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Introduction

Investment in health systems so that they are able to extend coverage of health services to the world's poor populations is increasingly recognized as an important contributor to saving lives, reducing poverty, spurring economic development and promoting global security (Commission on Macroeconomics and Health, 2001). The effective and equitable provision of essential health services depends to a large degree on the availability, competence, regulation, motivation and distribution of human resources for health (HRH), which represent the largest single use of public spending on health in developing countries (WHO, 2006; Glassman et al., 2008). Nevertheless, many low- and middle-income countries face acute shortages and maldistribution of skilled health workers, impeding the likelihood of meeting health systems objectives and attaining national and international health and development goals (WHO, 2006). Despite increasing interest in equity in health and the pathways by which inequities arise and are perpetuated or exacerbated, the global evidence base to inform policy decision-making on maldistribution in the supply, composition and deployment of the health workforce remains weak.

Exploring health workforce inequalities raises complex issues of depicting realities with simple indicators. Inequalities can be viewed along dimensions of population access to skilled workers (e.g. by need for health services, social consequences of illness, quality and cost of services) or across workforce equity strata (e.g. workers' compensation and career progression by sex, ethnicity and education). Drawing on an analytical framework for understanding health workforce imbalance (Zurn et al., 2004), at least four typologies for monitoring the distribution of health workers should be considered: imbalances in geographical representation, occupation/specialty, institutions and services, and demographics. The impact on health systems varies according to the type of imbalance; in consequence, there is a need to monitor and assess each of these dimensions of workforce distribution.

The present research was initiated in order to promote statistical discourse on measuring inequalities in national health labour markets and the implications for policy and planning. With the aim of arriving at a better understanding of specific dimensions of health workforce inequalities in their national contexts, three case-studies are presented from selected countries. The case-studies, each of which uses different analytical approaches and data sources, were undertaken by HRH researchers in Ethiopia, Brazil and Mexico. The document concludes with a discussion of the practical implications of the results.

1

Measuring health workforce inequalities in the Ethiopian context

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In Ethiopia, shortages and maldistribution of skilled health workers are recognized as a critical constraint to achieving the health-related Millennium Development Goals (MDGs). Although the overall size of the health workforce has grown substantially in the last decade, it started from a weak base that largely favoured community-based, task-oriented front-line and mid-level health workers such as health officers, nurses and health extension workers (Samuel et al., 2007; Yayehyirad et al., 2010). Global assessment approaches for monitoring HRH development tend to focus on numbers of physicians, nurses and midwives in a country (WHO, 2006; Anand & Bärnighausen, 2007). However, measuring appropriately the situation in a context of a large number of disparate cadres (from medical specialists with over 20 years of education to community health workers with a few months of training) remains challenging. The purpose of this case-study was to explore approaches for measuring health workforce inequalities that better reflect the Ethiopian realities.

Data and methods

Although a number of indicators can potentially be used to measure health workforce inequalities (Zurn et al., 2004), the workforce:population ratio is among the most commonly used calculation in health services research and planning, because it allows comparisons across regions and subregions with differing population sizes and is simple to construct from standard statistical sources, but still offers a basis upon which more sophisticated indices of relative inequality can be built. Comparing the actual workforce:population ratio with an established benchmark or "gold standard" allows not only to identify clearly an imbalance but also to quantify it. While there is no universal norm or standard for a minimum health workforce density in any given country or region recommended by WHO, the Organization has identified a threshold in density of physicians, nurses and midwives (2.3 per thousand) below which high coverage of essential interventions, including those necessary to meet the health-related MDGs, is very unlikely (WHO, 2006).

Ideally, health workforce assessments should capture all human resources in health systems: those providing preventive, curative, promotional and rehabilitation health services, as well as the management and support workers who help make health systems function. However, given the available data (i.e. from the national health management information system), this study is limited to formally employed health workers involved in direct health-care provision: physicians, nurses, midwives, health officers, health assistants and community-based health workers. Physicians, nurses and health officers working in management or education and training positions are also included. However, the analysis is

essentially limited to those in the public sector, which is by far the largest health-care provider in Ethiopia. Volunteers, village health promoters and traditional practitioners are not included.

Previous workforce analyses drawing on data for physicians, nurses and midwives have given equal weight to all categories of workers (e.g. WHO, 2006). Is this the most appropriate approach if, for example, we include non-physician clinicians and community health workers as well? In the Ethiopian context, all of these serve as first contact health-care providers, but the scope of the services and the level of care they provide are different (Yayehyirad et al., 2010). Some form of weighting seems necessary to account for such differences.

While many different weighting measures could be envisaged (using, for example, remuneration, length of service, place of assignment), only two – total number of years of education (including basic education and professional training) and number of years of professional training alone – were used in this analysis (Table 1).

Four options were explored for weighted measures of workforce density:

Option **A** – considers only physicians (including health officers), nurses and midwives and all with equal weight, i.e. the baseline analysis;

Option **B** – as in option **A** but adding health assistants, health extension workers and frontline workers, all with equal weight;

Option **C** – as in option **B** but weighted by total years of education;

Option **D** – as in option **C** but weighted by years of professional training alone.[1]

Calculations were made using the different options for the whole country, for the capital city Addis Ababa and for selected regions (the less resourced north-eastern highlands of Amhara and Tigray).

Table 1. Numbers of public sector health workers by category and years of education and training, Ethiopia 2006–2007

Category	Number	Years of education and training	
		Basic education and professional training	Professional training alone
Physicians – specialist	974	12 + 9 = 21	9
Physicians – generalist	832	12 + 6 = 18	6
Health officers	792	12 + 3 = 15	3
Nurses and midwives	18 146	12 + 2.5 = 14.5	2.5
Health assistants	3 184	10 + 1.5 = 11.5	1.5
Health extension workers	17 653	10 + 1 = 11	1
Frontline health workers	1 783	8 + 0.5 = 8.5	0.5

[1] For the most simple formulation, Option **A** considers only medical, nursing and midwifery practitioners and all with equal weight:

$Density^{Wa} = 1/p_i \sum MD_i + N_i + M_i$

where *MD* = medical doctors, *N* = nurses and *M* = midwives.

The formula for the Option **C** measure of workforce density (i.e. including more cadres and weighted by total years of education "e") can be expressed as:

$Density^{Wc} = 1/\Delta ep_i \sum MS_{ie_i} + MG_{ie_i} + HO_{ie_i} + N_{ie_i} + M_{ie_i} + HA_{ie_i} + HEW_{ie_i} + FLW_{ie_i}$

where *MS* = medical specialists, *MG* = medical 0 -lists, *HO* = health officers, *HA* = health assistants, *HEW* = health extension workers and *FLW* = frontline health workers.

For Option **D**, the cadres are the same as in Option **C** but weighted by years of professional training "t":

$Density^{Wd} = 1/\Delta tp_i \sum MS_{it_i} + MG_{it_i} + HO_{it_i} + N_{it_i} + M_{it_i} + HA_{it_i} + HEW_{it_i} + FLW_{it_i}$

Main findings

Figure 1 shows the results for Ethiopia and the selected areas. The density of medical, nursing and midwifery personnel is very low (Option A), especially when compared with the critical threshold established by WHO. There are considerable inequalities in workforce density across the selected regions; in particular, the density is over six times higher in the capital city compared with Amhara.

Including in the analysis additional categories of health workers (Option B) increases the density measure substantially. The interregional inequalities are found to decrease when the additional categories are included. This is especially noted in Amhara where there are large numbers of community-based health extension workers, who play an important role in providing services to poor and remote populations (Yayehyirad et al., 2010; Berman, Gwatkin & Burger, 1987).

Weighting the density by workers' years of education (Option C) gives comparisons that may better reflect local reality. Using this approach, observed interregional differences, notably between Addis Ababa and Amhara, remain acute (Figure 1).

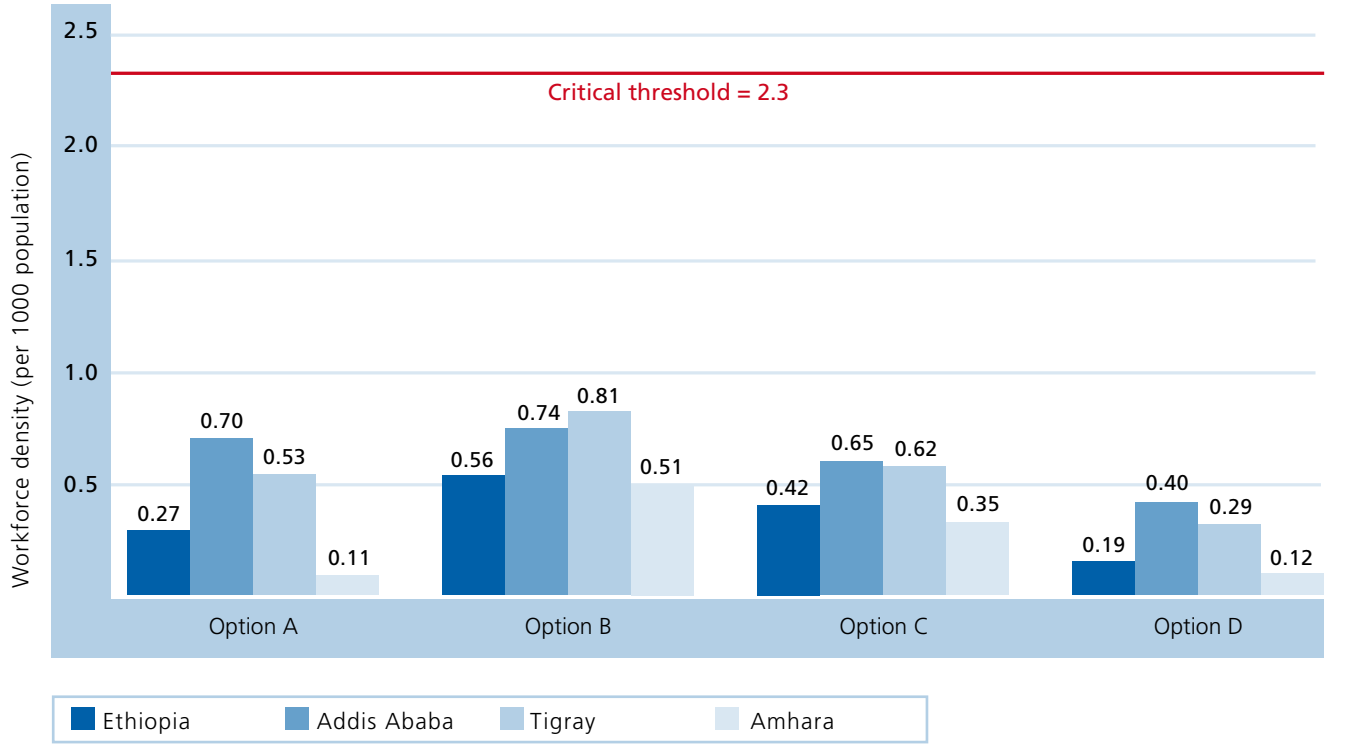
Another statistical option is to refine the weighting method to consider workers' professional training alone (Option D). This may be considered to approximate the scope and level of services offered as first contact health-care providers.

However, in the Ethiopian context where the entry criteria to health professions training programmes vary by category, this may not be the most appropriate approach.

Study conclusions

Measuring inequality in the health workforce is important in informing policy decisions and plans, but there remains a lot of uncertainty over the concept of imbalance and there are large differences within and across countries in its measurement. This study explored different measures for assessing geographical accessibility to health-care providers. The first measure, among the most commonly used globally, entailed calculating workforce density counting only physicians, nurses and midwives. The unweighted inclusion of additional categories of health workers, such as paramedical practitioners and community health workers, better reflects the context of local health systems but unacceptably "flattens" the observed regional inequalities. Comparative analyses of health workforce inequalities should be made cautiously, but the researchers believe that including broader categories of first contact health workers and weighting their possible contributions in terms of scope of services (notably by using a proxy indicator such as workers' education) would help refine the evidence base for HRH policy and planning.

Figure 1. Health workforce density by four different measurement options, Ethiopia and selected regions, 2006–2007



2

Inequalities in the Brazilian technical health workforce

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The Brazilian health sector is characterized by inequalities in labour conditions, resulting in limited opportunities for professional advancement among those initially recruited in a mid-level health technical occupation. This situation might be related, in part, to regional imbalances in the distribution of established posts in the public health sector, whereby positions requiring secondary or higher levels of education tend to be concentrated in the country's more prosperous south-east region and those requiring less education are more often found in the underserved north-east region. While there are important gaps in the availability of comprehensive data on HRH needed to analyse some of the causes and consequences of such workforce imbalances, some potential information sources are underused. This case-study draws on data from a household sample survey that includes statistical information on the national labour force, including health workers. The objective – and methodological challenge – is to make inferences about career progressions among health workers in technical occupations compared with their counterparts in professional-level occupations in order to inform workforce development policy and plans.

Data and methods

The data used in this study are derived from the 2005 Pesquisa Nacional por Amostra de Domicilios [National Household Sample Survey], a nationally representative survey of the (self-reported) socioeconomic and demographic characteristics of the Brazilian population, including educational attainment and labour force activity (Instituto Brasileiro de Geografia e Estatística, 2007).

The survey microdata on current work activity were categorized according to the Brazilian Classification of Occupations, a framework for delineating, organizing and analysing statistical information according to the levels and areas of work (Ministério do Trabalho e Emprego, 2009). The classification is the national equivalent to the International Standard Classification of Occupations, which defines an occupation as a set of jobs in which similar tasks and duties are carried out (International Labour Organization, 2009).

According to the classification, the main health occupations fall into two major groups: "science and arts professionals" (generally highly specialized workers in jobs requiring university-level education) and "mid-level technical occupations" (generally requiring knowledge and skills acquired through advanced formal education and training but not equivalent to a university degree). Selected characteristics of workers in five different fields for which occupation groups are precisely identified in the national classification at both the professional and technical levels were analysed: dentistry, nursing, pharmacy, chemistry and physiotherapy. The final survey sample consisted of 1828 health workers, of whom two thirds (65.9%) were health technicians (Box 1). A binomial probability function was used to assess the likelihood of workers' professional versus technical status, while controlling for a number of background characteristics including educational attainment, age, sex, employment sector (public/private), hours worked per week and income.[2]

Box 1. Selected health occupations at the professional and technical levels according to the Brazil National Household Sample Survey, 2005

	Professional	Technical
Occupations	Dentists	Dental technicians
	Nursing professionals	Nursing technicians and auxiliaries
	Pharmacists	Pharmaceutical technicians
	Chemists	Chemistry technicians
	Physiotherapists	Physical therapy technicians
Survey sample size	*N* = 624	*N* = 1 204

[2] The binomial probability function is expressed as:

$$P(Y = y) = \binom{n}{y} \pi^{y} (1 - \pi)^{n-y};\ y = 0,1,\ldots,n$$

where π is the probability of success, and y corresponds to the number of successes in n different subgroups (see McCullagh & Nelder, 1989). For the present analysis, the logit function was chosen analysing the Akaike Information Criteria and Bayesian Information Criteria for models selection.

Main findings

As seen in Table 2, the Brazilian health technician workforce is predominantly female and characterized by lower levels of educational attainment compared with their professional counterparts. At the same time, there are a large number (some 12%) of workers in technical positions who have graduated from university. One in three health technicians works part-time (less than 40 hours per week) and, on the other hand, one in six works 49 or more hours per week. Applying the binomial model to the survey data (Table 3) reveals some results in the expected direction: health workers with undergraduate degrees are 13 times more likely to be in a professional-level position and those with second stage university degrees 75 times more likely. Within the public sector, after controlling for education and other factors, workers are found to be approximately twice as likely to occupy a technical position.

A confusion matrix was built in order to evaluate the predictive power of the model. The percentage of health professionals "well" classified in their occupation was calculated at 93.1% while the percentage of technicians similarly classified was considerably lower at 86.8%.

Table 2. Percentage distribution of professional and technical health workers by selected characteristics, Brazil National Household Sample Survey, 2005

Background characteristics	Occupational status	
	Professional (%)	Technician (%)
Educational attainment		
Secondary diploma or less	14	88
University – first degree	82	12
University – masters or doctorate	4	< 0.1
Sex		
Male	29	15
Female	71	85
Employment sector		
Private	51	48
Public	49	52
Hours worked per week		
Less than 40 hours	32	34
40 – 44 hours	36	35
45 – 48 hours	10	14
49 hours or more	22	17
Total	**100**	**100**