Reviewer’s report

Title: Tracking Pregnant Women Displacements in Sao Paulo, Brazil: A Complex Systems Approach to Regionalization through the Emergence of Patterns

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Reviewer: Joachim Sturmberg

Reviewer's report:

This is important work, however, the current presentation lacks sufficient clarity in terms of the appropriate use of concepts/terminology, and the clarity of describing the contextual nature of the issues described as much as some limitation of the analysis. To have an impact the paper needs to describe the contextual features of the study region in more detail - place, seize and level of obstetric services in each area, morbidity and mortality of outcomes in each hospital, how these relate to the severity of obstetric problems, and how does this compare to the rest of Brazil and the world. The findings suggest that there are a number of strong recommendations arising from the study that need to be spelled out clearly. I am looking forward to seeing a revised manuscript.

The major issues include:
the use of complexity - in the background, the use of "high complexity hospital" is a meaningless term, while the use of "more complex networks of interactions" uses "complex" in its proper meaning. It is a common mistake to attribute something complicated/hard to understand with complex - the distinction between the colloquial use of the term is inappropriate in a scientific paper.

In the study of the complex health system, the emergence of patterns can be used as a guide to the underlying dynamics that force adaptations to the system, breaking down complex interactions to its parts 5, conducing to failures interpreted as "policy resistance" 6 or "turbulence" (4).

it is not clear what this means - breaking down is a reductionist approach and not a feature of complexity study

Still, most states are too large 143 to be managed as a unit, while most municipalities are too small to sustain complex health services.

I don't think that this is really the case. Firstly, there is a misuse/contextualized of the the term "complex health services". Secondly, while scale has important impacts, it is not the complexity of the health services but rather the capacity and capabilities inherent in a local service that matters. These
issues have been explored in detail in Sturmberg - Health System Redesign (2018), and Sturmberg et al - Health and Disease (2019), explaining how top-down constraining effects of higher level organisation limit what lower levels of organisation can achieve. the paragraph ending line 400 really requires reference to these concepts to make sense of these observations.

in line 154-158, it needs to be acknowledged that many hospital practices have led to overuse of interventions with negative outcomes, i.e. high rates of CS

in the following paragraph it needs to be acknowledged that "effectiveness and appropriateness" are at least as important as efficiency, and again that overuse and harm are real even if unintended issues the paragraph ending in line 199 misses important context - what are the rates of natural, assisted and surgical deliveries? how do they compare to expected rates? what are the specific morbidity and mortality rates in the study region? how do they compare to the rest of the country/other regions with similar and different SES characteristics/world

as does paragraph ending line 301 - it requires contextual data

line 210 - the paper does not provide "proposed modelling" it provides mapping of the "dynamics of the local/study system"

The present study shows that this municipal capacity is contrasted by the fact that none of the three micro-regions achieves enough autonomy, showing the need for further sub-regional consolidation. The intensity of flows crossing the three micro-regions of DRS XIII show that this micro-regional division is not able to adequately organize the flows of these pregnant women.

this is unclear, micro regions have not been defined clearly. Figures 1-3 do not show the hospital locations and their service level capabilities which makes it hard to follow the observations and arguments

Alves27 proposed the use of the concept and metrics of entropy (disorder) to measure the regulation of the flows of patients needing admissions in other municipalities. He found that the change from four to three micro-regions in DRS XIII in 2007 was linked to a greater order (expressed as less entropy) of the flows that presented improved coherence between places of origin and destination in the new regional design.

this is interesting, but entropy measures have not been demonstrated in the results section. It may well be appropriate to discuss it here for the first time, but it would need to be related directly to the findings rather than currently as a broad-brush statement

line 427 discusses demand, however, this is only one side of the equation, it must be juxtaposed to the
"need" or "appropriateness" of service and service delivery

Basic Obstetric Care and
450 Comprehensive Obstetric Care can help to find a technical quality parameter. Basic obstetric
451 care includes procedures that provide for safe simple deliveries, while comprehensive
452 obstetric care adds the ability to perform cesarean sections and the blood transfusion service.
453 The five major causes of maternal mortality in developing countries (which together account
454 for 99% of maternal mortality in the world) are hemorrhage, septicemia, unsafe abortion,
455 eclampsia and obstructed labor53-54.

this is important but not demonstrated in the results - there should be a figure to overlay the flows with
rates of actual complexity of birth, as well as rate of complications

Conclusions - there is a lack of pragmatic recommendations - what should be changed to achieve the
desired outcomes of "effective, efficient and equitable" obstetric care for the study region

minor points:
line 168 - it should be closely rather than closer
line 187 - it should be urgent rather than urgency
line 195 - it should be closely rather than closest
the column headings in Table 1 are not clear
line 355 - it should be we used rather than it was used
line 383 - I think you mean "key drivers" i.e. agent characteristics, relationships and dynamic
behaviours rather than mechanisms
line 392 - I think you mean concordant rather than coincident
line 432 - shortage and small scale - the latter is not clear in meaning
line 460 - I think the or should be and

it would be helpful to provide a figure to illustrate network principles - edges, arcs, vertices as many
readers will not be inherently familiar with these important concepts

figures 5 and 6 were not attached in the manuscript

definitions of high/low complexity of service need to be clearly explained

Are the methods appropriate and well described?
If not, please specify what is required in your comments to the authors.

Yes
Does the work include the necessary controls?
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Not applicable

Are the conclusions drawn adequately supported by the data shown?
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