

# Estimating inflows and outflows of health service providers in sub-Saharan Africa

Yohannes Kinfu, Hugo S. Mercer, Mario R. Dal Poz and David B. Evans

Evidence and Information for Policy  
World Health Organization  
Geneva, March 2006

## **Background paper prepared for The world health report 2006 - working together for health**

© World Health Organization 2006

The designations employed and the presentation of the material in this background paper do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines on maps represent approximate border lines for which there may not yet be full agreement.

The mention of specific companies or of certain manufacturers' products does not imply that they are endorsed or recommended by the World Health Organization in preference to others of a similar nature that are not mentioned. Errors and omissions excepted, the names of proprietary products are distinguished by initial capital letters.

All reasonable precautions have been taken by the World Health Organization to verify the information contained in this background paper. However, the published material is being distributed without warranty of any kind, either expressed or implied. The responsibility for the interpretation and use of the material lies with the reader. In no event shall the World Health Organization be liable for damages arising from its use.

This background paper was commissioned by WHO as background for the World Health Report 2006. The authors alone are responsible for the views expressed, which do not necessarily represent the decisions or the stated policy of the World Health Organization.

## I. Background

Health workers are the backbone of all health systems: they provide curative services; manage and implement preventive programs and respond to health emergencies. Recent study shows that to address key global health related Millennium Development Goals (MDGs), the stock of health professionals would need to increase worldwide by some 2.3 million (Speybroeck et al., 2006). An absolute shortage of health workforce is estimated to exist in 57 countries, 36 of which are in Africa. In sub-Saharan Africa alone, the current health workforce needs to be scaled-up by almost 140 per cent. While shortages are in part a consequence of past and current investment shortfalls in pre-service training, in many of these countries the goal of maintaining a sufficient and effective health workforce is also constantly challenged by migration, sectoral mobility, early retirement, morbidity and premature mortality among health workers.

Some workers leave the health workforce temporarily, because of illness or in order to attend advanced education courses, for example. Others are lost permanently, because of death or movement to non-health sector employment. In some cases, a health worker migrates from one country to another, thus permanently leaving one health workforce to join another.

High turnover reduces team efficiency, disrupts organizational function and causes a loss of institutional memory (Zurn et al., 2006). These, in turn, adversely affect the quality and cost of service delivery. Yet, in most countries statistics on entry and exit patterns of health workers remain far from adequate, limiting the capacity of stakeholders to implement relevant health workforce policies in these countries. The present study is, therefore, an attempt to provide a preliminary analysis of inflow and outflow patterns of health service providers in sub-Saharan Africa. The analysis is limited only to three types of health workers—*doctors*, *nurses* and *midwives*—and to countries in the region with critical shortages of health workers.

## II. Data and methods

The current and future size of the health workforce; its age, sex and sectoral distributions as well as its inflow and outflow patterns are better understood using a simple framework, commonly referred to, among demographers, as the ‘*balancing equation*’ (Preston et al., 2000). For any level of aggregation, the *balancing equation* relates the current (or future) workforce with the pattern and intensity of entry into and exit from the workforce as well as to the size of the workforce at origin. Using the same framework, it can also be shown that the structure of such a workforce, in the long term, is primarily shaped by the former two forces—pattern and intensity of flows—rather than of the original size of the workforce (Lotka 1882). This simple accounting identity can be algebraically expressed as follows:

$${}^i_t W = {}^i_0 W + {}^i_t G - {}^i_t D \pm {}^i_t M \dots\dots\dots [ 1 ]$$

Where  ${}^i_t W$  is the number of health workers in health system (or country)  $i$  at time  $t$ ;  ${}^i_0 W$  is the initial stock of health workforce in health system (or country)  $i$ ;  ${}^i_t G$ ,  ${}^i_t D$  and  ${}^i_t M$  are the number of new entrants into the health workforce, the number of reported deaths among health workers and the number who joined the health workforce from either other health systems or other economic sectors (net of those who left) since the initial period.  $M$  can be positive or negative. Rearranging equation (1) and dividing the resulting quantity by the initial stock, provides three important components of change—*entry rate* to the health workforce, the *rate of premature mortality* among health workers and *net migration rate*—the balance of which would determine the rate of expansion (or contraction) of the health workforce in a given health system.

While this demographic identity is conceptually neat and simple to understand, the required data are hard to come by, and where they exist are often inadequate. In the present study, the initial

stock of the health workforce ( $W$ ) was obtained from the WHO survey of health workers conducted in the Africa region in the course of 2004 (for a full discussion on the source and quality of data see Dal Poz et al., 2006). In most countries, this survey was also accompanied by a survey of health training institutions, which attempted to collect information on the number of trainees by cadre and year of graduation. We used the information on graduates from these data to determine both the number of new entrants as well as the *propensity of entry* in each country. As noted above, the latter is a measure of the annual input of new entrants (of a specific cadre type) as a percentage of the existing active health workforce (of the same cadre type).

The data on exits are even more sparse. Despite the increasing effects of migration and HIV/AIDS on the health workforce of most African countries, the recent WHO health workforce and health training institutions surveys did not collect information on mobility and mortality of health workers. The few estimates that are available from previous studies are also by and large limited in scope and rigour (Buve et al., 1994; Cohen 2002). In the present analysis, we used a *life-table* approach to estimate the total number of deaths among active health workers. This involved applying sex-specific survival ratios obtained from current national life tables onto the age distribution of the active workforce reported for each country (WHO 2005). These numbers were subsequently used along with the stock of the active health workforce to obtain an estimate of *rate of premature mortality* among health workers in each country.

The difference between the *rate of premature mortality* and the *rate of entry* gives what is called the *gross expansion (or contraction) rate* of the health workforce. This measure is a *gross rate* because it does not take into account of the effects of migration and early retirement. A measure which is adjusted for mobility and early retirement is referred to as the *net expansion (or contraction) rate* of the health workforce. However, as relevant data on these latter factors were not readily available for all countries under investigation, we adopted instead rates obtained from two separate studies in Mozambique and Zambia to estimate two alternative scenarios of *net rates* of expansion for these countries (Ngulube 2005; Ferriaho and Omar 2004). For lack of information, this analysis is, however, limited only to three types of health workers—*doctors, nurses* and *midwives*—and to selected countries in the region with critical shortages of health workers. The incomplete nature of the training data also meant that the analysis could be undertaken for 13 countries. The study is focused on the following 13 countries: Central African Republic, Cote d'Ivoire, Democratic Republic of Congo, Ethiopia, Kenya, Liberia, Madagascar, Rwanda, Sierra Leone, Tanzania, Uganda, Zambia and Zimbabwe.

### III. Results

#### *Patterns and intensity of inflows*

Table 1 presents the intensity of annual entry into the medical, nursing and midwifery health workforce in selected countries of the WHO Africa region. These are obtained by dividing the number of new graduates recorded for each country by the total stock of physicians and nurses and midwives in each country. For all countries combined, this shows that, on average, for every 100 physician practicing in these countries about 6 new medical graduates are produced each year. The rate is slightly higher for nursing & midwifery (some 6.4 per cent), reflecting the relatively faster pace of production of these cadres as compared to medical doctors in these countries.

**Table 1: Number of new graduates and annual entry for physicians, nurses and midwives in selected countries of the WHO African region**

Country	Workforce generation per 1000 active workforce:	
	Physicians	Nurses & midwives
Central African Republic	68	23
Congo, Democratic Republic	33	46
Cote d'Ivoire	140	27
Ethiopia	73	105
Kenya	49	20
Liberia	83	71
Madagascar	86	49
Rwanda	51	22
Sierra Leone	65	66
Tanzania	84	3
Uganda	49	16
Zambia	29	24
Zimbabwe	50	80
Grand Total	59	64

Source: Authors\* calculation based on data from WHO health workforce and training institutions surveys, 2004.

For the medical profession, the annual entry rate is relatively higher in Cote d'Ivoire and Niger where for every 10 practicing physician, the medical institutions in these countries would annually produce an equivalent of at least one new graduate. On the other hand, for the nursing and midwifery profession, the fastest entry rates were recorded in Ethiopia. In relative terms, Ethiopia, the Democratic Republic of Congo and Zimbabwe also tend to produce nurses and midwives at much faster rates than they are producing medical doctors.

### *Estimates of outflows*

Normally, we would expect that the effect of pre-service training on current and future stock of the active health workforce would be very much linked with the pattern and volume of outflows from the workforce. In countries experiencing high rates of outflows, for instance, training, and therefore, inflow rates should increase at a much faster pace if these countries are to avoid a fall in the density of health workers available in their health systems. This is particularly the case in many countries where illness and death from HIV/AIDS and high levels of international migration are putting pressure on the supply of the health workforce. Table 2 presents a measure of one element of outflow, premature mortality, for the 13 countries under study.

**Table 2: Estimates of pre-mature mortality in selected countries of the WHO African region**

Country	Crude death rate per 1000 active health workforce among:	
	Physicians	Nurses & midwives
Central African Republic	25	21
Congo, Democratic Republic	23	19
Cote d'Ivoire	25	22
Ethiopia	23	20
Kenya	23	23
Liberia	24	20
Madagascar	21	20
Rwanda	25	19
Sierra Leone	26	22
Tanzania	24	22
Uganda	26	22
Zambia	28	22
Zimbabwe	28	24
Grand Total	24	21

Source: Authors'\* calculation. Note: The estimated deaths only refer to the stock of health workforce aged under 60 years and does not include those who die after age 60. The national sex-specific life tables required for the calculation are from WHO database (WHO 2005).

Generally, pre-mature mortality rates are relatively lower for nurses and midwives than for doctors. This is consistent with the general pattern of lower mortality among females than their male counterparts in these countries. As a whole, each year 2.4 per cent of the medical doctors and 2.1 per cent of nurses and midwives are expected to be lost to pre-mature mortality. Among individual countries, death rates for medical doctors tend to vary from a low of 2.1 per thousand to as high as 2.8 per thousand in Zambia and Zimbabwe. It is interesting to observe that the death rate estimates presented for Zambia closely approximates the actual rates observed among female nurses in two hospitals in that country, and brings confidence to our estimates (Buve et al, 1994).

**Table 3: Annual gross and net rates of growth of the health worker force in selected countries of the WHO African region**

Country	Gross rate of expansion (contraction)		Net rate of expansion (contraction)-Scenario I		Net rate of expansion (contraction)-Scenario II	
	Physicians	Nurses & midwives	Physicians	Nurses & midwives	Physicians	Nurses & midwives
Central African Republic	4.3	0.2	3.3	-0.8	-0.7	-4.8
Congo, Democratic Republic	1.0	2.8	0.0	1.8	-4.0	-2.2
Cote d'Ivoire	11.4	0.6	10.4	-0.4	6.4	-4.4
Ethiopia	5.0	8.6	4.0	7.6	0.0	3.6
Kenya	2.6	-0.2	1.6	-1.2	-2.4	-5.2
Liberia	5.8	5.1	4.8	4.1	0.8	0.1
Madagascar	6.4	2.9	5.4	1.9	1.4	-2.1
Rwanda	2.6	0.3	1.6	-0.7	-2.4	-4.7
Sierra Leone	3.9	4.4	2.9	3.4	-1.1	-0.6
Tanzania	6.0	-1.8	5.0	-2.8	1.0	-6.8

Country	Gross rate of expansion (contraction)		Net rate of expansion (contraction)-Scenario I		Net rate of expansion (contraction)-Scenario II	
	Physicians	Nurses & midwives	Physicians	Nurses & midwives	Physicians	Nurses & midwives
Uganda	2.3	-0.6	1.3	-1.6	-2.7	-5.6
Zambia	0.1	0.2	-0.9	-0.8	-4.9	-4.8
Zimbabwe	2.2	5.6	1.2	4.6	-2.8	0.6
Grand Total	3.5	4.3	2.5	3.3	-1.5	-0.7

Source: Authors\* calculation. Note: Scenario I assumes an annual attrition rate of 1 % due to retirement and mortality. Scenario II is based on an annual attrition rate of 5 %; it includes losses due to early separation from the workforce attributed to mortality, retirement and migration.

Table 3 provides the rates at which the workforce in the study countries would change annually if premature mortality were the only attrition factor. The result suggests that, for the 13 countries as a whole, the stock of doctors would have increased annually by 3.5 % and those of nurses and midwives by 4.3 %; these are rates which are well above the weighted average annual population growth rate, 2.6 per cent per annum, estimated for these countries. However, if these trends were to hold, it would take over three decades—36 years for doctors and 29 years the nurses and midwives—before the densities in these countries as a whole reach the target level of 2.28 professionals required to address key health-related MDGs in these countries.

These estimates alarming as they are on their own right, the reality will be even much worse as the above estimate takes account only of mortality. These are clearly evident from the net expansion (contraction) rates presented in the same table which show the expected growth rate of the three professions once attrition due to spatial and sectoral mobility and retirement are taken into account. For most countries these rates are negative, suggesting a decline in density in the near future.

#### IV. Concluding remarks

Although this paper is not an exhaustive analysis of flows into and out of the health workforce in sub-Saharan Africa, it has nonetheless dealt with four major dimensions: new entrants, death among health workers, spatial and temporal mobility and retirement. Each requires separate and careful analysis in its own right, yet when examined as a group and specially in connection of the critical shortages of health workers that the countries under study face, a bigger picture of workforce dynamics emerges. This picture reveals that in several of the countries that have already critical workforce shortages even when outflows are restricted to premature mortality, the countries would continue to face shortages for sometime to come. For instance, even if there were to be no outflows of health workers due to migration, it would take another three decades or more—36 years for doctors and 29 years the nurses and midwives—before the densities in these countries reach the target level of 2.28 professionals required to address key health-related MDGs in these countries. If the effects of migration and retirement are take in to account, as they should be, not only that for most countries the growth rates of their health workforce are noticeably lower than their annual population growth rates, but they become negative in the majority of cases. Redressing the critical shortages in these and other countries in Africa, therefore, requires not only expanding inflows through training more workers but significantly diminishing the rate of outflow through better retention and improved workers health. However, it is important to note that as the data on which these estimates are based have serious limitation, the estimates presented are far from definitive, and should only be considered as illustrative.

## IV. References

Speybroeck N, Kinfu Y, Dal Poz MR, Evans DB. Reassessing the relationship between human resources for health, intervention coverage and health outcomes. Background paper for *World health report 2006: working together for health*. Geneva, World Health Organization, 2006 (available at: <http://www.who.int/hrh/documents/en/>).

Zurn P, Dolea C, Stilwell B. Nurse retention and recruitment: developing a motivated workforce. Geneva, International Council of Nurses, 2005 (Issue Paper 4; <http://www.inc.ch/global/Issues4Retention.pdf>, accessed 2 February 2006).

Preston S, Heuveline P, Guillot M. 2000. *Demography: Measuring and Modeling Population Processes*. Basil Blackwell. London.

Dal Poz MR, Kinfu Y, Dräger S, Kunjumen T, Diallo K. *Counting health workers: definitions, data, methods and global results*. Background paper for *World health report 2006: working together for health*. Geneva, World Health Organization, 2006 (available at: <http://www.who.int/hrh/documents/en/>).

Buve A, Foaster SD, Mbwili C, Mungo E, Tollenare N, Zeko M. Mortality among female nurses in the face of the AIDS epidemic: a pilot study in Zambia. *AIDS*, 1994, 8:396.

Cohen D. Human capital and the HIV epidemic in sub-Saharan Africa. Geneva, International Labour Organization, 2002 (Working Paper 2).

World Health Organization, Mortality database. (available at: <http://www3.who.int/whosis/menu.cfm?path=whosis,inds,mort&language=english>)