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Scaling up priority health interventions in Tanzania: the human resources challenge

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The international community has set ambitious goals (Millennium Development Goals) to improve health in developing countries by 2015. Effective and often cheap interventions exist to achieve these goals. In the mainland of Tanzania, one of the poorest countries of the world, we explored the human resources challenges of expanding the coverage of such priority interventions. We projected human resources for health (HRH) availability using a standard approach and estimated human resource requirements using a novel method (QTP) that produces estimates by task-specific skill categories and explicitly considers productivity.

In this paper, we present the findings of the case study in Tanzania and discuss the strengths and weaknesses of the QTP model. On the whole, the HRH challenge of expanding priority interventions in mainland Tanzania is daunting. HRH requirements exceed by far the estimates of HRH availability for 2015. The scaling up of the HIV/AIDS related intervention cluster, in particular the treatment and care of people living with HIV/AIDS, was the primary driver of increases in HRH requirements between the study's base year, 2002, and 2015, and thus of the overall imbalance. Scenario analysis points to three key areas for change in HRH policy and practice to reduce future imbalances: the increment-attrition balance, staff and service productivity, and the match between task-specific skill and occupational categories. However, even in an optimistic scenario, human resource availability will limit the extent to which priority interventions can be expanded in the mainland of Tanzania, and the government will not be able to avoid adjusting the globally set targets for service coverage and health outcomes to local realities and priorities.

Keywords Human resources for health, human resource planning, functional job analysis, attrition, productivity, Millennium Development Goals, priority interventions

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KEY MESSAGES

- In mainland Tanzania and probably many low-income sub-Saharan African countries, the scaling-up of priority interventions to achieve health improvements similar to the Millennium Development Goals will require human resources far in excess of the number likely to be available in 2015.
- Reducing future shortages will require policy action that adjusts the increment-attrition ratio, improves staff and service productivity, and optimizes the match between task-specific skill requirements and occupational categories.
- Even under optimistic assumptions, human resource availability will limit the extent to which priority interventions can be scaled up and governments will have to adjust globally set targets for service coverage and health outcomes to local realities and priorities.
- The paper's innovative QTP method can be used to analyse human resource shortages and the match between task-specific skill requirements and occupational categories; it appears to produce robust estimates of the human resources required to scale up priority health interventions in low-income countries.

Introduction

More than 18 million people die each year worldwide from communicable diseases, maternal and perinatal conditions, and nutritional deficiencies (WHO 2005). The vast majority of these deaths occur in developing countries. In endorsing the Millennium Development Goals (MDGs), the international community committed itself to significant improvements in the health of the developing world and set ambitious targets for 2015 (United Nations 2003): two-thirds reduction of child mortality, three-quarters reduction of maternal mortality, and the halt and reversal of the HIV/AIDS, tuberculosis and malaria epidemics. Effective and often cheap interventions exist to achieve these goals (Working Group 5 of the Commission on Macroeconomics and Health 2002). The Commission on Macroeconomics and Health (CMH) estimated that scaling up a small set of priority health interventions would halve child mortality in developing countries and yield the MDG targets for maternal mortality, HIV/AIDS, malaria and tuberculosis (Commission on Macroeconomics and Health 2001).

In 2005, the international community reviewed worldwide progress towards the MDGs. In the majority of low-income countries of sub-Saharan Africa, progress has been inadequate to achieve the health-related targets by 2015 (World Bank 2004). Accelerating progress to achieve the MDGs will require overcoming significant constraints in the supply of and demand for priority interventions (Hanson *et al*. 2003).

On the supply side, the availability of adequately qualified and motivated human resources for health (HRH) may prove one of the most challenging obstacles to achieving the MDGs in poor countries. There is a global shortage of health professionals (Joint Learning Initiative 2004). Demand outweighs supply in both poor and rich countries, with significant migratory flows from poor to rich fuelled by salary differentials (Joint Learning Initiative 2004; Vujicic *et al*. 2004). Adjustments of national health labour market disequilibria occur slowly as skills tend to be job specific, thus non-portable across different labour markets, and long curricula impede short-term increases in training outputs. HRH shortages in low-income countries are further exacerbated by low morale and productivity of staff (Bryant and Essomba 1995; Manongi *et al*. 2006).

The Republic of Tanzania, comprising the mainland and Zanzibar, is one of the poorest countries in the world (World Bank 2005). Its population suffers from high mortality rates for communicable diseases, maternal and perinatal conditions, and nutritional deficiencies that account for more than three-quarters of all deaths and the total disease burden (Lopez *et al*. 2006).

The government of Tanzania is committed to achieve the MDGs and has set even more ambitious targets, to improve the health of mothers and children and reverse the HIV/AIDS epidemic by 2010 (United Republic of Tanzania 2005a). Its health sector reforms aim to strengthen district health services, more specifically to ensure access to high-quality primary care services backed up by secondary and tertiary referral hospitals providing a broad package of essential clinical and public health interventions (United Republic of Tanzania 2003; United Republic of Tanzania 2005b).

Relative to other countries in sub-Saharan Africa, Tanzania is well endowed with HRH. It ranks among the top five countries of the region in terms of combined medical doctor and nurse density (WHO 2002b). In addition to the country's medical doctors, the health workforce includes thousands of clinical professionals who are trained to diagnose and treat common pathologies at the primary and secondary care level, but who lack a formal and internationally recognized university degree. Though doing well in comparison with other sub-Saharan African countries, in 2004, the government declared a HRH crisis (Dominick and Kurowski 2004). To date, however, a national HRH strategy remains to be developed.

In this study, we explored the HRH challenges of expanding the coverage of priority interventions in mainland Tanzania. The package of priority interventions followed recommendations of the CMH that were estimated to achieve the MDG targets for maternal mortality, HIV/AIDS, malaria and tuberculosis, and halve child mortality in developing countries (Commission on Macroeconomics and Health 2001), with some limited adaptations to reflect government priorities. Through the development of a HRH model and its application to Tanzanian data, we forecasted and compared HRH requirements and HRH availability for 2015. In sensitivity analyses, we evaluated the likely impact of different policy actions on the

HRH requirement and availability gap. In addition, we produced HRH requirement estimates for different types of primary care facilities and compared them with national staffing norms. This paper presents the study's methods and findings, and discusses both methodological issues and policy implications.

Definitions and methods

The Joint Learning Initiative, a network of global health leaders launched by the Rockefeller Foundation, defined HRH as all individuals engaged in the promotion, protection and improvement of population health, from both the formal and informal sector (Joint Learning Initiative 2004). This broad definition includes HRH with a wide range of qualifications and skills, from receptionists to neurosurgeons. In this study, we focused on HRH with sector-specific skills, i.e. skills that are non-portable across different labour markets, as they tend to be at particular risk of under- and over-supply. Among HRH with non-portable skills, we distinguished three main categories. The first two categories comprised HRH with formally recognized qualifications that require significant investment in training. We refer to these categories as health professionals; the first category with skills relevant to the provision of priority interventions, the second with skills not relevant for the provision of priority interventions. Examples of not relevant skills include dental care, occupational therapy and audiometric diagnosis. The third category of HRH included health workers with sector-specific skills mainly acquired through on-the-job training and relevant for the provision of priority interventions. We refer to this group as assistant health workers.

For ease of reference, we apply the term 'model' to the overall approach of weighing HRH requirements against HRH availability, as well as to the separate methods of forecasting requirements and availability.

Results are expressed in full-time equivalents (FTEs). A FTE is commonly defined as the number of working hours per year stipulated in the contract of a fully employed worker. This number may vary from employer to employer. In this study, we defined FTE by the stipulations of the standard contract between the government of Tanzania and a fully employed worker.

HRH requirements

We estimated current and future HRH requirements according to the QTP (service quantity, tasks, productivity) methodology that some of us have developed and refined since 2002. A complete description of the model is available online at [http://www.hefp.lshtm.ac.uk/publications/downloads/working_papers/01_06.pdf] (Kurowski and Mills 2006). In brief, the QTP methodology estimates HRH requirements for priority interventions based on three principal variables: service quantity, tasks and productivity. The version of the model employed here consisted of 42 priority interventions and 70 treatment lines. The set of interventions reflected recommendations by the CMH. Family planning was added given current practice and priorities in Tanzania. The intervention package addresses the disease burden related to tuberculosis, malaria, diseases of infancy and childhood, diseases and complications of motherhood, and HIV/AIDS. Each intervention includes medical and nursing care and diagnostic procedures. In addition to these five broad service categories, the model included 14 managerial, administrative and maintenance activities commonly carried out by health professionals at the service facilities. We calculated HRH requirements for the total package of interventions as the sum of HRH requirements for each intervention. Below we provide short descriptions of the principal variables of the QTP model; Table 1 summarizes for each principal variable of the model information requirements, data sources and methods employed in the study as well as alternatives.

Service quantity

Service quantity is the frequency with which a specific intervention is provided during a year. Countries, however, do not commonly report service quantity but rather service coverage, namely the number of services provided relative to the number of services needed. The model therefore calculates service quantity based on estimates for the number of services needed and information on service coverage.

Estimates of needed services rested on demographic data and information on risk, prevalence and incidence. Sources for demographic information included the Tanzania 2002 Population and Housing Census and the United Nations Population Database (National Bureau of Statistics 2003; United Nations Population Division 2004). Epidemiological data were drawn from national disease surveillance reports and the literature. They commonly reflect the status in 2002. In estimating future HRH requirements, 2002 levels of risk, incidence and prevalence were assumed to be constant over time.

Data for actual service coverage were primarily drawn from the Tanzania Demographic and Health Surveys and other official government sources (Appendix). Service coverage targets for 2015 reflected CMH recommendations (Commission on Macroeconomics and Health 2001).

Service coverage data commonly reflect averages across different treatment lines. To adjust service coverage information to individual treatment lines, the QTP model takes advantage of the fact that treatment lines differ by the level of service delivery and the intensity of treatment and care. It assumes that less severe conditions are treated at the lowest possible level of care, while in the case of more severe conditions, only the first contact with the delivery system is at the lowest level of care and further treatment, following referral of the patient, is delivered at a higher level of care. In the case of an intervention with an ambulatory treatment line for less severe cases and an inpatient treatment line for more severe conditions, the model makes the following adjustments. The service quantity of the ambulatory treatment line is primarily the need for this treatment line and the average service coverage. The service quantity of the ambulatory treatment line additionally includes the proportion of cases that need inpatient care, but receive ambulatory services because they are not successfully referred to a higher level of care. The service quantity for the inpatient line results from the estimate of the population in need for this treatment line and the average

Table 1 Determining Human Resources for Health requirements with the QTP model: Principal variables, information requirements, sources & methods as employed in the study as well as alternatives.

Variable	Information requirements	Information sources and data collection methods of the study	Alternative information sources and data collection methods
Service quantity (current and future)	• Demography (population by age group) • Epidemiology (risk, prevalence and/or incidence) • Current service coverage • Future service coverage	• Demography: national population census for current status, United Nations Population Database for projections • Epidemiology: country-specific reports for information on risk, prevalence and incidence • Current service coverage: Demographic and Health Surveys (DHS) and country-specific reports • Future coverage: recommendations of Commission on Macroeconomics and Health	• Current service quantity: data for absolute demand flowing from health management information systems • Future coverage: health sector reform goals
Tasks	• Definition of contacts and tasks by intervention • Tasks defined by quantity per intervention, skill level and time weight	• Definition of contacts (including level of care), tasks and their quantity by intervention: based on WHO treatment and national guidelines and refined in interviews with local health care providers • Specification of skill levels and time weights for each task: interviews with local health care providers	• Definition of contacts (including level of care), tasks, their quantity and skill levels by intervention: national expert commissions • Specification of time weights by expert commissions or direct observation of providers
Productivity	• Staff productivity • Service productivity	• Staff productivity: time and motion studies • Service productivity: proportion of productive time spent on the provision of priority services	• Staff productivity: measurement of client-provider contacts supplemented with interviews for personnel time not involving client contacts, provider interviews or self-administered time-sheets (Bratt *et al*. 1999) • Combined staff and service productivity: workload indicators of staffing need (WISN) method (ratio of actual staffing level in a particular facility and its calculated staffing requirements) (WHO 1998)

service coverage corrected for the referral probability. Information about the referral probability was generated through structured interviews with 90 primary health care providers.

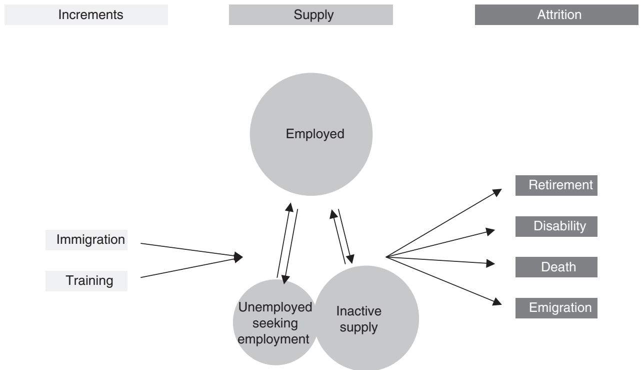
Tasks

The identification and definition of tasks is at the core of the QTP model. The underlying analysis included two steps. First, interventions and treatment lines were broken down into types of contact between the patient and the health service delivery system. Each contact was specified by its frequency during the course of the intervention or treatment line and the lowest possible level of service provision within the hierarchy of health service facilities. Secondly, each contact was broken down into tasks, with each task characterized by the required skills and a time weight. The task analysis was based on a series of treatment guidelines published by the World Health Organization (WHO), complemented by national policies and guidelines refined in interviews with Tanzanian health workers (WHO 1994; WHO 1997; WHO 2000a; WHO 2000b; WHO 2002a).

The task analysis resulted in a total of 18 skill categories. Time weights for each task were established through 320 structured interviews with a sample of 135 health workers that included all job categories involved in the provision of priority interventions (Kurowski *et al*. 2003). The health workers were randomly selected from staff of 10 public health facilities in two urban (Ilala, Kinondoni) and two rural districts (Rufiji, Mkuranga). These districts were selected deliberately to reflect a wide range of service coverage levels, staff per population ratios and differences in skill mix, plus accessibility by car within a day from Dar es Salaam. In each district, study sites included the District Hospital, two health centres and two dispensaries; the four primary care facilities were selected to reflect the broadest possible range of staff to population ratios for each type of facility. At the time of the study, highly active anti-retroviral treatment was not provided at the district level, so relevant time weights were established through interviews with health professionals in the country's tertiary health facility (Muhimbili Medical Centre, University of Dar es Salaam).

Productivity

The model combined two different concepts of productivity. Staff productivity was defined as time spent on service-related activities such as patient care or staff meetings.



Source: Kurowski (2003).

Figure 1 Components of health worker supply, sources of increments and attrition

Service productivity was defined as the proportion of productive staff time spent on the provision of priority interventions.

Staff productivity was investigated in a time and motion study (Kurowski *et al*. 2003). Trained research assistants followed 30 health workers during entire work-shifts for 2 weeks. They recorded the activity carried out by the health worker at constant time intervals (6 minutes), resulting in approximately 24 000 observations. Study participants were randomly selected at each of the 10 health facilities of the two urban and rural districts that were chosen as described above in relation to the interviews to identify and define tasks. Sites were assumed to represent a maximum range of staff productivity since they were selected to reflect the broadest possible range of staff per population ratios.

The direct study of service productivity proved infeasible, mainly for reasons of patient confidentiality. We therefore estimated service productivity as the ratio of estimates for HRH requirements according to the quantity of priority services delivered in 2002 and active, employed HRH supply in the same year.

The model considers staff and service productivity as a generic feature of the health service delivery system and does not consider potential variations amongst individuals, facilities and interventions. The time and motion studies carried out to determine staff productivity did not suggest that productivity was associated with characteristics such as occupational category.

HRH availability

The term availability refers either to the entire stock of HRH or to sub-groups of health labour supply (Hall and Mejia 1978). Total HRH supply comprises three key components (Figure 1): first, individuals employed in the health sector (employed active supply); secondly, individuals with sector-specific skills who are unemployed but seek employment in the sector (unemployed, active supply); and thirdly, individuals with sector-specific skills who are employed in sectors other than health or who decide not to work at all (inactive supply).

In this study, the results of the 2002 HRH census served as the baseline for HRH projections. The census was carried out by the Ministry of Health with cooperation of all district health management teams in 2001 and 2002. The census covered human resources publicly and privately employed in the health sector, thus the 2002 baseline for projections reflected active, employed supply.

Total HRH supply is a function of increments and attrition (Figure 1). Increments primarily result from training, but also from immigration of health workers. The most significant causes of attrition include retirement, emigration, disability and death.

We projected future HRH availability as a function of increments and attrition, using different approaches for health professionals and non-health professionals. In the case of health professionals, we estimated annual increments based on the average output rates of public and private training institutions between 1998 and 2000. Information on attrition rates was drawn from preliminary results of an ongoing study of attrition during a period of fiscal stabilization in Tanzania in the 1990s (Kurowski *et al*. 2006a). Alternatively, we calculated attrition rates as the reciprocal of the average length of service and the adult mortality rate (Kurowski *et al*. 2003).

By projecting HRH availability based on active, employed supply and increments and attrition rates, estimates of future availability of health professionals reflected a conservative approximation of total supply as they ignore unemployed and inactive health workers in the base year.

In contrast to health professionals, large numbers of assistant health workers can be trained within months. As their qualifications are primarily obtained through on-the-job training, their overall availability can be easily scaled up and is to a large extent dependent on the competitiveness of the compensation packages offered. Therefore, we assumed the size of this segment of the workforce as constant over time, in other words, increments and attrition were assumed to be equivalent.

Comparing HRH requirements and HRH availability

We estimated HRH requirements by classes of task-specific skills. In contrast, we calculated HRH availability by occupational categories. We developed two different sets of rules to convert classes of task-specific skill requirements into occupational categories (Table 2). The first set of rules reflected common practice in Tanzania. In the second, we attempted to optimize the actual match between classes of task-specific requirements and occupational categories by assigning classes of task requirements to the lowest occupational category competent to perform the tasks.

When comparing HRH requirements and availability, we calculated imbalances in absolute terms expressed in FTEs and in relative terms expressed as the ratio of HRH availability and HRH requirements.

Sensitivity analysis

The purpose of the sensitivity analysis was two-fold: first, to demonstrate the sensitivity of model outputs to parameter and modelling uncertainty; and secondly, to demonstrate the consequences of different policy actions. Characteristics of the model and data allowed both objectives to be pursued in a single scenario analysis. One-way analyses demonstrated that the model inputs staff and service productivity, attrition and increments and the rules to convert classes of task-specific skill

Table 2 Comparing Human Resources for Health availability and requirements: rules converting task-specific skill requirements into occupational categories—status quo versus optimized scenario

Occupational categories	Tanzanian health cadres	Task requirements, status quo	Task requirements, optimized scenario
Nurses other than community nurses	Nurses A and B, Nurse officers, Specialized Nurses	Nursing care of inpatients, assistance in operating theatre	Nursing care of inpatients, Integrated Management of Childhood Illnesses, assistance in operating theatre
Community nurses	Public health nurses, Mother-and-child health aides	Counselling during pregnancy, family planning	Counselling during pregnancy, family planning
Midwives	Nurse-midwives	Birth attendance, syndromic treatment of STI among female adults	Birth attendance, syndromic treatment of STI among female adults
Clinical professionals	Clinical officers, Clinical assistants	Patient management of uncomplicated cases, Integrated Management of Childhood Illnesses, counselling for infectious diseases, Directly Observed Treatment	Patient management of uncomplicated cases
Medical professionals	Medical officers, Assistant medical officers	Patient management of complicated cases, emergency obstetric care, anaesthetic procedures	Patient management of complicated cases, emergency obstetric care, anaesthetic procedures
Radiological technicians	Radiographer, Radiographic assistant	Radiological procedures	Radiological procedures
Laboratory technicians	Medical laboratory technologist, Laboratory technician, Laboratory assistant	Laboratory procedures	Laboratory procedures
Pharmacological technicians	Pharmacist, Pharmaceutical technician, Pharmaceutical assistant	Management of drugs	Management of drugs
Assistant health workers	Assistants (Various)	Basic inpatient care	Basic inpatient care
			Directly Observed Treatment
			Counselling for infectious diseases
			Distribution of drugs

Highlighted task skills reflect changes between status quo and optimized scenario. In some districts, nurses already manage childhood illnesses.
STI = sexually transmitted infections.

requirements into occupational categories influenced the largest proportion of model outputs. Staff and service productivity and attrition estimates were furthermore considered most uncertain among all model data inputs. At the same time, staff and service productivity, attrition, increments and the rules to convert classes of task-specific skill requirements into occupational categories reflect those parameters of the model over which policy-makers have most influence.

Varying these five critical parameters of the model, we defined likely, pessimistic and optimistic scenarios for the HRH requirement and availability equilibrium in 2015. The pessimistic scenario assumed maintaining the policy environment of 2002. The likely scenario built on the assumptions of the pessimistic scenario, but assumed that more recent efforts to increase training capacities and curb attrition would be expanded and sustained. The optimistic scenario assumed an ambitious but feasible reform effort to substantially increase training capacities, curb attrition, boost staff productivity and improve the match between on-the-job tasks and staff skills. Justifications for the alternative values or model structures used in the pessimistic and optimistic scenarios are in Table 3.

Comparing HRH requirements, minimum staffing levels and staffing norms

The QTP model permitted HRH requirements to be estimated for different classes of task-specific skills and types of service facilities. Based on these estimates, we calculated HRH requirements for occupational categories by converting classes of task-specific skills into occupational categories, as described above. We then estimated minimum staffing levels by rounding up HRH requirements for occupational categories to the

Table 3 Human Resources for Health (HRH) requirement and availability equilibrium in 2015: definition of scenarios

	Likely scenario	Pessimistic scenario	Optimistic scenario
HRH requirements			
Staff productivity	58%	46%	67%
Service productivity	64%	64%	80%
HRH availability			
Training capacity	1.2 fold	1.0 fold	1.5 fold
Attrition	5.7%	7.3%	4.1%
Comparing HRH requirements and availability			
Conversion of classes of task-specific skills into occupational categories	Rules reflecting status quo	Rules reflecting status quo	Rules according to optimized scenario

Staff productivity: The value used in the likely scenario is the average of all observations in the time and motion study; the values for the optimistic and pessimistic scenarios reflect percentiles 25 and 75, respectively.

Service productivity: The value used in the likely and pessimistic scenarios was calculated as the ratio of HRH requirements for the delivery of priority interventions in 2002 and the number of actively employed HRH in the same year. The optimistic value for service productivity resulted from discussion with health policy makers and reflected a mid-term objective.

Training capacity: Increments in the pessimistic scenario reflect training capacity levels as at the end of 2001. The likely scenario assumes a 1.2-fold increase of training capacity levels consistent with more recent trends for clinical officers and medical officers. The optimistic scenario assumes a 1.5-fold increase that national health policy makers considered ambitious but feasible.

Attrition: The rate used in the pessimistic scenario (7.3%) reflects preliminary results from an ongoing analysis of attrition rates during a period of fiscal stabilization in the 1990s (Kurowski et al. 2006a). The rate used in the optimistic scenario was calculated based on data for average length of service and age-specific mortality rates (4.1%) and corresponds to rates reported for stable health workforces in the literature (Hall and Mejia 1978). The rate used in the likely scenario is the average between the rates used in the pessimistic and optimistic scenarios.

next whole number. For example, we estimated the requirements for the class of task-specific skills related to laboratory procedures for health centres as 3.1 FTEs, which converted into a requirement for laboratory technicians of 3.1 FTEs, rounded up to 4 FTEs as the minimum staffing level for laboratory technicians at the health centre level. We then compared these minimum staffing levels to facility staffing norms issued by the Ministry of Health and former Civil Service Department Tanzania (Ministry of Health Tanzania and Civil Service Department Tanzania 1999).

Results

Projected total HRH requirements and availability

The scaling up of the 42 priority interventions would propel the total requirements for health professionals to 115 700 FTEs by 2015 for the mainland of Tanzania. The optimistic and pessimistic scenarios established a range of 66 200–144 000 FTEs. The forecasted requirements are equivalent to a likely health professional density of 2.7 (1.4–3.4) FTEs per 1000 population (Table 4). However, between 2002 and 2015, the likely availability of health professionals would grow from 24 700 to only 30 900 (25 100–38 600) FTEs, with 28 600 (23 200–35 800) FTEs possessing skills relevant to the provision of priority interventions (Figure 2). The forecasted HRH availability is equivalent to a health professional density of 0.7 (0.5–0.9) FTEs per 1000 population. Resulting shortages of health professionals would amount to 84 800 (27 600–118 900) FTEs in 2015.

In sensitivity analyses, we evaluated the impact of different policy actions on the HRH requirement and availability gap. Below, we present the three scenarios in more detail, including breakdowns by cadre and disease group.

Table 4 Staff density estimates: 2015 requirements

Cadres	FTE per 1000 population
Nurses	1.0 (0.8–1.2)
Midwives	0.2 (0.1–0.2)
Nurses and midwives	1.2 (0.9–1.4)
Physicians*	1.1 (0.3–1.4)
Technicians	0.4 (0.2–0.5)
Physicians, nurses and midwives	2.3 (1.2–2.9)
Total	2.7 (1.4–3.4)

Ranges presented in brackets reflect estimates for the pessimistic and optimistic scenarios.

*Includes both medical doctors and clinical professionals trained to meet medical needs at the primary and secondary care level but lacking a university degree.

FTE = full-time equivalent.

The likely scenario

Under the assumption that more recent efforts to increase training capacities and to curb attrition are sustained, the model predicted a shortage of 87 100 FTEs for health professionals with skills relevant for the expanded provision of priority interventions in 2015 (Table 5). Requirements would outweigh availability across all professional categories, though with significant variations. In absolute terms, the model predicted greatest shortages for clinical professionals (30 300 FTEs) followed by nurses (other than community nurses) (25 100 FTEs). In relative terms, shortages would be greatest for pharmacological technicians (availability equal to 4% of requirements) and clinical professionals (availability equal to 10% of requirements).

The model forecasted a need for 8700 assistant health workers. Under the assumption that the availability of assistant health workers is constant over time, there would be a surplus of 9500 FTEs in 2015. In addition, total supply as of 2015 would include approximately 2300 health professionals with skills that are not relevant for the provision of priority interventions.

Table 6 breaks down HRH requirements in 2015 by disease group, and also portrays (in brackets in the table) the increase required between 2002 and 2015. The HIV/AIDS and childhood disease intervention clusters accounted for one-third of all requirements for health professionals, followed by the safe motherhood (24%), malaria (7%) and tuberculosis (2%) clusters. The HIV/AIDS intervention cluster explained almost half of the increase in health professional requirements between 2002 and 2015.

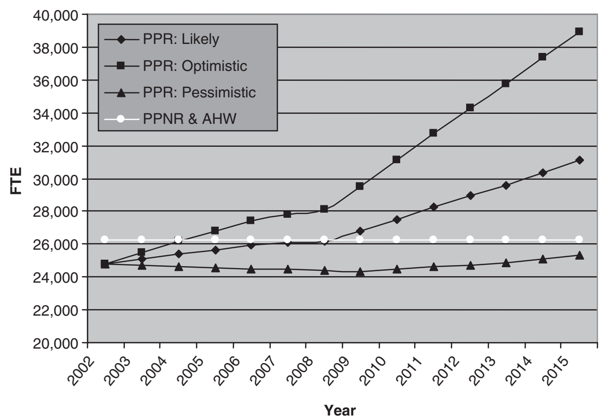


Figure 2 Human Resources for Health availability 2002–2015 by likely, optimistic and pessimistic scenarios: priority package relevant (PPR) health professionals versus priority package not relevant health professionals (PPNR) and assistant health workers (AHW)
Notes: See Table 3 for critical assumptions defining the scenarios. The slope changes in PPR projections between 2005 and 2009 result from lag-times between entry and graduation. FTE = full-time equivalent.

In the nurses and midwives category, the childhood disease and safe-motherhood service packages each represented approximately 40% of all requirements. In the categories of clinical and medical professionals and technicians, the HIV/AIDS cluster accounted for roughly half of all requirements and explained approximately two-thirds of the requirement increases between 2002 and 2015. For assistant health workers, the childhood disease cluster represented almost two-thirds of all requirements in 2015.

Pessimistic scenario

The pessimistic outlook assumed that the policy environment prevailing in 2002 would be maintained. As in the likely scenario, shortages would occur across all categories of health professionals with skills relevant for the provision of priority interventions but would amount to 120 800 FTEs in total (Table 7). In absolute terms, the model predicted greatest shortages for clinical professionals (40 300 FTEs) and nurses (other than community nurses) (35 400 FTEs) and, in relative terms, greatest shortages for pharmacological technicians (availability equal to 4% of requirements) and clinical professionals (availability equal to 10% of requirements).

The model forecasted a need for 10 800 assistant health workers. Under the assumption that the availability of assistant health workers is constant over time, there would be a surplus of 7400 FTEs in 2015. In addition, total supply would include approximately 1900 health professionals with skills not relevant for the provision of priority interventions.

The optimistic scenario

The positive outlook assumed an ambitious but feasible reform effort to increase training capacities, curb attrition, boost staff productivity and improve the match between on-the-job tasks

Table 5 Estimates of Human Resources for Health availability and requirements in 2015, likely scenario

Group of cadres	HRH_A	HRH_R	HRH_A – HRH_R	HRH_A / HRH_R
Health professionals, PPR	28 600	115 700	(87 100)	25%
Nurses and midwives	17 700	49 200	(31 500)	36%
Nurses other than community nurses	9 600	34 700	(25 100)	28%
Community nurses	1 900	6 900	(5 000)	28%
Midwives	6 200	7 600	(1 400)	82%
Clinical and medical professionals	8 200	48 500	(40 300)	17%
Clinical professionals	5 800	36 100	(30 300)	16%
Medical professionals	2 300	12 300	(10 000)	19%
Technicians	2 700	18 100	(15 400)	15%
Radiological technicians	300	500	(200)	60%
Laboratory technicians	2 000	11 700	(9 700)	17%
Pharmacological technicians	400	5 900	(5 500)	7%
Assistant health workers	18 200	8 700	9 500	209%
Health professionals, PPNR	2 300	–	2 300	–
Health professionals and assistant health workers	49 100	124 400	(75 300)	39%

Brackets indicate negative values.

HRH_A = human resources for health availability; HRH_R = human resources for health requirements; PPR = priority package relevant; PPNR = priority package not relevant.

and staff skills. Table 8 shows the predicted shortages and surpluses for different categories of health professionals with skills relevant to the provision of priority interventions. Combined shortages would total 33 900 FTEs, the majority (19 800 FTEs or 58%) among nurses (other than community nurses), followed by medical professionals and laboratory technicians (both approximately 5600 FTEs or 17%). Combined surpluses would amount to 3800 FTEs of which approximately two-thirds would be community nurses and more than a quarter clinical professionals.

The model predicted a need for 6100 FTE assistant health workers in 2015. Again, under the assumption that the supply of assistant health workers would be stable between 2002 and 2015, there would be a surplus of 12 100 FTEs. The total supply of HRH would include 2800 FTE health professionals with skills not relevant for the provision of priority services.

Table 6 Human Resources for Health requirements in 2015 and requirement increments between 2002 and 2015 by disease group (in brackets), likely scenario

Professional categories	TB	Malaria	IMCI/EPI	SMI	HIV/AIDS	Total
Health professionals, PPR	1780 (950)	7670 (5650)	38 720 (20 120)	27 560 (15 730)	38 780 (35 090)	114 500 (77 540)
Nurses and midwives	40 (30)	2790 (2260)	19 820 (11 640)	21 600 (12 660)	4910 (4080)	49 180 (30 700)
Nurses other than community nurses	40 (30)	2790 (2260)	19 820 (11 640)	7940 (5360)	4140 (3350)	34 740 (22 650)
Community nurses	–	–	–	6850 (3230)	–	6850 (3230)
Midwives	–	–	–	6810 (4070)	770 (730)	7590 (4820)
Clinical and medical professionals	1480 (780)	3380 (2420)	14 930 (6650)	2940 (1960)	25 740 (23 430)	48 470 (35 240)
Clinical professionals	1470 (780)	2960 (2070)	10 720 (3870)	–	20 990 (19 000)	36 140 (25 720)
Medical professionals	10 (10)	420 (340)	4220 (2790)	2940 (1960)	4750 (4420)	12 330 (9520)
Technicians	260 (140)	1500 (980)	3960 (1830)	3010 (1110)	8120 (7570)	16 850 (11 610)
Radiological technicians	10 (10)	–	390 (260)	–	40 (30)	430 (290)
Laboratory technicians	260 (140)	730 (510)	1140 (750)	2290 (920)	7110 (6710)	11 520 (9030)
Pharmacological technicians	–	770 (470)	2430 (810)	710 (170)	980 (830)	4900 (2300)
Assistant health workers	10 (10)	450 (390)	5260 (2580)	1600 (1080)	960 (800)	8270 (4850)
Health professionals and assistant health workers	1790 (960)	8120 (6040)	43 970 (22 690)	29 160 (16 820)	39 740 (35 890)	122 780 (82 400)

The presented totals reflect the sum of estimates for disease groups. As administrative and maintenance functions cannot be attributed to individual disease groups, the total presented here is smaller than the totals for the package of health, administrative and maintenance interventions presented in Tables 5, 7 and 8.

TB = tuberculosis; IMCI = Integrated Management of Childhood Illnesses; EPI = Expanded Programme on Immunization; SMI = safe motherhood interventions; PPR = priority package relevant.

Table 7 Estimates of Human Resources for Health availability and requirements in 2015, pessimistic scenario

Group of cadres	HRH_A	HRH_R	HRH_A – HRH_R	HRH_A / HRH_R
Health professionals, PPR	23 200	144 000	(120 800)	16%
Nurses and midwives	14 300	61 100	(46 800)	18%
Nurses other than community nurses	7 800	43 200	(35 400)	18%
Community nurses	1 500	8 500	(7 000)	18%
Midwives	5 000	9 400	(4 400)	53%
Clinical and medical professionals	6 700	60 300	(53 600)	11%
Clinical professionals	4 700	45 000	(40 300)	10%
Medical professionals	1 900	15 300	(13 400)	12%
Technicians	2 200	22 500	(20 300)	10%
Radiological technicians	300	600	(300)	50%
Laboratory technicians	1 600	14 500	(12 900)	11%
Pharmacological technicians	300	7 400	(7 100)	4%
Assistant health workers	18 200	10 800	7 400	169%
Health professionals, PPNR	1 900	–	1 900	–
Health professionals and assistant health workers	43 300	154 800	(111 500)	28%

Brackets indicate negative values.

HRH_A = human resources for health availability; HRH_R = human resources for health requirements; PPR = priority package relevant; PPNR = priority package not relevant.

Table 8 Estimates of Human Resources for Health availability and requirements in 2015, optimistic scenario

Group of cadres	HRH_A	HRH_R	HRH_A – HRH_R	HRH_A / HRH_R
Health professionals, PPR	35 800	66 200	(30 400)	38%
Nurses and midwives	22 200	42 000	(19 800)	38%
Nurses other than community nurses	12 100	31 900	(19 800)	38%
Community nurses	2 300	4 800	(2 500)	48%
Midwives	7 800	5 300	2 500	147%
Clinical and medical professionals	10 200	15 000	(4 800)	68%
Clinical professionals	7 300	6 300	1 000	116%
Medical professionals	2 800	8 700	(5 900)	32%
Technicians	3 400	9 300	(5 900)	37%
Radiological technicians	400	300	100	133%
Laboratory technicians	2 500	8 200	(5 700)	30%
Pharmacological technicians	500	700	(200)	71%
Assistant health workers I	18 200	6 100	12 100	298%
Assistant health workers II		15 000	(15 000)	–
Health professionals, PPNR	2 800	–	2 800	–
Professionals and on-the-job trained personnel, non-portable skills	56 800	87 300	(30 500)	65%

Brackets indicate negative values.

The category assistant health workers II refers to a new category of assistant health workers with different skills than currently trained assistant health workers (see Table 2).

HRH_A = human resources for health availability; HRH_R = human resources for health requirements; PPR = priority package relevant; PPNR = priority package not relevant.

The optimized match between occupational categories and task requirements would generate the need for 15 000 FTEs with skills that could be developed in the short-term (assistant health workers II in Table 8) to provide directly observed treatment and counselling, and to dispense drugs. Some of these could be recruited from the ranks of assistant health workers with a certain level of general educational attainment; others could be recruited and trained at the community level.

Comparing HRH requirements, minimum staffing levels and staffing norms

We estimated, using the QTP model, HRH requirements by type of health facility (dispensaries and health centres) for maximum levels of intervention coverage and staff and service productivity (100%), calculated corresponding minimum staffing levels, and compared the results with staffing norms. Estimates for HRH requirements and minimum staffing levels generally fell short of staffing norms.

At the dispensary level, the requirements for clinical professionals and corresponding minimum staffing levels were consistent with staffing norms (Table 9). However, the requirements for nurses and midwives and assistant health workers were only a small fraction of minimum staffing levels and staffing norms: estimated HRH requirements accounted for less than 75% of staff according to minimum staffing levels and for less than 60% of staff according to staffing norms.

At the health centre level, HRH requirements consistently fell short of staffing norms (Table 10), with the exception of laboratory technicians where requirements exceeded norms by a factor of 3. Across all other occupational categories, HRH requirements corresponded to approximately 65% of minimum staffing levels and 30% of staffing norms.

Discussion

Methodology

We estimated future HRH requirements with the QTP model and projected future HRH availability based on the 2001/02 HRH census (Ministry of Health Tanzania 2004). The method to project HRH availability reflects a standard approach in human resource strategy development (Hall and Mejia 1978; Kolehmainen-Aitken 1993).

The QTP model to estimate HRH requirements builds on the logic of task analysis, which is rooted in the concept of functional job analysis first described in the 1950s (Fine 1955; Fine and Wylie 1971). The model has been developed and refined by some of us over the last 5 years (Kurowski and Mills 2006). Recently, a WHO inter-cluster collaborative working group proposed in this journal a similar approach to estimating HRH requirements to achieve the MDGs (Dreesch *et al*. 2005). A first, fundamental difference between the QTP model and the approach proposed by the WHO inter-cluster collaborative working group is that the QTP model explicitly considers staff and service productivity. It is well known that staff productivity is less than optimal in many developing countries (Bryant and Essomba 1995; McPake *et al*. 1999; Kurowski *et al*. 2003), and hence improvements in productivity are a critical element of reforms to redress HRH shortages. Factoring-in service productivity allows for the reality that individuals will seek and receive treatment and care at all service delivery levels for conditions other than those addressed by the package of priority interventions.

A second, fundamental difference is that the WHO inter-cluster collaborative working group proposed incorporating managerial functions at the district, sub-national and national

Table 9 Human Resources for Health (HRH) requirements, staffing norms and minimum staffing levels: primary care level, dispensaries

HRH categories	Staffing norms (A)	Minimum staffing level (B)	HRH requirements* (C)	C/A	C/B
Nurses and midwives	1	1	0.5	50%	50%
Clinical professionals	2	2	2.0	100%	100%
Pharmaceutical technicians			0.3		
Assistant health workers	2	1	0.2	10%	20%
Total	5	4	2.9	58%	73%

*Assuming maximum coverage (100%), staff and service productivity (100%).

Table 10 Human Resources for Health (HRH) requirements, staffing norms and minimum staffing levels: primary care level, health centres

HRH categories	Staffing norms		Minimum staffing levels (C)	HRH requirements (D)	D/A	D/B	D/C
	Urban (A)	Rural (B)					
Nurses	2	1	1	0.2	10%	21%	21%
Community nurses	5	4					
Midwives	4	4	2	2.0	49%	49%	100%
Clinical professionals	4	3	1	1.0	26%	34%	100%
Medical professionals	2	1	2	1.5	74%	148%	74%
Laboratory technicians	1	1	4	3.1	312%	312%	78%
Pharmacological technician	1	1	1	0.1	15%	15%	15%
Assistant health workers	4	4	1	0.1	3%	3%	12%
Portable skills	6	8					
Total (non-portable skills)	23	19	9	5.9	26%	31%	66%

levels. Though we originally attempted to incorporate responsibilities of district management teams into the QTP model, we found it impossible to conceptualize managerial functions according to the principles of functional job analysis as they do not follow well-established standards and require much discretion in their execution. Therefore, the QTP model is limited to tasks carried out at the facility level, including clinical, administrative and maintenance tasks, all following well-established standards; furthermore, it allows adjusting for more discretionary management functions carried out at the facility level through changes of the variable staff productivity. In this aspect, the QTP model is similar to WHO's Workload Indicators of Staffing (WISN) and forerunner methods that established standard workloads based on unit times for specific work components (activity standards) and adjustments of working time for related maintenance, administrative, managerial and research functions (allowance standards) (Kolehmainen-Aitken and Shipp 1990; WHO 1998).

Other differences between the QTP model and the approach proposed by the WHO inter-cluster collaborative working group are of a procedural nature: in this study, we generated time weights through interviews with health care providers rather than through expert opinion or field observations; and the selection of priority interventions followed the recommendations of the Commission on Macroeconomics and Health adjusted to country-specific policy rather than a consensus developed in a national, participatory process.

The comparisons with international information on staff density and service coverage suggest that QTP model outputs are robust projections of HRH requirements. For example, the HRH requirement estimates produced in this case study correspond well with staff density estimates for the delivery of priority services that the Joint Learning Initiative (JLI) derived econometrically from a global dataset (Anand and Baernighausen 2004; Joint Learning Initiative 2004). The JLI staff density estimate for physicians, nurses and midwives to achieve high coverage levels for priority interventions was 2.5 per 1000 population, and our comparable estimate was 2.3 (1.2–2.9) per 1000 population.

The QTP model is innovative as it integrates staff and service productivity and produces HRH requirement estimates in terms of task-specific skill requirements. The latter feature permits, as presented above, analysing the match between task-specific skill requirements and occupational categories. The model, however, has significant weaknesses and limitations for strategic HRH planning. First, it is complex and the data requirements extensive (Kurowski and Mills 2006). Some information may not be readily available; for example, as in the presented case study, projections of disease incidence, prevalence and health risks. Secondly, rooted in functional job analysis, the approach primarily suits routine interventions that follow well-established standards and do not permit much discretion in their execution. For this reason, we failed to incorporate into the model health system management functions above and beyond the facility level. The same limitation probably applies also to complex medical interventions. Hence, the approach is primarily suited to investigate, as in the presented case study, HRH requirements for service provision at lower levels of care. This feature may prove a significant restriction to the more generic use of the approach as proposed by the WHO inter-cluster working group (Dreesch *et al*. 2005). Thirdly, the model is suited to estimating HRH requirements based on need and coverage targets, but it is difficult to link the estimates to health outcome targets such as the MDGs. Fourthly, the model ignores constraints to putting HRH to use effectively, for example the availability of infrastructure, existence of demand for health services, ineffective recruitment procedures, or fiscal implications. Finally, as applied in the presented case study, the approach ignores geographical variations, though the model could be applied more locally.

Findings of the case study

Our study estimated that expanding the provision of priority interventions to redress the disease burden due to communicable diseases, maternal and perinatal conditions and nutritional deficiencies by 2015 would require far more HRH than are likely to be available in mainland Tanzania. The scaling up of the HIV/AIDS related intervention cluster, in particular the treatment and care of people living with HIV/AIDS, is the primary driver of increases in HRH requirements between 2002 and 2015 and the overall HRH imbalance in 2015. HRH requirement estimates for the HIV/AIDS related intervention cluster already reflect a substantially lower HIV prevalence rate determined in the 2003–04 Tanzania HIV/AIDS indicator survey compared with earlier estimates (Tanzania Commission for AIDS, National Bureau of Statistics *et al*. 2005). However, substantial increases are also needed for the IMCI/EPI and safe motherhood clusters.

The sensitivity analysis points to three key areas for change in HRH policy and practice which could reduce future imbalances significantly: the increment-attrition equilibrium, staff and service productivity, and the match between task-specific skill requirements and occupational categories. However, even in the optimistic scenario, human resource availability will limit the extent to which priority interventions addressing communicable diseases, maternal and perinatal conditions and nutritional deficiencies can be expanded in Tanzania, let alone a package of priority interventions that more comprehensively addresses the country's disease burden. Hence, the government of Tanzania will not be able to avoid adjusting globally set targets for service coverage as well as health outcomes to local realities and disease priorities.

Augmenting increments by further enhancing national training capacity and reducing attrition would substantially increase future total supply. Increasing training outputs in the mid-term would require significant investments into training capacity in the short term. Effective policy change to reduce attrition would depend on a far better understanding of causes and levels of attrition. Paralleling efforts to increase total supply, measures would have to be put in place to improve the employment and retention of trained personnel. Currently, approximately 3000 clinical officers and nurses are not employed in the sector although approximately 2000 positions in public facilities are vacant (Dominick and Kurowski 2004).

Improvements in staff productivity would also have a significant impact on the future imbalance between HRH requirements and availability. Time and motion studies indicated that the average level of staff productivity in the public sector is likely to be below 60%. The ongoing public sector reform, in particular the reorganization of the performance management system, provides a platform for change to improve staff productivity. As the steward of the system, the Ministry of Health should be leading the effort to pilot this reform in the health sector, which could reap benefits in the short-term.

Improving staff productivity, however, also requires a better match between staffing norms and HRH requirements according to service demand and needs. As we demonstrated, HRH requirements consistently fell short of national staffing norms for health centres and dispensaries under the assumptions of 100% staff productivity, 100% service productivity and universal coverage of the selected priority interventions. Reducing staffing norms to the level of calculated minimum staffing levels for the provision of priority interventions would yield significant productivity gains. On the assumption that staff would take on tasks for which they are either under- or overqualified, staffing norms could be reduced even below estimates of minimum staffing levels, producing further productivity gains. Such a policy, however, would likely come at the price of impaired staff motivation (Kurowski *et al*. 2006b). The introduction of a multi-task trained professional category would facilitate the reduction of staffing norms.

Conversely, a better match between staffing norms and HRH requirements according to service needs could be achieved by expanding the package of priority interventions, for example, including cost-effective interventions that address the burden of non-communicable diseases. However, this may be a 'catch 22', as efforts to increase staff productivity, and thus technical efficiency, would reduce the allocative efficiency of the service delivery system. This conundrum sheds some doubt on the commonly promoted policy to concentrate scarce public resources on a limited number of highly cost-effective services (World Bank 1993). From the human resource perspective, prioritizing services to increase the allocative efficiency of health service delivery systems carries at least the risk of undermining staff productivity and thus the technical efficiency of service delivery.

We demonstrated that optimizing the match between task-specific skill requirements and occupational categories promises significant reductions in the imbalance between future HRH requirements and availability. In comparison with current practice, optimizing the match between occupational categories and task requirements would yield a substantial reduction in the predicted shortage of health professionals. The model showed that tasks equivalent to more than 15 000 FTEs could be delivered by occupational categories with lower skill levels or other individuals trained at the community level. Drug shop staff, for example, might be authorized to dispense drugs for common conditions such as malaria (Goodman *et al*. 2004). The scope for further improvements of the match will depend on technological advances that simplify intervention complexity, such as that achieved through syndromic approaches for childhood diseases (Gericke *et al*. 2005).

The optimization of the match between skill requirements and occupational categories would be facilitated by the formation of broadly skilled health worker categories. An alternative approach would include contractual arrangements that provide more flexibility in the hiring of staff and generally higher levels of unemployment across health worker categories. The latter approach, however, contradicts the strong preference for job security of public employees and the urgent need to employ all available HRH to meet the sector's requirement (Dominick and Kurowski 2004).

Mainly for two reasons, the results of the study need to be interpreted with some caution. First, the study assumed disease incidence, prevalence and health risks as constant over time. Projections have not been available and the modelling of future rates was beyond the scope of the study. Hence, high levels of uncertainty may surround estimates of service quantity. However, changes in incidence, prevalence and risks would most likely occur in disease areas where the study assumes a simultaneous scaling up of preventive and curative interventions, specifically, in the areas of HIV/AIDS and malaria. In the case of HIV/AIDS, prevalence rates are likely to be constant as treatment and care, in particular highly active anti-retroviral treatment, significantly prolongs the life expectancy of people living with HIV. HRH requirements for high coverage of malaria interventions constitute only a small fraction of the total HRH requirements; hence, uncertainty about malaria incidence under scaled-up prevention efforts is unlikely to affect the overall HRH requirement forecast.

Second, the study assumed that information on staff productivity and time weights established in 10 public health facilities is representative for the sector. Given the small sample size, the data may over- or under-estimate staff productivity. However, comparison with results of other studies in low-income countries of sub-Saharan Africa suggests that the likely range of error is small (Bryant and Essomba 1995; McPake *et al*. 1999; Kurowski *et al*. 2003). Time weights established in provider interviews were similar to those presented in the literature, for example, for the safe motherhood initiative (WHO 1994).

While the presented study was confined to the situation in the mainland of Tanzania, the model was also applied in Chad (Kurowski *et al*. 2003). The findings and conclusions have been similar, though in the case of Chad the relative gap between future requirements and availability was much greater. Though the detailed circumstances of countries in sub-Saharan Africa will vary, we believe that many of the points made here are likely to apply also to other sub-Saharan African countries.

Conclusions

We have presented and discussed the strengths and weaknesses of the QTP model to forecast HRH requirements. We believe that the analysis has demonstrated the model's value for strategic HRH planning. The model is available on the web and we encourage those interested to download and use it.

We compared HRH requirements to scale up priority health interventions in mainland Tanzania with forecasts of HRH availability. On the whole, the HRH challenge of expanding the coverage of priority health interventions is daunting, in both mainland Tanzania and probably many countries in sub-Saharan Africa (Kurowski 2003). Even in the optimistic scenario, human resource availability will limit the extent to which priority interventions can be expanded in the mainland of Tanzania, and the government will not be able to avoid adjusting the globally set targets for service coverage as well as health outcomes to local realities and priorities.

Recently, the government of Tanzania identified the need to develop a comprehensive HRH strategy. The strategy will have to address the three key areas identified in the comparison of long-term projections of HRH requirements and availability: the increment-attrition balance, staff and service productivity, and the match between occupational categories and task-specific skill requirements. While we discussed strategic options to tackle some of the issues faced in each of these areas, the government's ultimate task will be to elaborate the practicalities of implementation.

Governments facing the daunting HRH challenge of expanding the coverage of priority health interventions need support. HRH planning and development capacity is often insufficient; solutions require collaboration across government sectors; the global evidence base of what works is very thin (Joint Learning Initiative 2004). To date, international attention has focused largely on the financial cost of improving access to priority interventions (Attaran and Sachs 2001; Commission on Macroeconomics and Health 2001; Schwartlaender *et al*. 2001; Floyd *et al*. 2002; *Lancet* 2003; Heller 2006). However, if the HRH crisis in sub-Saharan Africa is not collectively and comprehensively addressed through knowledge generation, technical support, organizational and institutional capacity building and investment in HRH, additional funds being raised by the international community to improve health will sooner or later exceed the financial absorption capacity of countries. In this case, the impact of the global efforts to achieve the MDGs may be measured in interest from undisbursed dollars rather than saved lives.

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Appendix

Intervention coverage: baseline (2002) and targets (2015) recommended by the Commission on Macroeconomics and Health (CMH)

Intervention cluster	Intervention	Baseline	Target
Tuberculosis	DOTS; pulmonary smear-positive tuberculosis	43%[1]	70%
	DOTS; pulmonary smear-negative tuberculosis	44%[1]	70%
	DOTS; extra-pulmonary tuberculosis	44%[1]	70%
Malaria	Diagnosis and treatment of malaria (no children)	35%[2]	70%
	Insecticide-treated nets (ITN)	5%[3]	70%
Childhood diseases	Diagnosis and treatment of acute respiratory infections (ARI)[a]	70%[4]	80%
	Diagnosis and treatment of diarrhoea[a]	56%[4]	80%
	Diagnosis and treatment of malaria[a]	63%[5]	80%
	Diagnosis and treatment of fever[a]	63%[4]	80%
	Diagnosis and treatment of stunting[a]	63%[5]	80%
	Diagnosis and treatment of wasting[a]	63%[5]	80%
	Diagnosis and treatment of anaemia[a]	63%[5]	80%
	BCG vaccination	93%[4]	93%[b]
	DPT vaccination	82%[4]	90%
	Measles vaccination	78%[4]	90%
Pregnancy and birth related diseases and complications, family planning	Antenatal care	92%[4]	92%[b]
	Skilled birth attendance	44%[4]	80%
	Anaemia	43%[6]	77%
	Haemorrhage	25%[6]	67%
	Eclampsia	38%[6]	75%
	Obstructed labour	25%[6]	67%
	Puerperal sepsis	25%[6]	67%
	Newborn complications	25%[6]	67%
	Abortion complications	38%[6]	75%
	Postpartum care	92%[5]	92%
	Family planning	38%[7]	80%[c]
HIV/AIDS	Voluntary counselling and testing (VCT)	6%[4]	70%
	Prevention of mother-to-child transmission (PMTCT)	1%[3]	5%[d]
	Highly active anti-retroviral treatment (HAART)	1%[3]	65%
	Palliative care	16%[4]	70%
	Opportunistic infections (OI), local	35%[2]	70%
	Opportunistic infections (OI), systemic	35%[2]	70%
	Prophylactic treatment of tuberculosis	1%[3]	5%[d]
	Prophylactic treatment of pneumocystis-carinii pneumonia (PcP)	1%[3]	5%[d]
	Condom distribution in public outlets	5%[3]	80%
	HIV education in schools	5%[3]	80%
	Sexually transmitted infections; syndromic management	5%[4]	80%

[a] Delivered through the Integrated Management of Childhood Illnesses approach, the model allows for the possibility that the same child may suffer from various conditions.

[b] Whenever baselines exceeded targets, we assumed that baseline levels were maintained.

[c] The set of priority interventions recommended by the CMH does not include family planning. We used the target of 80% generically recommended for Safe Motherhood Interventions.

[d] Following the recommendations of the CMH, we assumed a generic target of 70% for treatment and care of people living with HIV/AIDS (PLWHA). The CMH recommended target for HAART, however, was 65%. Hence, the target for interventions that become redundant when PLWHA receive HAART is only the difference between the generic target for treatment and care and the somewhat lower target for HAART.

Sources of baseline data: [1] World Health Organization; [2] Estimate based on access to services and treatment seeking behaviour; [3] National expert opinion; [4] Demographic and Health Survey; [5] Demographic and Health Survey data from similar intervention served as proxy; [6] Demographic and Health Survey data from similar intervention served as proxy, data corrected for referral probability; [7] The Futures Group International.

Abbreviations: DOTS: Directly observed treatment, short-course.