Author's response to reviews

Title: Health Worker Densities and Immunization Coverage in Turkey: a panel data analysis

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To the editor,

We are pleased to resubmit a revised version of our manuscript: Health Worker Densities and Immunization Coverage in Turkey: a panel data analysis. Below, we have highlighted in boldface revisions to the text which respond to Dr. Clemens' most recent comments.

Thank you again for your consideration.

Abstract:

Conclusions paragraph:
We find evidence of relationships between HRH densities and vaccination rates even at Turkey's relatively elevated levels of each. **At the same time, variations in results between different empirical models** suggest that this relationship is complex, affected by other factors that occurred during the study period, **and warrants further investigation to verify our findings**. We hypothesize that the introduction of certain health-sector policies governing terms of HRH employment affected incentives to provide vaccinations and therefore relationships between HRH densities and vaccination rates. National-level changes experienced during the study period - such as a severe financial crisis - may also have affected and/or been associated with the HRH-vaccination rate link. While our findings therefore suggest that the size of a health workforce may be associated with service provision at a relatively elevated level of development, they also indicate that focusing on per capita levels of HRH may be of limited value in understanding performance in service provision. In both Turkey and elsewhere, **further investigation is needed to corroborate our results as well as** gain deeper understandings into relationships between health worker densities and service provision.

Discussion:

Paragraph 2:
Our main findings can be summarized as follows. First, combined PHC staff density (GPs, nurses/midwives, and health officers) has been positively associated with provincial-level vaccination rates EPI immunizations over our study period. We estimate that every 10% increase in aggregate densities is associated with a 2% increase in probability of fully completed EPI vaccination schedule. Further, this relationship is characterized by an initially positive association that diminished and even disappeared over the study period (by the end of the study period, a 10% increase in aggregate density is associated with a 1.5% decrease in probability of a fully completed EPI vaccination schedule). **While these point estimates provide a useful starting point to quantifying HRH density-vaccination coverage relationships, we also emphasize that they should be treated with much caution for policy purposes. The limited timeframe of analysis and sensitivity of results to model specification suggest that further investigation is warranted to verify our results before they can serve as a basis for policy choices.** Second, ...

Paragraph 8:
Our analysis can be of policy interest both internationally and for Turkey. On the one hand, our results suggest that size of the health workforce may matter to service provision even at

relatively elevated levels of development. Positive associations between HRH densities and vaccination rates might be expected at low levels of development in which inadequate levels of personnel are significant barriers to access to care. As a middle-income country possessing relatively much higher levels of health personnel, vaccination rates and development compared to low-income countries, it is not clear that the level of health personnel would continue to be a determinant of vaccination coverage in Turkey. It is interesting, then, that we do find evidence of relationships between HRH density and vaccination rates. While positive relationships are more apparent among Turkey's more rural provinces is still close to the average of all low- and middle-income countries (USD 3,700) [23]. This finding therefore suggests that HRH densities might matter for health services even at relatively elevated levels of development, and that Turkey's lessons are relevant for many other developing countries. **Nevertheless, we emphasize again that it would be premature to draw strong policy conclusions based on our results alone. Indeed, we hope that our results encourage further investigation in Turkey to verify these findings.** Given the paucity of research relating the health workforce to health and service provision outcomes, endeavors similar to ours would be of great use in other countries, as well.

Final paragraph:
Finally, our results may be of particular interest to the Turkish MOH in future provision of primary care services in Turkey. The MOH is currently emphasizing the role that primary health care must play in addressing Turkey's disease priorities [25]. The family medicine model emphasizes an approach to care in which GPs lead teams of PHC health workers to provide services. Our findings raise the possibility that different health worker cadres may be able to act as substitutes in provision of immunization services. That health officer density was positively associated with vaccination coverage in higher-density provinces during the entire study period - and nurse-midwife density from 2001 onwards - while positive associations for GP density disappeared over time is consistent with such substitutability. **While our findings alone are not sufficient to form the basis of related policy decisions**, their nuanced nature suggests that a better understanding of potential roles for each team-based approach may be important in helping Turkey improve vaccination coverage and bring its level of childhood mortality more in line with its European neighbors. More generally, it would be useful for the government to understand how its family medicine approach may affect other aspects of service provision through similar avenues of research.