Author’s response to reviews

**Title:** Workforce requirements for comprehensive ischaemic stroke care in a developing country: the case of Saudi Arabia

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1. The study objective as stated in the abstract is different from the one provided in the body of the paper - this must be clarified. Once this is done additional changes may be required to align the rest of the paper with the objective.

Author response

We thank the reviewer for highlighting this inconsistency. We have now updated the objective statement in both the abstract and in the main body. The objective given in the abstract is slightly shorter such that we do not exceed the word limit. However, the two statements are now consistent and provide a clearer summary of what we have done.

Objective in abstract: “Our objective was to use local epidemiological data to predict stroke incidence and to combine this with international staffing recommendations to estimate future staff requirements and their costs over a ten-year period.”

Objective in main body: “Our objective was to use local population and stroke incidence data to predict ischaemic stroke rates in Saudi Arabia, and to combine this information with existing staff availability within the Kingdom and with international workforce recommendations to estimate future staff requirements and costs over ten years.”
2. There is a large literature on different approaches to estimating the supply of and requirements for HRH in different contexts - within and beyond this journal - that does not appear to have been considered in the design of the study or the interpretation of its results. The rationale for the specific methods chosen to estimate HRH supply and requirements given the many alternative existing approaches is missing. Related to this point, the implications of relying on staffing ratios from other countries where professional scopes of practice (among other contextual factors of direct relevance to HRH planning) may be different from the setting of the present study should be elaborated upon in more depth.

Author response
This is a good comment and we have made some changes to incorporate discussion of some of the standard methods described for HRH in the literature. Specifically, we have added a paragraph in the first sub-section of the methods which highlights these approaches and describes the rationale for our own method. The text is provided below for reference:

“A wide body of evidence exists on methods for workforce supply estimation, covering both the supply element and the demand for services. Some such methods include regression-based models, simulation models, Markov chains and system dynamics. Epidemiological modelling is commonly used to determine demand for health care services, considering population demographics, health status and the types of service required (Barber, 2010; Tomblin Murphy, 2016). Existing supply has typically been estimated via national databases, online sources (such as the indicators available from the OECD) or tailored surveys in specific countries (Barber, 2010). The future supply of healthcare professionals, meanwhile, is often modelled via a stock-and-flow approach, incorporating the training and employment of new healthcare specialists, retirement, immigration and emigration, and taking into account practical changes such as flexible working hours and improvements in hospital efficiency (Van Greuningen, 2012).

Our approach used some elements of these methods (such as epidemiological modelling to determine future demand for stroke care services); however, we did not seek to model future staff supply via the methods described above. Instead, we combined the estimates of future demand with those of current staff availability and used international standards for stroke care as the basis for calculating the additional resources required.”

Regarding the transferability of staffing ratios between countries, we had included some text about this in the discussion section in the version we submitted, but have expanded this given its importance in the calculation of the future staff requirements (“In the absence of a comprehensive stroke care service in Saudi Arabia, we believe that using such international benchmarks as the basis for future requirements represents the most appropriate scenario to consider”).

Since the completion of this study, Saudi Arabia has adopted new standards for stroke care which are very similar those from the studies to which we referred, which supports their transferability between countries.

3. The explanation for how infrastructure requirements were estimated should be clarified. At present there is a single sentence at line 128 that says this was done through data collection.

Author response
Infrastructure requirements were in fact excluded from the analysis and so this statement should not have been included in the manuscript. There were two mentions of infrastructure within the methods section (in the ‘Current stroke workforce’ and ‘Epidemiological modelling’ sections) – these have now both been removed.

The exclusion of these costs has been mentioned as a limitation of the study in the discussion section. However, it is worth pointing out that many infrastructure costs are covered by private sector participation, meaning they are not borne by the Ministry of Health (from whose perspective the cost analysis was undertaken).

4. The process use to identify and obtain information from interviewees needs to be explained in more detail. For example, how were interviewees selected? What questions were they asked? How were the interview data collected and analyzed?

Author response
Agreed – this section needed some clarification and further detail. We have now provided more details on how this information was obtained within the ‘Current stroke workforce in Saudi Arabia’ subsection of the methods. In particular, the identification of the relevant contact within each hospital and the collection of information on staff provision have been addressed in more depth. The text added is given below:

“The data collection was supplemented via a survey of all hospitals providing stroke services within Saudi Arabia and was co-ordinated by one of the authors (FA-S) as part of the Ministry of Health’s Stroke Vision 2030 programme. Regional directors in the Kingdom were contacted by email via the Ministry of Health, with the survey cascaded down to individual hospitals to determine staff provision dedicated to stroke care. Thus, hospital-level data on staff in each of the specialties was recorded and scaled up to the national level. The data collected were validated by the authors to confirm accuracy.”

5. The specific calculations used to convert anticipated numbers of strokes to beds to FTEs would be clearer to the reader if the text of the paper was supplemented with equations and/or a diagram. It was not clear to me, for example, how the consideration of alternative models of service delivery was factored into the chosen staffing ratios.

Author response
The staff ratios given in Table 1 were taken directly from the UK and Canadian guideline documents on recommended staffing levels for the different locations (hyper-acute stroke unit, acute stroke unit and inpatient rehabilitation). Unfortunately, those documents do not provide a more detailed breakdown of the underlying calculations used to derive the FTE numbers. We have added a note to this effect just before Table 1. We have also removed the text ‘set to 50’ from row 252 as this was misleading and inconsistent with the subsequent sentence regarding the number of procedures undertaken by interventional neuroradiologists.

6. As a non-clinician I was surprised at the exclusive focus of the study on in-patient services; is there
no stroke care provided outside these settings in Saudi Arabia? This should be clarified.

Author response

Stroke services are largely provided on an inpatient basis, reflecting the acute nature of the condition and the need to act quickly to save brain function. Thus, the majority of stroke care takes place in the immediate aftermath of the stroke. Although there are some elements of patient follow-up which take place on an outpatient basis or via primary care, such services make up a small proportion of the overall burden.

We have added a sentence at the end of the introduction to specify the focus on acute care and inpatient rehabilitation (“The focus of the analysis was staff requirements for acute stroke care and inpatient rehabilitation in the immediate aftermath of stroke (outpatient and primary care services are small proportion of the overall burden of stroke care and were thus excluded)”).