HEALTH WORKFORCE SUPPLY AND REQUIREMENTS PROJECTION MODELS

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The World Health Organization has long given priority to the careful planning of human resources for health. Health workers represent the largest portion of the budget, and with good training, supervision, and an appropriate balance between the different occupational categories, they can make a major contribution to the health of a nation. Often, however, health personnel are working in the wrong proportions to each other, in the wrong geographic locations or in inappropriate types of institutions. Sometimes they spend too much time on activities that make a limited contribution to health. Moreover, many countries have trained more health workers, or a higher proportion of the more expensive categories, than their economies can support.

As part of its effort to help countries address these problems, in 1992 the World Health Organization commissioned the development of micro-computer-based models for long-range (20-30 years) strategic planning of human resources for health (HRH). After field testing in nine countries the models were improved through two versions and a second, intermediate-term (5-20 years) model (HRHShort) was created. By late 1999 more than 200 persons from at least 60 countries had received basic training in their use and some countries are using them in their planning.

The capabilities of the HRH strategic planning models and their required and optional data inputs and outputs are briefly described below. The HRHShort model is generally similar but easier to use, and is not described here. HRHShort offers three different methods of estimating requirements and the supply and requirements modules share the same spreadsheet. In the following description, the terms *B-Y* and *T-Y* refer to the base and target years, respectively, and *FTE*, to full-time equivalent personnel, eg, two half-time staff equal one FTE staff. The models come with extensive documentation which covers their design, uses, limitations, data requirements, methods of use, supplementary appendices, and printouts of tables and graphics.

THE PROJECTION MODELS

The WHO projection models are designed to assist countries with the development of human resource development plans. They permit planners, educators, managers and policymakers to develop alternative scenarios as to how health services could evolve in the future, and to determine what effects each set of assumptions could have on health personnel supply and requirements, on health system costs, and on the production and distribution of hospital and ambulatory health services. They can also be very useful for training planners and policymakers. The supply and requirements models:

- accommodate multiple user-specified occupational categories

- encompass both the public and private sectors

- accept data at varying levels of detail depending on data availability

- produce numerous summary statistics and graphics for data analysis and presentation

Before deciding to try the projection models countries should be well aware of what they can and cannot do. First and foremost, they are aids to the planning process. They can help answer important questions such as how fast can the health sector grow, how many health workers (and medical and nursing specialists) of each kind will be needed to meet anticipated needs, and what will be the probable production and distribution of services based on the planning assumptions. They cannot, however, make decisions, since this is a human function, based on human values. Likewise, they cannot predict the future, but rather, they can only suggest what could happen if the various user-specified assumptions are realized. Common questions about the models are answered below.

- **What are their primary limitations**? The long-term HRH requirements model has decreasing utility for projections much shorter than 10 years, and cannot be used without adaptation for specific health programs, eg, MCH, tuberculosis, malaria. The model is not suitable for making projections by the `need' or `demand' methods of workforce planning. The HRH models become less useful when the population size is very small, eg, less than about 100,000, while the HRHShort model can be used for shorter periods and smaller populations.

- **Why the emphasis on long-range planning**? Health programs can change significantly in only few years, but health systems usually require at least a decade before major changes can be fully implemented. For example, a 10% change in the entering class of medical students will result in only a 2% change in the supply of fully qualified doctors in 10 years. Due to the long delay between making major decisions that affect health worker supply or utilization, and attaining their full effects, one must project 10-30 years in the future. It is unrealistic, however, to try to anticipate precisely how such personnel will be utilized decades hence since future health administrators will be different from those of today and they will face problems that cannot be fully anticipated. Today's administrators must use a workforce that for the most part was trained years ago, often in inappropriate quantities and/or with inappropriate skills. Our task, then, is to reduce these constraints for future administrators to the greatest extent possible. To do this we must make long-term projections in order to guide short-term decisions, and we must update our projections every few years.

- **Why include requirements projections of the private sector**? Most countries have a significant and growing private sector, and this sector will claim its share of the available national workforce. Therefore, if the public sector is to have enough health workers to meet its own needs there must be enough health workers to also meet the needs of the private sector.

- **How are the supply projections made**? The supply model uses the basic formula: current supply of active health workers, plus projected new graduates, plus in-migration of graduates from elsewhere, minus projected losses. If country data are adequate, the model can take into account differential loss rates by age and gender, and net gains or losses due to in- or out-migration of health workers.

- **How are the requirements projections made**? Both the HRH and HRHShort requirements models are *deterministic* in that model inputs directly determine model outputs. Of the four basic methods for projecting workforce requirements -- needs, demands, targets, and ratios -- the WHO models use a variant of the target setting method. The user begins with the numbers and types of public sector clinical work locations (hospitals, clinics, etc.) available during the base year. The computer then divides the population by the number of each type of clinical facility to derive the population-per-facility ratio. The user then uses planning assumptions regarding target year ratios and average design capacities for the various facilities in order to meet the anticipated needs of the target year population, and the computer calculates the required number of facilities. These numbers are then multiplied by the assumed target year staffing norms for each facility to determine target year public sector requirements. Other methods are used for the projection of personnel required for public health, academic, and private sector personnel. A brief simplified example can illustrate the method used for public sector clinical facilities. Assume we are projecting staff requirements for large and small hospitals 30 years in the future in a country with a population of 10 million in the base year (B-Y) and 20 million in the target year (T-Y). Assume further that the target year staffing norm for large hospitals (LgeHsp) is 100 FTE doctors, and for small hospitals (SmlHsp), 10 doctors. The calculations are as follows, with the planning assumptions underlined:

  B-Y: 10M/5LgeHsp = 2 million population per LgeHsp; T-Y: 20M/2M = 10LgeHsp required x 100 doctors/LgeHsp = 1000 doctors required for large hospitals

  B-Y: 10M/50SmlHsp = 200,000 population per SmlHsp; T-Y: 20M/100K = 200SmlHsp required x 10 doctors/SmlHsp = 2000 doctors required for small hospitals

  From this very simplified example one can see that the population per large hospital has remained the same over the projection period while the population per small hospital has been cut in half. The projected total doctor requirement for both large and small hospitals is 3000. This change represents a policy favoring small hospitals, with the potential for improved access, lower costs per unit of service, and more primary care. With additional inputs and planning assumptions one can estimate the distribution of beds, the production in inpatient and outpatient services, and the change in the geographic distribution of hospitals, personnel and services.

  In practice the requirements model is far more versatile than outlined above, but the principle for public sector clinical work locations is the same, ie, multiply the projected

number of work locations of each type by the projected staff per work location to determine the number of staff required.

- **Can the models accommodate changing demand over time**? Yes! Many variables can affect the demand for services such as an aging population, changing morbidity, improved access to services, changing social and/or economic conditions, advances in medical science, and different patterns of delivering services. While the requirements model cannot predict what changes will occur, it can take into account assumptions about such change. For example, if the population is expected to age significantly during the projection period, with a resultant shift in morbidity patterns towards chronic disease, these changes can be taken into account by the assumed balance between different types of hospitals and clinics, by the assumed staffing patterns, and by assumed staff and bed productivity. Similar adjustments can be made to take into account changing health worker roles and responsibilities, patterns of care, etc.

- **What if my country doesn't have all the required information**? For at least two reasons the models will be useful even to countries with limited or inaccurate data. These are:

  -- Required data inputs are relatively few and almost all countries can develop estimates that are within 10-15% of the true, but unknown values. Many data inputs that could create problems are optional, and can be omitted if desired. Even when none of the five optional modules is used, the model can help policymakers understand the relationships between inputs and outputs.

  -- Users can easily test the sensitivity of model outputs to errors in model inputs. By identifying which inputs have the greatest effect on outputs, users can (1) set priorities for data improvement, and (2) develop alternative projections based on the assumed potential margin of error.

The supply and requirements models are briefly described below, along with required and optional data inputs, and potential data outputs. The models come with extensive documentation which covers their design, uses, limitations, data requirements, methods of use, supplementary appendices, and a full printout of all tables and graphics. The HRH models are available in English, French and Spanish, and are being translated into Russian. The HRHShort model is available in English.

SUPPLY MODEL

Overview and features. This model consists of a single spreadsheet with seven sections that accommodates up to five user-specified occupational categories. Additional spreadsheets can be used for any number of additional categories. Each supply spreadsheet includes a section which combines data for all five categories and a simple test of likely economic feasibility.

Required data inputs

- B-Y population
- Assumed average annual population growth rate
- B-Y supply of occupationally-active health personnel in each category
- Assumed annual loss rate for each occupational category
- B-Y and projected entering student enrolments for each occupational category
- Assumed percentage of entering students who graduate

Optional data inputs

- Annual number of male and female graduates in past years
- Assumed male and female cohort retention rates following graduation
- Assumed annual average change in staff incomes and in public sector expenditures on salaries
- Assumed B-Y and T-Y percentages of public sector personnel

Model outputs (for 5, 10, 15, 20, 25, and 30 years in the future)

- Projected supply of active personnel in each occupational category
- Average age of each occupational category
- Estimated annual rates of change during each five-year interval
- Health worker-to-population ratios
- Figures illustrating changes in the supply
- Probable economic feasibility of the projection (optional)

REQUIREMENTS MODEL

Overview and features. This model consists of a single spreadsheet with seven sections, and a second spreadsheet which makes it possible (1) to compare up to three alternative requirements projections for the same health system, and (2) to combine multiple subnational requirement projections. The requirements model takes into account five different types of work locations where health sector staff may be found: public sector hospitals; public sector free-standing ambulatory clinics and centers; the private sector; public health institutions that do not provide clinical services (eg, Ministry of Health, National Institute of Health); and academic and training institutions. The model includes a number of utility tables that can help users understand interrelationships between variables and to develop staffing norms. Model users may:

- Specify and project up to 15 different occupational categories

- Project to any target year and, if desired, to an intermediate year, eg, 5 years

- Use optional spreadsheet modules to.....
    -- project requirements for user-specified medical and nursing specialists
    -- test the economic feasibility of the public sector projection

-- project the potential production of hospital discharges and ambulatory visits by up to three user-specified occupational categories
-- project the possible urban-rural distribution and utilization of hospital and ambulatory services

Required data inputs

- B-Y population
- T-Y for the projection (normally 20-30 years)
- Assumed annual population growth rates (for 3 equal periods)
- B-Y full-time equivalent health personnel by occupational category in....
  - -- Entire health sector (including both the public and private subsectors)
  - -- Private sector, including both salaried and independent personnel
  - -- Public health (non-clinical) institutions
  - -- Academic institutions

  (Note: The above estimates will necessarily be approximate in most countries but can usually be determined within ±10% of the true, but unknown value.)

- For each of up to seven types of user-specified public sector hospitals
  - -- B-Y number of hospitals
  - -- Assumed T-Y average size, service area, and mix of hospitals
  - -- Assumed T-Y average staffing norm per hospital
- For each of up to seven types of user-specified public ambulatory facilities
  - -- B-Y number of clinics, centers and posts without beds
  - -- Assumed T-Y average size, service area, and mix of clinics
  - -- Assumed T-Y average staffing norm per clinic, center or post
- B-Y student enrolments in each occupational category
- Assumed average annual change in enrolments
- Assumed T-Y average number of students per instructor
- Assumed average annual increase in the private sector

Optional data inputs

- For public sector hospitals
  - -- B-Y numbers of beds, discharges, and average occupancy rates
  - -- Assumed T-Y productivity estimates for hospital discharges
  - -- Assumed T-Y productivity estimates for hospital-based ambulatory services
- For each type of public sector ambulatory facility without beds
  - -- Assumed T-Y productivity estimates for ambulatory services
- Assumed T-Y productivity estimates for selected private sector services
- Assumed annual average change in staff incomes and in public sector expenditures on salaries
- Assumptions regarding the urban-rural distribution of services

Model outputs

- Total numbers of required health workers by work location and specialty

- Total numbers of hospitals and beds required
- Economic feasibility of the projection
- B-Y and T-Y individual and aggregate private practitioner income
- B-Y and T-Y hospital discharges and ambulatory visits by subsector
- B-Y and T-Y per capita utilization rates of hospital and ambulatory services
- T-Y per capita urban and rural service utilization rates
- Numerous graphs and summary tables illustrating changes in the health system and in the health workforce
- Ability to compare up to three alternative projections
- Ability to combine multiple subnational requirements projections

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SUGGESTED METHOD OF APPLICATION

Much effort has gone into making the projection models as easy to operate as possible. Nevertheless, the intrinsic complexities of workforce planning and of operating a high level computer spreadsheet program make it likely that many countries will want assistance in getting started with these powerful new tools for planning. Accordingly, WHO has and will continue to sponsor training workshops and consultant support to further model application. Countries interested in possible application of the models may consider the three following alternatives.

- **On-site assistance**. In this option a country requests the help of its local WHO representative in obtaining a consultant familiar with the models. During a several-week consultation: (1) a small number of nationals are trained in the use of the models; (2) the models are loaded with approximate national data; (3) a plan is prepared for refining data inputs and for experimenting with the models; and (4) presentations and demonstrations are made to policymakers and educators to inform them about the models and their potential uses. Even countries with limited HRH data should be able to develop usable supply and requirements models within the first week of the consultation, and these will greatly facilitate the other objectives of the consultation. The country can then proceed on its own with the models and with further consultation as needed.

- **Participation in a regional training workshop**. Some countries may wish to send 1-2 persons to a regional training workshop and then request followup assistance as appropriate.

- **Self-application of the models**. A few countries may wish to try using the models on their own, without the assistance of a regional consultant. These countries may request the necessary model program software, including a diskette with the full documentation in word processor format, from WHO/Geneva (see address at bottom of last page).

COMPUTER SKILL REQUIREMENTS

The models require a basic knowledge of computer operation and intermediate level skills with spreadsheet programs. No programming is necessary. A person without prior computer experience will require at least several days of training to become familiar with basic computer and program operations, and about 6-8 days of hands-on training to become reasonably proficient in operating the projection models. Additional time will be necessary for persons without prior experience in health workforce planning.

EQUIPMENT REQUIREMENTS

Hardware. For acceptable performance the models should be run on a PC micro-computer with preferably a 486 or Pentium CPU running at 33 Mhz or higher, 8MB of RAM (Random Access Memory), a math co-processor, and a hard drive with at least 10 MB of free memory. With much less than these capabilities the model may be unacceptably slow. A color monitor and printer capable of printing graphics are very desirable.

Software. The models were originally programmed in the spreadsheet program Visual Baler, ver. 2.5, and are designed for use with MS Windows 95 and MS Windows 3.1xx or higher. They cannot run in DOS. Run-time program files total almost 7 MB and are provided by WHO on three compressed diskettes. Users may also request model spreadsheets in Microsoft Excel 97.
