Author's response to reviews

Title: The public sector nursing workforce in Kenya - a county level analysis

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

Re: The public sector nursing workforce in Kenya – a county level analysis

We refer to the manuscript titled as above (manuscript ID: 1357645441026332).

Following the comments forwarded from the four peer reviewers of the manuscript, please see below a point-by-point response to the concerns raised.

We hereby re-submit it to the Human Resources for Health journal the manuscript on a study that uses the Kenya Health Workforce Information System to describe the nurses deployed in the public sector that are likely to be inherited by county administrations so as to support their efforts towards health care delivery. The authors declare that they have no competing interests.

The Human Resources for Health journal is most suited for publishing our article as it aims to disseminate research on varied aspects of the health workforce including information, planning and policy, and it particularly welcomes articles concerning health workforce issues in developing countries, which is in line with our study.

The open access policy of the journal further contributes in generating a large knowledge base and interest in the field of human resources for health for all levels of stakeholders concerned. It is our intention that our work be freely available to anyone intending to learn from and contribute in this field.

We trust that the above is in order.

Yours sincerely,

Mabel Wakaba
Manuscript title: The public sector nursing workforce in Kenya – a county level analysis
Manuscript ID: 1357645441026332
Corresponding author: Mabel Wakaba (mwakaba@kemri-welcome.org)

Reviewer’s Comments (Jean Moore) Our Response

1) There is no explanation of differences in scope of practice for the three levels of nursing. Are BScNs allowed to do the same things as the two and a half–year trained enrolled nurses? Can differences in allowable tasks affect their ability to impact on health outcomes (e.g., giving immunizations?)

The manuscript text has been revised to read: “Generally nurses in Kenya are broadly categorized by qualification into enrolled and registered nurses. Primary training lasts two-and-a-half years for the enrolled nurses at certificate level, and registered nurses undergo either a three-and-a-half year diploma course or a four-year degree (BScN) programme. Both the registered and enrolled nurses are of varying cadres. In practice, registered nurses provide both general and specialized care and play managerial functions [24]. Enrolled nurses are entry-level nurses that work under the supervision of registered nurses [26]. However, various health-care tasks can be carried out by the different nursing cadres, for example, giving immunizations. Local training institutions are the main source of Kenya’s supply of nurses, as foreign supply is negligible [24]. As at the end of 2012 there were about 83 active nurse training institutions and over 4,000 nurses graduating annually.”
(Under Methods, page 8, part of paragraph 3)

2) For readers unfamiliar with Kenya’s public sector health system, it would be helpful to describe it. In the manuscript, national referral hospitals are mentioned but their roles are not well described. The basis for excluding the nurses who work there is unclear.

In regard to the public sector health system, the manuscript text has been revised to read: “The Kenya Health Policy, which guides attainment of the long-term health goals sought by the country, defines four main levels of care i.e. community, primary, county and national. The public sector stewards of the health sector include the national ministry responsible for health, the county departments responsible for health, and professional regulatory bodies [21]. Prior to Kenya’s new constitution taking effect after the March 2013 general elections, there were two health-related ministries, the Ministry of Medical Services and Public Health and Sanitation, now an amalgamated in the Ministry of Health.”
(Under Background, page 6 paragraph 2)

In regard to the national referral hospitals, the manuscript text has been revised to read: “National referral hospitals (i.e. Kenyatta National Hospital and Moi Teaching and Referral Hospital) provide highly specialized health care, facilitate health-related research and training, and they deal with referrals from across the country. County hospitals should support a network of primary care facilities so that together they ensure delivery of a comprehensive essential package of care. Hence referral hospitals were excluded from analysis of the nursing workforce available to counties because they are a national resource and, due to their specialized nature, these hospitals will remain under the national Ministry of Health rather than being handed over to county administrations. Analyses that allocate their nursing complement to one county would further distort the nursing workforce density in that county, unfairly suggesting it had a higher county-specific
3) While the article clearly states that this is about the public-sector nursing workforce, the impacts analysis looks at outcomes for the entire population (immunization rates). This could be misleading without a fuller explanation of the private sector in health care as well as the nursing workforce in that sector and the sorts of services they provide. Are immunizations only available from public sector providers? This is unclear and somewhat confusing.

4) The conclusion cites that there is a shortage of nurses when compared to the standard of 2.5 per 1,000 which was stated in the opening sentence of the background, but that was defined as including doctors, nurses and midwives. If you are referring to another standard, then it should be cited.

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<th>Reviewer’s Comments (Karen Plager)</th>
<th>Our Response</th>
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<td>1. The figures are a clear and detailed representation of the data findings. Having the figure explanations paired with each figure, as opposed to being on separate pages, would help the reader to track through the data findings more easily.</td>
<td>Thank you for all the useful comments. We were seeking ways to reduce the overall length of the manuscript. In line with the comment the 3 figures have now</td>
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<td>2. It is unclear why the 3 additional files, which are also important figures representing data findings, aren’t part of the text to read ‘. A widely used health workforce threshold is 2.5 /1,000 for doctors, nurses and midwives. Although concentrating on nurses alone in this work, we retain this threshold as a general reference point noting that in the Kenyan health sector there are about 10 nurses for each doctor in the public sector [23].’ (Under Methods page 10, part of paragraph 1)</td>
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3. What stood out for me in this study and which the authors note on page 13 “is an alarmingly low proportion of public sector nurses aged below 30 years”. The authors speculate that “this could be due to the public sector hiring freeze that began in 1994.” Is the hiring freeze still in effect? Was the hiring freeze associated with decrease in recruitment and education for producing new nurses?

The public sector hiring freeze is not currently in effect as it took place between 1994 and 2002. New recruitment has largely been at a level aimed at replacing exiting staff with the exception of a partner supported ‘emergency hire’ program that we referred to in the manuscript.

The manuscript text has been revised to read: “There is an alarmingly low proportion of public sector nurses aged below 30 years. This is consistent with a case study conducted on nursing human resources in Kenya that indicated that the nursing population in the Ministries of Health is aging [24]. This could be due to the public sector hiring freeze that took place between 1994 and 2002. This resulted in a shrinking health workforce and a substantial pool of qualified health professionals especially nurses who were unemployed and available on the local labour market [38]. Despite the hiring freeze nursing education continued but a recent study reflects a strong supply of nursing graduates and the inadequate employment opportunities in Kenya [39]. Outmigration of nurses also contributes to the health workforce crisis in Kenya. A previous study has shown that for every 4.5 nurses Kenya adds to the nursing workforce through training, 1 nurse in the workforce applies to emigrate, with 70 percent of nurses that applied to emigrate being between the ages of 21 to 40 [40].” (Under ‘Discussion’ from page 16 paragraph 3)

4. Conspicuously missing in the Discussion section is any discussion of the nursing education system in Kenya. Nursing education is a critical stakeholder in the any discussion about nursing workforce, especially when such a small portion of nurses are under 30 and a larger portion are over 50 and nearing retirement age? What is being done to recruit and educate new nurses to keep a vital nurse workforce? Is outmigration an issue in keeping younger nurses in the Kenyan workforce? Are a greater proportion of the young nurses working in the non-government sector? Addressing these issues would enhance the discussion, including what can be done to address these critical workforce characteristics.

With regard to nursing education, please refer to the response on page 2 comment 1 above.

With regard to outmigration of nurses, please refer to the response on page 4 comment 3 above.

5. How was average worker density of 2.5 per 1,000 determined? This ratio includes nurses, midwives and doctors, but the authors compare the ratio of nurses, 1.2 to 0.08 per 1,000, to the standard of 2.5 per 1,000 as if the 2.5 refers to nurse density only. Also see first sentence in second paragraph of Results section.

Please refer to a similar response on page 3 comment 4 above.

6. In the background section (paragraph 1), “57 countries including Kenya with critical shortages” are noted. How many countries total are included in the 2006 World Health report?

The manuscript text has been revised to read: “… According to the World Health Organization’s World Health Report 2006, based on data in the Global Atlas of the Health Workforce for 193 member states, there are currently 57 countries including Kenya with critical shortages.” (Under ‘Background’ page 4, part of

body of the manuscript. I would suggest placing them within the main manuscript as well for ease of reader tracking.

been incorporated as part of the main manuscript. However, we are happy for the journal editors to make a final decision on whether figures should be presented as additional files or in the manuscript.
7. Page 5, last sentence of middle paragraph, refers to "two Ministries serving the health sector in Kenya". What are these 2 Ministries?

8. The authors are clear that their project analyzed nursing workforce in the public sector only and they provided their rationale noting that "over 50% of health workers deployed in the public sector" and that "45.3% of that "over 50%" are nurses." "Over 50%" is a nebulous percentage as it could mean anything over 50.1, etc., leaving 49.9% of the health workforce in the non-public sector. That seems to be a significant sector of the workforce that could be providing health care to the population. The concern here is that a critical portion of the health workforce has been neglected in this study. Are there any plans in the future to do a similar analysis of nurses in this sector of the workforce? Also in the first sentence of the Discussion section, the authors state that "non-governmental and private sector is unlikely to make-up the large gap..." This seems to be an assumption made by the authors as no actual numbers of nurses in this sector are addressed.

9. Results section, first paragraph: for the non-Kenyan reader, it would be helpful to explain how Kenya Registered and Enrolled Community Health Nurses differ from the non-community health registered nurses in their preparation and roles in practice.

10. The statistical methods seem appropriate, but it is not my area of expertise. There are a number of statistical methods the authors reported using—kurtosis, Shapiro-Wilk W and Shapiro-Francis W tests—that I am not familiar with. For this reason only would I suggest that a statistician assess the statistics for appropriateness.

Reviewer's Comments (Thomas Ricketts)

1. The article needs to relate more closely to actual policy decision in Kenya. How and why the counties were created and it needs to include facilities data. The references and tabular material need to be better integrated into the article. I include several comments below.

Our Response

Thank you for all the useful comments.

The manuscript text has been revised to read 1. As of the 2013 general elections in Kenya, there are 47 counties which are Kenya's geographical units of devolved government. County boundaries largely reflect historical political and administrative units that are largely influenced by ethnic, demographic, and political considerations. Based on Kenya's new constitution, the health sector is being restructured such that the functions of the national government will include formulating health policy and managing national referral facilities, while the county governments' functions will include facilitating provision of health services at county health facilities and managing county workforce recruitment and retention. Health professional regulatory bodies will continue facilitating the
2. In abstract: Provide date for the "new constitution".

3. The association between health worker density and mortality reaches a certain inflection where the addition of more workers does not reduce mortality. The association does apply to nations like Kenya but there are other very important characteristics of nations that also affect health outcomes. Explain how this works (minor essential)

4. Major essential) To say that "... low availability of nurses may be exacerbated within countries by geographical mal-distribution" implies that the inequality of distribution is in itself a negative influence. That may or may not be so. To then link that to information needs is a bit of non sequitur...you also need to say that countries at risk for this mal-distribution often do not know what the actual distribution is. The emphasis on a "computerized database system" seems to me to be putting the cart before the horse, there must be a registration system and the mechanisms and regulations in place to do that before data can be computerized. Having these data "maintained" is a good thing, but the system of registration and its accuracy is more in present first step. Has this system been assessed for its effectiveness? Is compliance satisfactory? Although the material is described in a previous article, it would be good to review that. Later in the MS, one gets the impression that the nursing inventory is based on "staffing" lists (page 7). The paper needs to better describe the process for data gathering by outlining the process included in the chart offered as an appendix/table.

The new constitution was promulgated on 27th August 2010, but it came into effect after the March 2013 general elections. These dates have been captured in the background section of the manuscript text on page 6.

The manuscript text has been revised to read: "Of note is that the association between health worker density and mortality usually may reach a certain "inflection" where the addition of more workers does not reduce mortality. However it seems unlikely that nurse densities have reached such an inflection point in countries such as Kenya given the low density of health workers observed. Unfortunately lack of accurate county-specific mortality rates make examining this hypothesis in possible at present. Literature does suggest that in Kenya, maternal mortality as a health outcome can be affected by access to medical facilities/distance to nearest health facility and household income [41], and that the proportion of gross domestic product spent on health, and female literacy affects health outcome as related to infant and under-five mortality rates (per 1000 live births) [42]." (Under Discussion, page 18 paragraph 2)

We agree that it is not computerization per se that solves the HRIS problem and it is critical that the system for collecting primary data has high coverage, is up to date and is robust. Computerization may enable this and facilitate timely analysis/reporting. In this manuscript we illustrate the potential of HRIS data (with whatever data collection approach) to inform thinking.

In regard to the process of obtaining the data used, the manuscript text has been amended to read: "The deployment..."
Data were taken through an iterative cleaning process including matching nursing records from the staff returns and staff details data that are described above, elimination of duplicates, and also nursing attrition records were removed so as to provide the best available representation of the current in-service nursing workforce. The facilities to which the nurses were deployed had assigned standard geographical codes (in aster facility list codes) within counties, and where these were missing, available district and province codes were used to allocate the nurses to counties of deployment where possible. The exclusions of data on nurses deployed in the non-public sectors and in national referral hospitals were then made, and the data was then linked to the current qualifications of the nurses. The resulting deployment data used for analysis had 16,371 public sector nursing records (Figure 1).

5. Provide more details of the demographic variables available beyond gender. (Minor essential)

Besides gender, age, and qualifications of the public sector nurses that have been documented in the manuscript, the other main demographic variables available concern marital status and citizenship, though this data may be less accurate and not updated. However, the data shows that over 90% of the public sector nurses are Kenyan, and over 70% are married.

6. (Discretionary) The exclusion of the nurses in the two central hospitals doesn’t make much sense as it changes any denominator. Yes, their responsibility is different, but they are nurses and they may leave those posts and go elsewhere. They are reported in the results section.

Please refer to a similar response on page 2 comment 2 above.

7. (Major essential) The remoteness index is interesting, but how was the initial classification done (centres 1-3) and were there any population values assigned to the “grid pixels”? There needs to be some justification for the geographic analysis, what was the goal of this assignment of “remoteness” and does it follow any standard for this kind of work? I still do not get a sense of how it was calculated and whether it was anything beyond a measure of size of the counties. You may want to correlate the size with this index to see if it does have a different meaning. The references to the work of Nor et al. indicate that there is a more useful description of this work elsewhere and the article would be improved if there were more description of this process/method.

A more detailed description of the remoteness index has been provided. It measures of remoteness are useful for health service planning and equitable distribution of resources, and such indices can be used in understanding disparities in health indicators of the population, hence the justification for the geographical analysis in our work. The calculation of the remoteness index did not take into account the size of counties, which only came into play with the new constitution in Kenya.

The manuscript text has been amended to read: Generalized indices of remoteness are useful for service planning and equitable distribution of resources and also for assessing health and workforce needs and the resources allocated to meet these needs. The remoteness index as used in this study is an index of accessibility to service centers. To generate the remoteness index, population settlements in Kenya were classified by distance to three types of service centers in service centers 1 (market and trading centers), service centers 2 (division headquarters and small towns), and service centers 3 (cities, municipalities, major towns, provincial and district headquarters). The classification of service centers used in this study was developed by the Kenya National Bureau of Statistics for census purposes and was on the basis of population size and service functions. A surface of travel times at 1×1 km spatial resolution to various service center types was generated. Travel speeds were assigned to different land cover and land...
use classes, roads and slope by assuming multiple modes of transport within a single journey to a service center. From each grid pixel, the travel time to any category of service center was divided by the average travel time to that category. The result was a surface of ratio-to-mean travel time. For example, if a grid pixel had a ratio-to-mean travel time of 2 to service center 1, this implied that it took twice as long to reach the nearest service center compared to other service centers. This ratio for each pixel was capped at a value of 0.5, equivalent to approximately half an hour to a service center 1; 1.5 hours to a service center 2, and 2 hours to a service center 3. All pixels where the ratio-to-mean to any service center was \( \geq 0.5 \) were assigned a ratio-to-mean of 0.5. This was done to reduce the influence of the longer travel times to larger but fewer service centers on the overall index. The capped ratio-to-mean surfaces to each type of service center were summed, resulting in a continuous index of remoteness ranging from 0 to 1.5. For each county, the mean value was extracted, which was then classified into five categories as follows: highly accessible (0 - \( \leq 0.3 \)), accessible (0.3 - \( \leq 0.6 \)), moderately accessible (0.6 - \( \leq 0.9 \)), remote (0.9 - \( \leq 1.2 \)) and very remote (1.2 - 1.5). Further details about the methodology used for defining remote areas are described in Noor et al. (2012) [27].

(Figure under 'Methods' page 11 panel 1)

8. (minor essential) The "health spending per capita" explanation is not clear. That seems to be a mix of measures. How was this calculated?

The indicator was obtained from the Kenya Open Data Initiative, a government website that makes key government data freely available to the public through a single online portal (https://www.opendata.go.ke/).

As described in the manuscript text, the health spending per capita indicator was calculated using the county estimates of spending on health per capita (Kenya Shilling) based on bed-nets (the proportion of population that slept under a bed-net by region) and illness (the proportion of population that had a fever or malaria by region), according to data from the Kenya Integrated Household Budget Survey 2005/2006 data (page 12). However, the manuscript text has been revised to read We acknowledge that the health spending per capita indicator, presented publicly by the government [43], took into account only two items, based on a national household survey, as a proxy for health spending. Ideally, health spending per capita should be based on the country's total health expenditure which includes health expenditure from households, public and private sectors disaggregated by county.' (Under Discussion page 19 paragraph number 2)

9. (minor essential) The justification for the analysis of supply in the counties is adequate, but a little more detail about the devolution of power to those counties would be good to read. Will they have any role in the licensing or registration? Will they control payments?

Please refer to a similar response on page 5 comment 1 above.

10. (minor essential) The opening paragraph of the Methods section is awkwardly written and reveals a large hole in the inventory of nurses in the failure to report by "non-public"

Please note that the analysis does not include data on nurses in the non-public sectors (i.e. private-for-profit, FBOs and NGOs). Also excluded are nurses deployed in the two national
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<th>Reviewer’s Comments (Matthew M. McHugh)</th>
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<td><strong>1.</strong> Additional Information on the data and how they are collected to get a sense of completeness/representativeness including: Are all staff nurses represented? Is it compulsory? Are any institutions omitted? <strong>2.</strong> Authors must more clearly identify why the relationships</td>
<td>Please refer to the responses on page 6 comment 4, and on page 8 comment 10.</td>
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<td><strong>11.</strong> What does “concern” mean? Does the analysis include them? <strong>12.</strong> The standard of 2.5 per 1,000 may or may not apply to Kenya. Is this a “minimum” or is it something closer to an optimum. The 2.5 standard also include doctors, why are they excluded when you do any comparisons? (discretionary—may use references to justify) <strong>13.</strong> (Major essential) The conclusion makes a point with the 15-fold variation across counties. That is useful, but here is where we need to know something about the formation of the county boundaries. Were they meant to regionalize and/or centralize general public services or were they to trace ethnic or traditional boundaries or did they represent transportation networks. In short, were they meant to be in any way relevant to the distribution of health care resources? The lack of correlation with “outcome” variables hints that these areas were constructed to diminish variance in some measures. <strong>14.</strong> The discussion covers many issues and suggests many “explanations” for variances in nursing distribution and characteristics. But the distributions are hard to interpret beyond suppositions without some understanding of the construction of the denominator.</td>
<td>Please refer to the response on page 3 comment 4 above.</td>
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<td><strong>15.</strong> Comment and I encourage this to be considered more deeply) I hope that the inventory is a “reasonable representation of the current situation” (p. 14) but have the suspicion that there is a very sizeable number of nurses who are left out and who may cluster or distribute themselves in meaningful ways. <strong>16.</strong> (Minor essential) Table 1 and all tables using the number of counties as the N, need to state the number of counties. <strong>17.</strong> It would be good to have a geographer review this approach—I see there are people in the authors list with these skills, but the spatial method is very poorly described in the text.</td>
<td>Please refer to page 7 comment 7 above.</td>
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**Note:** Discretionary comments are indicated by parentheses and may include references to justify.
between density and the chosen variables are of interest. For example, age and qualifications seem reasonable but clarify why male: female is important (i.e., why would a reader care about gender disparity in workforce so long as there were enough well-trained nurses available to provide care, regardless of gender distribution).

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<th>3. If possible, examine distribution of nurses by additional characteristics including educational composition or foreign educated nurses. Educational composition of the workforce, for example, seems more meaningful in terms of concerns regarding male distribution. The work needs a better sense of not just the density but the characteristics and quality of the workforce distribution.</th>
<th>The nurses’ qualifications (based on their education/training) have been presented in the results section from page 13 of the manuscript. For example, the study shows that 53% of the nurses deployed in the public sector in Kenya are registered nurses.</th>
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<td>4. Figures 4 &amp; 5 aren’t particularly informative. At minimum, the labeling should be clearer. The gender figure could represent either male or female but need not be stacked. For the age, it may be more meaningful to focus on one category or collapse to show the distribution of the older nurses if that is the focus.</td>
<td>Please note that other reviewers found these figures satisfactory as presented. However, we are happy for the editors to guide us on whether they wish us to present non-stacked bars. Also we feel that the figure concerning nurses’ ages presents data on all categories and thus provides most information while being reasonably easy to interpret (but again we welcome the editors to guide us on this).</td>
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<td>5. A depiction of the distribution of institutions would be useful particularly since the nurses represented in the data are institution specific.</td>
<td>Regarding the labeling, county identification numbers have been used instead of county names to represent the 47 counties. This has been indicated in the figure legends. Every county has been assigned a specific county identification number that is consistent across all the concerned figures in the manuscript.</td>
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<td>6. Overall labeling of figures should be improved. For example, on the maps (figure 3 &amp; 6) – it isn’t clear what the numbers in the countries are labeling.</td>
<td>All the institutions represented in the data are government/public sector facilities. The Kenya Open Data Initiative provides a map giving a visual representation of the health facilities in Kenya (see <a href="https://www.opendata.go.ke/Health-Sector/Health-Facilities-in-Kenya/e53f-gps5">https://www.opendata.go.ke/Health-Sector/Health-Facilities-in-Kenya/e53f-gps5</a>)</td>
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