

Human Resources for Health Observer





Measuring health workforce inequalities: methods and application to China and India



WHO Library Cataloguing-in-Publication Data

Measuring health workforce inequalities: methods and application to China and India / Sudhir Anand.

(Human Resources for Health Observer, 5)

1. Health personnel - organization and administration. 2. Health manpower - trends. 3. Health planning - organization and administration. 4. China. 5. India. I. Anand, Sudhir. II. World Health Organization. III. Series.

ISBN 978 92 4 150022 7

(NLM classification: W 76)

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Design: Atelier-Rasmussen / Geneva Printed in Switzerland / September 2010

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Acknowledgements

This study was researched and written by Sudhir Anand (University of Oxford). Mario Dal Poz, Neeru Gupta and Angelica Sousa (World Health Organization) reviewed the document and provided constructive comments. Financial support for the publication was provided by the United States Agency for International Development. Thanks are due to Victoria Fan for research assistance and to Helen Wang for formatting assistance.

Executive summary

Despite increasing interest in equity in health access and the pathways by which inequities in health outcomes 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.

This study proposes methods for measuring inequalities in the distribution of health workers in a country by adapting techniques from the economics literature on income inequality to the measurement of health workforce distribution across geographical units. Calculations use three indices: the Theil L measure and the Theil T index (both of which are decomposable) and the Gini coefficient G which, though not decomposable, is the most well-known and extensively computed measure of inequality.

Decomposition involves a partition of country units (counties or semidistricts) into mutually exclusive and exhaustive groups (such as rural-urban strata, provinces or states) and a calculation of two separate components of overall inequality: a weighted sum of inter-unit inequality within each group, called the "within-group" component, and a "between-group" component that measures inequality due solely to variations in health-worker density across groups. Formulae to provide a consistent definition for the two components are proposed and explained, and interpretations are discussed and evaluated. It is pointed out that when two interpretations lead to the same answer, there is an unambiguous meaning to the between-group contribution to overall inter-unit inequality. For example, the contribution of between-stratum differences in health-worker density to overall inter-unit inequality can be measured either as the inequality that arises when these differences are the only source of variation, or as the amount by which overall inequality falls when these differences are eliminated but inter-unit inequality within each group is kept constant.

The measures of inequalities in human resources for health were applied and analysed in two countries with large and diverse health labour markets: China and India. The study uses health workforce data from official sources in the two countries obtained in disaggregated form (by country unit, rural-urban stratum and health-worker category). This allows measurement of inequalities by the three selected indices. The final section reports that the overall density of health workers in China in 2005 was much higher than that in India in 2001. The conclusions highlight some of the main differences and similarities that were found between the health workforce distributions in the two countries. The finding of greater inequality in India than in China is especially significant: the urban-rural disparity ratios in health-worker density are almost twice as high in India as in China. In India, 85–90% of overall inequality is explained by just the two variables of state and stratum. In China, however, only some 40-50% of inequality is explained by these two variables. Thus in China there are large variations within province-and-stratum, whereas there are not in India within state-and-stratum. Reducing state-and-stratum density differences in India will thus achieve much greater reductions in overall health-worker inequality than reducing provinceand-stratum differences in China.

Different sources of data typically found in countries can be used to establish the order of magnitude and sources of health workforce inequalities. Countries are encouraged to compile and publish the standard indices of inequality, as a means of strengthening measurement techniques and learning from experience.

Preface

There is increasing awareness at the national, regional and international levels of the critical impact that the supply, distribution and quality of the health workforce has on the achievement of health and health system goals, including the Millennium Development Goals. Countries and partners are investing significantly in the development of human resources for health (HRH), including activities for education and training, deployment, management and retention of health workers. Nevertheless, as was recognized in the *World health report 2006 – Working together for health* (World Health Organization, 2006), in many countries the scarcity and fragmentation of data and information on the health workforce remain a major obstacle to identifying, implementing and monitoring the most effective policy and programme interventions.

In 2009, the World Health Organization, in collaboration with the World Bank and the United States Agency for International Development, published the *Handbook on monitoring and evaluation of human resources for health* (Dal Poz et al., 2009). The handbook offers health managers, researchers and policy-makers a comprehensive, standard reference for monitoring the health workforce, bringing together an analytical framework and country experiences with strategy options for improving the human resources information and evidence base to support decision-making.

Following the production of the handbook, it was recognized that further attention was needed to support countries and stakeholders in analysing and using health workforce data to address sub-national distribution imbalances. Thus, additional research was initiated to systematically review the current state of evidence on measuring and monitoring maldistribution of the health workforce, with special attention to low- and middle-income countries.

This publication is an outcome of that research. It is the second issue in the *Human Resources for Health Observer* series with the goal of promoting statistical discourse on measuring inequalities in national health labour markets and the implications for policy and planning. The present study seeks to identify the most appropriate methods to measure

inequalities in the geographical distribution of the health workforce in a country by adapting techniques from the economics literature on income inequality. Three main indices are identified: the Theil *L* measure, the Theil *T* index and the Gini coefficient. Formulae to provide consistent definitions are proposed and explained, and the methods developed are applied and illustrated with reference to health workforce data in two countries with large and diverse health labour markets: China and India.

In China, although the production of skilled health workers has greatly expanded in recent years, important differences persist in their distribution across the country. In India, the formal health workforce includes professionals trained and qualified in western medicine as well as practitioners of traditional healing systems, including those trained and qualified in the ayurvedic, yoga, unani, siddha and homeopathic traditions. In both countries, monitoring and addressing the geographical distribution of health-care providers to enable the health system to deliver essential services in an equitable and efficient way is a key social and policy concern (Anand et al., 2008; World Health Organization, 2007).

In most countries there are many different data sources that can potentially be used to measure HRH stock and distribution, including administrative records on health facility staffing and professional licensure, population censuses and statistical surveys. The publication of this study is part of the World Health Organization's broader efforts to enhance country capacities to generate, analyse and use data and information to assess health workforce performance and track progress towards HRH-related goals. The ultimate objective is to improve and promote standards and methods of measuring inequalities of health personnel in countries with different health policy environments and data challenges, so that the results are more comparable within and between countries and over time. Countries are encouraged to apply the methods proposed in this study, as a means of strengthening measurement techniques and learning from experience to build on the knowledge gleaned from the examples from China and India presented here.

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The purpose of this study is to present methods for measuring inequalities in the distribution of the health workforce in a country, and to account for the sources of such inequalities. Techniques from the economics literature on the measurement and decomposition of income inequality are adapted to data on the distribution of health workers across geographical units (e.g. counties, provinces and rural–urban strata). The methods developed here are applied and illustrated with reference to health workforce data from China and India. The selection for this analysis was based on the accessibility of county- and district-level health workforce data from these two very large countries, which account for more than a third of the world's population.

The study begins with a description of different indices of inequality of the distribution of the health workforce and their decomposition between and within groups. The literature on economic inequality lists various desirable properties of inequality measures (Sen, 1997), but still leaves a multitude of indices that satisfy these properties. This study therefore reports three measures selected to describe, analyse and decompose health workforce inequalities: the Theil L measure, the Theil T index and the Gini coefficient. The reason for choosing the two Theil measures (Theil, 1967) is that they are additively decomposable (in a sense to be made precise later), which allows accounting for different sources of inequality. The reason for including the Gini coefficient, although it is not decomposable, is that it is the most well-known and extensively computed measure of inequality; it is thus possible to gauge the extent of inequality in the distribution of health workers with that of other distributions whose Gini coefficients have been computed (income, consumption, etc.). The Theil *L* measure has the most desirable decomposition property, but it is not defined when there are zero health workers in a geographical unit. The Theil T index has a slightly less desirable decomposition property, but it is well defined when there are zero health workers in a unit.

The measurement and decomposition of health workforce inequalities

The objective is to measure inequality in the distribution of the health workforce in a country. Geographical units within a country (e.g. counties) that have a high healthworker density are better able to serve the health-care needs of their people than units with a low health-worker density. Units (counties or semidistricts) are ranked in terms of their health-worker density, and inequality is measured in the per capita availability of health workers for people in different units.

2.1 Notation

For each of i = 1, 2, ..., n geographical units (e.g. counties or semidistricts), let

 h_i = number of health workers in geographical unit (county) i p_i = number of people (i.e. population) in unit (county) i.

Define the health-worker density in unit (county) i as

$$x_{\rm i} = h_{\rm i}/p_{\rm i}.$$

Label the units (counties) in non-descending order of healthworker density as follows:

$$x_1 \leq x_2 \leq x_3 \leq \ldots \leq x_n.$$

Note that this labelling does not imply a monotonic ordering of either h_i or p_i with respect to i. The distributional assumption is that h_1 health workers are available for p_1 persons, h_2 health workers are available for p_2 persons, and so on. This defines the national distribution of health workers across people in the country.

Let *H* be the total number of health workers in the country. Then $H = h_1 + h_2 + ... + h_n = \sum_i h_i$.

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