergency obstetrical care travels is similar to the slower pace of a person being carried on, for instance, a stretcher.

We do agree that this is a simplification of reality. In the same logic, we don't account for differences in travel speeds at different periods of a pregnancy, nor do we account for difficulty of travel in regard to the type of obstetrical complications one might be facing. Indeed, we can easily assume that, depending on the obstetrical complication, speed of travel may or may not be strongly impacted.

We rephrased the sentence to: "For women who have no access to motorized means of transport, accessibility [...]", insisting on the inaccessibility of motorized transport.

Page 12, Line 40: What is defined as "low access to EmONC" in this case? Is it that very little of the population is within 1-2 hours of access, or something else? This is the first time that I'm seeing this indicator.

We agree that this sentence lacks clarity to say the least. What we mean here by "low" access refers to all people that have to travel more than 2 hours to access the nearest EmONC, which is the maximum amount of time one should take to reach the nearest facility according to the WHO, as mentioned in the introduction on page 4.

For more clarity, we changed the sentence to read: "Thus, nearly half of the target population does not have access to EmONC in the maximum acceptable travel time if they cannot afford to travel by motorized means of transport."

Page 12, Lines 43-48: Could rewrite as, "Access to EmONC is greater for urban populations, even with substantially decreased travel speeds, due to a higher density of both EmONC facilities and road networks in urban areas."

The manuscript was edited accordingly.

Page 12, Line 50: Once again, describe the difference between the 2013 and 2018 facilities.

We added some details on the population coverage of the 2018 network.

Page 12, Line 51: What is defined as “good overall geographic accessibility”?

Our wording was indeed not adequate, and we rephrase by "... achieves high overall geographic accessibility "

Page 12, Lines 59-60: What does "over the next short-term programmatic cycle" mean, and which programmatic cycle is being described? That observed by the MoH, UN, or something else?

We had already explained it at the end of the "Study site and context" section, but to clarify it here we edited the sentence to read: "..., i.e. the next MoH programmatic cycle (i.e. 3-4 years). "

Page 13, Lines 21-28: I like this conclusion sentence! However, I would also caution the authors that parenthetical statements can be eliminated, or written as another sentence.

Thank you for this positive feedback ! We agree with your comment on parenthetical statements, and have thus decided to create a second sentence to solve this issue.

Limitations

Page 13, Lines 36: Does this national network encompass both government and NGO facilities? Not clear - need to describe the network a little more.

Yes, both government and NGO facilities were considered. This is now mentioned earlier in the description of the network in the "Study site and context" section.

Page 13, Lines 39-41: Would including this have been relevant to the paper? If this was clearly defined in the intro, there shouldn't be any implication that the person needs to expect this type of analysis.

We have often been asked in previous studies to mention that other types of barriers – financial ones or acceptability – were not accounted for and could constitute limitation to our studies, so we prefer to mention them here. However, we agree the sentence was not very clear, and we modified it as: " Although the three alternative transport models were created to acknowledge that motorized travel is not financially possible for some, there are additional financial barriers – such as formal and informal expenditures for health care – that our models do not address."

Page 13, Line 48: “findings transport” should be “finding transport”.

The manuscript was edited accordingly.

Page 14, Lines 12-15: It sounds like most experts came from Lomé to begin with - did I understand this correctly?

It is now clarified earlier in the manuscript that experts were coming from all regions of Togo, with a good overall knowledge of care-seeking behaviour of the target population, but they were not necessarily experts on on-road and off-road speeds. That's why we wanted to clarify here that a dedicated workshop with truly regional road experts could help improve the model and its uncertainties. To make it clearer, we

have modified the sentence as. "This could be captured by a dedicated workshop with regional experts having a thorough knowledge of the road network, providing ..."

Page 14, Line 20: "Non-functional facilities" should have been described at the beginning.

We are now defining a functioning and non-functioning EmONC facilities much earlier, at the end of the "Study site and context" section. Note that "functioning" is the right term (not "functional" as we wrongly put it initially).

Page 14, Lines 24-25: Are the authors claiming here that a national network of functional EmONC health facilities is needed to help decrease maternal mortality/morbidity?

We agree that it was a long and convoluted sentence. We have now split the sentence in three parts, and rewrote parts of it.

Page 14: Line 32: Write "up-do-date" as "up-to-date".

The manuscript was edited accordingly.

Page 14, Line 36-38: Do you want to describe a "dedicated publication" specifically in this paper?

We have rewritten the sentence as "This will be the subject of a forthcoming publication."

Page 14, Line 60: What is defined as "good availability" of the high-resolution geospatial datasets?

We rephrased the sentence with " ... thanks to the current online availability of key high-resolution geospatial data sets "

Bibliography - for Reference #18, the journal is actually, "Global Health: Science and Practice".

The manuscript was edited accordingly.

Figure legends

Figure 1: May want to describe what "GRUMP urban extents" stands for.

The manuscript was edited accordingly.

Figure 2: Is the walking scenario not being shown in the figure?

As both reviewers had the same comment on the absence of the walking scenario maps in the core of the manuscript, we have updated figure 2 to show all three scenarios at both time periods.

This update has also made Supplementary 3 (walking scenario maps) useless. We have thus deleted supplementary 3

Figure 3: Define more clearly here that "landcover uncertainty" are off-road travel. Readers may get confused here.

The manuscript was edited accordingly.

Supplementary Material

Supplement 1: May want to add an extra column for English-language labels. Not sure how the journal editors feel about this, but this could be something that someone will pick up upon.

We agree with this statement. The supplement was modified accordingly.

Supplement 2: So, this is the first mention I've seen of resampling spatial data - which I was under the impression wasn't the best approach to take. As I recall it, resampling is being used in this case to create a finer resolution for a raster - which is dangerous because it makes assumptions on the data. Better practice is to go to the most coarse resolution - so that you're not making assumptions on the data. Is there any reason the authors chose to resample here?

We fully agree with your statement, which is why we did not resample to a finer resolution, but we actually aggregated the 90m grids to the coarser resolution of 100m. Although the landcover dataset was sent to use by INSEED at 100m resolution, our other raster datasets (population and elevation) were at approximately 100m resolution at the equator (or 3 arc seconds), which is approximately 92 meters resolution in the region of Togo.

We clarified this in the text, and now use the word "aggregation". WE are also clarifying which data sets are vector or raster.

Supplement 3: What happened to non-asphalted primary roads?

Tracks are simply not shown on the map. But we agree that this choice creates confusion. We solved the issue by simply not showing roads on the travel time maps, as was done for the travel time maps for the two other scenarios.

Considering both reviewers think that the walking scenario should also be shown in figure 2, this supplementary has been removed.

Supplement 4: Given that the prefecture was NEVER assessed or described for in this analysis, I'm kind of surprised that this analysis is being shown here. It also seems that the walking analysis will not be shown here - why is that not the case? Lastly, please make sure that all decimals are represented in this table, and that there's no rounding in this table.

Walking-only scenario results were added to the table, and all missing decimal points have been added. This table on prefecture population coverage was given only for references, in the case readers would be interested to get the Figure for a particular prefecture.

Supplement 5: I think the authors meant that the "first figure" is the left-hand side of the table, while the "second figure" is the right-hand side of the table? This could be more clearly described. Also, please fix the decimals in all of the numbers!

We agree that the description for this table is unclear. When we mention the "first figure" and "second figure", we are referring to the numbers included in each cell (separated by a '/').

We modified these lines to read as follows: "In the table below, each cell is composed of two results. The first figure takes slope correction into consideration, while the second figure does not take into account the slope correction".

Reviewer: 2

Dr. Orvalho Augusto, Eduardo Mondlane University

1. As many analyses of this kind do is failing to account for the seasonal disruptions to the road network. Which is becoming more common due to climate change. The authors mention this in the limitations but it should be said more earlier in the manuscript. The 20% uncertainty may not be enough to capture this. Was this discussed in the 2 workshops mentioned in page 9 line 6 to 33?

We thank the reviewer for his positive feedbacks.

We agree that seasonality is an important component, and we always discuss it with participants of such workshops. In Togo, the participants present during the workshops recognized that indeed travel times indeed increase during the wet season (ie. travel speeds decrease), but they decided to work (and based their planning) only with the dry season scenario which is the longer season.

The 20% uncertainty that we incorporated was mainly to account for the uncertainty in travel speeds to variable road quality, traffic, and uncertainty inherent to the expert knowledge elicitation. It's true that this could also incorporate some of the speed variations of the wet season, but this would warrant a dedicated study to capture it well and was beyond the scope of our study.

To clarify, we added the following sentences in the "Accessibility & population coverage modelling" section: In both workshops, participants recognized that during the wet season the speeds of travel generally decrease in many areas. However, they decided to use only a dry season scenario to guide planning as this is the longest season in Togo (around 8 months)."

We also refined our sentence in the Limitations section: "Second, the workshop participants decided to model travel during the dry season conditions. The extent of the degradation of road conditions could not be captured in certain parts of the countries during the wet season, and these is known to heavily affect travel time."

2. I believe there is a bit of confusion of figure labeling. For example, figure 1F mentioned in page 11 line 5, seems to be figure 1E. Can you check this.

There was indeed an error here. We corrected this in the manuscript.

3. The walking-only scenario is important. Yes, it may not have changed from 2013 to 2018. But please bring it from the supplements to somewhere on figure 2.

We agree with this comment, which is also a comment that reviewer 1 made. We have thus decided to present the walking scenario maps in the core of the manuscript. Figure 2 was thus updated accordingly.

4. We discover that this study is for Togo first and may be applied to elsewhere in SSA in the methods. Please put some intro of Togo in the introduction as well.

We added a sentence on Togo in the last paragraph of the introduction, insisting on socio-economic context and deaths linked to obstetric complications.

Note to both reviewers on additional changes made

- in the third paragraph of the "Study site and context" section, we identified an error in the reported proportions of EmONC facilities applying vacuum extractions. We changed this to: "...the proportion of EmONC facilities applying vacuum extractions from 24% in 2014 to 43% in 2016,..."
- We have made small edits and corrections of typos in various places.
- There were several erroneous references to Figure2 panels in the section "Input geospatial data", and due to the request from the Editor to cite the panels in the text in the same order they appear in the Figure (A to I), we had to change the order of the description of the various data sets.

VERSION 2 – REVIEW

REVIEWER	Schmitz, Michelle Centers for Disease Control and Prevention
REVIEW RETURNED	10-May-2021

GENERAL COMMENTS	<p>I have read the comments from the authors regarding Dr. Augusto's last review and my own review, and am satisfied that all of our salient points were sufficiently revised. Please note that while I have included some VERY SMALL technical/grammatical revisions here, I do not think that these revisions constitute a "minor revision" in the manuscript publishing sense.</p> <p>ABSTRACT</p> <p>Strengths and limitations of this study mentioned the uncertainty analysis, which was dropped from the abstract of the study. I think it is still appropriate to keep the mention of the analysis in the strengths and limitations section, but the authors should be aware of this. (Personal note: I would also rewrite to: "...and associated uncertainty analyses assessed relative effects of travel speed.")</p> <p>INTRODUCTION</p> <p>Please cite the section which said that, "three-quarters of maternal deaths are due to direct obstetrical complications". I know that this might be known as fact, but it would be strengthened with a citation.</p> <p>Minor revision: "This national network encompassed both government and NGO facilities, and its selection was done by considering several pieces of information on each facility: high obstetric activity (i.e., favoring those with more than 30 deliveries/month)..." (added "by" and "high").</p> <p>Minor revision: "A non-functioning EmONC facility has failed to provide one or more EmONC signal functions during that same period." (added an "s")</p> <p>Minor revision: "...applying an anisotropic analysis (i.e. considering the slope of the terrain to accurately model bicycling and walking speeds)." (added parentheses around the i.e. statement)</p>
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Minor revision: "In both workshops, participants recognized that during the wet season, the speeds of travel generally decrease in many areas. However, they decided to use only a dry season scenario to guide planning as this is the longest season in Togo, around 8 months." (removed parentheses and added comma in this case).

Minor revision: "This highlights the areas in the country where the travel time results with the most uncertainty." (rewrote latter part of the sentence)

Input geospatial data: Separate out the two phrases into separate sentences in, "Various datasets were assembled and prepared to run the geospatial analyses in AccessMod (details of the preparation steps are found in Supplement 2)."

RESULTS

Minor revision: "Despite a reduction of the number of EmONC health facilities by one-third from 2013 to 2018, the population able to physically access the closest EmONC health facility within one or two hours is only marginally lower compared to the 2018 prioritized network." (changed preposition)

Table 1: Would reword scenarios to, "Walking & motorized scenario", "Motorcycle-taxi-only scenario", and "Walking-only scenario". If you don't want to reword that, you might want to make it more explicit that motorized = motorcycle taxi.

Minor revision: "As expected for the walking-only scenario, national population coverage of the 2018 network notably drops to 33.4% within 1-hour walking, and 50.8% within 2-hour walking."

Minor revision: "...the coverage percentages do not exceed 40% for all the other modelled regions." (changed wording)

DISCUSSION

Minor revision: " However, from a planning perspective, prioritizing the EmONC functionality of 73, rather than 109, facilities is a more feasible, achievable goal for the next MoH programmatic cycle (i.e. 3-4 years).

Limitations:

Minor revision: "Acceptability (i.e. "the match between how responsive health service providers are to the social and cultural expectations of individual users and communities", as mentioned in Peters et al.[37]) was also not considered."

Would cite the DHIS2 source mentioned here, "The quarterly monitoring of the national network of EmONC health facilities in Togo started in 2015, and was included in the health management information system (DHIS2) in 2020. This provides up-to-date information on the functionality of EmONC health facilities."

	<p>Citations:</p> <p>21 - The citation should read, "The World Bank Group", not "the World Bank".</p> <p>Figure 1 - These are good visualizations in general, although it is slightly more difficult to visualize differences in patterns between the 2013 and 2018 population density rasters.</p>
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VERSION 2 – AUTHOR RESPONSE

Reviewer: 1

Dr. Michelle Schmitz, Centers for Disease Control and Prevention

ABSTRACT

Strengths and limitations of this study mentioned the uncertainty analysis, which was dropped from the abstract of the study. I think it is still appropriate to keep the mention of the analysis in the strengths and limitations section, but the authors should be aware of this. (Personal note: I would also rewrite to: "...and associated uncertainty analyses assessed relative effects of travel speed.")

INTRODUCTION

Please cite the section which said that, "three-quarters of maternal deaths are due to direct obstetrical complications". I know that this might be known as fact, but it would be strengthened with a citation.

We added citation no 21 that quantified direct obstetrical causes and is the main citation for this.

Say L, Chou D, Gemmill A, et al. Global causes of maternal death: a WHO systematic analysis. The Lancet Global Health. 2014;2(6): e323-e333.

Minor revision: "This national network encompassed both government and NGO facilities, and its selection was done by considering several pieces of information on each facility: high obstetric activity (i.e., favoring those with more than 30 deliveries/month)..." (added "by" and "high").

The manuscript was edited accordingly.

Minor revision: "A non-functioning EmONC facility has failed to provide one or more EmONC signal functions during that same period." (added an "s")

The manuscript was edited accordingly.

Minor revision: "...applying an anisotropic analysis (i.e. considering the slope of the terrain to accurately model bicycling and walking speeds)." (added parentheses around the i.e. statement)

The manuscript was edited accordingly.

Minor revision: "In both workshops, participants recognized that during the wet season, the speeds of travel generally decrease in many areas. However, they decided to use only a dry season scenario to guide planning as this is the longest season in Togo, around 8 months." (removed parentheses and added comma in this case).

The manuscript was edited accordingly.

Minor revision: "This highlights the areas in the country where the travel time results with the most uncertainty." (rewrote latter part of the sentence)

After some exchange with the reviewer (Michelle Schmitz), we eventually changed the sentence to "This highlights the areas in the country where the travel time estimates have the most uncertainty."

Input geospatial data: Separate out the two phrases into separate sentences in, "Various datasets were assembled and prepared to run the geospatial analyses in AccessMod (details of the preparation steps are found in Supplement 2)."

The manuscript was edited accordingly.

RESULTS

Minor revision: "Despite a reduction of the number of EmONC health facilities by one-third from 2013 to 2018, the population able to physically access the closest EmONC health facility within one or two hours is only marginally lower compared to the 2018 prioritized network." (changed preposition)

The manuscript was edited accordingly.

Table 1: Would reword scenarios to, "Walking & motorized scenario", "Motorcycle-taxi-only scenario", and "Walking-only scenario". If you don't want to reword that, you might want to make it more explicit that motorized = motorcycle taxi.

The description of the three models (in the second paragraph of the section "Accessibility & population coverage modelling") is very explicit about what "motorized" means and what are the three scenarios. So we prefer not to change the names of the scenarios in this table, to keep the consistency of scenario names across the manuscript.

Minor revision: "As expected for the walking-only scenario, national population coverage of the 2018 network notably drops to 33.4% within 1-hour walking, and 50.8% within 2-hour walking."

The manuscript was edited accordingly.

Minor revision: "...the coverage percentages do not exceed 40% for all the other modelled regions." (changed wording)

The manuscript was edited accordingly.

DISCUSSION

Minor revision: " However, from a planning perspective, prioritizing the EmONC functionality of 73, rather than 109, facilities is a more feasible, achievable goal for the next MoH programmatic cycle (i.e. 3-4 years).

The manuscript was edited accordingly.

Limitations:

Minor revision: "Acceptability (i.e. "the match between how responsive health service providers are to the social and cultural expectations of individual users and communities", as mentioned in Peters et al.[37]) was also not considered."

The manuscript was edited accordingly.

Would cite the DHIS2 source mentioned here, "The quarterly monitoring of the national network of EmONC health facilities in Togo started in 2015, and was included in the health management information system (DHIS2) in 2020. This provides up-to-date information on the functionality of EmONC health facilities."

It's true that mentioning DHIS2 here comes a bit out of the blue. DHIS2 is a tool, and it actually does not bring anything to mention it here. We therefore removed its mention.

Citations:

21 - The citation should read, "The World Bank Group", not "the World Bank".

Figure 1 - These are good visualizations in general, although it is slightly more difficult to visualize differences in patterns between the 2013 and 2018 population density rasters.

The manuscript was edited accordingly.