Reviewer’s report

Title: The cost determinants of routine infant immunization services: a meta-regression analysis of six country studies

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Reviewer: Benjamin Johns

Reviewer’s report:

The authors put considerable work into standardizing immunisation cost data from 6 countries in order to estimate cost functions. The presentation of methods and results is well written and clear, and the authors are careful to interpret the results within the limitations of the data. A few comments for the authors to consider:

The data are cross-sectional for each country, and the cost functions then likely represent short-run average costs curves (as far as I can reason it out). To some extent this depends on whether we consider each health facility a "plant" (i.e., production units) with its own short run average cost curve, or whether we consider each country a "plant" with their own short-run average cost curve. To the extent that the authors try to measure facility 'coverage' in sensitivity analysis, they are implying that each facility should be a plant. I am not 100% sure, but I would think that this implies that the random-effects should be applied at the facility level (rather than higher levels). Since the authors use higher level random effects, they are implying that countries/provinces are "plants", but the presentation of the results does not couch the interpretation of these models in ways that help me distinguish what may or may not be long vs. short run cost curves, and I am simply confused as to what is being measured by the various coefficients.

This concept of long vs. short run is not mentioned in the manuscript, nor the implications of measuring short-run vs. long-run costs curves. Typically for public health programs, the primary goal is to provide high coverage, whether or not the coverage level is optimally efficient from a unit cost point of view. Rather, the goal often likely is to have a given level of coverage (or target level of coverage) and from there determine what the most efficient method of production. It seems to that the long-run average cost curve would be most useful for these kinds of decisions. Simply recommending larger sites (since the data on coverage at site level is inconclusive) does not strike me as overall terribly useful.

In any event, I think the paper would benefit from at least some theoretical discussion at the beginning of what it is exactly they are trying to estimate, and what information/decisions are informed by what they are trying to estimate. This may be largely an abridged rehash of intermediate microeconomics concepts, but I think it would be useful for most readers of a public health journal trying to understand the implications of this research.
The authors should check the language after they have done this. For example, Page 17, lines 7-8 (& page 19 line 41) may need to be "increasing returns to scale" rather than "economies of scale" (the latter being a long term concept). Or maybe not.

With respect to the conclusion that there are strong economies of scale (or what have you), and strong evidence for this, I am not completely sure that I agree with the authors. The sign of the variable "log(doses) sq" changes between models 4 and 5, which seems to imply switching whether the overall function has a negative vs. positive slope (at least across the output observed)?

-Missing in discussion: Overall variation in Ghana is quite large for a given number of doses (especially under 10,000 doses) as compared to Benin (visual inspection of Figure 1 is a bit difficult because of the differences in the units on the axis). Further, in all countries except Moldova, sites with <5,000/10,000 (depending on the country) total doses had unit costs that were as low as sites with high numbers of total doses, indicating that low unit costs are possible in all but the lowest service volume sites - it would seem like understanding the differences in average costs at low volume sites might be a priority for future research. The authors could expand this a bit. How much of this variation [at low service volume sites] disappears once the other factors controlled for in the regression are accounted for? How much resources could be saved if high cost / low volume sites could find ways to reduce their unit costs similar to other low volume sites? I think this kind of data - while a bit of speculation - would highlight the extent to which this type of research might be useful / valuable.

-Table 3: should explicitly state what the numbers in parenthesis represent (presumably the standard error)

-Total costs model 5: It is not clear to me if the random effect is for the intercept or a country-level random slope for log(doses)?

**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?**
If not, please specify which controls are required in your comments to the authors.

Yes

**Are the conclusions drawn adequately supported by the data shown?**
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Yes

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