Reviewer's report

Title: Single versus multivariate deprivation indices in resource allocation formulae: the case of the district resource allocation formula in Malawi

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Reviewer: Diane McIntyre

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This manuscript deals with a very important issue, namely promoting equitable allocation of limited health care resources. This is particularly important in countries such as Malawi that have extremely limited tax revenue and donor resources. However, there are some fundamental misconceptions and difficulties with the analyses that need to be addressed.

The key issues that must be addressed (major compulsory revisions) include the following:

Firstly, there should be a clear statement on internationally accepted indicators of relative need for health services for inclusion in resource allocation formulae (some of the references included in the manuscript outline these indicators). The reason for raising this issue is that the authors appear not to regard population size in each district as an indicator of need in relation to the equitable allocation of resources. For example, on page 8 it is stated that “Until 2000/01, the allocation of district health funding was determined purely based on population and as a result, allocations were directly proportional to district populations. This ignored equity considerations in resource allocation”. Population size is in fact the primary indicator of relative need for health services. This issue can be very simply addressed by including a summary of internationally accepted indicators of need, and going through the manuscript to identify places where they have not recognised population as being a key indicator of need.

Secondly, there is a fundamental misconception about the notion of deprivation and the authors conflate deprivation indices with asset indices (throughout the manuscript, the authors use the terms ‘deprivation index’ and ‘asset index’ inter-changeably – e.g. page 11: “Using assets as in the deprivation index”; page 12: “The deprivation index … where aik is the value of asset k …”; page 14 “To calculate district deprivation indices, individual asset indices were aggregated”). Although the paper claims to focus on deprivation indices, the authors develop a composite index comprising only indicators that are traditionally used in ‘asset indices’. The concept of wealth, as measured by asset indices, is fundamentally different to the concept of deprivation. Deprivation is not only related to the absence of ‘wealth’, but also to social deprivation (such as social isolation due to being an elderly person living alone, or being a single mother). Although there are some variables in common between asset and deprivation indices, there are also fundamental differences. The authors correctly define deprivation as “social
and material disadvantage, where material and social conditions experiences by individuals and households are inadequate compared to what is usually experienced in society”. They also state that measurement of deprivation includes socio-economic and demographic indicators. However, the indicators included in the composite index do not reflect the full range of deprivation concepts. This again can be relatively simply addressed – it is not essential that a ‘deprivation index’ as opposed to ‘an asset index’ is used in a resource allocation formula (either can be used as a proxy indicator of relative socio-economic status). It is simply necessary to remove all references to deprivation and deprivation indices from the manuscript (including the title) and replace them with the terms ‘asset’ and ‘asset indices’.

Third, it does not appear that the analysis presented meets the stated objective. The stated objective of the analysis is to assess whether it is preferable to use a multivariate index rather than a single indicator of socio-economic status for inclusion in a resource allocation formula. The way to assess this would be to analyse the extent to which a single indicator reflects the same distribution of relative socio-economic status as a more ‘complex’ or ‘inclusive’ composite index. This is very simply accomplished by running a correlation between the single indicator and the composite index.

Finally, the analysis of implications of alternative formulae for district allocations should focus on comparing a formula that include a single indicator of need for health care (population size in each district) with formulae that include more than one indicator of need (population size in each district as well as relative levels of ill-health as proxied by mortality rates and/or relative socio-economic status as proxied by an asset index and/or differential costs of service provision in each district, etc.).

I would encourage the authors to make the above revisions. Not only do I believe that this would make the paper worthy of publication but also that it would be of value in advancing the resource allocation policy processes in Malawi

**Level of interest:** An article whose findings are important to those with closely related research interests

**Quality of written English:** Acceptable

**Statistical review:** No, the manuscript does not need to be seen by a statistician.

**Declaration of competing interests:**

I declare that I have no competing interests