Author's response to reviews

Title: Need-based resource allocation: Different need indicators, different results?

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Author's response to reviews: see over
Dear Editor,

We are grateful for detailed thoughtful comments from three reviewers. The primary thrusts of our revisions were to more clearly emphasize the unique and important aspects of our research. The comments of all three reviewers stressed that we need to do a better job drawing out what is unique and surprising about our results, and to better emphasize the policy relevance of our results. We also conducted some reanalysis of the data to reduce omitted variable and endogeneity bias that may result from supply, access and unmeasured need variables.

Response to Eyles

This research is highly relevant to the current policy debate in Canada; however, given the international focus of the Journal, we had, in our first submission, focused on the methodological issues and downplayed the Canadian policy relevance in the reviewed version of the paper. We agree with the reviewer that drawing the Canadian policy relevance out more clearly would strengthen the paper. The last Canadian federal budget stipulated a plan to shift allocation of federal health transfer payments to the provinces to a strict equal per capita funding formula. In light of these changes, assessing the equity of this approach is vitally important. Moreover, recent evidence on income inequalities in health care use in Canada have found that inequality is largely due to inequality between provinces, rather than intra-provincial inequality (see the Jimenez-Rubio et al paper now added to the refs). This provides further impetus for studying how to allocate federal funding according to need.

We have thus made revisions to more clearly draw out the Canadian policy relevance of our study in both the background and discussion section of the paper. Moreover, we believe that aspects of the Canadian context also make this study more interesting from a methodological basis, as we explain in the background of the paper. We hope that the revisions clarify why it is important to study relative need between provinces (as opposed to relative need between regions within provinces) from both a methodological and policy perspective.

As noted by the reviewer, there has been considerable debate as to the role of utilization in resource allocation models. In our analysis, utilization data are used in modeling to establish a standard, but differences in allocation exclusively reflect differences in the distribution of need indicators between populations. Indeed, the approach we use is fully consistent with the framework for needs-based planning described in Birch, Kephart et al. (see the references), which as in all of Birch’s work, warns against using differences in utilization between regions to measure need. We have made revisions in the methods to try and make this point clearer.

Response to Dixon:

We disagree with the reviewer’s assessment that the results of this study were “unsurprising”. In particular, a surprising and important finding from our study is that an allocation model based on survey data, and using age and sex, chronic disease and health status as need indicators, produced strikingly different results for some provinces than did a model using age, sex and premature mortality ratios as need indicators. Given that the provinces with high premature mortality rates also have lower life
expectancy, this raises concerns about the validity of the allocations generated by survey data. In the discussion section, we offer a number of plausible reasons that may account for this discrepancy. Given the widely accepted use of survey data for allocation models, the publication of these results are important to researchers and policy makers interested in needs-based resource allocation models.

Moreover, in the Canadian context, the results of this study provide important evidence that allocating federal health care funding to the provinces on an equal per capita basis may be inequitable. We agree that this aspect of the results is not surprising to researchers working in this area, or for that matter to policy makers in countries such as the U.K., where needs-based approaches to allocation have been widely adopted. However, it speaks directly to current policy issue in Canada, which is also relevant to other countries and regional health authorities that do not employ needs-based approaches to allocate resources. At this time, federal government policy in Canada is, in fact, advocating equal per capita allocation of health care transfer payments as equitable. Peer-reviewed, published evidence to the contrary is important.

This reviewer states that a primary weakness of our study is the reliance on survey data which "contains information on only 111,000 or so of the population", which makes "ecologic fallacy a problem". The issue of an ecologic fallacy, which results when inferences about associations at the individual-level are made using area level data, does not apply here. Our models are estimated with individual-level data. As for the statistical power of the sample, the CCHS has an unusually large sample size that was designed to provide provincial and sub-provincial estimates of key variables. For our purposes, it provides a very high level of precision in our models. The sample for our analysis included a minimum of over 3200 subjects in the least populous provinces (the population of Prince Edward Island is only about 350,000) to a maximum of over 34,000 in Ontario. To put the size of the CCHS into international perspective, the last Health Survey of England interviewed just over 17,000 persons age 16 and over to make inferences about a population of about 60 million, and the last US National Health Interview Survey interviewed 296,000 persons to make inferences about a population of over 300 million persons in 50 states. The CCHS had a sample size of 133,000 persons to make inferences about a population of only 30 million in 13 provinces and territories. Statistical power is not a problem in our analysis.

Another concern raised is that the study uses self-report data on health care utilization. Unfortunately, administrative data on health care utilization have not, to this point, been linked nationally with the CCHS data (although Statistics Canada is working to do this for hospitals), and even if linked data were available, they would provide incomplete and potentially incomparable data on the use of physician services. Physician claims data are not directly comparable between provinces, and only include data for physicians paid fee-for-service (alternative payment of physicians is increasing rapidly in Canada). There is some risk that self-report utilization data produced some bias, and we have discussed this clearly in the limitations section of the discussion. However, given the literature on accuracy of self-report bias in utilization data, we think it is unlikely that our study conclusions would be affected by this limitation.

We were not able to include supply measures because comparable data on supply across provinces are not publicly available. The lack of measures of supply and access as non-need factors may result in bias
in the effects of need variables in the model. However, we do not think that this bias would alter the results of the analysis. Since the regression models estimate the average level of services use by level of need in the population, one would expect that variations in utilization at a given level of need due to supply factors would tend to be cancelled out across high and low supply areas. Indeed, we compared results obtained from models that were and were not weighted by the CCHS sample weights. The results were similar, and the conclusions robust. Since weighting, in effect, alters that contribution that regions make to the analysis (and in the CCHS, it does so dramatically), this provides evidence that variations in supply across areas are unlikely to affect our results. In addition, we have adopted the approach suggested by one of the other reviewers of including dummy variables for sub-provincial regions in the model. These regional fixed effects pick up unobserved need and non-need variables that are associated with the regions, and should help to reduce omitted variable and endogeneity bias on the need variables in the model. The revised paper and results now include this analysis. It did not alter the conclusions of the paper.

**Response to Sutton**

Major compulsory revisions:

1. **Address similarities with the paper by Jimenez-Rubio et al., and ensure that our work is distinct:**

   Thank you for suggesting we have a look at this paper. Although it uses the same survey data, there is no overlap with the analysis of this paper. It measured income-related inequality in health care utilization, and decomposed it into within and between provinces. However, the results of their study strengthen the relevance of our study and we incorporated it in the background and discussion to the paper.

2. **Approach 3, which uses premature mortality rates “is rather a `straw man’ in this paper and I would recommend deleting it.”**

   Your points about the use of the premature mortality rate as a sole need indicator are well taken. It was not our intent to present the premature mortality rate model (Approach 3) as a viable model, but as a point of comparison for assessing the validity of Approach 2. We have revised the paper to make this clear. Approach 3 provides a broad and fundamentally different measure of need than the survey based indicators used in Approach 2. Deciding what coefficient to attach to the premature mortality ratio is, of course, problematic, and the choice of a coefficient of 1.0 is rather arbitrary. Nevertheless, given the broad scope of the premature mortality ratio as a need indicator, one would expect models using this need indicator to correspond, at least in direction, with Approach 2.
Viewed in this way, we think that comparisons between Approaches 2 and 3 provide one of the most surprising and interesting results of our analysis: an allocation model based on survey data, and using age, sex, chronic disease and health status as need indicators, produced strikingly different results for some provinces than did a model using age, sex and premature mortality ratios as need indicators. What should we make of the fact that the province of Newfoundland, which has the highest premature mortality rate (and also the lowest life expectancy) is shown by Approach 2 to have the lowest level of need? A similar paradox exists for Quebec. In the discussion section, we offer a number of plausible reasons that may account for this discrepancy.

3. I did not understand why age-sex interactions were not included in Approach 1.

This was an omission. Thanks for catching this. They are now included in the models.

4. “Justification is required for why the analysis focuses on adults age 20+ and not in the Northern Territories.”

We have clarified this in the revised manuscript. We thought that estimating standard levels of health care utilization for children and youth required special considerations, and, thus, a separate model would be required. This could not be done using the CCHS, as it did not sample children under the age of 12. We thus decided to focus on adults only, which we defined as age 20+. As for the territories, they also require special consideration. Given the remoteness and the vast distances, the organization of healthcare in the Canadian North is different in many respects. Estimating a separate model for the territories would be impractical because of sample size and coverage of the CCHS.

5. “The assumption that education, income and home ownership reflect non-need variables is quite a strong one.”

We agree. It is of course likely that these variables pick up some degree of unmeasured need. As noted, there is a case for treating these variables as non-need if their coefficients take on a sign that is opposite to their correlation with measured need. For the most part they do, but in some cases there are exceptions in the second part of the two part models. For example, persons with lower education are less likely to use GP services, but if they do, the models
suggest that their intensity of use is higher. Conclusions about the direction of effect of
education require consideration of both parts of the two-part models, and this is not easy to do
given that the models are multiplicative. We concluded that, in balance, these variables do
behave as non-need variables. However, we have also run the models without fixing the non-
need variables at their means, and the effect on results was modest. The study conclusions
were insensitive to this change.

6. “It is conventional in these models to include dummy variables of fixed effects to control for any
supply variables that differ across provinces.”

In the version of the paper that was reviewed, we had included provincial dummy variables for
this purpose; however, provinces are probably too large to capture area differences in supply in
a meaningful way. We revised the analysis including CCHS health region dummies. The CCHS
was designed to produce sub-provincial estimates that could be used for provincial planning.
The CCHS used either provincial health authorities or consolidated groups of contiguous
authorities for this purpose. The paper is now based on these revised analyses.

Minor Essential Revisions

1. We have fixed the noted typos.

2. We have added a description of the structure and funding of the Canadian Health system to
the background.

3. We have noted that exclusions to the target sample of the CCHS mean that some high need
groups are under-represented.

4. In general terms, and in the description of the CCHS, we have noted that it is important that
the survey sample is representative of each region, and that this is true of the CCHS.

5. We have discussed lack of data on supply in the limitations, as well as in the methods.

6. We have noted in the description of the general approach to allocation the criteria that are
required for a variable to be useful in a formula (i.e., to have an impact on allocation).

Sincerely,