Author's response to reviews

Title: Human resources needs for universal access to antiretroviral therapy in South Africa: A time-motion study

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Author's response to reviews: see over
To The Editor:

Please find attached our revised manuscript entitled "Human resources needs for universal access to antiretroviral therapy in South Africa: A time-motion study", which we would like you to re-consider for publication as a research article “Human Resources for Health”. We estimate the human resource needs and associated salary costs for universal access to antiretroviral treatment for HIV in South Africa under different eligibility criteria, including ART at ≤350 cells/µL and ART for all HIV infected patients (i.e. 'treatment as prevention').

We found the comments raised by all reviewers constructive and helpful, and we feel that their suggestions improved our manuscript. In addition, we have carefully re-read our manuscript and made a few additional changes to improve clarity of the paper. Please find a detailed response to all issues raised by the reviewers below. All changes in the manuscript are highlighted using track changes, and we also provide clean versions without track changes. We look forward to receiving your decision.

With best regards, on behalf of all authors,

Jan Hontelez

Response to reviewers

Reviewer 1 (Norbert Dreesch):

The article is a welcome empirical study on the HRH implications for achieving universal access to antiretroviral therapy in one of the countries hardest hit by the HIV epidemic, South Africa. Even though the sample of three clinics for time and motion studies is small, the staffing and treatment pattern for HIV patients usually tends to differ little in other, similar environments. Thus the scenarios developed give highly relevant policy guidance for the HRH environments throughout the country.

The time-and-motion method applied yields highly significant results for HRH for HIV/ART planning needs and meets with relevant standards. The article contributes to the growing body of knowledge on HRH development needs for HIV/ART since some of the earlier works by e.g. Hirschhorn et al. (quoted in the study) and WHO (http://www.who.int/hrh/documents/en/HRH_ART_paper.pdf) attempted to provide estimates of HRH for scaling up access to ART at the beginning of the forced expansion strategies proposed by WHO and others as of 2003 (initial 3by5 movement).

We thank the reviewer for the positive comments on our paper. We have improved the discussion of our findings in comparison to the findings in the WHO report the reviewer points out to us and to the findings reported by Hirschhorn et al. (Discussion, 2nd paragraph):

“It is interesting to compare our empirical findings from a time-motion study to estimates based on other sources of information. Based on reports of the total numbers of health workers and patients in HIV treatment programmes, Hirschhorn et al estimated that in 2004 the number of doctors and nurses required to treat 1,000 HIV patients were 1-2 and 2-7, respectively, across different
developing countries [29]. Based on recommendations “by experienced practitioners based on experience at sites in Kenya,” a 2004 WHO report estimated that 1 doctor and 2 nurses were needed to treat 1,000 HIV patients [30]. The lower health worker requirements we estimate based on a time-motion study may be due to the fact that more than five years into the public-sector ART scale-up in South Africa [31] the productivity of delivering HIV treatment has increased because of scale effects and learning over time. Of course, it is also possible that the estimates differ because of quality-of-care differentials. The expert opinions elicited in the WHO report may have reflected a higher standard of quality of care than currently found in the real-life, public-sector HIV treatment programme in rural KwaZulu-Natal, in which this study took place. Similar to other treatment programmes in the region, non-retention and non-adherence in this programme are substantial[32]. At the same time, however, the programme, in which this study took place, has been very effective in reducing HIV-related mortality [31] and increasing life expectancy [33] in this community, and can therefore be considered an overall successful programme delivering relatively high quality-of-care.”

The authors provide scenarios for HRH for universal access to ART, including 'treatment as prevention'. We should remind ourselves that prevention strategies involving PHC and community level action towards individual prevention measures are still likely to cause the least impact on human resources development and HIV/ART plus co-infection treatment needs, thus contributing highly to effective health systems management and reduction of the epidemic. Scaling up rapidly and towards universal access may also benefit from the option of using a human resources/health systems approach as evidenced in the case of Botswana which created a public/private partnership to rapidly increase access to human resources for HIV/ART care (reported Dreesch et al. in an earlier article in this Journal). This may, however, be less relevant for the rural context.

We have improved our discussion of the preventive and mortality-reducing effects of ART on future HHW requirements (Discussion, 12th paragraph):

“We provide a point estimate for the HHW required for one year of treatment in the present time. In the longer run, the current HHW and ART coverage levels may themselves affect HHW requirements for a number of reasons [38]. On the one hand, because ART is effective in reducing mortality, the more patients receive ART in the current period, the more patients will require treatment in future periods, assuming that HIV incidence remains unchanged [58,59]. On the other hand, ART can effectively prevent HIV transmission [15,50,51,60-62], which would lead to a reduction in the number of HHW required in future periods if mortality remained constant. In future studies, dynamic models need to examine the impact of the mortality-reducing and preventive effects of ART on long-term HHW requirements. Those studies should also take into account that ART may change the type of patient needing ART. For one, ART may shift the age composition of ART patients towards older ages [63,64], increasing the average morbidity among ART patients and the average health-worker time required for providing appropriate treatment per patient. Moreover, the case mix of ART patients might change over time due to increasing ART failure and long-term ART toxicities. These changes may increase the average health-worker time required per patient because they necessitate time-consuming counselling, ART switches, and complex treatments of ART side effects [65].”

We have further added the following discussion of the potential of integrating private-sector health workers into the public-sector ART strategies, as suggested by the reviewer (Discussion, 4th paragraph):
“In addition, transferring public-sector ART patients to the private sector for routine follow-up and monitoring – as effectively done in Botswana and Mexico [41,42] – might increase the pool of available HHW. At the same time, of course, this strategy might increase the human resources costs per ART patient, because health worker salaries in the private sector in South Africa are higher than in the public sector.”

We have also added a discussion of the planned PHC reform in South Africa, which may have important implications for HHW in the country (Discussion, 11th paragraph):

“Task time allocation and HHW productivity will likely depend on the model of HIV treatment delivery. The current delivery model may change as South Africa has embarked on a major primary health care (PHC) reform, with the goal of providing universal access to a comprehensive package of health care services in the public sector through a national health insurance scheme [57]. Several initiatives included in the reform may improve the availability of HHW. So-called district specialist teams will be recruited and deployed in all of the 52 districts in the country to improve the standard of care delivered in community-based health care facilities [39]. These teams will consist of four medical specialists and three advanced professional nurses. In addition, each PHC ward will have at least one PHC outreach team consisting of a professional nurse, environmental health and health promotion practitioners, and four to five community health workers. The role of the outreach team will include health promotion and prevention campaigns, early detection and interventions for selected health problems, as well as support for treatment retention and adherence [39]. These initiatives, which are currently tested in pilot studies, could help to further devolve HIV treatment to communities and homes, freeing up HHW in health care facilities.”

The article is well written and adheres to international standards. A few oversights (plural nouns and verb forms not corresponding) should be checked and corrected where necessary.

We have carefully gone through the text again, corrected typographical errors and improved our phraseology.

Reviewer 2 (Kaspar Wyss):

The article analysis the additional number of doctors and nurses needed to expand population coverage with antiretroviral therapy (ART) in South Africa. The paper nicely presents a the re-sults of time motion study and applies them to staffing needs and is of high relevance given that human resource related challenges are the key issue so to improve health systems perfor-mance. Thus the topic covered by the manuscript covers a highly relevant and interesting topic

The study uses current time use patterns defined as patient contact, indirect patient con-tact and other and extrapolates them to increased coverage with ART at different thresholds. Through this approach no analysis is being done on potential productivity gains through better time allocation (the manuscripts looks only on efficiency gains through economies of scale using one single literature reference indicating possible gains between 72 and 73%). However, there are two potential major productivity gains possible: First, the productive time of workers may substantially be increased as for ex-ample in one study site staff worked only 4.9 hours per day. At average the work time was 6.3 hours. If it is assumed that health
workers do work over 7 or 8 hours per day (using the standard of South Africa), there are substantial potential productivity gains. Second, around 10% of staff time is used for “other activities” (see comment below). This time potentially can be better used. The manuscript does only account through an indirect approach assuming that there will economies of scale. Given that the data is available on time allocation and potential productivity gains this should be taken into account in the different scenarios estimating numbers of health workers for increased coverage.

We agree with the reviewer that productivity gains can effectively reduce the number of health workers required, as forecasted by our study. In scenario analyses, we show that if all clinics work with the same efficiency as observed in the most efficient clinic (clinic B), we find that the total number of nurses, counsellors and physicians required is reduced by 16%, 16%, and 31% respectively (table 4, and 4th paragraph of the results).

We agree that in some clinics the workday was relatively short (6.3 hours on average, as compared to 7.3 hours in clinic B). Therefore, as suggested by the reviewer, we have added an analysis to determine the impact of increasing the workday to 8 hours, and find that this would result in a reduction of the number of HHWs needed by 23%, 24%, and 37%, respectively (compared to baseline).

Finally, the time allocated in the ‘other’ category concerns break time and idle time between patients. The time spend in this category was on average 9% of the workday, which would translate to 43 minutes in an 8 hour workday (or 34 minutes in a 6.3 hour workday). While it may be possible to reduce the time spent in this category, we cannot rule out that breaks and idle time serve an important purpose alleviating work stress, and that reducing the time spent in this category may thus reduce long-term fitness and focus of the HHW, reducing HHW productivity. We have added discussions of these issues (Discussion, 5th paragraph):

“There are several options for improving HHW productivity in PHC HIV clinics. We found that the average duration of a workday varied widely across clinics. The number of health care workers required for the treatment of 1,000 ART patients could be reduced by about one third if all clinics achieved the productivity of the most efficient clinic. In addition, the average duration of a workday in our data was 6.3 hours. If we assume a HHW workday to last 8 hours, we find that the total number of nurses, counsellors, and doctors required will be reduced by 23%, 24%, and 37% compared to the baseline in Clinic A, B, and C, respectively. Another way to improve productivity might be to reduce opening hours in selected clinics. We found that in the least busy (and most rural) clinic in our sample, on one particular day only 20% of HHW time was spent on direct patient contact and 36% was spent on breaks and idle time, because only a few patients visited the clinics on that day. Limiting the opening hours of selected PHC HIV clinics might reduce wastage due to idle time. At the same time, however, such a strategy carries the potential danger of reducing access for particular populations, for instance, the employed or people living in rural areas. Finally, productivity gains might be achieved by cutting the time spent on breaks and idle time between patients. However, we found that on average only 9% of the workday was spent in this category - which translates to 43 minutes of break time on a workday of 8 hours - which is very short considering the demands of the job and the need for the health staff to eat and look after themselves during the work day, likely leaving little room for considerable productivity gains through this approach.”
The study recorded activities along 3 predefined categories (patient contact; indirect patient contact, and other). There are two substantial flaws in this categorization: (i) indirect patient contacts defined by the authors as discussion with other health workers may be warranted for assuring adequate care but also simply may consist in social networking or “chatting” (e.g. in clinic C the counsellor use 44% of their time for indirect patient contact”). Indeed the time used ; (2) other activities include tasks which are relevant and needed to assure adequate care for patients such as continuous education, administration, meetings but also activities which are unproductive such as waiting for patients, being absent from work etc.

There is a needed that a stronger rational and more in-depth explanation is given by the authors on the categorizations and the potentially productivity gains (see comment above)

We have improved the explanation of these categories of time. The second category “indirect patient contact” concerns time allocated to meetings or face-to-face discussions with other HHWs that concerns necessary work related to providing HIV care. “Chatting” is captured in the “other” category, in which idle time between patients and breaks are captured (during which “chatting” might occur). We do think, as discussed above, that time in the other category is not necessarily wasted time. Breaks may be important in order to maintain HHW focus and fitness of the HHWs. We have improved the description of the different time categories (Methods, 3th paragraph):

“Two investigators independently coded the recorded activities into pre-defined categories: i) direct patient contact (talking to patient; writing; writing and talking; venepuncture; physical examination; dispensing medication); ii) indirect patient contact (discussing clinical or work-related issues with other HHW; performing work-related paperwork or administration, contacting health workers in other health-care facilities, such as hospitals, for patient referral); and iii) other (breaks; idle time; unaccounted time). Categories i and ii are times allocated to perform tasks within the job description of the particular HHW. Category iii contains breaks and idle time. It is important to note that breaks and idled time do not necessarily imply wasted or unproductive time. Breaks may serve an important purpose in resting the HHW in order to maintain productivity when performing tasks in categories i and ii. The final assignment of category codes was determined in discussion between the two investigators and, when conflicting assignments could not be resolved, through discussion with a third investigator.”

Second, we agree that some activities are not captured in our analyses. Administration and meetings are captured in the “indirect patient contact” category, but we did not included continuous education or attending workshops and conferences, which may be important for HHW performance. However, overall these activities will take up only a small proportion of the total work-time of a HHW over a year. We added the following sentence to the discussion to reflect on this (Discussion, 10th paragraph):

“Fourth, the observed activities might not be all encompassing, as some infrequent activities such as continued training and attending workshops or conferences were not observed. However, these activities will take up only a limited proportion of the total number of work-hours over a year [39] and biases due to excluding these activities will thus be limited.”

Increased coverage will also imply that the number of other staff categories, especially laboratory technicians, but also of managers overseeing the performance of the addi-tional
staff has to be recruited in addition to the doctors, nurses and counsellors. The manuscript does not at all discuss this aspect and this has to be taken-up.

We have added the following discussion (Discussion, 6th paragraph):

“In addition, the need for support staff not involved in direct patient contact – such as laboratory technicians, supply-chain workers, general management staff, and trainers – will also grow with increasing treatment coverage."

Along the national guidelines, the model for increased coverage assumes that there is ART initiation-visit and estimates staffing needs for this initiation visit. Around 30% of the additional doctors and nurses are needed for this initiation visit. Or this is a one-time investment. In other words should the respective staff been fired once this one time investment for full coverage completed? The model used should take into account this (e.g. for discounting over years) or simply state that around 30% of estimated additional workers are only needed in year 1 and any longer in year 2.

This is an important question, yet hard to answer with our study. The epidemiological impact of the different treatment scale-up strategies should be considered when forecasting HHWs needs over longer time periods. Antiretroviral therapy reduces transmission of HIV, and increases survival. Thus, depending on the number of patients on treatment, the inflow (through continued transmission) and outflow (through mortality) will change over time, and thus the dynamics of the required HHWs will constantly change over time. We have improved our discussion of these dynamic issues, which will be important to address in future work (Discussion, 12th paragraph):

“We provide a point estimate for the HHW required for one year of treatment in the present time. In the longer run, the current HHW and ART coverage levels may themselves affect HHW requirements for a number of reasons [38]. On the one hand, because ART is effective in reducing mortality, the more patients receive ART in the current period, the more patients will require treatment in future periods, assuming that HIV incidence remains unchanged [58,59]. On the other hand, ART can effectively prevent HIV transmission [15,50,51,60-62], which would lead to a reduction in the number of HHW required in future periods if mortality remained constant. In future studies, dynamic models need to examine the impact of the mortality-reducing and preventive effects of ART on long-term HHW requirements. Those studies should also take into account that ART may change the type of patient needing ART. For one, ART may shift the age composition of ART patients towards older ages [63,64], increasing the average morbidity among ART patients and the average health-worker time required for providing appropriate treatment per patient. Moreover, the case mix of ART patients might change over time due to increasing ART failure and long-term ART toxicities. These changes may increase the average health-worker time required per patient because they necessitate time-consuming counselling, ART switches, and complex treatments of ART side effects [65].”

Budgetary implications of increased coverage are only discussed in relation human re-source costs. Or a relevant share of additional costs for scaling-up coverage will related to investments in infrastructure (e.g. are all the necessary facilities for providing services availability) and running costs (ARVs, consumables, etc.) Especially the additional run-ning costs need to be further discussed and taken into account so to adequately analyse the implications of the increased coverage on the health budget of South Africa.
We have added the following discussing of these additional costs (**Discussion, 6\textsuperscript{th} paragraph**):

“Of course, salaries are only one part of the running costs of added health care workers and expanding HIV treatment. Other expenditures necessary for HIV treatment include running costs for drugs, medical supplies, water and heating as well as investment costs for equipment, facilities, and continuing HHW education [48,49]."

The indicates that the additional required doctors (around 300). Nothing is said about the availability of the 2,200 additional nurses. If additional nurses or counsellors need to be trained, then this is an additional cost and should be taken into account in the cost calculations.

We have added the following discussion (**Discussion, 3\textsuperscript{rd} paragraph**):

“On the other hand, recruiting the required additional 2,200 nurses fully devoted to HIV care may prove to be a greater challenge, given that the total of all professional nurses who graduated from nursing schools in South Africa in 2011 was only about 5,600 [39].”

The tables indicate the additional human resource needs in person – months. It should be considered to display them also in terms of full-time equivalents.

We thank the reviewer for this suggestion. We added FTEs to the tables, and added the following to the text (**methods, 7\textsuperscript{th} paragraph**):

“We then translated the total number of doctor-months into the number of full time equivalents (FTEs) on an annual basis needed for initiating all patients in one year, and the number of doctors per 1,000 initiations.”

And (**Methods, 8\textsuperscript{th} paragraph**):

“We then translated the total number of nurse-months and counsellor-months into the number of FTEs needed for universal ART coverage.”

As indicated above, in clinic C the counsellor use 44\% of their time for indirect patient contact. This outlier should be discussed.

This outlier reflects the rural nature of the clinic. The observation day was not a busy day, and consequently counsellors were able to perform the necessary administrative work (which falls under ‘indirect patient contact’), but also spent a substantially proportion of the day on breaks and idle time (36\%). We added the following phrase to the text (**Results, 1\textsuperscript{st} paragraph**):

“The observed health worker with the shortest observed duration of a workday was a counsellor in clinic C, who spent only 20\% of the workday on direct patient contact, while the counsellor used 44\% of workday time to perform administrative work and 36\% on breaks and idle time. This time distribution was likely due to the fact that the patient load in this rural clinic was relatively low.”

Especially the time spent on breaks and idle time could have implications for health care worker productivity. We have added the following discussion (**Discussion, 5\textsuperscript{th} paragraph**):
“We found that in the least busy (and most rural) clinic in our sample, on one particular day only 20% of HHW time was spent on direct patient contact and 36% was spent on breaks and idle time, because only a few patients visited the clinics on that day. Limiting the opening hours of selected PHC HIV clinics might reduce wastage due to idle time. At the same time, however, such a strategy carries the potential danger of reducing access for particular populations, for instance, the employed or people living in rural areas.”

*In the introduction section is stated that in 2007/08 there was a shortage of 79'791 health workers in South Africa. On what this assumption is based on how this has been calculated. Some additional comments would be welcomed here so to underline the data*

We have improved our explanation of the provenance of this number *(Introduction, 1st paragraph):*

“Based on a review of scientific publications and government documents, George et al concluded that in 2007/2008 there was a total shortage of 79,791 health workers in South Africa's public sector [11].”

*The manuscript assumes 20 work days per month. Typically 22 work days are being used. In consequence there is a need to give a rational for the 20 work days (as opposed to 22 days) as this has an impact on staff numbers needed.*

We assume 20 days per month to correct for (public) holidays and other types of leave, such as sick leave. The 22 days per month estimate ignores these holidays and leaves (356.25 days per year on average divided by 12 equals 30.5 days/month. Multiplied by 5/7, this gives 21.7 workdays per month).

We added a description in the manuscript *(Methods, 6th paragraph):*

“A full-time HHW is assumed to have 20 work-days per month (based on a total of 22 workdays per month, after accounting for holidays and sick leave).”

*In the discussion section the possible bias in work patterns through the presence of an observer is discussed. One way to control for this is to analyse time allocation over the 14 days observation period. If patterns are similar then this is an indicator that the presence of the observer did not substantially influence work patterns. Has this analysis been done and if not it is strongly recommended to so and to refer to this in the manuscript*

We appreciate the comment raised by the reviewer and have added the following *(Discussion, 9th paragraph):*

“Third, HHW were aware that they were being observed which might have induced HHW to increase their productivity during observed visits in comparison to unobserved visits. However, such a Hawthorne effect [55] is likely to be limited for a number of reasons. For one, the observer was not involved in the HIV treatment programme and was not known to the HHW. Moreover, the observer completely abstained from providing performance feedback to the observed HHW, even if asked for such feedback, to eliminate this underlying cause of the Hawthorne effect [56]. Finally, we did not detect substantial changes in time allocation patterns within one clinic across the different observation days, suggesting that observer bias, which is likely to wane (due to increasing HHW
tolerance to being observed) or grow (due to feedback and learning) over time, may not have plaid
an important role in this study.”

Reviewer 3 (Gustavo GH Nigenda)

This is a very interesting study to measure the time dedicated by health workers to provide
ART therapy in South Africa. HR costs of expanding universal ART are estimated and
discussed. This paper could be replicated to estimate dedication times, efficiency and costs of
providing care in different contexts and for different types of problems. The document
contains the merits to be published at the journal. Comments and suggestions provided next
are meant to obtain extra clarification of some methodological and analytical aspects that
could be beneficial for the readers.

Discretionary revisions:

Introduction

1) Authors should justify why the article’s initial intention is based on the need to add up
extra personnel to the task of providing universal ART to the South African population.
Therefore it would be necessary to provide more information about the amount of doctors,
nurses and counsellors that provide ART services in South Africa and its provinces. Readers
should be clearly aware that regional distribution is not an underlying factor in its own or in
combination with a shortage of human resources.

We appreciate the comment by the reviewer, and acknowledge the need for more contextual
background information. We have added numbers on the total health workforce in South Africa,
using data from the WHO (Discussion, 3rd paragraph):

“Data on the current health workforce specifically devoted to HIV care in South Africa are not
available, but WHO estimates show that in 2004 there were about 35,000 doctors and 180,000
nurses in total in the country [34], i.e., South Africa had a health worker-to-population ratio
exceeding the threshold of 2.3 doctors and nurses per 1,000 population, which has been proposed
by WHO as a critical minimum [35,36].”

We have further added extensive contextual information and discussion on health worker shortages
in South Africa (Discussion, 3rd & 4th paragraph):

“While our study determines the additional numbers of health workers required for future ART
scale-up under different scenarios, it does not enable us to directly evaluate this number in relation
to the supply of health workers to establish whether there is a health worker shortage in South
Africa, either nationwide or in regions. The number of doctors required to provide universal access
to ART is currently one of the most critical capacity constraints in SSA, since only a few thousand
doctors graduate from medical schools in the entire subcontinent each year [37,38], and the rates of
doctor migration to countries outside the region remains high [11]. However, scaling up treatment
to universal access for initiation at CD4 cell count ≤350 cells/µL will require only about 300 additional
doctors committed to performing ART initiations, and may thus be feasible without major changes to
national health worker production and retention. On the other hand, recruiting the required
additional 2,200 nurses fully devoted to HIV care may prove to be a greater challenge, given that the total of all professional nurses who graduated from nursing schools in South Africa in 2011 was only about 5,600 [39].

It is therefore vital to increase efforts to expand the health worker pool for HIV in South Africa by increasing training and retention, reinstatement of retired health workers, or increasing HHW productivity, in particular to achieve universal coverage at more relaxed eligibility criteria [37]. Currently, public-sector HHW are paid a salary on a monthly basis and, additionally, receive contributions to health and old-age pension insurance, as well as a rural allowance for service in underserved areas. Alternative models of contracting and incentivizing HHW, such as performance-based payment, could improve productivity. On the other hand, such new models may also lead to inefficiencies, such as the transaction costs of monitoring performance, and unintended behavioural consequences, such decreased quantity and quality-of-care of services not included in the performance-based payment scheme [40]. In addition, transferring public-sector ART patients to the private sector for routine follow-up and monitoring – as effectively done in Botswana and Mexico [41,42] – might increase the pool of available HHW. At the same time, of course, this strategy might increase the human resources costs per ART patient, because health worker salaries in the private sector in South Africa are higher than in the public sector. Health-worker interventions, such as shifting task from more to less skilled health workers [43] and integration of ART delivery into the general primary care services [44] should also be considered as means to free up human resources for HIV treatment. Integration might improve productivity, if it either increases capacity utilization (e.g., reducing idle time) or leads to economies of scope, as different health services are combined. Redistribution of HHW from overstaffed to understaffed clinics could further improve HHW productivity by reducing idle time. Finally, a number of interventions could increase the supply of health workers in South Africa, nationally or in regions, including interventions to decrease health worker out-migration and to increase health worker production [45,46]. One recent example is the 2012 agreement between Cuba and South Africa, which is intended to ensure continued placement of Cuban doctors in South African and increased training of South African nationals in Cuban medical schools [47].”

2) It would be beneficial for readers to understand the ART strategy within the context of a Primary Health Care model in South Africa. Is PHC important for the SA government to provide care to HIV as well as other health care problems? Implantation of PHC model could also have middle- and long-term implications in the ART strategy.

We have added the following background information to the introduction section (Introduction, 2nd paragraph):

“The National Strategic Plan on HIV, STIs and TB for the period 2012 – 2016 states that all HIV treatment in South Africa should be delivered through decentralized, nurse-led primary health care (PHC) HIV clinics [17]. Treatment initiation is performed by doctors who rotate between clinics, while professional nurses and HIV counsellors perform follow-up visits. Recently, the South African government changed its guidelines to also allow nurse-initiated ART [18]. Health care workers are usually employed by the Department of Health on a contract basis, and payment of salaries is based on full time equivalents (FTEs) on a monthly basis.”
In addition, the PHC model in South Africa is currently undergoing reform and health worker task times are likely to be a function of the health care delivery model. We have added the following discussion (Discussion, 11th paragraph):

“Task time allocation and HHW productivity will likely depend on the model of HIV treatment delivery. The current delivery model may change as South Africa has embarked on a major primary health care (PHC) reform, with the goal of providing universal access to a comprehensive package of health care services in the public sector through a national health insurance scheme [57]. Several initiatives included in the reform may improve the availability of HHW. So-called district specialist teams will be recruited and deployed in all of the 52 districts in the country to improve the standard of care delivered in community-based health care facilities [39]. These teams will consist of four medical specialists and three advanced professional nurses. In addition, each PHC ward will have at least one PHC outreach team consisting of a professional nurse, environmental health and health promotion practitioners, and four to five community health workers. The role of the outreach team will include health promotion and prevention campaigns, early detection and interventions for selected health problems, as well as support for treatment retention and adherence [39]. These initiatives, which are currently tested in pilot studies, could help to further devolve HIV treatment to communities and homes, freeing up HHW in health care facilities.”

3) Is ART provision a vertical program not having links with other programs? Is there a possibility that ART provision could benefit with extra resources from other areas?

The HIV care programme in South Africa has been mostly vertically-structured, yet as we move from ART as an “emergency response” to a sustainable, long-term solution, integration of health care services may serve to improve the efficiency of health care services. We have added the following discussion (Discussion, 4th paragraph):

“Health-worker interventions, such as shifting task from more to less skilled health workers [43] and integration of ART delivery into the general primary care services [44] should also be considered as means to free up human resources for HIV treatment. Integration might improve productivity, if it either increases capacity utilization (e.g., reducing idle time) or leads to economies of scope, as different health services are combined. Redistribution of HHW from overstuffed to understaffed clinics could further improve HHW productivity by reducing idle time. Finally, a number of interventions could increase the supply of health workers in South Africa, nationally or in regions, including interventions to decrease health worker out-migration and to increase health worker production [45,46]. One recent example is the 2012 agreement between Cuba and South Africa, which is intended to ensure continued placement of Cuban doctors in South African and increased training of South African nationals in Cuban medical schools [47].”

We have also added further information on the South African PHC reform (Discussion, 11th paragraph):

“Task time allocation and HHW productivity will likely depend on the model of HIV treatment delivery. The current delivery model may change as South Africa has embarked on a major primary
health care (PHC) reform, with the goal of providing universal access to a comprehensive package of health care services in the public sector through a national health insurance scheme [57]. Several initiatives included in the reform may improve the availability of HHW. So-called district specialist teams will be recruited and deployed in all of the 52 districts in the country to improve the standard of care delivered in community-based health care facilities [39]. These teams will consist of four medical specialists and three advanced professional nurses. In addition, each PHC ward will have at least one PHC outreach team consisting of a professional nurse, environmental health and health promotion practitioners, and four to five community health workers. The role of the outreach team will include health promotion and prevention campaigns, early detection and interventions for selected health problems, as well as support for treatment retention and adherence [39]. These initiatives, which are currently tested in pilot studies, could help to further devolve HIV treatment to communities and homes, freeing up HHW in health care facilities.

4) A further context element is to expand on the way personnel is contracted. Duration of contract, mode of payment, value of salaries, use of extra payments to incentivize behavior. Are workers paid by hour, day, activity, product?

We have only measured task times under current employment contract policies. Other ways to improve productivity include indeed different modes of contracting and incentivizing health workers. We have added the following discussion (Discussion, 4th paragraph):

“Currently, public-sector HHW are paid a salary on a monthly basis and, additionally, receive contributions to health and old-age pension insurance, as well as a rural allowance for service in underserved areas. Alternative models of contracting and incentivizing HHW, such as performance-based payment, could improve productivity. On the other hand, such new models may also lead to inefficiencies, such as the transaction costs of monitoring performance, and unintended behavioural consequences, such decreased quantity and quality-of-care of services not included in the performance-based payment scheme [40].”

Further explanation is needed in the data collection and data analysis subsections.

6) In the data collection is important to specify how observers were trained to make observations and estimate time. Instructions to start keeping time, instruction to stop the timekeeper, reporting of errors in timekeeping. Did the training included rehearsal and piloting of time keeping strategy?

We have added the following text to the methods section (Methods, 2nd paragraph):

“Data were collected by a single observer trained in quantitative and qualitative data collection, and the observer was closely supervised by three doctors and two professional nurses. There were written instruction on how to keep and record time for different types of tasks. The observer was trained in two stages. The initial stage involved observing the workdays of different health care workers without recording any tasks, in order to become familiar with the work routine. Next, a pilot was conducted in which tasks were observed and recorded, and subsequently coded. The pilot data were checked for errors or inconsistencies, and the study protocol was improved based on the pilot
findings. During the actual data collection, data were continuously entered and checked by the supervising doctors.”

7) The assumption of a 20 work-day per month by HHW is based on a contractual arrangement, labor law? Is there also an initial definition of the number of hours by day that HHW are supposed to work?

We assume 20 days per month to correct for (public) holidays and other types of leave, such as sick leave. The 22 days per month estimate ignores these holidays and leaves (356.25 days per year on average divided by 12 equals 30.5 days/month. Multiplied by 5/7, this gives 21.7 workdays per month).

We added the following description in the manuscript (Methods, 6th paragraph):

“A full-time HHW is assumed to have 20 work-days per month (based on a total of 22 workdays per month, after accounting for holidays and sick leave).”

Results:

8) Table 1 shows that for Clinic C “Indirect patient contact” and “other” categories have a very different behavior from the other two types of Clinics particularly for the case of counsellors. Spending 36% in breaks and idle time is an expected figure? Does it deserve a specific interpretation and a policy recommendation about ART provision in least busy and rural units?

This outlier reflects the rural nature of the clinic and the particular observation day. We added the following explanation (Results, 1st paragraph):

“An average workday lasted 6.3 hours, and the average duration of workdays differed significantly between the busiest and least rural clinic (clinic B) and the least busy and most rural clinic (clinic C) in our sample (7.3 versus 4.9 hours; p=0.01). The observed health worker with the shortest observed duration of a workday was a counsellor in clinic C, who spent only 20% of the workday on direct patient contact, while the counsellor used 44% of workday time to perform administrative work and 36% on breaks and idle time. This time distribution was likely due to the fact that the patient load in this rural clinic was relatively low.”

In addition, we appreciate the comment raised by the reviewer regarding the implications for less busy rural clinics, and have added to the discussion that these findings could imply that opening hours for less busy clinics might be adjusted to increase efficiency (Discussion, 5th paragraph):

“Another way to improve productivity might be to reduce opening hours in selected clinics. We found that in the least busy (and most rural) clinic in our sample, on one particular day only 20% of HHW time was spent on direct patient contact and 36% was spent on breaks and idle time, because only a few patients visited the clinics on that day. Limiting the opening hours of selected PHC HIV clinics might reduce wastage due to idle time. At the same time, however, such a strategy carries the potential danger of reducing access for particular populations, for instance, the employed or people living in rural areas. Finally, productivity gains might be achieved by cutting the time spent on breaks and idle time between patients. However, we found that on average only 9% of the workday was
spent in this category - which translates to 43 minutes of break time on a workday of 8 hours - which is very short considering the demands of the job and the need for the health staff to eat and look after themselves during the work day, likely leaving little room for considerable productivity gains through this approach.”

Discussion:

9) In the discussion about the graduation of physicians and its external migration patterns, is it possible to expand on the role of Cuban doctors in this affair. Are they participating in ART provision? Would the government consider this possibility if they are not participating?

We have added the following discussion of the most recent health worker agreement between Cuba and South Africa (Discussion, 4th paragraph):

“Finally, a number of interventions could increase the supply of health workers in South Africa, nationally or in regions, including interventions to decrease health worker out-migration and to increase health worker production [45,46]. One recent example is the 2012 agreement between Cuba and South Africa, which is intended to ensure continued placement of Cuban doctors in South African and increased training of South African nationals in Cuban medical schools [47].”

10) The call for additional financial commitment is realistic? Is there some sign of interest by SA health authorities to invest more money in ART provision? Are other politicians (Congress) sympathetic with the idea? OR, SA would have to rely on external aid to be able to hire more personnel for expanding ART provision?

The call for additional financial commitments we make is conditional on the intentions of the South African government. In other words, if the government decides to further expand treatment eligibility criteria, they should be prepared to invest substantially in human resources. We simply highlight the trade-offs (more people on treatment requires substantially more investments in financial and human resources), regardless of the intentions of the government.

We write in the (Discussion, 6th paragraph):

“At present, a strategy of ART for all HIV infected patients seems unrealistic for South Africa without large additional financial commitments and substantial increases in HHW training capacity.”

11) Task shifting sound like a promising alternative. Is this alternative only related to ART program? Could other programs within the Ministry of Health strategy provide extra resources that could work in favor of task-shifting?

Task-shifting and integration of health service delivery might be the most promising short term alternatives to increase the pool of available health care workers for HIV care. We have added the following discussion (Discussion, 4th paragraph):

“Health-worker interventions, such as shifting task from more to less skilled health workers [43] and integration of ART delivery into the general primary care services [44] should also be considered as means to free up human resources for HIV treatment. Integration might improve productivity, if it either increases capacity utilization (e.g., reducing idle time) or leads to economies of scope, as different health services are combined.”