HUMAN RESOURCES FOR HEALTH:

Models for projecting workforce supply and requirements

--- Projection model documentation prepared by ---

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FOREWORD

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 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 WHO commissioned the preparation of supply and requirements projection models to facilitate the long-range planning of health personnel. This document describes Version 3.0 of these models and provides instructions in their use. The models can accommodate many different occupational categories and user-defined economic, staffing, productivity and wastage (or staff loss) variables. They can thus help planners and policymakers answer “What if....?” questions about the effects of alternative planning assumptions. During 1993-94 WHO field tested versions 1.0 and 2.0 of the models in both small and large countries, and these tests led to significant improvements. Model users are invited to send their impressions and suggestions to Dept. of Organization of Health Services Delivery (OSD), World Health Organization, 1211 Geneva 27, Switzerland, with a copy to the model's author, Dr. Thomas L. Hall, at the cover page address.

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I wish to acknowledge with great appreciation the support and guidance provided to me by Drs. E. Goon and A. Goubarev of the Division of Organization and Management of Health Systems of the World Health Organization. The suggestions made by Dr. H. Nakatani and by participants at two WHO-sponsored consultations in 1992 at the University of York (UK) and WHO/Geneva also provided very useful guidance. The ultimate test is, of course, how the models work in the field. I am therefore especially appreciative of the many suggestions for model improvements that I have received from planners, policymakers, statisticians, consultants and WHO staff over the past six years. By the year 2000 more than 200 persons from more than 60 countries have had experience with the models, and a number of countries are now beginning to use them for policy analysis and planning.

I am especially grateful to Lucille M. Hornby of Stockton, New Jersey, for the many hours she contributed to the initial programming and testing of the projection models. Gisele Almeida of the Pan American Health Organization has also made important contributions to the programming and translation of the models. Without the valued
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HUMAN RESOURCES FOR HEALTH:  
Models for projecting workforce supply and requirements

Part I. INTRODUCTION AND OVERVIEW

This document describes two microcomputer spreadsheet models for developing 10- to 30+ year projection scenarios for the supply of and requirements for human resources for health, and for studying the interactions between personnel policies, health sector costs and productivity. The models are designed for use at the national or subnational level, and users may define their projection period in the requirements model according to their needs. Model documentation describes required and optional data inputs, suggests ways to make data collection easier, describes the relationships among data inputs and outputs, illustrates simulated data inputs and outputs, and provides step-by-step procedures for model operation. In addition to their use in planning and policy making, the models can also be used in training to illustrate the interactions among the different health sector inputs and outputs.

This documentation was prepared for the Version 3.0 VisualBaler models, a run-time spreadsheet program that requires no other application program. The Baler version was subsequently complemented by an almost identical Microsoft Excel version. Accordingly, these instructions will also be informative for those who wish to use the Excel version. Such differences as do exist are detailed in the Excel-specific instructions, available both as Appendix N and as a separate file.

Model uses, limitations and characteristics

A model may be defined as any representation of a system or process. Models can help:

- define a problem
- organize our thoughts
- understand data
- communicate and test our understanding of the data
- make predictions
There are many different kinds of models for accomplishing these functions and for assessing the future. Some models attempt to predict the future such as those used by meteorologists to forecast the weather or by economists to predict short-term interest, inflation or growth rates. Others make no effort to predict the future but instead are used to assess the likely consequences of alternative policies or events. The models developed by WHO are in this latter category, and hence perhaps best be termed scenario generators. They indicate what might happen if the major input assumptions are realized; the models cannot indicate what should be done, which is a human decision. Scenarios represent alternative views of what the future could look like. Scenarios have several important qualities:

- **Scenarios are intended to promote discussion and debate.** They provide policymakers with different consequences of different, and at times extreme, policy options. They answer the `What if?' questions that should be asked before choosing from among various alternatives.

- **Scenarios are exploratory, not predictive.** They are not forecasts and are never `wrong' or `untrue', in the sense that forecasts or predictions are often in error. Only if the assumptions are fulfilled will the scenario come to pass.

- **Scenario assumptions should be internally consistent,** that is, they should reflect a set of policies that all contribute toward the same general goals, and not be in contradiction with each other.

- **Scenarios are usually based on available data or on reasonable assumptions** in the place of such data. As a result, they are relatively easy to develop and are not, in the initial phase of their development, dependent on precise estimates.

Once a preferred scenario has been identified, planners and policymakers can proceed to:

- Review and revise the database used in this scenario order to make the best possible projection of the likely consequences of the preferred policies.

- Develop a plan and set of implementing actions and policies designed to bring the proposed scenario into being.

The requirements projection model, in particular, provides planners and policymakers with a chance to `design' alternative futures, each of which calls for different numbers and mixes of health personnel. By way of illustration, some of the major policy variables that could be considered, and their more common effects, are listed below.

- **Hospital size.** As hospital bed capacity increases...
- the number of staff required per bed increases
- the service area increases
- specialized capabilities increase
- emphasis on providing specialized services increase
- the number of hospitals that can be afforded decreases
- service accessibility, especially for rural residents, decreases

- **Inpatient versus ambulatory services.** Inpatient services require relatively more nursing and technical personnel, and ambulatory services tend to require more medical personnel. Inpatient services are far more costly per patient treated, and many less patients are served in a given period of time.

- **Type of inpatient capabilities.** Hospitals that serve acutely ill patients require more staff per bed, especially medical, nursing and technical, than do bedded facilities that care for chronically ill patients, mental patients, and patients requiring long-term nursing care.

Long-term strategies that many, but not all, health care systems may want to consider are:

- Reduce the size of very large hospitals and increase the size of very small hospitals. Very large hospitals tend to become inefficient, overly specialized, and less accessible to patients. Very small hospitals tend to have limited capabilities and low occupancy rates, yet because they provide inpatient care, require 24-hour staffing.

- Increase staff densities in hospitals to achieve higher bed-turnover rates and greater productivity for installed bed capacity. Thus a country could meet the needs of a growing population as much through increased bed productivity as through increased numbers of beds.

- Give priority to increasing the qualifications of nursing and technical personnel. Many health facilities are inefficient due to the relatively low level qualifications of mid-level personnel, and/or to the low percentage of qualified mid-level personnel relative to support personnel.

- Give priority to increasing ambulatory services, in hospitals, clinics and health centers. Compared with hospital services, ambulatory services serve more people, at less expense, earlier in their illness, and can be more oriented to prevention.

- Give priority to providing convalescent, chronic disease, long-term nursing and home care services. With aging populations and expensive acute care hospitals, it makes good sense to have a variety of lower cost ways of caring for chronic conditions that do not require the staff densities of acute care hospitals.
In summary, if and as appropriate to the country situation, policies could be oriented towards:

- upgrading the quality but not the numbers of high level personnel, increasing the quantity and quality of mid-level personnel, and increasing the quality but not necessarily the numbers of auxiliary personnel

- a slow rate of hospital construction, with priority given to ambulatory care. As existing hospitals become outdated or in need of major repairs, consider converting them into extended care facilities or including such facilities in the remodeling of the health system.

**Model simplicity versus complexity.** The health workforce models attempt to represent what is happening in a large and complex sector of a national or regional economy. Accordingly, one must seek a balance between model simplicity at the expense of many important variables, and complexity at the risk of inadequate data or of inadequately verified relationships among the variables. Although the models take into account many important variables and can be operated with varying levels of input data, they must nevertheless omit much of what really happens in the health sector. The documentation calls attention to the more important simplifications and Appendix C addresses many questions and answers about the models and their use. The models can be used at both the regional and national level, as well as for different subnational health care systems, such as a social insurance fund, the Ministry of Health, or the armed forces health system. They may be less useful for making projections for individual institutions or very small health care systems.

**Model characteristics.** Both the supply and requirements models are deterministic and transparent. They are deterministic in that the computer program incorporates previously specified numerical relationships between data inputs and outputs, and transparent in that the relationships between these values will usually be readily evident. This latter characteristic will make the models especially useful for both training and policy testing purposes since users can trace the potential effects of their various assumptions through the health system.

Both models are designed to be iterative, that is, repeated and refined. The first run of the model will almost invariably reveal data errors, inconsistencies or unrealistic assumptions, and these should be improved through successive refinements of the input data and assumptions. Similarly, the supply and requirements models will need to be run in parallel, with varying sets of assumptions, until the two sets of projections are economically sustainable and in reasonable agreement.

**Model inputs and outputs**
Each country is different and each has a different set of data available to it. Accordingly, the models have been designed for use by countries with widely varying databases. In some countries it may only be possible to estimate the current supply of health workers or the total output of new graduates of, say, nurses, while in others it may be possible to provide additional details about characteristics such as age, sex, and level of training. Each of the two projection models requires certain minimum data in order to operate. Other data inputs are desirable but not essential, and the computer program makes it possible to use this additional information, if available, but does not require it. The documentation for individual spreadsheet tables indicates which data items are essential and which are optional, along with suggestions regarding methods of data collection or estimation. Appendix H provides template data collection forms that can be duplicated and used for the collection of input data for the models.

Supply model. The supply model has one spreadsheet with seven sections called "pages":

- The first Info page develops population projections for the model.
- The next five Occup pages are identical, each one containing five tables for projecting the supply of a single, user-defined occupational category such as nurses, doctors, and dentists. Additional supply models can be developed to project as many different occupational categories as desired, though usually 10 to 15 is sufficient.
- The last page, Region, has three tables that combine the up to five supply projections and make it possible to apply a simple test of the economic feasibility of the projections.

Major data inputs are given below with required data inputs shown in CAPITAL letters and optional inputs in small letters. Depending on data availability users may select either Option A or Option B.

**Option A** (results in a more detailed and precise projection)

- ESTIMATED NUMBER OF HEALTH WORKERS TRAINED BY YEAR OF GRADUATION (or licensure), training location (in country or overseas), occupational category and sex
- ESTIMATED PAST AND PROJECTED PERCENTAGE RETENTION IN HEALTH-RELATED SERVICE according to year of graduation (or licensure), occupational category and sex. Default retention rates are provided and can be used if country-specific rates are not available.
-- or --

Option B (results in a less detailed and precise projection)

- ESTIMATED NUMBER OF ACTIVE HEALTH WORKERS IN THE BASE YEAR
- ESTIMATED ANNUAL PERCENTAGE LOSSES FROM THE ACTIVE WORKFORCE DURING EACH OF THE NEXT SIX FIVE-YEAR PERIODS

Data inputs used by both options:

- ASSUMED NUMBER OF ENTERING STUDENTS, YEARS OF REQUIRED STUDY, AND PERCENTAGE EXPECTED TO GRADUATE, BY SEX AND BY OCCUPATIONAL CATEGORY

- Estimated base year relative public sector incomes for the selected occupational categories. For example, if the lowest paid category, such as auxiliary nurse is paid 1.0, what is the ratio of professional nurse incomes, of doctors, etc?

- Estimates of: BASE YEAR POPULATION and the PROJECTED POPULATION GROWTH RATE; percentage of health workers in each category employed by the public sector in the base year and the assumed percentage in the target year; and assumed real (uninflated) average annual rate of change in the amount of funds to be allocated to pay health personnel.

Major data outputs include:

- Projected health workers in each occupational category at five-year intervals from the base year up to 30 years, along with multiple indices such as population-health worker ratios, average gains and losses, and projected supply to an intermediate, user-defined year.

- Probable economic feasibility of the supply projections.

**Requirements model.** The requirements model consists of three spreadsheets:

- **REQUIRE**, which is the projection model and consists of 31 projection input and output tables, 10 graphs, and 11 utility tables for carrying out planning-related tasks

- **COMBINE**, which provides summary tables which combine two or more different requirements projections in order to combine into one single projection separate regional or system projections
• **COMPARE**, which provides side-by-side summary comparisons of up to three alternative requirements projections for the same geographic area or health system, and using the same base year data; this comparison can be used to assess the relative merits and costs of alternative projection scenarios.

Users may specify a projection period of any duration. Major data inputs are as follows (required data inputs are in CAPITAL letters):

• BASE YEAR NUMBERS OF HEALTH WORKERS BY OCCUPATIONAL CATEGORY, PUBLIC OR PRIVATE SECTOR, and work location.

• BASE YEAR NUMBERS OF UP TO 7 DIFFERENT TYPES OF PUBLIC SECTOR HOSPITALS, AND OF UP TO 7 DIFFERENT TYPES OF PUBLIC SECTOR AMBULATORY CARE FACILITIES; TARGET YEAR ASSUMPTIONS OF THE POPULATION PER WORK LOCATION.

• Base year estimates of hospital discharges and average bed occupancy, and target year estimates of average bed occupancy and length of stay.

• TARGET YEAR STAFFING NORMS FOR EACH TYPE OF PUBLIC SECTOR HOSPITAL AND CLINIC.

• BASE YEAR SUPPLY OF ACADEMIC AND NON-CLINICAL PUBLIC HEALTH PERSONNEL, AND ASSUMPTIONS REGARDING THE ANNUAL RATE OF CHANGE FOR SUCH PERSONNEL.

• BASE YEAR SUPPLY OF PRIVATE SECTOR SALARIED PERSONNEL AND ASSUMPTIONS REGARDING THE ANNUAL RATES OF CHANGE FOR SALARIED AND INDEPENDENT PRACTICE PERSONNEL.

• Base year estimates of private sector hospitals, bed capacity, and ambulatory care services, and assumptions regarding changes in these variables.

• Estimated base year public sector average annual income for each occupational category, and assumed annual real income growth over the period of projection.

• Estimates of the BASE YEAR POPULATION, POPULATION GROWTH RATE, rate of growth of available budget to spend on health personnel and selected other economic indicators useful for testing economic feasibility.

Major data outputs include:
• Projected numbers of health workers required, and numbers and service outputs (hospital discharges and ambulatory care visits), by sector and type of work location, and occupational category.

• Indicators that show how the population, economy, health workforce, and the per capita utilization of services are likely to change between the base and target years according to the planning assumptions used.

• Projected gross public sector health worker costs, by occupational category, and comparisons between the base and target years of the economic burden of the health workforce.

• A side-by-side comparison of up to three alternative requirements projections that can be used to help choose among preferred options.

• A consolidated projection of different requirements spreadsheet.

Both models come with on-line, context sensitive HELP files that provide help both with the input and output tables and with the spreadsheet commands.

Model documentation and presentation

Part II describes the operation of the supply model and Part III, the requirements model. Each part begins with an introductory section that describes the operation of the respective model and provides the reader with an overview of the spreadsheets and of their component tables. Individual pages and tables are presented in logical sequence followed by a step-by-step description of how users should collect and enter the necessary data. Page names have a capitalized first letter (eg, Occup, Region) and table names are written in capital letters (eg, COSTS, HOSPSERV).

This written documentation of more than 220 pages has been produced using MS Word (ver. 7). You may print it in whole or in part, or translate it to another word processor.

Table row and column headings. You will be asked to supply certain information such as the names of the occupational categories to be projected and the types of work locations where health personnel may be found. These labels should be selected with care. Each required label is entered only once in each model and the computer automatically copies that label into all the other locations where it is required. The labels must not exceed the number of characters and spaces specified for each model. Where text labels are called for they should be listed according to some logical order and their meaning should be reasonably obvious to all who use the program’s tables. This topic is discussed in more detail in the applicable sections and Appendix B suggests a number of terms that may be useful.
Spreadsheet limitations on the number of characters used in the various row and column headings make it necessary to abbreviate some of the words or phrases used. Most cases abbreviations should be obvious but for completeness the major abbreviations used are:

- Average = Avg.
- Base year / target year = BY, TY; B-Y, T-Y; Base Yr, Target Yr
- Full-time equivalent = FTE [which is the same as `Whole-time equivalent]
- Health Worker = HW
- Population = Pop.; Popul. All population values are rounded to the nearest thousand, eg, 1,234,567 = 1235 (rounded to the nearest 1000)
- Total = Tot.
- Work location = Locn; Locns.

**Required software, hardware and expertise**

The projection models have evolved through several versions and several different application programs. Originally developed in Lotus 1-2-3, version 2.0 was offered in Quattro Pro and version 3.0 in Visual Baler (ver. 2.0; called just “Baler” from here onwards) for Windows 3.xx or Windows 95. In recognition of the widespread use of Microsoft Excel, starting in late 1999 the models were also offered in Excel and a simpler, intermediate (5-15 years) projection model was developed. Though these instructions are most relevant to the Version 3.0 Baler long-term (10-30 years) projection model, all three spreadsheet program options are briefly described below.

**Baler long-term scenario model.** This model, first offered in 1997, was written in the Baler application program because it offered two important advantages over the previous proprietary application programs, Lotus 1-2-3 and Quattro Pro. First, it was a *run-time* program and hence did not require users to have another spreadsheet application program in their computer in order to run it. Thus we were no longer faced with the problems of constant program upgrades, of training users in a new spreadsheet program, and of providing these expensive programs when they were not already available in the country. Second, the Baler program could be freely and legally copied, without the risk of violating copyright laws. The English language program was later translated into Spanish and French.

**Baler intermediate-term scenario model.** In 1998 an intermediate-term scenario model was introduced as the request of countries wishing to make shorter, 5- to 15-year projections. This model had several new features: supply and requirements tables were on the same spreadsheet rather than separate ones; users could project up to 20 occupational categories instead of 15; users could select from three alternative methods of projecting requirements; and six additional utility tables were available.
Although the general features and the "look-and-feel" of the intermediate model were similar to those on the long-term model, it was significantly easier to use.

**Microsoft Excel models.** The Baler program worked well but had two important limitations: it could not be changed, and it could not be translated into languages that used non-Roman characters. By the late 1990s it became evident that most countries had Microsoft Excel on their computers and the technical expertise to handle that program. Accordingly, it was decided to convert the two Baler programs into Excel and make this available to countries that wished the Excel format. This conversion was completed in 1999 but the Excel program is only available in English.

Both the Baler and Excel models are now available in file-compressed format, either on several 1.44MB diskettes or by download from the WHO website. Minimum hardware requirements are 4 MB of Random Access Memory (RAM), about 10 MB of hard disk space (about 7 MB for the run-time module and 3+ MB for the projection spreadsheets), a math co-processor, and at least 133 MHZ of CPU. A Pentium processor chip will provide much better performance. A color video display terminal will greatly facilitate data entry and interpretation since different colors are used to distinguish between those values that can be changed and those that are write-protected. The program is designed for MS Windows 3.xx or W95 and will not run in DOS.

**Required computer expertise.** The projection models assume users have a general familiarity with microcomputer operation and with spreadsheets similar to Quattro Pro, Excel, or Lotus 1-2-3, and this documentation is no substitute for such familiarity. Basic instructions on routine file management and for performing common tasks are provided in the sections that follow, and Appendix I provides additional guidance on these topics as well as suggestions for troubleshooting computer and file problems.

**Spreadsheet management and manipulation**

This section provides basic information on how to manage and manipulate your files. For your convenience some of these instructions are repeated later on when you are asked to perform a required action. Indented supplementary notes also call your attention to special features or precautions, and Appendix I provides a summary listing of major file commands.

**Conventions used for describing computer keystrokes.** Many times you will be asked to enter data or perform a computer task with the models. In Baler, the program used by the models, the keystrokes are essentially the same as in any Windows program. Named keyboard keys will usually be enclosed in the <> symbols. The most important ones include <Enter>, <Esc>, <Ctrl>, <Alt>, <Home>, <Shift>, <End> and the function keys <F1>, <F2>....<F12>. All menu commands are written in *italics*. A command such as File|Save indicates that you should select the File pulldown
menu and then within that menu, select the Save command. You can select choices either by clicking a mouse key or using the <Alt> key and, while holding it down, pressing the appropriate letter.

**Filename extensions.** The two main filename extensions are BDT [=Baler Data file] and BWB [= Baler Workbook]. You will normally use only the BDT type of file since it is small (<30 KB), saves quickly, and only includes your actual data inputs. The BWB file is very large (up to 1 MB), takes at least a minute to save, and includes the entire program, including inputs, formulae, labels and outputs. You will only need to save the BWB file when you change formatting instructions since these are not a part of the BDT data file. In either case you will not have to enter the BDT or BWB filename extension since Baler does that automatically.

**Diskette and file write-protection.** The master diskettes containing projection model files are write-protected so that users are kept from accidentally changing them. As an additional protection, each spreadsheet has protected and unprotected cells. Protected cells contain labels or formulae which cannot be changed by the user, while unprotected cells, displayed in yellow, are those into which the user can enter data. Cells which do not require any data are filled with the letter x, eg, xxxxx. By protecting many of the cells users are prevented from accidentally overwriting a cell that contains a formula with a data input, and thus destroying part of the model. If you attempt entering data into a protected cell nothing will happen.

**Spreadsheet structure.** Spreadsheets may be two- or three-dimensional, with the Version 3.0 spreadsheet belonging to the latter type. Each spreadsheet can, in turn, be divided into a varying number of “pages”. Each page potentially contains more than two million cells which are located in a grid established by 256 columns (A, B, C...IV) and 8192 rows (1,2,3...8192); cell A1 is at the upper left corner of each page. By way of example, the requirements projection model consists of eight pages (Info, Core, Econ, Serv, Dist, Interyr, Utilities, and Program), each of which has a number of tables. The last page, Program, contains macro formulae, range names, working tables and other kinds of information relevant to the computer; it does not require the attention of the user.

**Spreadsheet icons.** Immediately above the main spreadsheet screen and below the menu bar is a task bar with special function icons or buttons that will simplify your work. In the sections that follow the functions and locations of these buttons are described. To keep their functions near at hand, however, you may find it useful to print out Appendix I, which provides a listing of the major computer commands as well as the functions and locations of all the buttons.

**Installing the HRH program**
Insert diskette #1 in the a: [or b:] drive of the computer. In Windows 95, select Start\Settings\Control Panel, then Add/Remove Programs, then Install, and follow the directions on the screen. In Windows 3.xx, select Run through the File manager. The program will display the message “Initializing, Please Wait” and then install itself. Either accept or change the default Destination Directory (HRH), which will be placed on your hard disk. Enter diskette #2 when requested. Accept or change the default Program Group (HRH). After installation the computer will display a small box with a red and yellow HRH toolbox icon and a README.TXT icon, along with another Question box which asks if you would like to review the README.TXT. If this is your first use of the HRH program, we strongly suggest you read and print the brief README document, which will provide you with basic instructions about the program. After exiting the README.TXT file we suggest you move the red and yellow HRH toolbox icon to your desktop display. Proceed as follows:

1. Click the icon with the right mouse button and while holding the button down, drag the toolbox to a convenient location on your screen; release the button.

2. Select and click with the left button the Create Shortcut Here command on the pulldown menu. You now have a toolbox on your display. If desired, you can change the name of your toolbox icon by clicking it with the right mouse button, selecting the Rename command, and then giving it a new filename.

3. Close the HRH box by clicking the “X” in the upper right corner.

From now on you can now open the HRH program by double clicking the toolbox icon.

Duplicating the HRH program diskettes. Before proceeding further we strongly recommend that you make duplicate copies of your master diskettes and keep them in a safe place separate from your computer and your original master diskettes. Also, there will be occasions when you will want to make duplicate master sets for colleagues. Follow the instructions for copying a diskette in either the MSDOS or Windows environment. For Windows 3.xx, you would use the Copy Disk command, located in the Disk menu, which in turn is in the File Manager. In Windows95 click My Computer, click once the diskette drive, click File, and select Copy Disk and then Paste the file(s) to another disk.

A projections models session. Double click the toolbox icon and select the activity. If this is your first time with the models choose Supply and “fill” the supply model by either clicking on the leftmost button (a grid with an arrow pointing at it) or using the File\Get Version command. Choose the demosup.BDT data set, which will load demonstration supply data. Investigate the supply model and change input values if you wish. Once you are familiar with the basic structure of the model, you can erase this information with the File\Clear Data command, and start creating your own data set. Alternatively, if you have saved your data during a previous session, reload your data.
with the same button. Each time you use the Get Version command you will overwrite the existing dataset.

As with all computer work, you should make a regular habit of saving your data every 10-15 minutes and before exiting the program.

**Saving your data.** Click either the icon button with a grid and an outgoing arrow (near the upper right corner of the taskbar) or use the File|Put Version command on the edit bar. A dialog box indicates the data (only) will be saved with a BDT extension and asks you to provide a filename. If saving for the first time, provide a name such as SUPPLY1, SUPPLY2, REQUIRE1, SUPRAPID (= Supply, rapid growth), etc., that will tell you whether you are dealing with a supply, require, or combine spreadsheet and then press the OK button. Your filename is a DOS filename and thus should not have more than eight characters and cannot include most special characters. You should then press OK for the next menu indicating that you only want to save “Input Cells.” If saving over a previous data set file, the computer will ask if you want to “Replace” the file. If your answer is “yes,” press <Enter> twice, one to replace and one to indicate you want to only save the Input Cells. This method of saving data is the one you should use most of the time since it is quick and the data file is small.

If you have modified the spreadsheet by attaching notes (explained later), specifying printer default values, and/or setting page defaults, the entire one megabyte spreadsheet must be saved. Click File and then either Save or Save As. If you choose Save, the spreadsheet will be saved under its existing name and if you select Save As, it will be saved under the filename that you select. Pressing <Ctrl>S will also result in saving the file under its current name. By either Save or Save As you are saving the data, labels and formulae. Since this file is large it will take up to a minute to save.

**Closing or exiting the program.** The File|Close and File|Exit commands result in different actions. Closing a spreadsheet will still leave you in the HRH program, ready to load another spreadsheet, while the exit command will close both any open spreadsheets and exit the program. In either case, be sure to save any new data input using the Put Version button or command. Depending on your wishes you may then either close the current spreadsheet and open another, or exit the program entirely. To exit the program you can either click the File|Exit commands or the green door button with footsteps leading away from it. This will result in closing all open spreadsheets and exiting the program. In the process of exiting the program the computer will give you one more opportunity to save any data set that has been changed since you last saved it to the hard disk.

**Opening multiple spreadsheets.** If desired, and depending on available computer memory, you may open multiple spreadsheets at the same time. For example, if you are working on a Require spreadsheet and would like to open a Supply spreadsheet, you can open it in the usual way. You can then use the Window|Tile
command to have the two files displayed, side by side, or the Window\|Cascade command to show them overlapping. Either way, you can then use the mouse to mover the cell pointer from one file to the other.

**Moving within a spreadsheet.** In the HRH program the active cell is shown surrounded by a small box and is referred to as the cell pointer. There are several ways to move the cell pointer around the spreadsheet, described below.

- Use arrow keys, <Tab> or other screen movement keys. The <Tab> key will move the screen about 80 character widths (or one screen width) to the right, and the <Shift><Tab> keys will move it one screen to the left. For this latter procedure, press the <Shift> key and while holding it down, press the <Tab> key.

- You can move between pages by either clicking the page tabs at the bottom of the screen, or by pressing the <Ctrl> key and while holding it down, pressing the <PgDn> key to move through successive pages to the right, or pressing the <PgUp> key to move to the left. When in the Require spreadsheet you can also click on the GoTo pulldown menu and select the desired page and then table.

- The <Home> key positions the cell pointer at cell A1 on the current page.

- Use the mouse to position the cell pointer over the desired location or to select a block of cells.

- Press the <F5> key to select the desired named cell, block or table, or write in the desired cell, block or table. For example, in the Require spreadsheet the keystrokes <F5> DEMO <Enter> (or <F5> demo) would place the pointer at the top left corner of the DEMOgraphic table, and the keystrokes <F5> A41 <Enter> would place the pointer on cell A41 in the current page of the spreadsheet. To reduce the number of letters that need to be typed while not compromising understanding, some of the tables are, as in the DEMOgraphic example, a combination of CAPITALIZED and small letters. To access or print a table you should only enter the capitalized letters.

**Entering text or data.** When the cell pointer is in a yellow shaded cell you may enter text or data. Pressing <Enter> or moving the cell pointer to another cell then puts the new information into the cell. Existing information may be changed by entering new information over it or edited by pushing the <F2> key. To examine the contents of a cell, press the Fx button, which will display the formula or text that has been entered.

Spreadsheet application programs such as Lotus 1-2-3, Quattro Pro and Excel allow users to enter a small formula in an unprotected cell to calculate a number which is then re-entered as input to that cell. For example, assume you wanted to calculate 7*153. In the normal spreadsheet you could enter this simple formula and the result, 1071, would
be displayed and used in the spreadsheet for further calculations. Unfortunately, this nice feature can produce problems in Baler, which is the application program for the HRH models. A taskbar button has been provided to help you, at least part way, out of that problem. Continuing with the example, let’s assume you have the formula 7*153 in the cell, and the number 1071 is displayed. You proceed to enter 1071 in the cell and while it appears, it is now in red. If you press the yellow Fx button you will see your 7*153 formula still in the cell, and if you enter another number, say, 829, it, too, will appear in red while the underlying 7*153 formula remains in the cell. If 829 is entered the computer will use that number for calculations, even though the 7*153 formula persists. At this point you will find that you cannot now enter another formula or delete the 7*153 formula, and any other number you enter will also appear in red. You cannot even eliminate the formula with the File|Clear Data command. You can, however, return to your original formula and eliminate the red by pressing the gray “@su” button. However, the only way to clear the formula from that cell is to press the yellow “#” button, which will eliminate the formula and return the cell to “0”.

One very important caution! Although the # button can delete a formula inserted in an unprotected cell, it has a very bad characteristic when applied to a protected cell. If you press the # button on a white, protected cell, it will insert a “0” there, which cannot then be eliminated. Your only solution is to close the spreadsheet without saving and then re-open it, thus returning you to the original spreadsheet. We wish this potential risk did not exist but this was the way the Baler program was created.

Getting online help. You can easily obtain detailed help instructions for almost all of the tables in the Require, Supply and Combine spreadsheets. Place the cell pointer within the boundaries of a table for which you would like help, and press the <F1> key. You can scroll down the information or, by clicking and dragging the top bar, move it to a better location. Press <Esc> or click outside the help display to close the Help window. You can also obtain help by clicking the yellow “?” button in the task bar for help with Microsoft Windows commands, Visual Baler commands, and the WHO_HRH tables. Click Search to open the full list, type the first few letters of the desired index entry, and click the desired entry.

Attaching a note to a table. You may occasionally wish to attach one or more notes to your spreadsheet to remind you of something. For example, you could attach a note that provides additional information on the population growth rate projections or the assumptions used to project hospital and ambulatory care. If a cell has an attached note and your cell pointer is over the cell you will see a few words of the note immediately to the right of the last page tab (usually Program) near the bottom of the screen on the status bar. Proceed as follows:

1 Put the cell pointer over the relevant cell location. Put the cell pointer over some standard cell location where you will always save notes. Though you can attach a note on any cell, already filled or not, we suggest a filled cell since otherwise you will have
difficulty remembering where and whether you have notes stored. Probably the best option is to use the top left cell A1 on the Info page, and to save all your notes relevant to that spreadsheet in that location. Alternatively, you could use the top left short table name for a table, though in the absence of any marker that a note is there you may forget which tables have notes and which do not.

2 Press the note pad button; it shows a tiny yellow lined paper pad. A small note pad will open for your notes. Make your comment very brief and when you have completed it, click OK.

3 When you end your work session, save first the BDT data set and then the full BWB spreadsheet file. Notes are saved in the BWB files but not in the BDT data sets, which contain only input data.

4 When your cell pointer rests on a cell to which a note has been attached a few words will automatically appear on your status bar. If the note is too long for this space, you can press the paper pad button to see the rest of it. If you want to revise or erase the note, use the arrow keys and add or erase text as desired. Be sure to save the BWB file with your new changes so that you will have the same notes attached.

The “note” feature is nice but it introduces a problem of its own. Since it is part of the large BWB file if you save that file under the name of Supply, Require, or Combine, your original master WHO spreadsheets will now have notes attached to them, notes that may later become irrelevant or misleading due to changing data inputs. To minimize this problem we suggest: (1) you use the note feature only rarely; (2) if possible, you reserve notes for clarifications or other matters that are likely to affect all subsequent spreadsheets; and (3) that any spreadsheet that has notes specific to it only, be saved under a unique name different from Supply, Require or Combine.

Graphs. The Supply and Require spreadsheets contain a number of graphs which can be displayed by using the Graph|View command, and then selecting the appropriate graph. They can be minimized or closed in the usual way.

- **Printing tables and graphs.** Spreadsheet tables, graphs and indeed any other section of your choosing can be printed. Proceed as follows:

- **Page setup.** Before printing your first table or graph, access the Page Setup menu using either the File|Page Setup command or the Page Setup button, which has a small page with vertical and horizontal arrows on it. With the Page Setup menu you can enter headers, footers, titles, change margins, set options, select between portrait and landscape orientation, and determine the page size. Page setup values can be saved with the File|Save (or File|Save As) command, which results in the full spreadsheet save. They are not saved with the Put Version command.
• **Printer setup.** Click the *File|Printer Setup* command to select an appropriate printer and establish the default setup commands for that printer. Printer setup values are saved only when you save the large BWB file, as with page setup.

• **To print a table.** Click *File|Print* or the button with the small printer button and then enter the desired table name. Alternatively, in the Require spreadsheet you can go to the Info page and click a crosshatched *Print...* beside the desired module. This will instruct the computer to print all the tables in that module.

• **To print a graph.** Click the *Graph|Print* commands and then select the desired graph. If necessary, you may have to first use the *File|Printer Setup* command. When in the Supply spreadsheet you must first go to the Occup page for which you wish to print a graph.

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**Part II. SUPPLY MODEL**

Health worker supply projections are a vital component of health workforce planning. Without such projections, efforts to project workforce requirements will be of little value. The spreadsheet tables presented here outline the essential and desirable data for making supply projections. Each supply file can accommodate up to five different occupational categories, with five input and output tables for each category, plus several tables that are applicable for all categories. Appendix C provides important guidance, in a question-and-answer format, on various aspects of the supply model. If this is your first experience with the projection model you should review the listing for Appendix C entry in the Table of Contents. The headings listed for Appendix C indicate the kinds of questions you may want to explore further as you progress through the models.

**Supply spreadsheet.** Load the HRH program by double clicking the toolbox icon labeled HRH, click *Choose activity* and select Supply. This will load an empty supply spreadsheet ready for use. The cell pointer will usually be in or near the upper left corner of the Info page, but if not, press the <Home> key or, if this doesn’t work, the <Ctrl> <Home> keys.

The supply spreadsheet can accommodate up to five user-defined occupational categories and you can have as many data sets as necessary of five occupations each. The spreadsheet will normally come empty of data. Proceed as follows: If this is your first use of the supply model, click on either the top left button with the arrow pointing toward the spreadsheet or on the *File|Get Version* pull-down menu, and select demosup.bdt. This will load a demonstration data file which you can experiment with. When through you may clear the demonstration data *without* saving it by using the *File|Clear Data* commands. This will remove the data from the Supply file while keeping
it available on hard disk for future training or review sessions. Alternatively, if you want to save your own, customized demonstration and training file, make changes in the data and then save it using either the button with an arrow pointing away from the spreadsheet or on the *File|Put Version* menu commands, giving your new file a distinctive name. The computer will automatically put a BDT extension on your file name.

**Info page (Supply)**

You are now ready to proceed to build your supply model. We will assume you now have the supply file loaded but without data in it; if not, use the *File|Clear Data* command so that you start with an empty spreadsheet. If your cell pointer is not on the Info page, click the Info tab at the lower left corner and then, if necessary, press the `<Home>` key to go to the top left corner of the page. Proceed as follows:

1. Provide identifying information for your supply spreadsheet. Move your cell pointer down column A filling in the shaded blocks with: today's date, which should be updated each time you modify and save the file; the name of your country, province or planning region; the filename you have used for this data set; and a name for the type of projection you are making such as Baseline, Slow Growth, Mod. Growth and Fast Growth. A name for the type of projection will allow you to distinguish this set of tables from another set.

2. Save the data set you will be working under a filename of your choice, not exceeding eight characters. Use the *File|Put Version*, newname, command. Appropriate filenames might be: numerical (SUPPLY1, SUPPLY2, etc.); a name of a province (NORTH, SOUTH); a group of occupations such as SUP-PROF, SUP-TECH, SUP-AUX, covering professional, technical, and auxiliary level personnel; or type of projection such as STATQUO, BASELINE, RAPIDGRO.

3. Enter the base year of your projection in the uppermost shaded cell. The base year refers to the most recent year for which reasonably complete data are available and must be the same for all occupational categories. Once the base year is specified the computer will automatically insert the base year and five-year increments up to 30 years in all relevant tables throughout the supply model. You may find that you have most of the data required by your projection model for the base year but not all of it. In this case data from years prior to the base year should be extrapolated or otherwise estimated to provide the best approximation possible for the base year. **The same base year should be used for both the requirements and supply projection models.**

4. Enter the base year population, rounded to the nearest 1000, eg, 5,678,901 is entered as 5679.
5 Enter in the assumed average annual population growth rates to one decimal place (eg, 2.7% should be entered as 2.7, without the % symbol) for the first, second, and third decade of the 30-year projection period. These rates should take into account, approximately, expected changes in the future. In other words, if the rate is currently quite high, eg, 2.7%, and is expected to decline to about 1.8% in 30 years, you might enter 2.7, 2.4, and 2.1 as the three values. Most countries with currently high rates can expect some reduction in the future and to plan based on continue high rates could result in unnecessarily high and costly production of health workers.

Congratulations! You have now completed all the basic information required for the supply model. Later on, if you wish to do so, you can enter a limited amount of additional data that will permit you to make a simple test of the economic feasibility of your supply projection. A more comprehensive and informative test can be made in the requirements model, to be presented in Part III. However, let us leave until later the decisions about whether to make the feasibility test, and if so, which one to make.

**IMPORTANT NOTE!** Be sure to save your file frequently on the hard disk, especially after entering data for a new table, making a significant change in your model, or before trying any new or unusual action. You can either use the *File|Put Version* command, or click the toolbar button with an arrow pointing away from the small spreadsheet. Double click the proper filename, click *Replace* (which replaces your older data set with the new one), *Backup* (which moves your older data set to a backup file), or *Cancel* if you want to return to the spreadsheet without saving. And remember, too, to save your day’s work to a diskette in case your computer has a fatal crash.

**Supply of one occupation (Occup page)**

The supply model has five pages named Occup1, Occup2, ... Occup5, each one suitable for a single occupational category. We will describe procedures for only the first page, Occup1, since all the rest are identical. Click the Occup1 page tab to go to this page.

**INFO (Occup) table**. Identifying information is provided so that if you print this table you will know what is in the page. Enter the name of the occupational category you wish to have on this page in the shaded cell to the right of the ACTIVES or GRADUATES table title. This name will appear on all tables on this page and on the Region page. Before entering this name you should consider carefully the occupational categories for which you wish to project supply, and the sequence in which you want them listed. Your category list should be written down on paper and used for reference throughout your work with both the supply and requirements spreadsheets. Once you begin entering data, especially in the requirements model, it can be confusing and even difficult to change the categories or change the order of their listing without starting all over. For the supply model occupational categories should meet at least three criteria: (1) be relatively large (eg, about 3% or more of the health workforce); (2) require a
significant period of pre-service health-related training, and (3) be easy to distinguish from other categories. According to these criteria you would not include in your supply model such categories as: general administrative or clerical personnel (due to no pre-service health-related training); computer analysts (due to no health-related training and small numbers); hospital orderlies and service personnel (due to minimal pre-service training); nurse specialists (which cannot be readily distinguished from staff nurses). With regard to this last example, you should include in one single category all types of nurses, or all types of doctors, etc., that require the same basic pre-service training. In other words, don't make separate pages for different medical-surgical specialties or for different categories of fully qualified nurses. All doctors, irrespective of specialty or hierarchical rank, should be in one single category, and the same for other occupations such as nurses, dentists, etc. Appendix B has a detailed list of basic and specialist categories you may wish to consider.

**Which supply projection method to use?** You are now ready to start entering data for your first occupational category. Before proceeding to the tables, however, you need to consider carefully two alternatives and decide which one can best meet your country's circumstances. First, some background information.

To project the supply of an occupational category into the future one must know three types of information:

(1) the base year supply of active personnel

(2) new increments to the supply during the projection period; and

(3) probable losses during the projection period.

We assume you can estimate within 5-10% the base year supply, and with the aid of this model, that you can test the effects of different assumptions about probable increments (to be described later on). But how will you estimate losses? The best method is to have data on, or to assume, the age distribution to your current supply of health workers, and to project losses based on the effects of further aging over time. In other words, if your country has 200 active doctors age 30-34, how many will remain active in 5 years, in 10 years, and so on for the other five-year cohorts? As you will soon see, this projection model makes it possible to use this "cohort method" of projection for those countries that have the required data. Some countries, however, may know the approximate base year supply of some of their occupational categories but do not have adequate data for either the current age structure of this supply or the number of persons trained in each time period in the past. This supply projection model is therefore designed to meet the needs of countries both with and without information about the age structure of their health worker supply.
The following sections describe the two methods for projecting losses, starting with the simpler but less accurate *annual loss rate method*, and then followed by the more complex, and versatile, *cohort method*. Unless you already know which method is applicable to your country we suggest you review both methods before deciding which one to use. You can then come back to the preferred method to review it in detail and implement the instructions. If you later decide you would like to change the projection method this can be done very easily.

**GRADUATES table: Annual loss rate method.** Go to the GRADUATES table, which actually consists of one small table surrounded by a box at the top of the screen and a much larger table below it. Enter your best estimate of the base year number of active male and female health workers. If you have an estimate only for the total but not by gender, make a guess as to the proportion of each gender, multiply these percentages times the total number, and enter the two values in the table. Thus if you estimate there were 1200 doctors in 1996 and that the sex ratio is about 65% males and 35% females, you should enter 780 males (1200 x 0.65), and 420 females (1200 - 780).

Now look at the shaded row just below where you entered the active supply and enter here your estimate of the annual percentage loss that will occur to the active workforce in each of the five-year periods up to the target year. Some countries will have reasonably good estimates of the current loss rate while others have almost no data on which to base their estimates. Over time you will want to improve your database on losses but for the present you can make estimates using one of the several methods described below.

**Historical loss rate.** The best way would be to compare estimates of the number of active health workers in several different years over the recent past. Continuing with the above example, assume that the active supply of doctors in 1990 was estimated at 950 and that during the five-year interval up to 1995 a total of 420 new doctors were graduated and 20 foreign-trained doctors were newly licensed to practice, for a total increment of 440 doctors. If there had been no losses during the five-year interval the 1995 supply would be 950 + 440, or 1390, as compared with an actual 1995 supply of about 1200. Thus total losses were 1390 - 1200, or 190 which, when divided by five (years), equals an annual loss of 38 per year. This average annual loss rate is then compared with the average supply during the period, which is 1075 (1200 + 950 / 2). An average loss of 38 per year against an average supply of 1075 results in an average loss rate of 3.5%. You could use this value for the first five-year period and then either modify it gradually or keep it the same for the remaining five-year periods. If you believe that loss rates will gradually decline and/or that the production (or immigration) of new graduates will substantially increase (and hence result in a younger workforce), you can assume that the average annual loss rate will decline, and vice versa. By way of reference and using simulated data in the supply model, if new graduates had an average working life of 40 years, and if the workforce size remains exactly the same over time, there will be a 2.7% annual loss rate, or about 13.7% for a
five-year cohort. Thus, if the workforce is predominantly female, or if the average working life is substantially less than 40 years, or if new entrants do not equal losses (and hence the workforce is getting older), then your estimated annual loss rate should be higher than 2.7%, and if the opposite conditions are valid, then the loss rate should be lower. Most countries will probably have loss rates somewhat higher than 2.7%, and in the case of predominantly female occupations, much higher. For example, if you assume an average working life of only 10 years, the annual loss for a stable workforce would exceed 10%!

**INFORMATIONAL NOTE!** The Losses table ("Supply and Loss Rates based on Average Working Life") in the Utilities page of the Require spreadsheet may be of use in estimating loss rates. It displays the nominal average annual loss rates for a steady state supply of health workers with differing average working lives.

**Informed loss rate estimate.** If you have no reliable estimate of the workforce during the past decade you will just have to guess. Using the guidelines in the above paragraphs you might try the following estimates:

- Divide 100 by the assumed **average** working life to obtain the stable workforce loss rate, eg, 100/35 years = 2.9%, and add to this amount about 0.2%. Thus the annual baseline loss rate for an average working life of 35 years would be about 3.1%, and for 25 years, about 5.2%.

- If your total supply of this occupational category is projected to increase rapidly over time you could **decrease** the annual baseline loss rate by a small amount (perhaps 0.1-0.2%) to take into account that the younger age structure will mean a lower overall loss rate. Conversely, if the projected supply is likely to decrease, then you could **increase** the annual baseline loss rate due to the aging workforce. The precise arithmetic in making these calculations gets complicated since loss and gain values are interdependent, but these approximations will be adequate until you have an information base that allows you to apply the cohort method, described below.

You have now completed all the necessary data to establish the base year active supply of health personnel and the projected annual loss rates by the Annual Loss Rate Method. You can therefore skip over the next section, which describes the Cohort Method, and proceed to the section describing the TRAINING table.

**GRADUATES table: Cohort method.** This method is preferable and even if you are unable to use it now, you should gradually strengthen your statistical database so that in time you can move towards its adoption. The method requires two major data inputs, (1) the number of graduates over the past 40 or more years, and (2) the losses that can be expected as each cohort of graduates ages over time.
IMPORTANT! If you have already entered data in the ACTIVES table then the GRADUATES and RETENTION tables can be left blank, but if you plan to use the cohort method, then both tables are required. You should also be aware that as long as there is a number of any size in the ACTIVES table, then the computer will, by default, use this number and ignore any numbers in the GRADUATES table.

Go to the lower, More precise method section of the GRADUATES table, which starts with the title PAST GRADUATES. This table provides essential information for projecting the current stock of health personnel into the future. The table summarizes the total historic output up through the base year of all national (or regional) training programs combined, plus the number of foreign trained graduates licensed to practice (or licentiates), by year of graduation or licensure. You should provide the required information only through the base year of the projection, eg, if your base year is 1996, then provide the estimated number of graduates only through 1996.

By making estimates of the number of graduates in each occupational category by both year of graduation and sex, it is possible to anticipate the effects of these two important variables on workforce losses over time. There are two methods, described below, for completing this table. The first method requires detailed and reasonably accurate data, and therefore may not be feasible for many countries. In countries with as yet an inadequate data system on past training outputs, a second method can be used which is considerably easier and can provide acceptable results until more precise information is available. Either way, the focus should be on estimating the number of persons in each occupational category who were qualified to enter the health workforce at the time of graduation, and not on the number who actually entered the workforce. To illustrate this further, imagine a country in which in the year 1985:

- 200 male dentists were graduated by national training institutions and licensed to practice;
- 20 male foreign-trained dentists were authorized (or licensed) to practice; and
- 180 male dentists actually entered the workforce.

In the above situation 200 (national graduates) should be entered in the first shaded column and 20 (foreign graduates) should be entered in the third shaded column; the number 180 (the dentists who actually entered the workforce) is usually not known but even if known, should not be used. If the sex of the graduates is not known, a reasonable guess of the approximate numbers of each sex should be entered in these columns; no entries should be made in the TOTALS column since this contains a formula for calculating the total from the other entries.
For most purposes projections of the number of health workers who were trained in the country can be made either based on the number of graduates or by the number of persons who were licensed to practice (i.e., licentiates), and the choice can be based on the relative ease of data collection or on data accuracy. For persons trained overseas, data on the number who were licensed to practice will probably be the most useful. In either case, planners need to complete the GRADUATES table only once, perhaps by means of a small survey of all known training institutions, to get information about their past numbers of graduates along with their estimates regarding student losses, the number of full-time equivalent (FTE) instructors, and entering class size. Once this information is in a database file it can be updated every one or two years with the numbers of recent graduates. The two methods for estimating data inputs are:

**Data are available on past graduates.** Eventually, every country or large region should have a central registry that records each year the number of persons, by sex, who (1) satisfactorily completed a health-related training program in the country, or (2) received their training overseas and, based on that training and/or examination, were authorized to work in their profession. Such record systems should include all those with professional or technical qualifications, though they may elect to omit those with auxiliary or assistant level training. This information can be kept in a computer file such as EPI-INFO, or in a written file, and from either source can be transferred directly to the GRADUATES table for those occupational categories for which planning estimates are to be made.

**Data are not available on past graduates.** Many countries do not have information on the sex distribution of their graduates or on the number of overseas-trained graduates entering the country, and quite a few do not have annual graduate information for the distant or even the recent past. Though projection accuracy will suffer, even in this last situation useful supply projections can be made.

One method is to estimate the number of graduates (or licentiates) for each five- or ten-year period and divide these totals by the number of years in each period. For example, if an estimated 2000 nurses graduated in the 1975-1979 period, then about 400 can be assumed to have graduated each year. If a longer historic period of, say, 10 years or more is used, it may be useful to establish a reasonable gradient between the starting year output and the ending year output. Continuing with the example, if an estimated 3000 nurses were graduated during the 1970-79 period, or 300 per year on average, then the earlier years might be recorded as approximately 200 per year and the later ones at 400 per year, for an average of 300 per year during the decade. For most occupations it will be possible to estimate within ±10% the proportion of males and females. For these occupations there will usually be a known and reasonably constant sex ratio that can be used to estimate the numbers of males and females in each graduating class.
As a final point, planners will need to decide how far back to obtain data for their supply projection model. For most occupational categories this earliest year will probably be at least 40 years before the base year of the projection and may be over 50 years earlier (50-54 years is the oldest cohort used in this supply model), depending on the usual age of retirement and on data availability for the earlier cohorts. Since most occupational categories will complete their training at an age between 18 and 24, depending on the discipline, a 40-year period following graduation will include persons close to 60 years of age. For most male occupations, and especially for doctors, it will probably be best to go back 50 years, the maximum possible in the GRADUATES table.

The GRADUATES table may be difficult to complete but once done, keeping it up to date should be easy; you will only have to enter data for the several years since the last use of the model. Let’s now turn to projecting new entrants to the workforce and then conclude this section by taking into account losses.

**RETENTION table: Cohort method**. This table, required if you completed the GRADUATES table, provides the supply model with estimates of occupation-specific retention rates over time and with increasing age. Retention rates are the opposite of loss rates. The table has default retention rates that can be used if your country does not now have any better basis on which to project the retention of graduates in the active workforce, and if these estimates appear to be reasonably acceptable. Alternatively, your country may modify these values as described below. Proceed as follows:

1. Note the left-hand column labeled YEARS SINCE COMPLETING TRAINING. This displays the range of years since graduation (or licensure) for each cohort, which will make it easy to estimate the approximate age of the cohort. For example, persons in the youngest five-year cohort will have a range of 0 to 4 years since graduation and those in the oldest cohort, 50-54 years since graduation.

2. Note the last column which is labeled DEFAULT RATE. These values refer to the maximum percentages of male (upper table) and female (lower table) professional health workers likely to be active in the workforce the stated number of years after graduation. They are based on the actual percentages of all U.S. male physicians who worked 20 hours per week or more in 1979-81. (The default rates based on U.S. physicians will be replaced with rates obtained from a developing country with precise and relatively high rates of retention as soon as such rates become available.) These default values will be used to project the future supply of past and new graduates unless you provide more realistic values in the preceding two columns, described below. The default values are likely to represent the upper range of retention rates that can be expected for a health care occupational category; in most countries and for most occupational categories the retention rates are likely to be lower. Actual female retention rates in the U.S. 11-20 years after graduation are considerably lower than for males due to young and usually pre-school children in the home, though retention rises.
again during the period 20-24 years post-graduation, reflecting a net return to employment. You may wish to make substantial changes in these rates to take into account your own situation regarding female employment. The default retention rates take into account only persons working 20 hours or more per week and they do not consider the total number of hours worked (which is lower for women than men), or productivity per hour worked (which declines towards the end of an individual's working career).

3 The four columns under the label ASSUMED % ACTIVELY WORKING IN HEALTH SERVICES provide you with an opportunity to modify the sex-specific retention rates for both past graduates and future graduates in accordance with your country situation. There are two ways to use this section:

Retention rates are available. If actual data on retention rates are available in your country, then the shaded DATA-BASED ESTIMATE columns should be completed, using your country-specific rates. Such rates might be generated from a comparison of the numbers of past medical, nursing, etc., graduates, by year of graduation, with the number of doctors, nurses, etc., now active in the workforce, again by year of graduation. Even without survey- or registry-based information it may be possible to improve projection accuracy through the use of informed opinion. For example, persons knowledgeable about a given occupational category may propose lower (or higher) retention rates than those given as default values to better reflect national or regional realities. If no national estimates are given, then the default rates will be used in the model, though for reasons already noted, for most countries these rates are more likely to be too high than too low.

Retention rates are not available. If actual data on retention rates are not available but you can make a reasonable estimate of how your country’s rates compare with the default rate, you can enter a number at the top of the % OF DEFAULT column. The table comes with the number 100 in that column, indicating that the model is using the default rates as shown. If, however, you enter 90 in a % OF DEFAULT column, all the default values will be 90% of the DEFAULT RATE column. So, if you think your retention rates somewhat lower than the default rates, enter a value less than 100, and if your rates are somewhat higher, enter a value greater than 100. You should not go much above 101, however, since this would result in a retention rate for the younger cohorts of over 100%, and impossibility.

To illustrate how the values in this table affect the projections assume that there was a total of 1000 national and foreign-trained male doctors who completed their training during the period 15-19 years prior to the base year. If you use the default values in the RETENTION table this would result in estimates of 940 (94%) professionally active doctors from this cohort in the base year, 920 (92%) active doctors five years in the future (when they would be 20-24 years post-graduation), 900 (90%) doctors 10 years in the future, and so on. Alternatively, if national data or informed opinion suggests that
these rates are too high or too low, other rates can be assumed. In some countries and in some occupations retention rates have historically been quite low, leaving a margin for improvement in the future. The two columns, PAST GRADUATES. and FUTURE GRADUATES, provide you with an opportunity to use different rates for those who graduated prior to the base year, and those who will graduate in the future. This option would be of value to a country that had, for example, experienced high loss rates in the past but which expected that these rates could be reduced through a combination of policies affecting retention.

**TRAINING table**. This required table provides the basis for projecting additions to the current supply of health workers. It must be completed for each occupational category of interest. The lower part of the table, concerning the ACTUAL AND DESIRED FTE INSTRUCTORS..., is optional, though the requested information can help guide planners regarding the number of instructional faculty likely to be required for each occupational category, information that will be of use in the requirements model.

Start completing the TRAINING table by entering your estimates for the five years ending in the base year in the first shaded column. For purposes of illustration assume you are entering data for the occupational category doctors.

1. First enter the total number of medical schools or programs operating in your country or region. We use the word “programs” since many auxiliary and technical occupational categories are trained in programs rather than schools or faculties.

2. Move down to the ESTIMATED TOTALS FOR ALL SCHOOLS AND PROGRAMS COMBINED section. Depending on which projection method you used, the more precise method based on the lower, main portion of the GRADUATES table, or the smaller top portion, the procedure used is slightly different.

   - Less precise method: Enter the average number of new first year entering students during the previous five years.

   - More precise method: You can fill in or leave blank the cell corresponding to the 1st year class. The computer will ignore a value entered here since it will calculate the number of graduates from data entered in the GRADUATES table.

**INFORMATIONAL NOTE!** The TRAINING table makes an important simplifying assumption that somewhat reduces the accuracy of the projected numbers of new graduates. This assumption is that the number of first year students entering in each five-year cohort, minus the assumed losses, is also the number of graduates during the same cohort. In reality, especially for occupations that require three or more years of study, persons entering in any one five-year period, will actually graduate in another, later five-year period. With stable student intakes the errors will be negligible; with rising intakes the projection may tend to overestimate output and with falling intakes, it may underestimate output. By adjusting the intake assumptions these errors can be minimized. See Appendix I for further details.
3 Move down and enter the normal number of years of study required to complete the training program, eg, 5. If the training program requires more or less than a whole year, eg, 0.5, or 5.5, round off the duration to the nearest whole year.

   Less precise method: Enter the number of years.

   More precise method: Enter the number of years.

4 Move down one row and enter the average percentage of entering first year students who are likely to graduate, irrespective of the number of years of study they actually take. By way of example, if your country averaged during recent years (1) an entering class of 100 new first year medical students, (2) 10 students who were repeating the first year, and (3) a graduating class of 95, you would enter 100 as the \textit{1st year class} and 95 as the \% \textit{who graduate}.

   Less precise method: Enter the number of first year students.

   More precise method: Leave this cell blank.

5 Move to the (Number of) GRADUATES row.

   Less precise method: The computer has used the above information to calculate the average annual number of graduates from all schools and training programs combined.

   More precise method: The computer uses data entered into the GRADUATES table to calculate the average annual number of graduates during the previous five years.

6 Move down to the \% MALES row.

   Less precise method: Leave this cell blank.

   More precise method: Leave this cell blank.

7 Move down and enter the approximate net permanent flow of recently trained doctors into or out of your planning region during the base year. For example, assume that your country (or region) graduated 100 new doctors in the base year, that an estimated 10 doctors came into the country from elsewhere and an estimated 5 newly trained doctors left your country, presumably permanently. With these estimates you would enter \textit{1$^{st}$ YEAR CLASS} and \% \textit{WHO GRADUATE} values which would result in 100 graduates, and 5 (ie, 10 in-migrants - 5 out-migrants), as the net annual flow. If the
cross boundary flow were reversed such that your region lost 10 and gained 5, you would enter -5. By this means you can take into account likely permanent gains and losses that are not reflected in your estimate of national graduates. If your country has few or no net gains, enter zero (0) in this cell. Also, do not count in your estimate of net gains or losses any temporary personnel movements into or out of your planning area such as might be the result of recent graduates who are seeking short-term postgraduate training and experience.

Less precise method: Enter net annual flow of graduates.

More precise method: Enter net annual flow of graduates.

With regard to the above estimate, we acknowledge at the start that few countries have accurate data on the net flow of recent graduates into and out of their planning area. For most countries this net flow will usually be small but for subnational regions within a country, the flows can be substantial, with some regions being donors of new graduates and others being recipients of new graduates. Even when precise numbers are not available, informed persons can usually make a reasonably good estimate of the net flow. If the net gain or loss is much more than about ±5% of the annual regional production of new graduates, it should be taken into account in this table since otherwise the projected supply may have a significant error.

8 Move to the AVERAGE ANNUAL STUDENTS AND GRADUATES IN ONE SCHOOL OR PROGRAM section.

Less precise method: The computer will calculate averages based on the estimates given above. The average for ALL CLASSES will be less than the number in the entering class multiplied by the number of years of study due to your estimate of the percentage who graduate. In other words, if 100 students enter, and 80 graduate five years later, the computer divides 180 by 2 for an average enrolment of 90 per year, times 5, equals 450 as the average for all classes.

More precise method: Average values cannot be calculated since the number of entering students is not known. Accordingly, a “NA” (“not applicable”) will be appear.

9 In the last row shaded cell of the base year column enter the approximate number of full-time equivalent instructors, including academic administrators and researchers, that were employed in the base year at all training institutions combined. As used in both the supply and requirements models, the term instructors always refers to full-time equivalent (FTE) instructors, training program-based directors and administrators and researchers of the same discipline as the students they are teaching or administering, eg, doctors teaching medical students, pharmacists teaching pharmacy students.
More precise method: If you have followed the instructions above a 0.0 will appear in the STUDENTS/FTE cell for the base year. Since the computer does not have a value for ALL CLASSES, it cannot calculate a student/FTE ratio. You can correct for this situation by entering in white cell U18 the approximate total class enrolment, which temporarily overrides the formula in that cell. A red-pink number will appear, indicating that you have temporarily replaced the formula with a value. You will now see the NA in the STUDENTS/FTE cell replaced by a ratio. This can provide a baseline estimate which can guide you in deciding how to change the student-to-faculty ratio in the future. You can then restore the formula (and the 0.0) by pressing the @su button in the task bar.

With the base year estimates entered, the fun now begins! Your next task is to develop a first approximation of future training rates and outputs so that you can fill in the remaining columns. Proceed as follows:

1 Decide, in general terms, how you would like to see the supply of this occupational category change in the future. Do you want the supply to increase faster, at the same rate, or slower than the rate of population growth, and by about how much? Factors that will affect your decision include current training plans and policies, your sense of the adequacy of the current supply, the rate of growth of the economy, and factors that could lead to greater or lesser requirements for this category of personnel. Also, do you want the changes in supply to be roughly constant over the 30 years, or to be faster either at the beginning or at the end, or to be stepwise, with major changes every five or ten years? As a first approximation, to keep the ratio of health workers to population constant, you will probably have to increase the entering class by at least the rate of population growth. This approximation is based on the assumption that the age distribution of your workforce is neither unusually young or old and that the worker-to-population ratio has been improving in the recent past. Later on you can easily modify your assumptions to bring them more in line with reality.

2 Convert these decisions into estimates of the numbers of entering students you would like to have at the end of each of the six projection year cohorts and enter these values in the 1ST YEAR CLASS row. For a start, you might try increasing the entering enrolment by 20-25% every five years, for an effective average annual increase of 4-5%, significantly ahead of most population growth increases. These increments can later be adjusted up or down, as necessary, to achieve desired supply targets. Student intake adjustments can either be geometric (e.g., 1%, 2%, etc., increase or decrease per year) or stepwise (50 students more, or less, per year or per five-year period).

3 Make changes as appropriate in your assumptions regarding years of study, percentage who graduate, percentage of male graduates, and the net annual flow of graduates across your national or regional boundary.
4 Change as appropriate the assumed number of training programs so that you have a realistic number of students in each program. While doing this you should note the average values calculated by the computer for each program that appear in the next to last section of the table. For purposes of illustration, enter the following values in one of the five-year projection columns: 3 training programs; 190 first year students; 5 years of study; and 77, which is the percentage who graduate. You will now see the computer has calculated that there would be an average of 63 students in each school's entering class and 280 students in all five years. The number 280 is less than 5 years of study multiplied by 63 entering students, which would equal 315. This is due to the assumed losses prior to the last year of study, and is calculated based on the assumed average enrolment in each class. In other words, the sum of the first and last year enrolments are multiplied by two, divided by the number years of study, and then divided by the number of schools.

5 Enter your assumptions of the desired number of students per FTE instructor of the same discipline in the bottom section. The computer will then calculate the average number of instructors required per program and in all programs combined, based on the total student enrolment and your ratio of students per FTE instructor. These values will help you when you project overall health sector workforce requirements.

You have now completed your first approximation of the future output of new health workers of this occupational category. If you haven’t done so already, be sure that you have entered data for your assumed loss rates. These should be in the top section of the GRADUATES table if you used the Annual loss rate method of projection, or in the RETENTION table if you used the cohort method. Once this has been done you are ready to review the combined effects of training outputs and losses on the future supply of health workers.

PROJECTIONS table. Go to and review the PROJECTIONS table, noting especially the lower portion. This table should now provide projections at five-year intervals to 30 years after your base year. Depending on which method you selected in the supply model you will find two different presentations:

- **Annual loss rate method.** With this method you will find zeros (0) in all the rows above the base year since you have provided the model with no data on the age structure of the workforce.

- **Cohort method.** With this method you will find supply estimates for each cohort of graduates, for the base year, and for each of the six projection years. If you recorded the number of graduates for, say, only the last 25 years, then the estimates will only extend back this amount of time.

At the bottom of the year by year section you will find the total estimated supply of active health workers for each of the seven projection years, shown in red numbers.
Immediately below the totals is a row which repeats the projection years followed by rows with useful information that can help you revise your projections. The significance of each row is as follows:

- **% CHANGE PER YEAR** indicates the approximate annual percentage change in the supply of this occupational category during each of the preceding five years, e.g., if the supply increased by 15.9% during the preceding five years, the annual percentage increase is 3.0%. The annual percentage change will show whether the workforce is changing at a similar or different rate than the population and various economic indicators. It can also be used to interpolate between two projection years to an intermediate year. If, for example, the supply increased 15.9% between 2008 and 2013, and an estimate is desired for 2010, then the estimated 2008 supply is multiplied by 1.0609 (i.e., 1.03 x 1.03, or a 3% annual gain compounded over two years).

- **% PAST GRADUATES** indicates the percentage of the active workforce that graduated up to and including the base year. If, for example, the training curriculum is substantially changed around the time of the base year, this will indicate the percentage of the workforce that has not had the new curriculum.

- **NUMBER LOST and PERCENT LOST** indicate the number and percentage of the workforce lost due to all causes during the preceding five-year period. For example, if the base year supply was 1000, the projected supply five years later was 1200, and the interval production of new graduates was 300, then the 'number lost' would be 100 and the 'percentage lost' would be 100 divided by the starting supply of 1000, or 10%. [A more accurate estimate would be the number lost divided by the **average** (and not starting) supply during the five-year period, but this refinement is unnecessary.] Monitoring this percentage from one five-year period to the next can help identify a changing loss rate.

- **AVERAGE AGE OF WORKERS** indicates the estimated average age of the workforce in each year. This is useful for anticipating a higher or lower loss rate in the future. By monitoring age changes over time, planners can determine whether the workforce is aging significantly, which could warn of higher loss rates to come. A country with a stable workforce year after year, and in which retirements prior to reaching an age in the 60s are minimal, will have an average age in the low 40s, and a **median** age slightly higher (because some work into their 70s and few persons graduate at an age much younger than the average). Most countries with an expanding workforce and good retention rates will have an average workforce age in the high 30s, and those with low retention rates may have an average age in the middle or low 30s. The formula makes the simplifying assumption that the average age at time of graduation is 20, though this will be high for some occupations and low for others.
• WORKERS PER 10,000 POPULATION and POPULATION PER WORKER provide two widely used indicators of the degree to which the health worker supply is keeping pace with population growth. The population values are taken from the Info page.

After inspecting the PROJECTIONS table, and if you like the results and want to make no further changes, you are a very rare planner and should either be congratulated or perhaps sent for further training. In reality, your first projection will probably not appear reasonable and you will want to refine it, following the steps outlined below.

1 **Split the computer screen.** Select and double click (or press <Enter>) on the GRADUATES button at the bottom of the PROJECTIONS table. This will split the screen, placing the top section of the GRADUATES table at the top and the lower portion of the PROJECTIONS table at the bottom. You can move the cell pointer from the lower to the upper screen and back using the <F6> key.

2 **Confirm the base year supply, loss and retention rates.** (a) If you used the Annual Loss Rate Method, review, and if necessary, modify, your base year supply estimates and assumptions of future average annual loss rates. (b) If you used the Cohort Method, review, and if necessary, modify, your estimates of the number of graduates over the past years, and of the retention rates. You can shift the cell pointer to the right by pressing the <Tab> key, and to the left by pressing <Shift> <Tab>, making fine adjustments with the arrow keys or mouse. Note the effects of any changes, especially of the loss or retention rates, on the projected supply.

3 **Adjust training intakes and losses.** Press the <Tab> key to bring the pointer to the TRAINING table to the upper part of the screen. Modify the variables (First year class; % who graduate; Gains or losses; and % males) in this table to attain the desired supply projection in the lower screen. The biggest changes will result from changing student intakes, but significant changes can also result from changing the assumed percentage who graduate. Lesser changes will occur if the sex ratio or the net annual gains or losses is altered.

4 **Clear the split screen.** This can be done using the *Window Split Clear* command.

Congratulations! You have now completed the first Occup page for one of your selected occupational categories. The remaining Occup pages should be a lot easier, at least as regards data entry. At this point you should be sure to save your input using the *Put version* button or command.

The Occup page include a graphic projection of the supply. Use the *Graph View* command and select the Occup page you are working on to view a projection of the supply. This graph displays the projected numerical supply of health workers (left scale,
blue triangles and red squares) and the population per health worker (right scale, green crosses). You can enlarge or close this display by using the small symbols in the upper right corner of the screen.

**Combined supply for five occupations (Region page)**

After completing the desired number of Occup pages, go to the Region page, which contains three tables.

**SUPPLY table**. This table combines the projections of each of the preceding five Occup pages so that you can see in one table the numbers of health workers of each type and their percentage distribution. The percentage distribution section, in particular, will be useful since it shows how the relative numbers of health workers will change over the projection period. The bottom INDEX VALUES section compares the change in the health worker supply with that of the population. Index values are used so that one can compare very dissimilar numbers, in this case thousands of health workers and millions of population. With the base year of an index value set at 100, one can easily determine the percentage change. For example, if the target year population has an index value of 210, it means that the population has a bit more than doubled, for a 110% increase (210 - 100 = 100%). Thus if the health workers index value is 250 and the population one is 210, health workers have increased relatively faster than population.

**COSTS table: Testing for economic feasibility**. The supply model includes a simple test for economic feasibility. This test is applicable only to public sector health workers and is less flexible than the one provided in the requirements model. Nevertheless, it can provide a preliminary assessment as to the likely economic feasibility of the projected workforce supply. If you plan to complete the requirements model soon you may skip this section.

1. Complete an Occup page for the every occupational category that you would like to include in the cost projection. This will optimally include the largest and most expensive categories, eg, doctors, nurses, auxiliaries, technicians.

2. In the upper section of the COSTS table, enter in the first shaded cell the assumed average annual percent (0.0) change in available *real funds* (ie, not counting inflation) available for personnel over the next 30 years. Do not take into account capital investments. It is, of course, impossible to know with certainty what this rate will be over an extended period of time but you can easily make a reasonable and conservative estimate for purposes of a simple economic feasibility test. There are two main alternatives.
**Estimates based on past experience.** One approach is to calculate the approximate real change in recurrent public health expenditures over, say, the past 8-10 years, and adjust it up or down a bit to take into account likely developments in the future. For example, if real expenditures increased 50% over the last 10 years, the average annual rate of increase would have been a bit under 4.6%. If there is reason to think this average might increase, or decrease, in the future, then minor adjustments could be made.

**Estimates based on a reasonable guess.** An even easier alternative is simply to assume that real recurrent public health expenditures will increase at about the same rate as the gross domestic product, perhaps adjusted up or down to take into account likely developments. For example, if the GDP has historically risen at about 4% per year, this would be your point of departure. You could then take into account likely trends such as a projected higher GDP growth rate in the future, a slowing rate of public health sector growth, etc., to come up with a final estimate. Since no one can possibly predict the actual growth rate, emphasis should be given to making the assumption reasonable and not too optimistic.

3 In the next shaded cell enter the assumed average annual percentage change in real public sector salaries over the 30-year projection period. This assumption must be reasonable since it cannot be accurate; no one can possibly predict this value with precision. By reasonable is meant that it should consistent with the historical and likely future rate of real public sector income growth. Assume constant monetary units and do not attempt to take inflation into account. Thus if real per capita income has increased at about 1-2% per year, income growth probably will be in that range. Real incomes are unlikely, over an extended period of time, to either be much less or much greater than real per capita income growth, though they may greatly exceed these bounds over a relatively short (<10 years) period of time. A reasonable first estimate for salary growth for countries with a history of moderate economic growth (3-4%) and a substantial population growth rate (>2%) would be about 1%. Annual income increases of 1%, 2%, and 3%, will result in total income increases over 30 years of 35%, 81%, and 143%, respectively.

4 In the lower section of the COSTS table and note that the left-hand column lists your occupational categories. Enter into the next two columns your best guess, rounded to the nearest 5-10%, of the percentage of full-time equivalent personnel time from each category that worked in the public sector in the base year, and that will work in the public sector in the target year. Thus you might assume that 50% of all doctor time was in the base year public sector, and that this percentage, based on current trends and likely policies, might rise to 60%.

5 Turn now to the RELATIVE INCOMES column and with 1.0 entered in the row corresponding to the lowest paid personnel of the five listed, enter the relative incomes earned by the other (up to) four categories. For example, if you have a supply
projection for doctors, dentists, nurses, nurse auxiliaries, and technicians, you might enter 1.0 for the auxiliaries, 1.7 for the technicians, 1.9 for the nurses, 2.6 for the dentists, and 3.1 for the doctors. Taking the two extremes, these numbers mean that full-time equivalent public sector doctors receive average salaries about 3.1 times as great as do full-time equivalent nurse auxiliaries, and that the other categories have intermediate earnings. Using these relative incomes you do not have to enter the actual salaries, though these are, of course, your ultimate reference values.

So, you have come this far and have entered data in all the shaded cells, what next? Review the index values shown at the right side of the COSTS table. Do the changes look reasonable? For countries with a 2% annual growth rate the population will more than double in 30 years. You can compare the change in the population with that of the supply of your five occupational categories and of the portion of that supply assumed to be working in the public sector. The bottom two values, AVAILABLE FUNDS and STAFF COSTS, provide the simple feasibility test. If funds and costs rise at about the same rate, and are no more than 10-15% apart at the end of the projection period, congratulations; the projected supply is probably affordable based on your input assumptions. However, if they are quite different, you will need to re-check your assumptions. Let's try some experiments as described below. For purposes of illustration assume that your 30-year index values are as follows: population growth, 150; public sector FTEs, 250; available funds, 350; and staff costs, 450. Since 450 is a lot more than 350 this means that according to your assumptions you would have to spend a lot more on staff than is likely to be available. To bring matters in approximate balance you could:

1. Assume a lower rate of income growth. Earlier you had assumed 3%, which increased incomes by 143% total. You now try 1.5%, for an 56% total increase; though this decreases the projected funds for staff significantly it is not enough to close the gap. You decide that it would be unrealistic to slow income growth any more.

2. You then increase your assumed annual rate of growth of real public health funds from your original value of 3.0 to 4.5. This increases the available funds value but not enough to completely close the gap and you don't think a higher expenditure growth rate assumption can be justified.

3. Having adjusted downward your income growth assumption and adjusted upward your expenditure assumption to the limits of realism, the only options that remain are: (1) the projected growth in the various occupational categories, especially the high income ones, and (2) the projected percentage of the workforce that is in the public sector. You now proceed to adjust these until the Available funds and Staff costs index values are in reasonable approximation.

INTERYR table. You have now come to the last, and easiest table of them all. With this table you can project supply to a year that is not included in all the previous
supply tables. This could be useful where your country’s planning period did not fit the projection years included in the model. For example, if you use 1996 as your base year, the main tables will only provide projections to 2001, 2006, etc., up to 2026. To obtain an intermediate projection to, say, 2004, enter 2004 into the one shaded cell and the computer will calculate the necessary numbers, percentages and index values. If you enter a number that is beyond the 30-year projection period you will get error (ERR) messages.

We are now at the end of Part II on supply. Undoubtedly these projections can be further improved but let’s postpone further refinements until after you have developed your requirements projections. Then you can make parallel improvements in the quality of both sets of projections while at the same time bringing them into closer approximation.

### Part III. REQUIREMENTS MODEL

The health workforce is the single most important and expensive resource input to the health sector. The requirements model is designed to help planners and policymakers:

- project health worker requirements according to input assumptions and targets;
- project the potential production and geographic distribution of selected types of hospital and ambulatory care services; and to
- project health sector costs according to alternative sets of user-defined assumptions.

It can also be used in teaching to demonstrate what might be termed the anatomy and physiology of the health sector, and to demonstrate the interactions between differing sets of assumptions about resource inputs, outputs and productivity. Similarly, it can be used to develop and test the feasibility of alternative policies affecting health sector growth.

The model is designed to develop alternative scenarios of how the health sector might develop. For each scenario projections are made of costs, selected service outputs, and likely workforce requirements for up to 15 user-defined occupational categories working in up to 16 different types of public and private sector clinical work locations, as well as in teaching, research, and non-clinical public health activities. The target year for the projection can be for any period from one year up, though generally the projection period will be for 20 or more years.

The requirements model consists of one large (Require) and two small (Combine and Compare) spreadsheets, both of which have on-line help notes. Brief descriptions of
the spreadsheets are provided below and more detailed instructions are given in later sections of this document.

- The Require spreadsheet is the basic projection model and consists of 31 data tables, 10 utility tables, and 8 graphs.

- The Combine spreadsheet makes it possible to combine the results of many requirements projections for different segments of a country’s health system in order to produce a consolidated national projection. These segments can be based on geographic areas such as states or provinces, or on administrative units such as would be the case where a country has different health care systems to meet the needs for different beneficiary populations, e.g., the military, employees of a very large industry, or for a major social insurance fund.

- The Compare spreadsheet makes it possible to compare side-by-side up to three alternative projection scenarios. The projections are based on base year data but different planning assumptions. This capability will be of great use for assessing the relative advantages and costs of different visions of the future.

Requirements model structure and logic

The detailed characteristics of the requirements model will gradually become apparent as you proceed through the various steps described in the following pages. Before examining the details, however, it may be useful to review the underlying structure and logic of the model. As you will recall there are at least four basic approaches to estimating requirements:

- Population-to-personnel ratio method. Desired ratios of doctors, dentists, etc., to population are determined by various means and then are used to convert the projected population into the number of personnel required.

- Health needs method. This method converts diseases, disabilities and injuries into the numbers and kinds of services ‘needed’ to attend to them, which are then converted into required personnel by means of productivity norms.

- Service demands method. This method projects the demand for services based on observed service utilization rates for different segments of the population, applies these rates to the future population to determine the number and kinds of services likely ‘to be demanded’, and then converts these services into required personnel by means of productivity norms.

- Service targets method. This method assumes specified targets for the production (and presumably, the resultant utilization) of different types of services based on
various methods, and converts these into required personnel by means of productivity norms.

The requirements projection model is based on one variation of the service targets method. For the majority of World Health Organization countries likely to use this projection model this method has several important advantages since it....

- Requires much less detailed data than either the health needs or service demands methods, yet can still accommodate elements of these two methods where appropriate
- Is likely to be more appropriate to the way most developing country health systems are organized and to how decisions are made
- Provides much more insight into health system operation and to the relative merits and costs of alternative planning assumptions than would be possible with the ratio method

In the more usual form of the service targets method a country first sets targets for the numbers and kinds of health services to be provided at a future point in time, and then converts these services into the personnel required to produce them. These targets can be determined by different planning methods, depending on such considerations as the population to be served (eg, mothers, children, workers, general population), anticipated morbidity patterns, geography, social insurance coverage, economic factors, etc. Targets for specific segments of the population can then be aggregated to determine the overall target for hospital care, ambulatory care, preventive services, and the like.

For a number of practical reasons the present model uses a rather different approach from the classical one described above. The starting point for the model is the estimated base year number of health facilities, or better termed, work locations, of each major type. To use a simple example, a small country might have one 700-bed tertiary care hospital associated with its medical school, four regional hospitals with an average of 400 beds each, 15 district hospitals with an average of 100 beds each, about 50 health centers with an average of 5 beds each, and 250 health posts with no beds. In addition it will have some non-clinical public health work locations (eg, Ministry of Health, District Public Health Offices, etc.), a private sector, and some training programs and academic institutions. In this country, there would be five public sector clinical work locations -- a national hospital, regional hospitals, district hospitals, health centers, and health posts.

In essence, the first task is to divide up the entire health sector into those major types of work locations where virtually all economically active health personnel will be found. Routine data available in most countries can usually provide base year estimates of the service outputs and staff complement of most work locations, and informed estimates
can be made for those for which actual data are unavailable. Estimates for individual locations can then be aggregated to develop base year estimates for each type of location.

With the base year thus described, the next task is to modify this base year pattern of work locations so that it can best meet the anticipated needs of the target year population. Population growth will likely have to be accommodated by an increased number of at least some types of clinical work locations but the potential effects of many other changes can tested with the model. To know which changes to make one must first ask the question:

Are the current types, numbers, productivities, and other characteristics of clinical and non-clinical work locations appropriate for the current population?

Almost certainly the answer will be “no”. Typical problems that may affect one or another segment of the base year health sector include: inappropriate balance between urban and rural services; low service productivities; poor quality services; inappropriate balance between preventive and curative services; inappropriate staff mix or inefficient staff densities; some work locations are either too large or too small for the populations served or for operating efficiency, or perhaps either over- or under-worked in relation to their design capacity; and some locations may suffer from poor access due to inappropriate geographic location. To ease these problems planners could test the potential effects of changes such as the following:

- Differential rates in the expansion of the various types of work locations in order to improve imbalances in the types and geographic distribution of services produced, and to better meet anticipated morbidity
- Gradually decreasing the average size of some types of locations and/or increasing the size of others, both to improve efficiency and accessibility
- Correcting staffing mix and density problems in order to improve quality, appropriateness, and/or productivity of services

The projected numbers of work locations by type are then multiplied by: (1) the assumed average staff densities per location to determine the number of personnel required; and (2) the average production of services assumed for each location to determine the total production and distribution of services. The sequence of data input and analysis for the core model is graphically shown in Figure III-1, with the calculations made by the computer enclosed in brackets [ ].

-- Proceed to the next page --
Figure III-1. Sequence of steps in the requirements model

Specification of the base and target years

B-Y population, health worker supply, & public sector clinical work locations (W-L)

- [B-Y population per clinical W-L]
- Assumed population growth & T-Y population per W-L
  - [Projected numbers of clinical W-Ls by type]
  - Assumed T-Y staffing norms for each type of clinical W-L
  - B-Y public health personnel & assumed annual increase
  - B-Y academic personnel & enrolments, & assumed annual increase
  - B-Y private sector salaried personnel & beds, & assumed increase
  - B-Y private practitioners & assumed annual increase
  - [T-Y clinical, non-clinical & private sector staff requirements]
  - [T-Y health personnel requirements by sector & W-L]
  - T-Y projected supply by type of health worker
  - [T-Y surplus or shortage of health workers]

In summary, the model asks users, in sequence:

1. To quantitatively describe the base year characteristics of those public and private sector work locations where health workers may be found

2. To propose certain changes in the numbers and characteristics of these locations in order to better serve the anticipated target year needs of the population

3. To test the projected production and distribution of services, workforce requirements, and costs of this first run of the model, against the projected supply of funds and personnel, and lastly,

4. To make successive adjustments in the model in order to gradually bring the workforce supply, requirements, costs and performance of the health system into an acceptable balance.
The model uses work locations as the basis on which to plan. These locations produce services, which can then be converted into service utilization rates, e.g., 2 doctor-visits per capita, or 40 hospital discharges (or admissions) per 1000 population. If one wishes to set a specific target for the production of services the model can be adjusted to meet this target, and the resource costs calculated. Conversely, if one wishes to make quantitative and qualitative improvements in the system that are in accord with resource constraints, then the model can be manipulated accordingly and the consequent production of services calculated.

**Projecting requirements: Problems and choices**

With the above general description of the model in mind it is now time to look more closely at some of the choices that must be made. The health sector in any country is extraordinarily complex, with many poorly understood interactions between resources used, services produced, and health outcomes. As a result, any simulation model must therefore make many compromises between what is desirable and what is feasible. This section comments briefly on the major choices made in this model.

**Data availability.** A major constraint to model complexity is the lack of data, and this is especially true in low income countries. Few users of this model will have, or even attempt to collect, all of the required data inputs. Missing data should not significantly limit the use of the model, however, since most countries will be able to develop reasonable estimates or educated guesses that will satisfy the level of precision required in long-range strategic planning. Instructions for each table include suggestions as to how reasonable estimates can be made for missing data, and how the sensitivity of the final results to data errors can be tested.

**Flexibility.** The requirements model has been designed to accommodate different types of planning situations. As noted, the model can accommodate many different occupational categories and clinical work locations. Private sector non-profit and for-profit health services can also be included in the model. Model complexity increases rapidly, however, as the number of options increases, and to the extent that some occupational categories and/or work locations can be combined, it will be easier to use and understand. Each of these planning variables can be defined by the user.

**Health status.** The model does not attempt to use morbidity or mortality indicators either as inputs or outputs. The reasons for this are several.

First, the model does not make use of the *health needs* method for projecting workforce requirements, which is the only method that would require detailed data on health conditions. According to the health needs method each category of disease or disability is converted into the numbers and kinds of services required and these are then converted into the personnel needed to provide them.
One option might be to use the health needs method for a few high priority health conditions, eg, maternal and child health care (MCH), certain communicable diseases such as tuberculosis, and the service targets method for the rest of the health sector. While the health needs method has a number of important advantages in detailed, short-term, program-specific planning, partial use of this method in a long-term sectoral growth model would greatly increase the model's complexity without necessarily adding either to its accuracy or its utility. For example, to use the health needs approach for MCH and the service targets method for everything else would require dividing out personnel requirements according to whether they were assigned to an MCH- or non-MCH function in every type of health facility that offers MCH services, and estimating the at-risk MCH population for each of these facilities.

Second, we are still unable to correlate, with few exceptions (eg, immunizations), the number and quality of specified health services provided with the resultant morbidity and mortality rates. The requirements projection model is designed to make estimates of the numbers and types of services that could be produced with a given set of staffing assumptions, and the resultant average per capita utilization rates. As these numbers increase it is possible to assume potential improvements in health status but it is not yet possible to say what effect a given improvement in the number and/or kinds of services produced will have on morbidity and mortality.

Even though morbidity rates are not explicitly used in the model, morbidity can and should be taken into account at the same time norms are established for the provision of different types of work locations and for staffing them. The model requires targets for the number, distribution and types of work locations to be provided and standards for staff deployment and productivity. These targets and standards should, in turn, be based on a thorough understanding of the distribution and determinants of health problems experienced by the populations to be served.

**Characteristics of specific health programs.** As described in the previous section, the requirements projection model is based on user-defined norms for the provision of different types of work locations, ranging from national tertiary care referral hospitals to rural health posts, academic institutions and non-clinical public health facilities. The possibility of also including health programs such as those for mothers and children, environmental sanitation, or health promotion was considered but not done at the present time. The reality is that most programs operate out of a health facility such as a hospital or health center, and many staff are involved in several different programs. Multi-purpose, multi-program personnel would make it difficult to avoid double counting staff unless costly time-utilization studies were first undertaken. However, the model does permit the inclusion of staffing requirements for large scale programs not closely linked to a clinical facility, as will be evident in the PUBHEALTH table.
**Age-specific services.** As with the case of health status it would be difficult to plan separately to meet the needs of each major age group since this would require the disaggregation of health worker time and services produced according to the age group served. However, if you expect that your country's median age will increase significantly over the course of the projection period, you can take this factor into consideration when developing your facility targets and staffing standards.

**Urban-rural gradient of services.** Original drafts of the model included provision for specifying targets for the delivery of services at different points along the urban-rural gradient, eg, large cities, small cities, towns, densely populated rural areas and sparsely populated rural areas. This made the model unnecessarily complex, especially since many countries do not have estimates of the production of services according to whether patients are urban or rural residents. However, this important variable can be taken into account to some extent by means of user specification of the approximate proportion of the population served by each type of health facility who can be considered *urban* residents, and by difference, the proportion who are *rural* residents. For example, a national tertiary care referral hospital presumably serves and is available to the entire national population, though realistically most of its services are provided to persons who live within, say, several hours of travel time. If patients served by this type of hospital are 85% urban residents, then this value can be entered in the computer, and similar estimates made for other types of work location. In essence, by estimating the percentage of each type of work location's patients who are urban residents, the projection model will calculate population-specific service utilization rates for the region as a whole and separately for urban and rural residents. These estimates can help planners determine the degree to which their proposed facility targets will meet the needs of the different geographic segments of the population. Detailed descriptions of the various tables will show how these assumptions can be used to show the approximate geographic distribution of services.

**Persons vs. full-time equivalents.** Part-time health workers and part-time jobs present any projection model with difficulties, and part-time employment is a reality in any health sector. Training programs train *people* while health systems employ health worker *time*, time which can come from either full- or part-time employees. Moreover, many doctors, dentists and other health professionals divide their time between the public and private sectors, with part-time jobs in each. An additional problem is caused by the gradual reduction in the number of hours worked as persons age, especially after they reach their 60s. Few information systems maintain reasonably comprehensive data on the number of part-time workers and hardly any will have information on the number of hours or fractions of full-time that these persons work. To minimize double counting of health workers the requirements projection model makes use of *full-time equivalents* (*FTEs*) whereby two half-time or three third-time health workers are the equivalent of one full-time worker. The relevant tables provide guidance as to how FTE estimates can be made.
**Private sector.** For several reasons planners may prefer to limit health workforce planning to only the public sector: there is more and better information on the public sector; the public sector has little control over, and does not directly pay for, the private sector; and those who call for and do planning are almost always employed solely by the public sector. This limitation is not a realistic option for any country except those with a very small and static private sector. For most countries the private sector exists, it employs at least 10% and often a higher proportion of the health workers, especially high level professionals such as doctors, dentists and pharmacists, and in many countries this sector is growing faster than the public sector. Moreover, in some countries government is actually promoting or partially subsidizing the activities of the private sector. For these and other reasons planners must include private sector workforce requirements since failure to do so would inevitably leave a substantial portion of public sector requirements unmet. The World Health Organization requirements model can accommodate several distinct segments of the private sector such as those who work in salaried positions in both for-profit and not-for-profit hospitals and clinics, and those who work in independent private practice.

**Occupational categories.** The projection tables can accommodate up to 15 different user-defined occupational categories and additional categories can be listed on a separate spreadsheet. Version 1.0 of the model offered up to 30 user-defined categories but it became clear during the field test that 15 categories could adequately cover most of the major occupations that planners and educators need to consider in a long-range projection. Criteria favoring inclusion of a occupational category include:

- economic importance
- long and costly training
- government responsibility for training
- large number of persons in the category
- shortages or surpluses severely affect the sector

A later section will review in some detail how these criteria can be used to decide which categories to include in the model, and Appendix B provides a master list of the health-related occupational categories found in most health systems. These sections will require careful attention since once you develop your model for one set of health occupations it will become increasingly complicated to change these occupations at a later date.

**Health facility types and other work locations.** The model allows users to specify up to 16 different clinical work locations (14 public sector and 2 private sector), and to take into account health personnel working in non-clinical public health activities or in training and research institutions. Listed below are examples of the five different types of work locations that might be specified, though the actual number and names of
the facilities are user-defined. Appendix B provides a more complete list of potential locations and suggests terms that might be used for them in the projection model.

- **Public sector clinical facilities with beds**: national hospital, regional hospital, district hospital, health center with beds, long-term care hospital, mental hospital, and specialized acute care hospital (for cancer, infectious diseases, etc.). Most of these bedded facilities also provide ambulatory care.

- **Public sector clinical facilities without beds**: free-standing urban specialty polyclinic, health center without beds, health subcenter, maternal and child health center, health post, and aide post.

- **Private sector clinical facilities**: salaried personnel working in hospitals or clinics; independent private practice doctors, dentists, midwives, pharmacists, or other such practitioners.

- **Non-clinical public health and research work locations**: Ministry (or Department) of Health, Provincial (or State) Department of Health, national research institute, and major public health programs not based in clinical health facilities or in the Ministry of Health.

- **Academic and research work locations**: instructional, administrative, and research personnel working in a primarily academic institution and where patient care is not the primary activity.

No model can take into account all of the many complexities of a real health sector and inevitably many compromises and simplifications must be made. The essential task is to take into account those resources and activities that collectively define the major characteristics of the health sector. Special studies can be done to project the requirements of small, unusual or rapidly changing programs and/or of small but especially important occupational categories. And now, on to the details....

**Requirements spreadsheet**

Load the HRH program by double clicking the toolbox icon labeled HRH, and either choose an activity (Supply model) if this is your first session of the day, or use the *File Open* commands, and select the Require.BWB file. This will load an empty requirements spreadsheet ready for use. The cell pointer should in the upper left corner of the Info page, but if not, press the <Home> key.

The requirements spreadsheet can accommodate up to 15 user-defined occupational categories and the spreadsheet will normally come empty of data. Proceed as follows:
If this is your first use of the requirements model, click on either the top left button with the arrow pointing toward the spreadsheet or on the File, Get Version pull-down menu, and select demoreq.bdt. This will load a demonstration requirements data file which you can experiment with. When through you may clear the demonstration data without saving it by using the File, Clear Data commands. This will remove the data from the Require file while keeping it available on hard disk for future training or review sessions. Alternatively, if you want to save your own, customized demonstration and training file, make changes in the data and then save it using either the button with an arrow pointing away from the spreadsheet or on the File, Put Version menu commands, giving your new file a distinctive name. The computer will automatically put a BDT extension on your file name.

Info page (Requirements)

You are now ready to proceed to build your requirements model. We will assume you now have the Require file loaded but without data in it. The Info page provides a list of all the tables and graphs in the spreadsheet. In the first column are the table titles, with the CAPITALIZED letters referring to the abbreviated code name for the table, followed by a consecutive table number and lastly with the full name of the table, eg, DEMOgraphic. By pressing the <F5> key, followed by the abbreviated table name and <Enter>, you can move the cell pointer immediately to the top left corner of any table. For example, <F5> ACAD <Enter> will immediately place you at the top left of the ACADemic table (TEACHING AND RESEARCH PERSONNEL).

The first section of 15 tables constitutes the core of the projection model; it is required, and without completing this section none of the optional modules will work. If you use the <PgDn> key you will see a listing of the tables used for the five optional modules that allow you, in turn, to test the economic feasibility of the projection, to estimate doctor and nurse specialist requirements, to estimate the production and geographic distribution of services, and to make an intermediate year projection.

At this point you may want to print out the full set of requirements model tables using the demonstration (demoreq.bdt) data. These tables use realistic but entirely simulated data. Do not use any of the values shown in these simulated tables as guides to what your country should use for bed, staffing or productivity standards since such norms vary widely and are country-specific.

If you are loading the Require spreadsheet for the first time or working on a new data set you should proceed as follows to fill in the information requested in the yellow box near the top right section of the Info page.
1 **Today's date.** Enter today's date (eg, Jan 1, not 1 Jan) here and update this date every time you modify your requirements spreadsheet. This will show you when you last modified and saved the file.

2 **Country name.** Enter the name of your country, province or planning region.

4 **Filename.** Enter the filename (up to 8 characters per the DOS format) for this specific data set. Since you will be making different data sets for different types of projections, give a unique name for each data set. Examples might be based on growth assumptions (eg, SLOWGROW, FASTGROW); health sector priorities [eg, HOSPEMPLH (= HOSPital EMPHasis), AMBUEMPH (= AMBUlatory care EMPHasis), PHCEMPH (= Primary Health Care EMPHasis)]; time period [eg, REQ10YRS (= a 10-year projection)]; subsector [eg, SOCSECUR (= social security health system), ARMFORCE (= armed forces health system)]; or perhaps just REQUIRE1, REQUIRE2, or REQ10Jan (= REQuirements projection of January 10th).

5 **Projection type.** Enter a name for the type of scenario you have projected. Although there is no limit on the number of characters, if the name is too long, some of the latter characters may be eliminated from the display due to column width restrictions. Examples might include: Slow Growth, Moderate Growth, Fast Growth, or perhaps Ambul. Emphasis and Hospital Emphasis, standing for projections that give emphasis to ambulatory, or hospital care. These names will allow you to distinguish this set of tables from another set.

The last three items of information will appear at the bottom of each table to remind you of the location and underlying assumptions used in the table.

Every time you start a new data set you should immediately save it under a new name. As described earlier, you can either click the Put Version button or the File|Put Version command, and then enter the new file name.

You have now completed the first page of your model. Remember to save every 10-15 minutes your evolving data set using the Put Version command, or after any significant improvement, so that you don't run the risk of losing too much work in case of power or computer failure. At the end of the day you should save your data set(s) on a floppy disk so that you will not lose your work should your computer fail.

**DEMOgraphic table.** Go to the DEMOgraphic table to enter your basic demographic assumptions. Proceed as follows:

1 Enter the base year of your projection near the top of the table. The base year refers to the most recent year for which reasonably complete data are available and should be the same for all occupational categories. Once the base year is specified the computer will automatically insert it in all relevant tables throughout the model. You
may find that you have most of the data required by your projection model for the base year but not all of it. In this case data from years prior to the base year should be extrapolated or otherwise estimated to provide the best approximation possible for the base year. *The same base year should be used for both the requirements and supply projection models.*

2 Enter the target year of your projection underneath the base year. It may be of any duration but we suggest that you make at least a 20-year and preferably a 25- or 30-year projection in order to provide you with enough time to test the longer range impact of alternative policies. Though your projections may be long they should be used to formulate action policies for only the next several years, policies which must then be updated with another set of projections. Appendix C (*Shorter- vs. Longer-term Planning*) addresses this issue in greater depth. Your specified target year will be inserted by the computer in several tables of the spreadsheet. If you are working with a much shorter planning period, eg, five years, you may also wish to develop an intermediate projection of this duration, and a later section in this document describes how this can be done.

3 The computer subtracts the base year from the target year to calculate the length of the projection and this is used in many different parts of the model.

4 Continuing down the same column, enter the base year population; round your estimate to the nearest 1000, eg, 1,234,567 = 1235.

5 Enter the assumed annual population growth rate to one decimal place (eg, 2.7% should be entered as 2.7) for the first third of your projection period in the next cell, the assumed rate for the second third in the following cell, and for the last third in the next cell. Though population growth rates change slowly, they do change! While you may wish to assume a single rate of growth for a short projection period, if your projection is for 10 or more years you will probably want to assume different rates for each third. It is important to take into account probable changes in the population growth rate since the population size is the single most important variable affecting health sector requirements. If the population growth rate is low and unlikely to change you can probably use the rate assumed by the census bureau during the next few years for each of the three thirds. However, if the rate is expected to decline you may wish to incorporate this assumption in the model. The computer will then use the three rates to calculate the population at the end of each period and the average annual growth rate over the entire period.

6 Next enter the approximate percentages of the base and target year populations that could be considered urban for purposes of planning health services. The word `urban' is defined differently in every country and there is, of course, no precise dividing line between urban and rural, so a rough estimate is entirely satisfactory. The target year estimate should reflect informed opinion as to the degree to which the country is
becoming more urban (the usual case) or less. Your urban/rural estimates will not affect the requirements projections; they will, however, make it possible, if you wish, to estimate the approximate utilization rates of hospital and ambulatory services by urban and rural residents. The computer will use your estimates to calculate the approximate base and target year urban and rural populations and the approximate annual urban and rural growth rates.

**SUPPLY table**. Go to the SUPPLY table. This required table defines the occupational categories to be used in the model and the base year supply. Proceed as follows:

1. Make a list on paper of up to 15 occupational categories for which you would like to make requirements projections. Assign each category a brief name and place them in an order that has some logical meaning to you. Plan on using the same categories and sequence for all separate requirements projections if you plan to compare or combine them later on. The illustrative tables in the demonstration dataset show some possible categories that you could use, a more complete list is given in Appendix B, and Appendix C provides additional suggestions regarding criteria for the inclusion or exclusion of occupational categories. You may wish to label the last row ‘All others’ so that your final list will include all or almost all personnel in the health sector. The categories you list here will be automatically used in all other tables that list the occupational categories so you will have to enter them only once.

**IMPORTANT NOTE!** Think through very carefully, before entering data into your model, what occupational categories you would like to use. Once your model is loaded it will be take a lot of time to change either the categories or their sequence, and you will likely make errors in the process. Ask yourself questions such as those listed below to help you decide which ones to include and which to exclude. Consider having no more than two levels of any one category, eg, nurses and nurse auxiliaries, doctors and doctor assistants, etc. And, do not list any more categories than are useful; you do not have to fill out all 15 rows!

- Is the category large enough, more than about 2-3%?
- Is the category reasonably costly?
- Can the category be easily distinguished from others?
- Can the category be best projected by other means?

If your answers to the first three questions with regard to a given category are ‘no’, and if the projections can be made by other means, we suggest you do not include it in this model, at least for your first projection.

Lastly, be sure to use the same categories, listed in the same sequence, if you wish to later compare alternative projections for the same geographic area or to combine projections for different geographic areas into a national projection.

Once you are satisfied that you have important, clear, and non-overlapping categories listed in the sequence that you want them, enter the name for each category in the
OCCUPATIONAL CATEGORY column. These names will now be replicated automatically by the computer in many other tables in the spreadsheet.

2 Enter in the TOTAL ACTIVE WORKFORCE column your best estimates of the total base year numbers of economically active public and private sector health workers in each of your named occupational categories. Make your estimates in terms of persons, not full-time equivalent persons, and round your estimates off to the nearest 10s or 100s if appropriate.

3 Enter in the FTEs IN PRIVATE SECTOR column your estimates of the total number of full-time equivalent (FTE) health workers in each category who were working in the private sector in the base year. In making your FTE estimates, do not attempt to correct your FTE estimates to take into account doctor (or nurse, etc.) `hours on call'. An example will make this point clear. Some doctors work 7-8 hours per day in a full-time job while others, especially when in postgraduate specialty training or when combining both public and private sector jobs, may work a regular daytime shift and then an additional number of night and weekend hours. One can thus ask, what is a FTE doctor? Since accounting for the on-call hours and correcting for the proportion of this `on call' time during which the doctor or other health worker is actually providing services would be much too difficult, it is best to count only the regular daytime hours worked. Thus, if the normal work day is 7.5 hours you should estimate about how many doctors, nurses, etc., are working at least the equivalent of this amount of time. In practice we know that a certain portion of the workforce will be working overtime or be on-call but this is likely to continue indefinitely and is part of the responsibility of working in a job that requires service availability around the clock. Once you have entered your private sector FTE estimates, the computer will calculate, by difference, the estimated number of public sector FTEs and enter these values in the next column (D). The last two computer-generated columns will show the resulting distribution of the total workforce and the percentage of each category that is in the public sector. Review the initial distributions and modify them as appropriate.

If you were able to develop estimates without much difficulty you may want to skip the below text and proceed directly to the next section. However, if you had difficulty generating good estimates or would like to understand the rationale for these instructions, read on.

- Why does the SUPPLY table ask for the total workforce and then for the private sector workforce, rather than for the numbers in each subsector? Version 1.0 of the projection models asked for individual estimates of FTE public and private sector personnel, and the computer calculated the total. It was found that aggregations of two FTE subsectors often resulted in a total that was clearly quite different from the known total of persons. The current model structure avoids this problem.

- Why ask about the private sector rather than the public sector? Version 1.0 of the
projection models asked for estimates of FTE public sector personnel and the computer calculated private sector personnel by difference. This proved more difficult than the reverse since public sector personnel were usually in the great majority and were in much more diverse work locations than private sector personnel. Moreover, in this model all instructional personnel are counted in the public sector, even though some may work in private universities or training programs. Since the private sector was usually small, reasonably well defined, and since most private sector personnel were in only a few occupations, eg, doctors, dentists, pharmacists, and nursing staff, it was easier to start with this subsector and then calculate the public sector by difference.

- Why use both total persons and FTEs? The model must ultimately provide estimates of the number of persons required to staff the health system, since training institutions are concerned only with persons, not jobs or FTEs. However, many persons in both the public and private sectors have multiple part-time positions and hence if positions were counted rather than persons, total positions would exceed the number of persons working in the health sector.

- How can I develop estimates of private sector FTEs? There are four main problems to consider: (1) What defines the private sector; (2) How many persons of each category work in the private sector; (3) How much time is worked in the private sector; and perhaps most importantly, (4) How will erroneous estimates affect the projections. Each of these problems is addressed below.

  (1) What defines the private sector? Each country defines the private sector according to its own circumstances. Normally it will include all private, independent practitioners, all for-profit hospitals and clinics, all not-for-profit hospitals and clinics such as might be operated by religious, industrial and voluntary organizations, and perhaps some social insurance health care systems as long as they do not receive much in the way of government subsidy. In reality many private organizations receive significant government subsidy, either directly or in the form of government insurance for specified populations. The central objective here is to have a practical division between (a) those institutions that are primarily dependent on government, and whose budgets will weigh heavily on government, and (b) those for whom the government is only a minor contributor. The main reason for making a distinction between the public and private sectors is to allow the model to test the economic feasibility of your projections, so you will want to include those work locations that primarily depend on government in your public sector and leave the rest arbitrarily allocated to the private sector.

  (2) How many persons of each category work in the private sector? Most countries can develop reasonably good estimates based on informed opinion, if not actual statistics, of how many independent practitioners (doctors, dentists, pharmacists) work in the private sector. For other personnel, informed estimates of reasonable staffing
norms for private sector hospitals and clinics of differing sizes can be used to approximate the number of nurses, technicians, therapists, etc., may be working in the private sector. Informed estimates can also be made of the proportion of independent practitioners who will have trained health workers present in their offices. For example, a country with 1000 doctors, might proceed as follows: 1000 doctors minus an estimated 400 full-time public sector clinical doctors minus about 50 full-time teaching, research and public health doctors, leaves 550 full- and part-time private sector doctors. Of these 550, about 50 are in full-time salaried private sector positions and the balance of 500 have at least some private practice. Of the 500, about 25% have an employed nurse, thus resulting in 125 employed nurses in private doctor offices. For staff such as technicians one might multiply an assumed average ratio of, say, 4 laboratory technicians per private sector hospital by the number of such hospitals to develop an estimate of the number of technicians in private hospitals, this being supplemented by similar estimates for clinic and independent practice technicians.

(3) How much time is worked in the private sector? This is more difficult, but not impossible. For salaried personnel working in private sector institutions the number of persons is assumed to equal the number of FTEs, eg, 100 salaried nurses is equal to 100 FTE nurses. For independent practitioners the main problem is with doctors since most private sector dentists, pharmacists, midwives, technicians, etc., are in full-time private practice. For doctors the problem is twofold: estimating the time they work in the private sector, and deciding how to record that time in the model. In many countries doctors work part-time for the government, and the hours contracted are known, and the balance of the day, usually in the afternoons and evenings, is spent in private practice. As with the example above, one could start with the total number of doctors, subtract the number of full-time or almost full-time doctors in the public sector, and then multiply the number of part-time public sector doctors by the estimated proportion of their time that they spend in the private sector. This method works well if most doctors actually work the amount of time they are contracted for. Unfortunately, some countries may have difficulty deciding whether to allocate professional time between the public and private sectors according to the nominal or the actual time worked. Nominal time refers to the time doctors, dentists, etc., are under contract to provide to their employer, and actual time refers to the time they actually work. It is well known that in some situations doctors may be contracted for, say, six hours per day in a salaried public sector job but actually average only four or fewer hours daily, with the rest of the time in their private practice. Also, some practitioners may have so many different jobs that even if all their time is spent in the public sector, their effective time on the job is much reduced. In one country with detailed information about the number of jobs worked some doctors have up to 15 different jobs, and employers, per week. Each alternative way of allocating hours (by nominal time, by actual time, or by some mixture of the two) has its problems both in real life and in the projection model. Even though either method can be used, probably the least confusing is to use nominal time, ie, the hours that they are supposed to work. By way of illustration, assume that a country has about:
• 500 doctors in active practice in the health sector
• 900 public sector full- and part-time doctor positions
• 400 FTE public sector doctor positions, ie, all full- and part-time positions combined equal 400 FTE positions

Further assume that in reality it is widely known that public sector doctors actually work only about 70% of their nominal contract hours, thus resulting in about 280 FTE effective public sector doctors (400 FTE positions x 70%), and an effective private sector doctor supply of 220 FTE doctors (500 FTEs - 280 public sector FTEs). In this situation the least confusion will result if you use the nominal time (400 public sector FTEs and 100 private sector FTEs, ie, 500 - 400 = 100), as well as the nominal staffing norms (to be discussed later), and then make adjustments, as necessary, at the end of the projections.

(4) How will erroneous estimates affect the projections? Good news! Even relatively large errors in your allocation of health worker FTEs between the public and private sectors will not greatly affect your requirements projections, for reasons that will become apparent later on. They could, however, affect your economic feasibility test and your projections of the numbers of services produced and of their distribution between the public and private sectors. If you decide to test the feasibility of your projections you can, however, act to minimize the risk that erroneous estimates will adversely affect your economic feasibility test. An example will illustrate how this can be done. Assume you have 500 doctors in your total workforce, and that you estimate that the number of private sector FTEs lies between 75 and 150, with a best guess of about 100. In this case your first projection might be based on 100 doctors, and an alternative projection based on 75 doctors. By entering a value that errs on the low side of your best estimate you reduce the risk that you will overestimate the feasibility of your projection. In summary then, the important points are that: estimation of private sector FTEs is likely to be difficult for only a small number of your occupational categories; errors will not have a major impact on your projected requirements; and the potential significance of these errors can be reduced even further by leaning towards the lower end of your range of values, ie, by underestimating somewhat the size of the private sector and hence overestimating the size, and cost, of the public sector.

OCCUPREF table. The OCCUPREF (OCCUPation REFerence) table allows you to tell the computer where it should look for certain variables used in this module. You may list your occupational categories in any sequence you wish without constraint. Go to the OCCUPREF table and proceed as follows:

1. Note the upper portion of the table in which your list of occupational categories is shown along with their respective row numbers. If desired, you may list the years of general education, of health-related training, the base year total enrolment of students in each occupation, and any additional comments that may help others understand the major roles and functions of the category. For example, if a new occupational category
is to be introduced into your model, or if some persons are not likely to know the typical educational qualifications of a Community Health Worker, this information can be provided here.

2 In the middle MEDICAL and NURSING PERSONNEL section of the table enter the row numbers for fully qualified doctors, nurses, and for assistant and auxiliary nursing staff. This will make it possible for the computer to calculate ratios between these three core personnel categories.

3 In the AMBULATORY VISITS section enter the row numbers of up to three occupational categories listed in the SUPPLY table for which you want to estimate base and target year public sector production of visits. For example, if you would like to estimate doctor visits, and doctors are in the first row of the supply table, then enter the number `1'; alternatively, if doctors are in the 3rd row, then you should enter the number `3'. Follow the same procedure for up to a total of three categories. The computer will now enter the corresponding occupational category labels in this table and in others in this module.

4 Move the cell pointer down to the bottom shaded section and enter the relative row numbers of those occupational categories that could be considered high level, mid-level, and support level personnel. Use your own country's operational definition of what is high level, mid-level, etc. This information is used in the SUMSERV table to compare the base and target years as regards the level of personnel.

Another table completed! Now, to a rather more complicated table.

**Describing the health sector (Core page)**

Now the fun begins! Up to this point you have defined the demographic dimensions of the base and target years, and the characteristics of the base year supply of health workers. From here on the model asks you to describe the characteristics of the various work locations in which health workers can be found, and to provide planning assumptions for how the sector might or should evolve in the coming years. The Core page is as its name suggests, the core element of the requirements model.

**HOSPital table**. This will be a long but very important section for you to review since it defines a major portion of the health sector. Once you understand how this table contributes to the model many of the remaining tables will be easier to understand and complete, and the documentation will be briefer.

Before proceeding to the specifics of this and the following tables it is useful to comment briefly once again on the concept of work locations (or work settings) and how they relate to the projection method used in this model. The requirements projection model
is based on one variant of the service targets method. However, instead of starting out by asking how many services of each type are or should be produced, the model asks you first to define the different work locations where health personnel perform their jobs. Examples of work locations include national hospitals, regional hospitals, health centers with beds, health centers without beds, private doctors' offices, and provincial health departments. The base year work locations are then described according to their sector (public or private), inpatient or ambulatory nature, bed size, the production of selected services and their staff complement. Then assumptions are used to project the number of target year health sector work locations, using the same location names, and to define the characteristics of these locations. Lastly, the model compares the projected number of health workers required in the target year according to the planning assumptions, with the number used in the base year. Thus, although the traditional service targets method starts with services and ends up with personnel and work locations, the method used in this projection model starts with work locations and ends up with personnel and services.

Now, back to naming your work locations. In this and the following AMBULATORY table you are asked to specify up to 14 different public sector clinical work locations. You should therefore give careful thought to your location names you specify for these tables will be replicated throughout the model. Though you can't change the name of a work location between the base and target years, you can change its defining characteristics and staff complement, as will be evident later.

At this point you will find it helpful to write on paper a full list of work location names, using no more than about 7-9 characters for each one. By making the full list now, before you start to collect and enter data into the computer, you can minimize potential problems later on. At this point you may recall that it was essential to list the same occupational categories, in the same sequence, if you eventually want to compare or combine projections using those spreadsheets. This precaution is not necessary in the case of work locations. Accordingly, each province can list the work locations that best describe its health system and they can be listed in any order they wish. Proceed as follows:

1 Make a list of all the major types of clinical public sector work locations that now exist in your province or country. If necessary you can accommodate an entirely new type of work location planned to be introduced before the target year simply by including its name among the seven options available to you, and entering zeros for that work location in the base year. You should add new work location names reluctantly, however, since they may cause confusion and will reduce the number you have available to you in the base year. Refer to Appendix B for ideas of possible work locations.
2. Review your list to determine whether the numbers of work locations of each type will fit within the available numbers of locations you can use in the model. Specifically, you can name up to:

- Seven different public sector work locations with beds (normally called hospitals, though some may be health centers with beds or extended care nursing homes).

- Seven different public sector locations without beds, eg, free-standing polyclinics, health centers without beds, health posts, etc. It is important to emphasize here the word free-standing, which means that the clinic or center is not an integral part of a hospital. Two examples will help explain the distinction.

  -- Clinics that are part of hospital system. Imagine a country where most regional hospitals have clinics that are inside the hospital walls as well as clinics that are physically separate from the hospital but are administratively and functionally part of the hospital. Clinic staff are part of the total hospital staff and their staff positions are included on the hospital payroll. These types of clinics, their staff and their service outputs should be included along with those of the parent hospital type.

  -- Free-standing clinics. Imagine now a situation where there are a number of different types of clinics, centers, posts and other ambulatory care units that are administratively independent of hospitals. These units are usually physically separate from hospitals, their numbers do not bear a fixed ratio to the numbers of hospitals in the area, and their staff are usually administered at the level of each unit. These ambulatory care work locations should have their own labels, eg, polyclinic, health post, health center (without beds), and their characteristics recorded separately from those given for hospitals. Keep in mind, however, that even though these may be listed as free-standing ambulatory care work locations, this does not mean that their programs need to be independent from those of hospitals. If your country has a regionalized health care system, for example, it would be normal for your ambulatory care facilities to operate in close coordination with nearby hospitals, and to benefit from continuing education programs and supervisory activities originating in these hospitals.

If you find that your number of work locations fits within these limits of seven and seven, congratulations! If, however, you have too many distinct types of work locations in, say, the category of public sector hospitals, to fit within the limit of seven, then you will need to consolidate the types so that you can accommodate them all. For example, a country might start out with the following 13 types of public sector work locations with beds: national hospitals, regional hospitals, district hospitals, bedded health centers, cancer hospitals, infectious disease hospitals, tuberculosis hospitals, leprosy hospital, maternity hospitals, children's hospitals, mental hospitals, chronic disease hospitals and extended care facilities. Since this passes the limit of seven, consolidation must occur. You could do this by leaving the national, regional, district and health center hospitals as defined types, and then combining the remaining nine categories down to three. This
combination could take into account the relative numbers of beds (and staff) of the remaining types available in your country and, most importantly, their similarities. Thus you might combine together: the infectious disease, tuberculosis and leprosy hospitals (all dealing with infectious disease); the cancer, maternity and children's hospitals (all requiring relatively high staffing norms and meeting acute care needs); and the chronic disease, mental and convalescent hospitals (all requiring relatively low staff levels and providing long term care). Though these combinations may seem strange their similarities are, for the most part, greater than their differences. To make the model able to accept much more than seven of each type greatly increases its complexity without materially improving its accuracy.

If your country or planning region is small you may have only one hospital or center of a given type, or perhaps you have less than seven hospitals in all. In this case rather than assign a name for a defined type of hospital, you can instead assign the actual name or names of the hospitals you wish to plan for.

Lastly, make any final adjustments to your work locations to ensure that you can obtain reasonable data for the several types. For example, you may find that several proposed types of work location are so ill-defined or overlapping in the available statistics that it would be too difficult to distinguish them, one from the other. In this case, they should probably be combined. Now you are ready to proceed to the tables.

3 Enter the names of the different types of public sector hospitals at the top in the section labeled HOSPITAL TYPE. Make your names as informative as possible so that those who review the tables can readily understand what is meant. Possible names might include: NatlHsp (national, tertiary care hospital), ReglHsp (regional hospital), DistHsp (district hospital), PsycHsp (or MentHsp, for a mental hospital), ChrnHsp (chronic disease or long term illness hospital), SpecHsp (for specialized hospital dealing with cancer, infectious diseases, etc.), and perhaps HCtrHsp (for a combination health center with a inpatient few beds).

4 Enter the total number of hospitals of each type that were in operation in the base year.

5 Enter the total number of beds in each type of hospital. You should preferably use the actual bed capacity, even if this is different from the design bed capacity.

6 Based on your previous input values the computer will calculate the average number of beds in a single hospital of each type, obtained by dividing the total beds in a given type of hospital by the total hospitals of that type (eg, 1000 beds in 10 hospitals = 100 beds per hospital, on average) and the average population (000) per hospital. Thus, if a country has 20 hospitals of a given type for a population of 10 million, the computer will display 500, indicating an average population of 500,000 per hospital (10,000,000 / 20). As will be evident shortly, this average value will be an especially
important reference point for your target year projection. It is important to emphasize that this is a purely mathematical relationship that has no necessary functional relationship to the average population actually served by the hospital, a factor that is considered in the bottom of this table.

7 Enter next (BY % OCCUPANCY RATE) the average bed occupancy rate for each type of hospital, eg, entering 70 indicates that on average, only 70% of the beds are occupied. As in many other situations, if actual data or even sampled data are too difficult to obtain, an informed estimate is much better than leaving this row blank. The rate is normally calculated from the formula: actual bed-days divided by available bed-days multiplied by 100, where the available bed-days is the result of total beds multiplied by 365 days (per year), eg, 22,000 actual bed-days, divided by 100 beds times 365 days, equals a 60.3% occupancy rate. Since your occupancy rate estimate affects only your projection of inpatient services but not your projections of staff requirements or of costs, you can base this estimated on informed opinion. In many low income countries large hospitals tend to have high occupancy rates (eg, 95-100%, while small, and especially rural hospitals, have very low rates (eg, 20-50%). Typical occupancy rates for well managed hospitals of varying characteristics are noted below, and Appendix C (Typical ranges for input and output data) provides additional information on the usual range of values for hospitals and clinics.

- Large acute care hospitals (600+ beds): 85-95%
- Medium size acute care hospitals (250-600 beds): 75-90%
- Small acute care hospitals (<250 beds): 65-80%
- Small health center / hospitals (<50 beds): 60-70%
- Long-term care and mental hospitals: 90-95%

It is important to add, however, that local circumstances such as geographic conditions, population densities and seasonal variations in morbidity patterns, may justify considerable variations from these average values.

8 Now consider the target year and enter in the shaded cell the assumed average number of beds per hospital type at that time. Your assumption may be based either on what you think is likely to happen in the absence of planned change, ie, a baseline scenario projection, or what you would like to see happen, ie, an alternative scenario projection. This row makes it possible to modify the average hospital size for one or more types of hospitals in order to make the hospitals more efficient. For example, a common problem in many countries is to have a few very large tertiary care hospitals located in major cities, and a relatively large number of very small hospitals in the rural areas. The large hospitals are too large to be efficient, and because there are only a few such hospitals, they are not readily accessible to much of the population, while the rural hospitals are too small to justify enough staff and equipment to provide adequate care. Over 5-10 years the average size of hospitals cannot change much, but if your
target year is 20-30 years in the future there will be enough time to gradually increase or decrease the average size of hospitals to improve efficiency and access. These changes can be accomplished by policies affecting hospital remodeling and replacement, and by the sizing and location of new hospitals. Thus one could test the effect on costs, personnel, and services of, say, downsizing tertiary care hospitals in order to make them more efficient and accessible, and upsizing rural hospitals to make them more efficient and better able to care for sick patients. In making these changes your reference points are the base year beds per hospital values that you entered above.

9 The next row [POP(000) PER HOSPITAL] is for your assumptions about the average target year population per hospital. Since the values you enter here have a major effect on your projections an example will be used to illustrate how you can develop planning assumptions for this row. Let’s assume your first column is for tertiary level national hospitals, and that your country has two of them in a population of ten million, for a base year average population of five million per hospital. Further, assume that the two base year hospitals together had a total of 3000 beds, or an average of 1500 beds per hospital, and an unacceptably high 97% occupancy rate. Looking to the target year some 30 years away you assume that the national population will double and that there will be a continued rapid migration to the urban areas. While little can be done to improve this situation over 3-5 years, with time important changes can be made. Consider three scenarios:

- **No changes**: If there are no changes in any of the values or ratios, four hospitals and 6000 total beds will be needed for the target year population of 20 million, and the bed-population ratio will remain unchanged at 0.3 tertiary level hospital beds per 1000 population (6000 beds / 20 million x 1000).

- **Similar ratio, better distribution**: With target year hospitals averaging 750 beds and 2.5 million population per hospital, 8 hospitals with 6000 total beds would be needed. These still large hospitals could provide all specialized services, the base year bed-population ratio of 0.3/1000 would not change, but by having 8 hospitals rather than 4, hospital accessibility would be much improved.

- **Improved ratio, better distribution**: With target year hospitals averaging 1000 beds and 2.0 million population per hospital, 10 hospitals with 10,000 beds would be required, for a ratio of 0.5 beds/1000. This last alternative would provide both a more efficient hospital size and a better distribution, which increases accessibility.

You may well ask at this point: How can one decide what assumptions to enter? No country is likely to have these values ready to enter. Continuing with the above example, your starting point is the base year population per hospital, which in the above example would be 5000 (or five million, since the population size is rounded to the nearest 1000). If you want the same ratio of hospitals to population in the target year
you should enter 5000; if you want an improved ratio you should enter a lower value, and if you want a decreased ratio, you should enter a higher value. Your decision about any one hospital type is not especially important; rather, it is what you do with the full range of hospital types, and what you assume regarding the average hospital size. By looking at the whole range of hospitals you could, for example, downsize the large hospitals, upsize the small hospitals, increase the average population per hospital for very large and very small hospitals, and decrease the average population per hospital for the middle range of hospitals. You might also increase the proportion of extended care beds as compared with the more expensive acute care beds. The net effect of changes such as these across the full range of hospital types could be to improve both the efficiency and accessibility of the public hospital system, perhaps even to the point where the target year population's needs could be better cared for with little or no change in the actual bed-population ratio.

10 TY % OCCUPANCY RATE is the last row requiring data inputs. Enter here your target year estimates of the average occupancy rate for each type of hospital. As before, your starting point is the base year values you entered above. You may want to refer to paragraph 7 above, which provided typical occupancy rate ranges for hospitals of varying characteristics. As noted earlier, if you are making a short-term projection (<10 years), it may not be realistic to propose a significant change in the occupancy rate. For a longer range projection, however, such changes could be feasible and depending on the adequacy of the observed base year values, may be desirable. The target year occupancy rate assumptions will affect your estimate of the projected number of inpatient discharges (or admissions) but not of staff requirements. These assumptions can be easily changed later on to test their impact on the production of services.

11 Before proceeding to the lower half of this table take a look at the results of your work. The computer will display the percentage distributions of all public sector beds by hospital type in the base and target years, and the numbers of beds and beds per 1000 population in the base and target years. Do you like the effects of your first set of assumptions? Is the distribution of hospitals by type and size improved? What has happened to the bed-population ratio? If your first assumptions didn't have quite the desired effect, go back to the appropriate row(s) and change your values, but don't try fine tuning your assumptions at this stage; there will be better opportunities later on once you see the larger picture.

Proceed now to the lower half of the table, titled ESTIMATES OF PERSONS ACCESSIBLE TO EACH HOSPITAL TYPE. This optional section makes it possible to see how adequate will be the effective coverage of your hospital system.

1 Enter in the first shaded row [POPULATION SERVED (000)] the estimated population actually served in the base year by an average hospital of each type. For example, if you have a theoretical ratio of one regional hospital per 2 million population
but in reality an average regional hospital can effectively serve only about 500,000, then enter 500 in this row.

2 Enter in the second shaded row the assumed population that will be served in the target year by an average hospital of each type.

The last two rows will show the computer’s calculation of the percentage of the total population that will be served by, and accessible to, each hospital type. For example, if in the base year there are five regional hospitals with an average effective catchment population of 500,000 in a country with 10 million population, there is a theoretical ratio of one regional hospital per 2 million population (10 million / 5 hospitals), but only about 25% of the national population is actually served by and accessible to a regional hospital (5 x 500,000 / 10 million).

CONGRATULATIONS! You have now completed the HOSPital table and are ready for those that follow. This table required the most instructions since it was the first one. Since the other tables have a number of similarities, they will be easier.

AMBUlatory table. This table describes the characteristics of public sector ambulatory clinical work locations not directly controlled by or located in hospitals. Do the following:

1 Enter under the heading TYPE OF CLINIC the names for up to seven different types of free-standing public sector ambulatory clinical work locations. Possible names within the seven-character limit might include: PolyCli (= urban multispecialty polyclinic), HCtr-A (= health center type A, without beds), Hctr-B (= health center, type B, without beds, etc.), MCHClin (= maternal and child health clinic or center), HlthPst (= rural health post). Appendix B provides additional ideas for assigning names. As with the HOSPital table, you need to consider carefully the types of ambulatory work locations you will include in your model, the names you assign them (which should be readily understood by your intended audience), and the ease with which you can obtain data on each type. Develop your list on paper first and have it reviewed by colleagues before you start entering data in your model; it could be complicated to change later on. And, if you want to propose a new type(s) of work location, not available in the base year, enter the name(s) in row 5 so that you can build in target year planning assumptions in row 11 and in later tables.

2 Enter in the B-Y LOCATIONS row the number of each type of base year ambulatory work location. The computer will calculate the average population (000) per location and enter these values.

3 Go next to the T-Y POPULATION(000) PER LOCATION row and enter your target year planning assumptions for the average population (000) per location of each type. As with the HOSPital table, if you want the same ratio for a given type of location, enter
the same value in this row as you find in the base year row, a lower value if you want an improved ratio, and a higher value if you want a less favorable ratio.

This row, and the comparable one in the HOSPital table, provide policymakers with a chance to test the effects of a re-configured system of clinical work locations. Many countries find they have too high a proportion of their health care facilities in large urban areas, and too high a proportion of their total workforce in hospitals. If this or some other adverse pattern is affecting your country’s health system, you can use these rows to test the effects of your planning assumptions on personnel requirements, costs, and the production and geographic distribution of services.

Complete the optional bottom section if you would like to see the effective coverage by each type of facility in the base and target years. If the coverage of your smaller clinics and centers is low, remember they are serving predominantly the rural sector, which is only a portion of the total population.

Now, that wasn't so hard, was it? We are picking up speed.

PRIVHOSPital table . At last, the private sector! The private sector certainly complicates the life of public sector health authorities, but most countries would probably be worse off if there were no significant private sector in operation. In workforce planning the private sector must be taken into account since it will certainly employ a portion of available personnel. This table and a companion one on private sector health personnel give dimension to the private sector. Go to the PRIVHOSP table and proceed as follows:

1 Enter the base year total number of private sector hospitals. As noted earlier, the definition of private sector hospitals should match your country’s situation. In a typical country private sector hospitals would include all those which are privately owned and operated, whether for profit or not, and where public support and/or control is limited.

2 Enter the base year total number of beds in all private hospitals. The computer will display the average number of beds per hospital.

3 Enter your estimate of the annual rate of change (0.0) in the number of private sector beds between the base and target years. But, you will ask, how can you make such an estimate since the private sector is not under government control? Be reassured by several realities: for most countries the private hospital sector is relatively small and will not weigh heavily in the projections, and within that sector, the range of realistic growth rates is relatively narrow. Several steps of analysis can be used.

- First, review data covering the past ten years or so to determine the approximate annual rate of change. Note any changes in the pace and direction of change that occurred during this period, and when. For example, if the number of private
hospital beds increased from 1500 to 1900 in the ten years leading up to the base year, the overall change was 26.6% and the annual rate of change was a bit under 2.6%. Was this growth steady throughout the decade, or was it accelerating or slowing down in the more recent years? And, if the observed rate of change was very high, eg, 6% annual increase, how likely is it that such a high rate can be sustained over a considerable period of time?

- Second, consider whether the economic, demographic, political and social conditions that affected private sector hospitals during the recent past are likely to continue well into the future, or whether anticipated changes might modify past trends. For example, an aggressive program of public sector hospital construction might slow private hospital expansion, or alternatively, an extension of government sponsored health insurance that covers private sector hospital services might accelerate it. Demographic and economic factors such as rapid urbanization and/or slow economic growth might also affect private sector hospitalization. By considering these and other variables you can decide whether, on balance, to increase, decrease and leave unchanged the historical rate of change observed in the past.

It was noted above that the long-term annual rate of change will likely fall within a rather narrow range of values. Unless major policy changes are anticipated that would affect private sector hospitals, and assuming that the private sector is already well established, growth rates will probably not exceed by much the rate of urban population growth. With the possible exception of countries with large church-operated hospital systems in rural areas, private hospitals depend primarily on the more affluent sectors of urban populations. Accordingly, for an average low income country that projects a 2% population growth rate, a 3.5% urban population growth rate, a 1-2% annual per capita real income growth rate, and with base year private hospital beds accounting for no more than about 15% of all beds, a reasonable assumption might be for private beds to grow at about 3.6 or 3.7%. Try a couple of different rate assumptions and note their effects on the summary statistics shown in the bottom three rows. The values in the % OF ALL BEDS THAT ARE PRIVATE BEDS and the TOTAL BEDS PER 1000 POPULATION rows take into account your data entries regarding public sector beds and if this part of the HOSPital table was not completed, these numbers cannot be calculated.

Now, on to the next series of tables on staffing norms!

**HOSPSTAFF table.** Before getting to the details let's make a brief review of where we are in the projection model. Most of a country's health personnel works in hospitals, health centers and clinics, and with the previous three tables you have defined the first major component of your requirements projections, that is, the projected numbers of hospitals and clinics of each type required in the target year. In the process we hope you have had a chance to improve the geographic and functional distribution of
work locations to better meet future health care needs. Now it is time to address the second major component, the average staff required in the target year by each type of clinical work location. Once you have finished with the next three tables you can then complete your health sector model by including the public health and academic work locations, which together account for perhaps 4-15% of the total workforce.

Go to the HOSPSTAFF table and note the column and row labels. They should display the same hospital type and occupational category names that you assigned in previous tables, along with the average number of beds assumed for each hospital type. You now need to enter under each hospital type the staffing norms assumed for an average hospital of each type in the target year, and the same procedure is used for the ambulatory work locations. Entering data into the staffing norm tables will be easy but coming up with the norms requires some time.

The key question for this and the following (AMBULATORY) table is, of course: How does one develop staffing norms for a target year well in the future? The World Health Organization document on computer diskettes, HUMAN RESOURCES FOR HEALTH: A ToolKit for Planning, Training and Management, has a number of topics devoted to this theme (see Appendix E). The reader is referred to ToolKit topics 5*2, 5*3, 5*4, 5*6, and 5*7, and especially to topic 5*5 (METHODS FOR DETERMINING STAFFING STANDARDS), which outlines various approaches that can be used. One might divide these methods into two broad categories, the pragmatic (or judgmental) method and the microanalytic (or detailed task analysis) method. The former is much the easier and probably should be the only method considered for use in this long range requirements planning model, while the latter can be justified on a selective basis to improve operating efficiency, productivity, and staff training. The pragmatic method is described in some detail below and a brief description of the microanalytic method is given at the end of this section but is not recommended for long range planning. Appendix C has additional comments relevant to setting staffing standards.

The pragmatic method for determining staffing standards acknowledges that there is no truly scientific, precise method for determining optimum staffing standards for a complex institution 30 years in the future. Future administrators and clinical staff will face rather different health, social and economic problems than are now faced, and the art and science of health care will have changed in ways that are not entirely predictable. Accordingly, rather than trying to make `scientific' and exact standards for use years in the future, an impossible task, the pragmatic method asks:

- How should current staffing patterns for each type of work location change over the coming years in order to provide future decision makers with the approximate numbers and mix of health workers that they are likely to need and can pay for?

The starting point for answering this question is the current normative staffing for new facilities of each type. To illustrate the point, let us assume you are developing future
staffing standards for a typical district hospital, which at the present time averages about 100 beds.

1. Obtain the Ministry of Health's normative staffing standards for a new district hospital, or if these are not available, the staffing norms that were used in the most recently constructed district hospital. Note the bed size of this reference hospital, the year in which these standards were developed, and if possible, the way in which these standards were developed. In brief, are these outdated standards; were they the result of detailed studies; have they been applied widely or just for the reference district hospital; and is the reference hospital representative of most district hospitals? Also note whether these norms are or have been actually applied in practice. In other words, staffing norms may exist but due to lack of budget, or perhaps personnel shortages or surpluses, the norms cannot be applied as specified. One alternative to the above is to obtain from the personnel office the staffing rosters for a small but representative sample of district hospitals, and then develop an average staff profile for hospitals of this type.

2. Decide on the desired average size of your target year district hospital. In other words, should it be larger, smaller, or about the same bed size as your reference district hospital, and by how much? Also, would the likely mix of beds (medicine, surgery, pediatrics, obstetrics, etc.) be approximately the same, or significantly different? Such changes might be introduced either to correct a current maldistribution of beds and patients, or to anticipate trends in morbidity patterns, as would be the case with an aging population or declining birth rate. Lastly, are there any changes that should be considered in the balance between inpatient and ambulatory care? For example, in many cases it might be desirable to give greater emphasis to ambulatory care both to prevent hospitalization later on and to shorten the length of stay.

3. Convene a small group of knowledgeable hospital administrators, clinicians and planners for, say, a half day meeting. In advance of the meeting provide them with information on meeting objectives, the reference staffing norms, and the proposed average target year hospital size. To make the process more efficient this meeting might be arranged so that the staffing norms of several different types of work locations can be considered at the same time, perhaps starting with a plenary session to orient all participants, and then divide them into smaller working groups concerned with the several different types of work locations. Several tables (STAFF1, STAFF2, STAFF3, BEDS and OUTPUTS) on the Utility page can help with developing staffing norms.

Continuing with the district hospital example, meeting participants would be asked to recommend revised staffing norms for the target year hospital. They would first have to take into account any significant proposed changes in the average hospital size, eg, if the future district hospital was to be downsized to an average of 80 beds, corresponding adjustments would have to be made in the total staff complement. They would then proceed to review each major occupational category required in a district hospital and
recommend an appropriate average full-time equivalent target year staff complement, taking into account anticipated morbidity patterns, balance between inpatient and ambulatory patient services, quality of care to be provided, staff functions, shift work, weekends, coverage for staff on leave, etc.

Staffing norms should be developed to include all personnel normally covered by the hospital or clinic’s payroll, irrespective of type of activity (inpatient, outpatient, public health, etc.) and actual work location. In other words, staff working in the hospital’s clinics, in administration, in non-clinical public health activities such as environmental health or malaria control should be included in the staffing norms, or in an satellite free-standing clinic, as long as they are regularly included in the hospital's budget.

For reasons already noted, all staffing norms must be expressed in full-time equivalents (FTEs) to avoid double counting of persons who work in several different work locations. This requirement for listing staff in terms of FTEs instead of persons will not be a problem for the great majority of occupational categories but may be troublesome for doctors and perhaps several other higher level categories. For most staff categories and in larger hospitals you will probably enter in staff norms in whole units, eg, 2, 9, 15, but for some specialized categories and/or small hospitals or clinics that use part-time or rotating personnel, you may wish to enter fractional staff (1.2, 0.6), and this is acceptable.

**IMPORTANT NOTE:** The challenge for those who organize and lead a meeting to develop staffing norms will be get the participants to think creatively! All too often when people are asked to consider future staff requirements they simply increase current staff densities by ‘X%’. The base year reference staff norms will likely have been determined in large part by the current availability of personnel and budget, irrespective of requirements, and by the traditional roles and responsibilities of each health worker category. If fully qualified nurses are in short supply, and/or budgets are very tight, there is no point in having staffing norms that call for a large staff of qualified nurses since the positions will either be unfilled or there won’t be enough money to pay them. And, if there is a relative surplus of doctors compared to nurses, it may have evolved that doctors now assume responsibilities that could well be assigned to qualified nurses. For these and other reasons you should make sure your expert panel is encouraged to look well beyond current constraints imposed by budgets, staff surpluses and shortages, and inadequate or inappropriate training. Encourage them to come up with what would make good staffing norms in the target year. If the target year is far enough in the future, say 20-30 years, many of these constraints can be significantly reduced, if there is the political will to reduce them. Your task is to start out by asking what numbers and mix of staff would make good sense; later on you may have to modify your assumptions to take into account political, economic and other realities.

4 The judgmental outputs of these expert panels will now provide you with the normative staffing profiles for the different types of work locations. Later on, should you decide to test the effects of changing the average size of a hospital or clinic type, you can increase or decrease the average staff complement accordingly.

The *microanalytic method* for determining staffing standards is far more time consuming than the pragmatic method just described. This method involves detailed time-and-
motion studies, functional job analysis, and other techniques designed to quantify precisely what must be done to carry out each function, what knowledge and skills are required, how much time is required, and what quantitative and qualitative indicators can be used to monitor each activity. These kinds of studies can be very useful when used selectively to improve staff productivity and the quality of care, and they can provide important guidance to training programs. It would be difficult to justify carrying out these time-consuming and costly studies for the entire range of health sector work locations for purposes of making longer range workforce projections. Moreover, such studies are most useful for looking at present needs and potentials, and not for trying to anticipate the details of staff requirements many years in the future.

Once you have developed the staffing norms, entering the data into the tables is easy. Enter your proposed target year staffing norms in each column in the HOSPSTAFF table. At the bottom of this table is valuable summary information that can help you monitor the impact of your assumptions on staff numbers and distribution. The last row, number of FTE staff per bed, is especially useful. Normally one expects to find increasing numbers of staff per bed as a hospital increases in size and complexity, the only exception being mental and chronic disease or convalescent hospitals, which tend to have substantially lower staff-to-bed ratios. Typical staff-to-bed ratios for acute care hospitals (and their associated clinics) range from about 1.0 staff per bed for smaller hospitals up to 3-4 staff per bed for large tertiary care hospitals. These latter hospitals can have a ratio as high as 6:1 in high income countries, especially when the hospital also serves as a teaching and research center.

CAUTIONARY NOTE! The percentage distribution (% PUBLIC STAFF) will not be meaningful until you have entered data for all types of work locations. As you enter data for the first type of work location you will note that 100% of your workforce is in this location, since there are no other locations to compete with it. The percentages shown here will progressively decrease as you complete data entry for more and more work locations, until finally it represents the true distribution of your workforce.

AMBUSTAFF table. After all the explanations for the previous table, this should be much easier, especially since the staffing of a purely ambulatory work location is likely to be much less complicated than for a hospital. As before, each column should display the average staff complement for a single clinic, center or post; the bottom of the table will display the totals and percentage distribution. As you complete this table be sure to avoid counting free-standing ambulatory facilities twice. This could happen if staff for a given type of clinic are counted both as staff of that type of clinic, and also as staff included in the payroll of a hospital that has administrative jurisdiction over that clinic.

PRIVSTAFF table. With completion of the basic data inputs for the clinical portion of the public sector it is now time to turn to the private sector. Even though your country may have almost no reliable data on the private sector, there are ways of
making reasonable estimates that will help complete your health sector projection model. Go to the PRIVSTAFF table and proceed as follows:

1. Note that the names of the occupational categories have been automatically entered and that the total estimated base year private sector FTEs have been entered in the first column with values. The rest of the table is divided into two major sections, SELF-EMPLOYED FTEs, and SALARIED STAFF FTEs.

- **Self-employed practice.** The left hand section refers to those in self-employed (or independent) private practice, which would include private practice doctors, dentists, midwives, pharmacists, and perhaps a few independent dental technicians, nurses and others. A few doctors and dentists may have salaried nurses or hygienists working for them, and they too would be included in the `self-employed' category.

- **Salaried personnel.** The right hand section refers to salaried personnel working in private sector work locations. Typical examples include the staffs of hospitals operated by industries, private investors, and by religious, non-profit community, or labor union organizations. They could also include large group practice polyclinics that operate with largely salaried staff. Most salaried personnel, with the exception perhaps of doctors and dentists, are employed full-time.

2. Enter the estimated number of base year FTE self-employed personnel in each category. The computer subtracts these numbers from your earlier estimate of the total number of private sector FTEs (obtained from the SUPPLY table) and enters the difference as the estimated number of base year salaried FTE personnel. Most countries lack good information about the number of FTE self-employed health workers but reasonable estimates are not hard to make. For example, based on informed opinion about the way public and private sector doctors work, a country might proceed as follows: a base year supply of 1200 total doctors; about 350 FTE doctors working in the private sector, leaving a balance of 850 FTE doctors in the public sector; about 200 FTE private sector doctors in independent practice, leaving a residual of 150 FTE doctors in salaried practice. For most countries these estimates can be made with a margin of error of no more than 10-20%, which for this type of long-range planning model is satisfactory.

3. With your base year estimates made, how fast and in what direction will the numbers of private sector personnel change in the future? You should start with the column for salaried personnel. Recall the annual rate of growth you assumed for private hospitals in the PRIVHOSP table. If, for example, you assumed that private hospital beds would increase at about 3.2% annually, then a reasonable starting assumption is that salaried personnel should increase at least this fast. To this starting assumption of 3.2% you could then add an average increment of about, say, 0.2% to provide for a gradual improvement in staffing norms, with somewhat more for some categories of personnel now in short supply, and somewhat less for others that may be...
in excess or are destined to be phased out. In other words, you might assume an
average increase in salaried personnel of about 3.4%, with perhaps a 3.8% increase in
nurses, a 2.9% in auxiliaries, a 3.6% in technicians, and so on. By linking staff change
rates to that assumed for private hospital beds you are making the underlying (and
reasonable) assumption that staff employed by private sector clinics will change roughly
in parallel with changes in the private hospital bed supply.

**SUPPLEMENTARY NOTE!** You may be wondering at this time whether you made an acceptable estimate in
the SUPPLY table of the number of private sector technical and auxiliary level personnel. If you have doubts,
an easy way of improving your estimates is to do the following: (1) assume virtually all private sector technical
and auxiliary personnel are salaried and work in hospitals and clinics; (2) review the base year number of
private hospital beds; (3) compare the assumed target year staff-to-bed ratios for different categories of
technical and auxiliary staff in small public sector hospitals with those estimated for base year private sector
hospitals; (4) if the ratios are too dissimilar, adjust them so that the private sector ratios are consistent with
what is known about private sector staffing. In essence, hospital (and associated clinic) staffing norms in the
public and private sectors will differ, but for most occupational categories these differences will not be great. If
you have no idea how many technical and auxiliary staff are working in the private sector, apply similar bed-to-
staff ratios to the private sector as were found in similar sized hospitals in the public sector, adjusted to take
into account informed opinion.

4 Now for the last set of assumptions -- the projected annual change in self-employed
personnel. No one knows or can know with precision what this value will be but the
range of reasonable estimates is quite narrow and will apply almost entirely to just
doctors, dentists, pharmacists and perhaps trained midwives. As before, the starting
point is the observed average annual change, based on data or informed estimate, over
the past 5-10 years. Let us assume, for example, that the number of FTE self-
employed dentists increased 42% from about 74 to 105 in 10 years, for an average rate
of just under 4.1%/year. With this value as a starting point, is the rate of increase likely
to be the same, more, or less? Some variables may favor a faster rate while others a
slower one. Major variables include: rate of per capita income growth; rate of
population, and especially, urban population growth; anticipated government policies
that might affect the demand for dental services (eg, changes in the supply of dentists,
in provision of dental services, introduction of fluoridation in major cities, etc.); trends in
the migration and retention of dentists; and current evidence of either over- or under
supply of dentists. Equally well informed observers may come up with estimates that
vary by as much as 1% per year. Nevertheless, over a long period of time it is unlikely,
in the absence of major policies affecting self-employed private practice, that the rate of
change will be less than the rate of urban population growth, or more than 1-2% above
the rate of urban growth. Within this narrow range of reasonable values, a useful
planning estimate can be developed.

You have now completed the PRIVSTAFF table. Before going to the next table review
the summary statistics at the bottom. Do the totals seem reasonable? Have the
proportions of private sector staff working in self-employed and in salaried positions
changed much between the base and target years, and if so, are there justifiable reasons for this shift? If you are uncomfortable with any of these summary results you can adjust your planning assumptions accordingly. And to make you feel a bit easier about making all these assumptions, remember the following: The model is not expecting that you plan for or predict the evolution of the private sector. Rather, it gives you a chance to include, in your target year health workforce, a ‘reasonable’ allocation of personnel to accommodate the likely needs of the private sector so that the public sector will not have serious competition for personnel.

**PUBHEALTH table**. You will use this table to make estimates of the base year supply and target year requirements for public health workers not based at a clinical or academic work location. Examples of such personnel include those working in the Ministry of Health, in provincial or district health departments, at a National Institute of Health or other research institute, the national public health laboratory, and perhaps personnel working in national programs concerned with environmental sanitation, malaria or communicable diseases, and family planning, as long as these personnel are not on the payroll of a hospital, clinic, or other clinical work location. The dividing line between clinical and public health personnel is often blurred and indeed many public health workers provide direct services to individuals. The object here is not to attempt a precise separation between the two classifications, clinical and public health, but rather to avoid either double-counting or omitting significant numbers of personnel. Go to the PUBHEALTH table and proceed as follows:

1. Enter in the first shaded column [FTEs in (the base year)] the estimated base year number of FTE public health workers in each category. As suggested above, probably the best basis for deciding who should be included here is the payroll; if personnel are on the payroll of the central Ministry of Health or of other predominantly public health programs, include them in this table. In many countries public sector hospitals and clinics are all Ministry of Health owned and operated, and hence all their personnel are on the Ministry's payroll. In this situation count only those who are not based in hospitals or clinics. The numbers of such personnel will usually not be large, perhaps 3-7% of the total workforce, and they will include proportionately more medical, technical, and administrative personnel, and less auxiliaries, nurses, and midwives than will clinical work locations. Moreover, if you have an ‘All other’ personnel category, your estimates of clerical personnel, drivers, mechanics, warehouse and maintenance staff, and other support personnel can be very approximate since their numbers are not needed for your training program projections and they will weigh relatively little in the economic feasibility test.

2. In the next column (ASSUMED CHANGE/YEAR) you are asked to enter your assumed percentage change per year in the public health workforce --- but how can you make these estimates? Few countries have staffing norms for their larger, more complex public health institutions and programs. Unlike hospitals and clinics, institutions such as ministries of health, tropical disease research institutes, and malaria
programs usually do not have a standardized staffing pattern, either as regards the mix of occupational categories or as regards total staff complement. Your target year staffing norms will therefore have to be based on the current staffing pattern, modified to take into account such considerations as the following:

- Projected rates of the total population growth, the urban population growth, and the per capita income growth. Unless the Ministry of Health is considered very overstaffed, the overall growth in the public health workforce should probably exceed the total population growth rate and at least keep up with the urban population growth rate. If the projected rate of per capita income growth is favorable an additional increment may be possible.

- Current adequacy of the mix and total staff numbers of the public health workforce, and projected effects of anticipated changes in morbidity, and in public sector priorities, policies and programs. Is the current pattern of staff generally adequate for the existing situation, and if not, what changes would be desirable? What further changes should be made to take into account likely or desired future developments?

Taking factors such as these into consideration you can propose different rates for the various workforce categories in order to achieve a better balance in the workforce in the target year.

After entering your assumptions you can check the totals and percentages at the bottom of the table to see if they make sense. The bottom row [% OF TOTAL (target year) WORKFORCE] value will not be useful until all the other core tables have been completed. In most countries it will probably be desirable to have a moderate increase in the proportion of the workforce active in non-clinical public health activities. Later on, when you start making final adjustments to your model, you can use the `adjustment factor' (ADJUSTMENT FACTOR) to quickly test the effects of increasing or decreasing by a constant amount all of your ASSUMED CHANGE/YEAR values, but for now leave the default value of 1.00 unchanged. Now, on to the last required data entry table in the core module, for academic personnel.

**ACADemic table**. This table provides bases for estimating the numbers of FTE health workers required for teaching and research. The table involves two simplifications. First, it considers only training program personnel of the same health-related occupational category (or discipline) as the students under instruction, i.e., doctors who teach medical students, doctors who administer medical schools, and doctors who are primarily engaged in research while in a medical school. Many training programs use instructors of disciplines other than that of the students being trained, e.g., biologists and chemists teaching medical students, doctors teaching technicians, etc., but to capture this diversity would make the model far more complex without adding any value. Second, teaching, administrative and academic-based research personnel are combined since it would be difficult to separate out academic personnel according to
function, especially since many instructors in the higher level careers also do research and/or administration. From this point on in the documentation the word "instructors" refers to all those who carry out one or more of the three functions of teaching, academic administration and research in an academic setting. Proceed as follows:

1. Enter in the (base year) ENROLMENT column the total number of students enrolled in the base year in all training programs in each occupational category. By way of illustration if you have assigned the first row to doctors, enter the total number of medical students in all medical schools and all classes of study that were studying medicine in the base year, say 1000, including those who are repeating a year of studies.

**IMPORTANT NOTE!** You will probably find it advantageous to not make estimates for auxiliary, assistant, administrative and support personnel. Enrolments for these categories can change quickly and are highly variable, and in the lower levels of personnel, the number of instructors of the same discipline will be few or none. In other words, it is not useful to estimate the number of auxiliary nurse instructors required for an auxiliary nurse training program. Accordingly, complete this table only for the higher level personnel categories where you want to be sure to take into account your staff requirements and leave the rest of the categories with zero (‘0’) values.

2. Enter in the next column labeled (base year) FTE STAFF the estimated total number of FTE instructors, researchers and academic administrators of the same discipline as each of the occupational categories. Continuing with the doctor example, let's assume you have estimated that there are 70 FTE doctors working in medical schools for a total student enrolment of 1000. The computer will display the STUDENTS/FTE ratio in the next column, which in the above case is 14.3 (= 1000/70 = 14.2857..., which is rounded off by the computer to 14.3).

3. Enter in the next column your projected percentage ENROLMENT CHANGE/YEAR for each occupational category. Your starting point is the average population growth rate over the duration of the projection. Let us assume that your country is projected to increase its population at 3% per year in the first decade and 2.5% and 2.0% in the following two decades. Your average growth rate would therefore be about 2.5%. You must next decide how fast you want the supply of each occupational category to grow in relation to the population. In most low income countries the supply should probably increase somewhat faster than the population in order to provide higher population-to-health worker ratios as per capita income improves. You will almost certainly want to increase the supply of some categories faster than others in order to improve the mix of personnel. Also, there may even be some categories that are in surplus and hence should increase more slowly than the population growth. Let us assume that you decide the medical student enrolment should increase at about 3.5%, faster than your average population growth rate; this value (3.5) would now be entered in our example.
4 Enter in the next column your assumed ratio of (target year) STUDENTS per FTE instructor (of the same discipline). In our doctor example, the base year estimate was about 14.3 medical students per FTE medical school instructor. As a first approximation you might try a ratio of 10, a substantial improvement in the student-to-instructor ratio. Continue in the same way to complete the rest of the column. The computer will calculate the required number of FTE instructors in the target year and enter the values in the second column from the right. The overall percentage increase in the number of FTEs between the base and target years is shown in the last column.

The target year requirements will be taken into account by the computer to calculate overall base and target year health sector requirements. Later on, when you revise your projected requirements, you will probably want to return to this table and revise your assumptions for the projected annual percentage increase in enrolments. You may also find the more precise estimates of required academic personnel that can be generated from by supply model useful for entering in this table.

CONGRATULATIONS!!!! If you have completed all of the required tables up to this point, you are now almost finished entering data in your core projection module. The computer will generate the remaining three summary tables. After reviewing your projections you can then refine your estimates and, if desired, complete one or more of the optional modules.

REQuirements table. At last, this is what you have been waiting for! Go to the REQuirements table and review its contents and layout. Here you have the required numbers and distribution of health workers according to category and type of work location. Now the real fun and model outputs begin. Your first projection is almost certain to produce strange findings such as too many health workers in some categories, too few in others, and perhaps an inappropriate distribution of health workers according to the five major types of work location. But, let's leave this table for now and continue our review of several additional tables. After looking at these summary results you will have a better idea of the possible problems with your scenario and how to deal with them. You can then return to the data input tables and make any changes needed to improve the reasonableness of your scenario.

COMPARE table. This table compares the supply and requirements projections. If you have already made supply projections for at least some of the occupational categories, enter them now. As noted Part II you may need to interpolate the supply projections to make sure that the values you enter in this table are for the same year as are the requirements projections. You can only enter data in the PROJECTED SUPPLY TO column, and the next to last column shows the percentage distribution of the projected supply. The PROJECTED REQUIREMENTS values are obtained from the REQuirements table. Several observations:

- Both the supply and requirements models can project up to 15 occupational
categories but if you have already worked with the supply model you will recall that it
was recommended that projections be made only for the larger occupational
categories that require health-related training. Accordingly, you may not have
supply projections for all of the categories for which you have requirements
projections. No problem! You need to project total workforce requirements in order
to test economic feasibility but you only need supply projections for higher level
occupational categories, with perhaps one exception.

* That exception is auxiliary nursing personnel. This category is usually very large
and hence costly, program training capacity may be limited, loss rates may be high
and hence many more need to be trained than will be employed, and there may be
limits on the numbers that can be recruited to work as auxiliaries. These reasons
may also justify the inclusion of several other of the larger auxiliary or support
categories.

For the above reasons make supply projections only for higher level personnel and
selected lower level personnel, and leave the other categories with a `0' in the projected
supply column! As a result your COMPARE table will show you which categories are in
surplus or shortage, at least according to your first set of assumptions; later on you can
adjust your supply and requirements models to bring them into approximate balance.

**SUMREQ table.** This is the last of the core set of required tables and is entirely
generated by the computer. As with four additional summary tables it consists of side-
by-side comparisons of base and target year values that will help you evaluate your
planning assumptions and decide what alternatives you would like to consider. The
numerical values in this table can be viewed graphically by displaying the graph
HWNUMBER (health worker numbers). Two additional graphs, HWLEVELS (changes
in the distribution of the workforce according to high, intermediate, and support level),
and HWINDICES (indices of change in the health workforce), are especially interesting
but will not be complete unless and until you complete some of the optional modules.
Now let's return to the SUMREQ table and see whether the observed changes are
generally consistent with national priorities and trends.

Note the third INDEX column, which indicates how each target year value compares
with the base year. These index values are calculated by dividing each target year
value by the corresponding base year value and multiplying the result by 100. Thus, if
the base year value was 48 and the target year value was 58, then $58/48 = 1.2$, which is
then multiplied by 100 to obtain the value 120. An index value of 120 means that the
target year value is 20% greater than the base year value. In some cases an index
value above 100 indicates progress whereas in others a value below 100 may indicate
progress, as when the population per health worker declines between the base and
target years. By comparing changes in the index values, one can quickly see whether
the changes occurring in related indicators are in harmony or not, eg, whether health
care workers are increasing faster, slower or at about the same rate as the population.
Now let's take a look around the SUMREQ table. Have paper and pencil at hand since you will want to note problems and questions that need to be attended to in your revision. Alternatively, you can print the SUMREQ table as described in Part I, and make notes beside the values that need further investigation or changes. Let's review the sections in sequence.

1 POPULATION. Do the projected changes in the population growth and urban-rural distribution seem reasonable? If not, re-examine the DEMOgraphic table.

2 POPULATION PER... Has the population per health care worker (HCW) gone down? If not, you may already have a very satisfactory workforce-to-population ratio or your input assumptions regarding staffing densities and work locations may have been too cautious. Are there improvements in the mix of personnel? If not, note any problems and keep these in mind when you review the staffing norms used in the target year staffing tables.

3 PERCENTAGE OF ALL HEALTH WORKERS IN... Do you like the projected changes in the distribution of health care workers according to work location and sector? For many countries desirable changes may be in the direction of a higher proportion of personnel in public health and a stable or perhaps slightly declining proportion in the private sector, though other countries may wish the opposite. Note any problems that arise.

4 % OF ALL PUBLIC SECTOR HEALTH WORKERS IN... Do you like the distributions of all public sector health workers employed in clinical and non-clinical work locations? The tendency in many countries is towards increased numbers in hospital locations while stated policies tend to favor more ambulatory and public health activities. If you don't like the trends, note them down.

5 CLINICAL WORK LOCATIONS. Are there desirable changes in the number of beds per 1000 population, in the numbers of hospitals and clinics, and in the average beds per public hospital?

If this is your first projection you will almost certainly find some problems due to faulty data, incomplete tables, or perhaps inappropriate planning assumptions. You have two choices, either start revising your projections now or proceed first to the optional modules. If you do not plan to do any of the optional modules (ECONOMIC FEASIBILITY, MEDICAL AND NURSING SPECIALISTS, PRODUCTION OF SERVICES, DISTRIBUTION OF SERVICES, INTERMEDIATE YEAR PROJECTION), turn now to Part IV and start revising your model. However, if you wish to complete any of the optional modules, follow the instructions in the following sections. The economic feasibility module, in particular, will be of great help when it comes time to refine your projections. For this reason you will find it advantageous to complete at least that module before going back over your core module.
You will also find a SUMMARY table in the core module. This table will be the most informative of all your tables but will not be complete until you complete the optional modules. Take a quick look at it now but it is probably not worth much attention at this point.

SUMMARY table. This table will likely be the most valuable one of all, one that you will want to include in all your presentations and reports. It compares the base and target years for all the major components of the model. Take a quick look at the table to get an idea of what you can expect once your model is complete. Later on, once you have completed the rest of the model, come back to this table and enjoy the wealth of comparative data.

Testing economic feasibility (Econ page)

This optional but very useful module, consisting of three tables, makes it possible to test the economic feasibility of your requirements projection. Feasibility is determined by comparing target year costs of public sector personnel with target year funds available to pay for personnel. In earlier versions of the requirements model `available funds' were projected based on assumed changes in four variables, the gross domestic product, recurrent public sector expenditures, recurrent public health expenditures, and the proportion of public health expenditures allocated to personnel. Though this method worked, the lack of good financial data made it difficult to use so a much simpler method has been developed for Version 3.0, described below.

INCOMES table. To project personnel costs one must multiply the number of public sector health workers of each type by the average income of each type of worker. The INCOMES table provides the basis for projecting average target year incomes. Proceed as follows:

1 In the AVG FTE ANNUAL INCOME column enter your estimates of the average annual base year income that would be earned by a full-time equivalent health worker in each of the listed occupational categories. Incomes may either be gross, including the costs to government of benefits such as health care, pensions, housing and educational allowances, bonuses, etc., or net, which is the amount actually received by each employee. Whichever income estimate you use, gross or net, you should be sure to use the same type for all occupational categories. The economic feasibility test does not consider the cost of private sector personnel, though as will be evident later on, estimates can readily be made for those in independent private practice. So, how can one estimate the `average annual income' of a specified category of health worker?

Let us assume we are considering the occupational category, `nurses', and that this category includes fully qualified professional nurses at all levels. Further, assume that
the payroll department informs us that typical base year starting and end-of-career
salaries for a FTE public sector nurse are 3000 and 6000 monetary units (abbreviated
MUs), respectively. We must now go from these starting and ending salary estimates to
one for the current average for the entire public sector nursing workforce, including
nurses at all levels of seniority. There are two ways to estimate this average, one easy
(and adequate) method and one that is quite a bit more difficult.

**Easy method.** This is based on general knowledge about the salary gradient
over time, ie, the rate at which salaries rise over time, and about the average age or
seniority of the nursing workforce. For example, if gross nursing salaries in the Ministry
of Health start at 3000 MUs, rise about 50% in the first 10 years of service and another
50% over the next 30 years, and if the average nurse seniority is about 7 years, then a
reasonable estimate would be an average annual salary of about 4100 MUs (ie, 3000 +
70% of a 1500 MU increase). This estimate could be either increased or decreased
slightly to take into account higher or lower salaries in other public sector institutions
that hire nurses, and will be adequate for purposes of planning.

**More precise method.** This option is based on personnel or financial office
estimates of the gross amount paid to nurses divided by the number of FTE nurses.
Data can be obtained either for the entire public sector, a major portion of it, or even for
just one large and reasonably typical employer, such as a hospital. Though this method
is not complicated, getting the proper information for both the numerator money value
and denominator FTE nurses value could be time-consuming and, if it is done for up to
15 different categories, could be a major task. Since precise income estimates are not
needed for reasons mentioned later on, the easy method should be preferred.

2 Now review the RELATIVE INCOME column calculated by the computer. This
shows the amount paid to each occupational category *relative to* the amount paid to the
lowest income category. The lowest category is shown as 1.0 and all the rest have
higher numbers. You may either leave this income gradient unchanged for purposes of
your projections, or may experiment with the economic implications of a changed
gradient, as will be explained later on. In reviewing this gradient two dimensions should
be considered:

**Is the maximum spread acceptable?** If the highest paid category receives no
more than 3-5 times what the lowest paid category receives your gradient probably has
an acceptable spread. If it is much below 3:1 there may not be enough incentive for
higher level health personnel to work for the public sector and retention may be a
problem; and if it is much above 5:1 you may have too much inequity in the salary
structure, with adverse consequences both for your budget and the ability to attract and
retain qualified support personnel.

**Is the differential between selected categories acceptable?** Even in
situations when the maximum income spread is acceptable there may be serious
inequities. For example, you may find several categories with similar levels of education and responsibility, eg, nurses, midwives and technicians, with quite dissimilar salary levels. In this situation you may wish to test the economic impact of a policy designed to gradually increase salary equity.

**CAUTIONARY NOTE!** As you review the salary gradient remember that it is based on average salaries, and not starting salaries. Thus the salary differential between, say, nurses and midwives, may seem unsatisfactory but in reality the differential is because one group has, on average, considerably more seniority than the other, and hence higher salaries.

3 The column labeled ANNUAL % REAL INCOME CHANGE takes into account a major but often overlooked variable in testing the economic feasibility of a projection, that is, the fact that real salaries tend to increase over time. A simple illustration will make the point. Imagine two countries with 30-year workforce projections, each with 1000 doctors in the base year, each paying their doctors an average of 10,000 monetary units per year, each spending 10% of their health budget on doctors, and each increasing both real health sector expenditures and the supply of doctors at 4% per year. Country A assumes that average doctor incomes remain fixed over the 30-year period at 10,000 MUs, and Country B assumes average real incomes increase 1% annually. By the end of 30 years Country A will spend 10% of its health budget on doctors while Country B will spend about 13.5% on them. Country B's estimate will likely be much more realistic! As countries increase their real national income, part of the additional funds must go to increasing health sector capacity to accommodate the growing population, and part will go to improving real salaries. There are two options for this column:

**Easy option.** Enter 1.0 for all occupational categories and make adjustments later when you start the economic feasibility test. This value means you are arbitrarily assuming that real (uninflated) incomes will increase at 1.0% per year for all occupational categories. For a 30-year projection this will result in a 35% increase over the period.

**More realistic option.** Enter your best assumption of the future rate of growth of the real annual incomes for an average public sector health worker in each occupational category, that is, by what percent do you think the real gross income for the average doctors, nurse, technician, etc., will increase over the projection period? Although the computer can accept growth rates with several decimal places we suggest you use only one decimal place, eg, a 1.2% growth is entered as 1.2. Real, ie, uninflated, estimates are used since long-term inflation rates are impossible to predict and in any event, the safest assumption is that government and unions will seek to adjust salaries to retain, approximately, their past buying power.

Several bases for estimating the rate of salary growth may be used.
Projection of past rate. If, for example, real public sector salaries have increased at an average rate of about 1.1% per year over an extended period of time, this same average rate could be projected into the future.

Projection of per capita GDP growth rate. Alternatively, one might use the average change in the projected per capita gross domestic product (GDP) or some other economic indicator as a basis for projecting changes. For example, assume that a country projects a 4.5% GDP growth rate, a 3% population growth rate and a 1.5% per capita GDP growth rate. In this case one could assume that at least 1% of that 1.5% annual improvement in the per capita GDP goes to improve the real salaries of the workforce.

If you consider the income gradient shown in the second column satisfactory, enter the same growth rate values for all the occupational categories in the third column. However, if you find the gradient needs some improvement, enter slightly higher or lower growth rates for those categories you wish to boost or depress relative to other categories. For example, if you have assumed that the historical rate of growth was 1.1%, and that doctors are earning too much relative to nurses, you might make a first entry of 1.0% for doctors and 1.2% for nurses; these values will tend to reduce the income differential between the two categories over time.

CAUTIONARY NOTE! Testing the effects of differential income growth rates is interesting, informative, and relevant, but it may be hazardous to your health! First, in many countries salary levels for the entire public sector are set by a central administrative agency and not by the Ministry of Health. Thus even though inequities exist, it may be difficult to reduce them due to the necessity of addressing inequities throughout the public sector. Second, and even if the public health sector has some control over salaries, the issue is bound to be of great interest and potential controversy for the health workforce. Favored occupational categories will be pleased, others will be unhappy, and the politically easiest solution is always to just leave things unchanged. However, inappropriate salary gradients are often a reality and they should not be maintained forever, so if your country has a problem, take it into account and see if ways can be found to gradually improve the situation over time. The projection model will help explore alternative options in this regard.

4 The computer completes the rest of the table, showing the average annual target year income based on the growth rate assumed and the target year income gradient. The last two columns and the 'adjustment factor' at the upper left corner of the table will be explained in more detail later on when the economic feasibility test is made. However, in summary, by means of the adjustment factor you can quickly change the ANNUAL % REAL INCOME CHANGE column by entering just one number, rather than having to change each number individually. In this way if you found an initial assumption of, say, a 1.1% average annual salary increase resulted in a too costly target year health workforce, you could enter 0.95 as the adjustment factor and all the projections would be multiplied by 0.95. You could then try 0.9, or 0.93, or whatever, to
achieve the level of change compatible with your economic projections. This adjustment factor will make it easier to revise your projection model.

The last column shows the resultant percentage increase in target year incomes over base year incomes. A 1% annual increase will increase incomes by 35% over a 30-year period.

One final observation regarding the INCOMES table. If you had difficulties estimating average real base year incomes, you can use 'hypothetical' incomes. By this method you would arbitrarily assume that the lowest paid occupational category earns, say, 1000 monetary units per year, and then assign higher incomes for the other categories that are in proper relation to the lowest income. By way of an example, assume that auxiliary nurses are your lowest paid category. Assign them an annual income of 1000. If nurses average about 80% more than auxiliaries, assign them 1800, and if doctors earn four times as much, assign them 4000, and so on. As long as the relative incomes for the several occupations are approximately correct, you may use any 'lowest' value you want, 100, 1000, 10,000, or whatever.

COSTS table. Go to the COSTS table and review its content. The upper section of this table is entirely computer-generated and you cannot change any of the numbers. The base year estimates and target year projections of public sector expenditures will be used to test the economic feasibility of your projection. The target year cost projections have no value for budgeting purposes since they likely cover too long a time period, they do not take into account inflation and other unpredictable variables, and they may even be expressed in hypothetical monetary units and not the currency of your country. The cost estimates can be used, however, to provide a rough indication of the relative amounts spent on the different occupational categories, and to test the relative amount likely to be spent on health personnel in the target year as compared with the base year.

The lower optional section of this table can be used to estimate the income of private sector health workers in independent, fee-for-service practice. Enter in the first shaded column the average base year fee charged per visit or consultation with each of the listed practitioners, and in the second shaded column, the assumed average annual percentage change in real (uninflated) fees. The average base year fee can be estimated by persons knowledgeable about private practice. It will be easy to estimate the approximate upper and lower limits of private medical and dental fees, but the final estimate will need to approximate a "weighted" average fee, considering such factors as the approximate ratio of generalist to specialist practitioners, of urban to rural practitioners, etc. Over a long period the average annual change in private fees will probably be in the 0.5-2% range, depending on the anticipated rate of increase in per capita incomes, and especially, of the incomes of urban residents. The computer will complete the rest of this table only after you enter appropriate data in the Services module.
The small table at the lower right of the COSTS table can provide an informative comparison of FTE public and private sector annual incomes, assuming you have used estimates of actual public sector incomes and not hypothetical estimates. The computer divides the average annual FTE private sector income by the FTE public sector income. If the resulting number is greater than 1.0, the usual case, it means that a doctor working full-time in the private sector earns more than a FTE doctor in the public sector. A ratio of perhaps 3-5:1 is to be expected but in some cases the ratio may be far higher. If the two estimates are reasonably accurate, within about 20-25% of the probable true values, and if the private practice income is more than, say, 8-10 times public sector incomes, the public sector may have difficulty recruiting and retaining professionals to work for government. And even if they are able to recruit them, it may be difficult to keep them working for the contracted hours rather than arriving late and leaving early to attend to private patients. One must be cautious, however, in interpreting the significance of public-private sector income differentials. First, public sector incomes may be underestimated to the extent that the costs of pension, vacation, sickness and other benefits are not taken into account. Second, private sector income estimates are subject to overestimation since they don’t take into account the overhead costs (rent, staff, supplies, etc.) of operating a private office, and to underestimation since they don’t take into account fees earned from the care of private hospitalized patients and may not take into account the underpayment of income taxes, which are easier to avoid in the private than in the public sector.

**ECONTEST table.** This table provides the model with the bases for projecting the potential target year funds available to pay for public sector health personnel. The upper section provides the actual test and is very simple to use. The lower, optional section has no effect on the feasibility test but can be helpful in deciding what would be a realistic growth rate for public sector expenditures on health personnel.

**Feasibility Test of Projected Public Sector Workforce Requirements** (upper section). The calculated base and target year expenditures on the health personnel included in your projection scenario are obtained from the COSTS table. The only other estimate you need to provide is that of the assumed average annual percentage change in funds available to pay personnel. While subject to many different and unpredictable variables, over a 20- to 30-year projection period this value will probably be in the 2-5% range for most countries. The primary determinant of growth will be the real (uninflated) growth rate in the gross domestic product. Additional factors that will affect it include: tendencies to increase or decrease the relative amount of the GDP spent on the public sector, on the public health sector, on that portion of the public health sector allocated to recurrent personnel costs, and for some countries, the availability of international assistance for recurrent expenditures. As with other estimates, the best starting point for developing this estimate is the historical rate of growth for public sector health personnel expenditures. This rate would then be modified to take into account whatever
changes are anticipated in economic growth, public sector growth, and public health sector growth.

The way the feasibility test works can be demonstrated with a simple example. Assume your country has projected requirements for only doctors and nurses, and that based on the numbers working in the public sector and your income assumptions, their combined costs are 10 million in the base year and 40 million in the target year, or four times as much. This increase is due in part to a large increase in the supply, to a relatively greater increase in higher cost doctors than in lower cost nurses, and to an assumed 1% annual increase in real personnel incomes. You then assume that average expenditures on personnel will increase by 3% per year. Since the computer assumes that the public sector could pay for public health personnel in the base year, the base year “costs” as calculated using estimates given in the INCOMES table are assumed to be the same as base year “expenditures”. If the base year expenditure of 10 million is increased at an annual rate of 3%, it will equal 24.3 million in 30 years, much less than the projected 40 million cost and the projection can be considered not feasible. To make the projection feasible, annual expenditures would have to increase at an average of approximately 4.7% annually to cover the 40 million cost. If confronted with the initial result, costs of 40 million and expenditures of 24 million, planners would need to re-consider their growth assumptions regarding personnel, incomes, and expenditures, and adjust one or more of these accordingly. A later section considers these questions in more detail.

One important caution. As noted, the feasibility test assumes that personnel included in this scenario represents all base year public health sector expenditures on personnel for your country, province, or health system. If your SUPPLY table includes most health workers, and especially most high cost health workers, then the feasibility test will present no problems. However, if you projected only several occupational categories and omitted many others, your feasibility test projection could be in error to the extent that the omitted categories increase faster or slower than those that you have included. In the former case you would overestimate of feasibility and in the latter, underestimate it.

Once you have entered your estimated growth rate for personnel expenditures the computer will calculate target year personnel costs as a percentage of projected target year funds available to spend on personnel. A result near 100% is best, and indicates that projected costs and funds are almost the same. Given the many uncertainties of long-range projections, a result ranging from 80-120% should probably be considered as ‘feasible’. If the result is much more than 120% you should look for ways to reduce costs or increase available funds, and much below 80%, you could probably afford more public sector personnel and/or a faster income growth, or accept a lower growth rate for funds.
Public Health Sector and the Economy (lower section). This rather complex but optional section can help greatly to estimate what is a reasonable growth rate for personnel expenditures. If you choose to complete this section, be careful to observe the following cautions:

- **Currency to use.** All monetary values should be expressed in your national currency and rounded off to the nearest 100,000 (plus one decimal, if required), eg, 12,345,678 would be entered as 12.3. Since the columns can accept up to 11 characters, the maximum value that can be shown is 999,999,999, which means you can have a GDP of up to 999,999,999,000,000 (999 trillion).

- **Constant, not current money.** All monetary estimates should be made in terms of constant (ie, base year) money, with no adjustments made for inflation. Inflation rates are hard to predict over the short term and impossible to predict over the long term. The safest assumption is that government will try, at least over the long term, to increase public sector incomes and expenditures sufficiently to keep pace with inflation.

- **Growth rate projections.** Projected gross domestic product (GDP) and expenditure growth rates should be entered to one decimal, eg, 4.7% is entered as 4.7. No government can predict with accuracy the annual growth rate of the economy or of public expenditures but for the longer-term projections used in this model, precise estimates are not necessary. The essential requirement is that your assumed rates are reasonable and preferably somewhat on the low side; you should not try to accurately predict the future, which is impossible. The starting point for such estimates is past performance, preferably over the past 5-10 years, adjusted for any new developments that appear reasonably assured. For example, if the real (uninflated) GDP increased, on average, about 3.6% per year over the past decade, this would be your starting value. Next, if there is any reason to think that over the longer run, ie, 10-30 years, the GDP will increase more rapidly, or more slowly, than in the recent past, then this adjusted value should be used. Since you should update your projections every 2-4 years, you will have regular opportunities to take into account new developments. Moreover, once the first trial projection has been completed and the economic feasibility test results examined, subsequent repetitions of the model can test its sensitivity to the different economic and expenditure assumptions that were used.

Now for your planning assumptions; proceed as follows.

1. Enter the base year gross domestic product (GDP), or gross national product (GNP) if the GDP is not available. If you are planning for a subnational administrative unit you will need to enter the gross regional, provincial, or state product, as may be appropriate. Alternatively, if you are planning for a self-contained health system such as a government sponsored health and social insurance plan, you should use the gross
annual revenues of the plan as your GDP, and then proceed to complete the rest of the
cells as if the plan were the overall `economy'.

2 Enter the projected average annual real percentage increase in the GDP over the
planning period in the next cell, and don't be too optimistic! Some years will be better
than this average, some years will be worse, and perhaps a few years will be a lot
worse. We are seeking a realistic, sustainable and preferably a somewhat conservative
assumed value. The projected target year GDP and the base and target year per capita
GDP will be calculated by the computer and shown below in the ESTIMATES AND
PROJECTIONS section of this table.

3 Enter the estimated base year total public sector expenditures (rounded to
000,000.0) in the next cell. Note that you are asked for the total public sector, ie,
education, health, transportation, public safety, national defense, administration, etc.,
and not just health.

4 Enter an estimate of base year total public sector expenditures on health personnel.
For these estimates you need to develop a consistent definition of the boundaries of the
`public health sector`. In some countries this may be just the Ministry of Health and the
military health services, while in others it may include social insurance systems,
segments of the Ministry of Education (for expenditures on training), and so on. Your
estimates do not need to be precise as long as they capture the great majority of public
sector expenditures on health-related activities. If the Ministry of Health pays for all or
part of health personnel training, these Ministry of Health training expenditures should
be included in your estimates. If actual base year expenditures are not available you
can use budgeted expenditures, though with an approximate correction. If, for example,
actual expenditures have tended in past years to be 10% higher than budgeted
expenditures, then multiply the budgeted values by 1.1 to approximate actual
expenditures.

5 Enter an estimate of total base year recurrent public sector expenditures on health-
related non-personnel goods and services. This estimate should include the costs of
drugs, equipment, supplies, vehicles, food, routine maintenance, and all contracted
services, and exclude major capital investment expenditures. In summary, this and the
previous estimate should approximate the recurrent amount spent in the base year by
the public sector on health care, excluding major capital expenditures on construction
and remodeling.

At this point you may wonder why we have excluded capital expenditures? These were
included in Version 1.0 of the model were found to be more confusing than useful.
Major capital expenditures present two problems:

• They fluctuate widely from year to year depending on government priorities and the
  availability of funding.
They usually involve borrowed funds, often from foreign sources, and hence the payback period may last decades and vary widely depending on international interest rates.

As a result it is often difficult to determine how much is actually being spent in any one year on capital expenditures, and even more difficult to set an average rate of expenditure over an extended period of time. And even if these measurement problems did not exist, the inclusion of capital expenditures would add little or nothing to the value of the economic feasibility test. Recurrent expenditures are relatively stable and predictable, capital expenditures are not, and in any event, all health personnel expenditures must come out of the recurrent, and not capital, account.

6 Note now the values calculated by the computer for the base year that are shown in the left-hand column in the ESTIMATES AND PROJECTIONS section. The first three percentages will be of great help to you and the remaining five numbers make it possible for the computer to project potentially available funds to support health personnel. Enter in the top shaded cell in this section your target year assumption as to size of the TOTAL RECURRENT PUBLIC SECTOR AS % OF GDP. Most developing countries will be in the 15-30% range, and as their national income increases, the percentage spent by the public sector tends to rise. Thus if your country now spends about 15% of the GDP in the public sector, a reasonable assumption might be that this would rise to 18-20% in 30 years. Later, you can experiment with this assumption to see how it impacts the economic feasibility of your workforce projection. The last section in Appendix C provides data on typical values for this and other input estimates.

7 Next enter your target year assumption of total RECURRENT HEALTH EXPENDITURES AS % OF PUBLIC SECTOR. Your starting point for making this assumption is the base year percentage shown in the cell to the left. Many developing countries allocate about 3-6% of all public sector expenditures to health and this percentage tends to rise over time. In industrialized countries this percentage can rise to 6-9% and even higher. Thus, if your base year estimate was around 4% you might reasonably assume that this would rise to 5-6% over a 30-year projection period.

8 Enter your target year assumption of PERSONNEL EXPENDITURES AS % OF PUBLIC SECTOR. As before, your starting point for this planning assumption is the base year value. World experience suggests that most well-operated health systems spend about 60-75% of their total recurrent health expenditures on personnel. For various reasons, however, many developing countries find that they have to allocate more than 75% of their expenditures to personnel, leaving insufficient funds for drugs, supplies, equipment, maintenance and contract services. If your country is now spending much above 75% you may wish to assume a somewhat lower proportion in the target year.
9 With the above estimates and planning assumptions entered, the computer can now complete calculations of the amounts of funds available for the recurrent public sector, public health sector, and for health personnel. The computer then calculates the average annual percentage change in health personnel expenditures that would have to occur to explain the observed differences between the base and target years. This last value, if based on reasonably good GDP and expenditure estimates, can suggest the approximate value you should use in the upper section of the ECONTEST table, described above.

10 One final caution, applicable only for those countries that receive more than 5-10% of their base year recurrent health budget from foreign sources. For such countries it could be hazardous to assume that the same proportion will come from external sources over a period as long as 30 years. Accordingly, if this situation applies to your country, you may wish to assume somewhat slower public health sector growth rate to take into account a possible reduction in the amount of foreign support available for recurrent health sector costs. This will make your feasibility test a bit more conservative and less liable to result in policies that expand excessively the health sector.

Congratulations! You have now completed the tables required for this module. A later section in this document will show you how to use these assumptions to test the economic feasibility of your supply and requirements projections.

Requirements for medical and nursing specialists

This optional module located in the Core page and consisting of three tables, makes it possible to project up to nine different specialist categories for doctors and nurses.

**HOSPSPEC table**. This table comes provided with a list of nine medical and nine nursing specialties, plus a tenth, *All other specialties*, category. You may change the nine categories to better meet your own needs and terminology. Once entered in this table these categories will be repeated in the next two tables. We will only describe the upper half of the table (doctors), since the lower half (nurses) is completed in exactly the same way. Note that the upper table headings remind you for each type of hospital as to (1) the number of beds in an average hospital and (2) the number of doctors required in an average hospital. If the staffing norm for a given type of large hospital is, say, 30 doctors, you must then allocate these 30 doctors among the 9 specialty categories. The computer will subtract the total of named specialists from the total number of doctors to determine what number of assign to the `All other specialties` cell. Be careful to check the `All other specialties` cell to make sure it is not a negative number, which would mean you have assigned more specialists among the nine named specialty categories than the number of doctors required according to the norm. Proceed in the same way for each of the different types of hospitals and for the nurse specialist section.
**AMBUSPEC table.** Complete this table in the same way as the HOSPSPEC table. Since most ambulatory facilities will depend primarily on generalist doctors and nurses, the number of specialists required will be small. For those clinics that offer specialist services only on certain days, eg, once a week, once a month, etc., you can enter staffing norms that reflect this part-time involvement. For example, if a given clinic type averages one half-day surgical clinic a week, with one surgeon in attendance, you should enter 0.1 as the FTE general surgeon requirement. The 0.1 FTE indicates that 10% of an FTE surgeon is required for this clinic.

**REQSPEC table.** Enter your estimates of how the required number of doctors and nurses would best be distributed according to specialty. For each of the three columns common sense will guide your decisions. In public health most doctors and nurses in the public health sector will be either generalists or public health specialists. The academic sector will have a relatively high proportion of specialists, with somewhat more medical than surgical specialties. To estimate private sector specialist distribution, start with that observed in public sector hospitals and adjust this distribution to take into account ways in which private sector practice may differ from the public sector.

**Production of services (Serv page)**

This optional module allows you to project the potential production of several different types of inpatient and ambulatory services and to estimate the per capita utilization of services. The summary table compares base and target year estimates of service production, which can help policymakers decide whether their planning assumptions are likely to result in an improved health care capability. The module consists of four tables, three of which require data inputs. Several comments are appropriate.

- **Service providers.** You will recall that in the OCCUPREF table you were asked to specify up to three occupational categories for which you would like to estimate the production of ambulatory services. Heading the list will usually be doctors, but other categories to consider include dentists, assistant doctors, nurses, and midwives. You should not include categories for which reasonable service statistics are not available (eg, pharmacists, technicians) or where the relative number of services produced is quite low (eg, physical therapists).

- **Services produced.** A health sector produces an almost infinite variety of services and any model would soon become impossibly complex if it tried to disaggregate services according to type, purpose, provider, location, etc. This model considers only four services, hospital discharges (or admissions) and three types of ambulatory visits, or patient-provider contacts, categorized according to type of provider, eg, doctor, dentist, midwife. Even with this major simplification, projection
of these four services can provide important insights into the potential work of the health workforce.

- **Productivity.** Most countries have statistics on the number of hospital discharges (or admissions) and can make reasonably accurate estimates of the number of visits provided in the public sector by doctors and dentists, and often by other categories of personnel. These public sector estimates are supplemented in the model with estimates, accurate to perhaps within 20%, of the production of private sector services.

- **Production versus utilization.** In the health services industry a service to a patient is considered to be *consumed, utilized or used*. The model projects the potential productive capacity of the health sector and makes the implicit assumption that if services are produced, they will be used. In other words, if 1000 doctors in clinical practice are projected to the target year, and if they average four hours per work day seeing patients and four patients per hour, then their potential productive capacity is 1000 x 4 x 4, or 16,000 patient visits per day, and if 16,000 visits are produced, it is assumed 16,000 visits will be used. But, if the average number of patients who actually seek a doctor visit each day is only 13,000, then only 13,000 visits will in fact be ‘produced’. In this documentation we talk of service production being equal to service utilization, but in reality utilization rates depend on both the capacity of the health sector to produce services, and on the actual demand of patients for those services. Planners therefore need to ensure that the projected staff capacity to produce services is consistent with the likely demand by the population for these services.

- **Quantitative versus qualitative aspects.** The projection model only takes into account the quantity of services produced, omitting entirely important aspects such as quality, timeliness, appropriateness, and efficacy. Even though these latter aspects cannot be explicitly included in the model, they can be taken into account. The staffing norms you propose, the balance between different types of work locations, the mix of services provided, and the geographic distribution of work locations, all serve to increase or reduce the ability of the system to provide high quality, appropriate, timely, and efficacious services.

**BASESERV table.** This table provides base year estimates of both public and private sector services. Proceed as follows:

1. Enter in the public sector column the total number of discharges from all types of public sector hospitals during the base year and the total number of visits, rounded to the nearest thousand (000), the estimated number of ambulatory visits. The row label refers to discharges, though in some countries statistical data may only be available for admissions. If this is the case in your country, use admissions wherever data on discharges is required. Admissions should equal discharges as long as the latter term
includes both live and dead patients, though there may be some confusion in the case of maternity admissions where a pregnant woman enters the hospital and she plus her newborn(s) are discharged. In practice, this problem will not materially affect the model's utility and does not affect the personnel requirements projection in the slightest.

2 Enter the estimated base year bed occupancy rate (%) and average length of stay for private sector hospitals. The computer will then calculate the approximate number of discharges and other production indices based on your previous estimate of the supply of private beds.

3 Enter in the shaded section at the bottom of this table your assumptions regarding the private sector productivity of the three occupational categories. The first column in this small table displays the approximate number of health workers in each category that are working in the private sector, based on estimates you made in the SUPPLY table. When you estimate the percentage of time spent attending patients, remember to make allowance for the substantial amount of time when practitioners are not in direct contact with ambulatory patients. Examples of time that should not be counted include time spent in travel, waiting for patients, attending hospitalized patients, opening and closing the office, consulting with other staff or specialists, attending to administrative matters, self-study, and in time taken up in coffee breaks and other personal matters. Accordingly, for most private practitioners the actual time spent attending patients will usually be in the 50-70% range. Those occupations (eg, doctors) that also provide substantial care for hospitalized private sector patients will be at the lower end of this range, while those occupations that provide services to ambulatory patients (eg, dentists) will be toward the upper end of the range. These estimation problems are further discussed in the section on the AMBUSERV table.

HOSPSERV table. This table has a lot of rows but only some of them require numbers. The upper part of the table is for the target year production of hospital discharges (or admissions) and the lower for the production of ambulatory visits by hospitals. Proceed as follows:

A SUGGESTION. The Utility page of the requirements model has four tables (BEDS, STAFF1,2,3, MATERNAL, and NORMS) that are designed to provide step-by-step help with developing many of the estimates required in this module.

1 Enter the assumed target year average length of stay for each type of hospital. You may find the typical values listed at the end of Appendix C of some use in deciding reasonable assumptions for length of stay. By using the above formula the computer can calculate the total number of discharges and the number per hospital and per bed.
2 The largest section of this table provides bases for projecting the target year production of visits. Enter first the assumed average number of hours worked in a year by FTE public sector staff; do not include ‘hours on call’ by doctors (Appendix C provides further information on this potentially confusing point). You can calculate the average annual hours as shown below and the HOURS table on the Utilities page provides a step-by-step method to make this estimate.

- [365 days] - [non-working weekend days] - [paid legal holidays] - [vacation days] - [average lost time due to sick leave, maternity leave, study leave, etc.] = [average days actually worked] x [average hours worked per day] = [average annual hours worked]

- For most countries this value will lie between low and high values of 1500 and 2200 hours, with 1700-1800 being typical.

3 Enter next the assumed percentage time that a typical FTE health worker of each of the three categories will actually be seeing patients in a hospital of the specified type. These values will almost certainly not be provided by the typical statistical reporting system nor will target year standards be available. By way of example, assume you are completing the row for doctors and are providing this target year estimate for ‘district hospitals’. Assume further that you have assumed a staffing norm of 5 FTE doctors for a district hospital with an average size of 100 beds. The question now is, What percentage of the time worked by the 5 FTE doctors will be actually spent seeing ambulatory patients, i.e., not hospitalized patients? A reasonable planning assumption can be developed as follows:

- [5 FTE doctors] - [1.0 FTEs in administrative and other non-patient care activities, eg, radiology, laboratory] - [1.5 FTEs attending hospitalized patients] - [0.5 FTEs in non-patient care ambulatory clinic activities, eg, chart review, waiting time, consultation with other staff, staff meetings, coffee breaks] = [2.0 FTE doctors actually seeing patients].

In developing this planning assumption, three points must be emphasized. First, your time estimates must necessarily be quite approximate, probably rounded to the nearest 10%; more accurate data on the present situation are not usually available and since you are making long range projections, and it is not worthwhile to do an actual task analysis. Second, you should avoid making overly optimistic estimates of the amount of time actually seeing patients. Though a health worker may be physically present in a clinic setting for a three-hour clinic session, the actual time with patients may be considerably less due to time spent on both necessary activities (chart review, consultations with other staff, etc.) and personal activities (coffee breaks, personal conversations with other staff, etc.). And third, the percentages will vary considerably depending on the type of work location and occupational category. For example, larger hospitals will probably have a greater proportion of their staff concerned with inpatients.
and non-clinical activities than smaller hospitals, and dentists will spend a larger percentage of their time on visits than doctors, nurses, or perhaps midwives.

4 In the next section enter your assumptions regarding the average number of ambulatory patients seen per hour (0.0) in the target year by each of the three occupational categories. At the extremes hourly productivity will range from less than one to more than eight patients per hour, depending on the type of service, health care worker, and work location, though in reality the averages for an entire hospital or clinic will probably be in the 4-6 range. Larger hospitals will probably have somewhat lower productivities than smaller ones due to sicker patients and more specialized services, and hospitals as a group will likely have somewhat lower productivities than free-standing ambulatory clinics.

The next three sections of this table provide target year estimates of the average production of visits by one FTE staff, by one hospital, and the total produced by each hospital type.

5 In the bottom section enter your assumptions of the average bed occupancy rate and length of stay in private sector hospitals. Using these values, the computer will calculate the target year discharges from such hospitals, based on the projected number of private beds.

**AMBUSERV table**. This table is identical to the previous one except that it does not include hospital discharges. Enter the assumed average number of hours work per FTE, which should be equal to or very close to that assumed for hospital staff. The assumed percentage of staff time actually spent seeing patients should be considerably higher than the values assumed for hospital staff (who must divide their time between inpatients and ambulatory patients). This percentage will probably not exceed 70% for any type of clinic and indeed a more realistic estimate may be in the 50-60% range. Your assumption regarding the average number of patients seen per hour (0.0) may be slightly higher than for hospital-based clinics, but should probably not exceed about 6, especially if you want to ensure that services are of a satisfactory level of quality. In the bottom shaded section enter your planning assumptions for the production of visits by health workers in the private sector. As was noted in the BASESERV table, your planning assumption for doctors should take into account that a substantial portion of private sector doctor time will be spent attending to hospitalized patients.

**INFORMATIONAL NOTE**. Some statistical reporting systems use *attendances* rather than *visits*, and do not classify these services according to type of provider. In this situation list only one provider in the OCCUPREF table, specifically, that occupational category that provides the largest proportion of clinic services. In some countries this will be the doctor and in others the nurse. Either way, the base and target year estimates of the number of attendances provided should be understood as those produced by all provider categories, including doctors, nurses, dentists, and auxiliaries.
**SUMSERV table.** The computer-generated results presented in this table are self-explanatory and the graphs HOSPSERV, AMBUSERV and SERVINDICES provide graphical representation of the key hospital and ambulatory service values. Review the base-to-target year comparisons to see if the direction and magnitude of change is consistent with likely trends, your planning assumptions, and with your assessment of what the country could accomplish over the planning period. Are you satisfied with the calculated public sector clinical staff ratios? Do these reflect improvements, and will they make it possible to provide better and more efficient services? Are there any changes in the proportions of the clinical workforce at each level, and are these changes favorable? Note down any problems or inconsistencies that will require further investigation and perhaps changes in planning assumptions. However, if you would also like to complete the next module, on the geographic distribution of services, we suggest that you do this first before making any major changes in the data inputs you have just made.

**Distribution of services (Dist page)**

We are almost to the end! This optional module, located on the Dist(ribution) page and containing only one data entry table, makes it possible to compare the potential urban-rural distribution of services in the base and target years. The underlying logic of the module is simple. With estimates of the proportion of patients served by each type of work location who were urban residents, the computer can calculate the number of services provided to urban and to rural patients, and the urban and rural utilization rates. Here is a simple example:

If regional hospitals produce 500,000 visits per year

If 60% of these visits are by urban residents

Then 300,000 doctor visits are by urban residents

And 200,000 doctor visits are by rural residents

With the estimated numbers of visits to urban and rural residents it is then easy to calculate the urban and rural per capita utilization rates, eg, 300,000 visits by urban residents divided by, for example, 600,000 urban residents, equals 0.5 regional hospital visits per urban resident, this rate then being added to the rates for other types of hospitals and clinics.

The only problem is, of course, how to estimate the proportion of services provided to urban residents. There are two methods, one accurate and difficult, the other easy and approximate. But first one must define *urban.* Precise definitions used by
demographers are complicated and despite their complexity, are often not very precise simply because the definition of urban is based on a human perception of what looks and feels urban. Strict demographic definitions may involve measures of population concentration, proximity to other urban centers, transportation patterns, and geographic area, and are not useful in this model. Since the model's key outputs, projected requirements and economic feasibility, are not affected by your estimates of urban patients, better to make an informed guess than to try and gather field data. As with many previous assumptions, rely here on persons with experience in clinical work locations. With several examples you will see how the range of reasonable estimates can be quickly narrowed.

Consider first the situation of large hospitals and urban polyclinics. Large acute care national and regional hospitals are almost always located in cities, and though they certainly care for patients from rural areas, the great majority (eg, 80-90%) of their ambulatory patients and perhaps a somewhat smaller proportion (70-80%) of their inpatients will come either from the city in which they are located or from other nearby towns and cities. For most urban polyclinics more than 90% and perhaps close to 100% of the visits will be to urban residents. The percentage for each type of work location will vary depending on the degree of urbanization of the country, patient referral patterns, transportation networks, and the availability of services readily accessible to rural residents. Despite all these variables, however, it will not be difficult to estimate these percentages to within ±15% of the true value. As before, a likely range is established within which the true value lies, eg, no less than 75% and no more than 90%, and then a best guess is made.

The second situation is that of health facilities designed to serve a predominantly rural population, eg, certain types of small hospitals, health centers, and posts. Here, too, a reasonable range can be established for each type of work location and each type of serve, and then a best guess made and used. Let's now proceed to the LOCATIONS table and see how this works.

**LOCATIONS table.** The LOCATIONS table is very large but only two rows require data. You will recall that you estimated in the DEMOgraphic table the percentage of the base and target year populations that could be considered urban residents, and by difference the computer calculated the percentage that would be rural residents. Using this same rough definition of urban, enter your target year estimates for each type of work location of the percentages of hospitalized and ambulatory patients who are urban residents. Unless you have actual data we suggest you round your estimates to the nearest 10 percent, eg, 60, 70, 80, etc.

In making estimates you need to consider three major variables, specifically: rate of urbanization; proposed geographic distribution and mix of health facilities; and likely changes in the transportation system. For example, if the country is rapidly becoming more urban, then the percentages of urban residents will rise in all but the most rural
health facilities. And, if the health system plans to give priority to the rural sector, then this could increase the percentages of urban residents in facilities located in large cities (since less rural residents will need to go to these facilities to seek care), and decrease the percentages of urban residents in facilities located in small towns and rural areas.

• Major improvements in the transportation system could decrease somewhat the percentages of urban residents served in urban facilities by making it easier for rural residents to travel to the city for care.

• The LOCATION table does not ask for separate estimates for each of the three selected occupational categories but has instead made the simplifying assumption that the percentages are similar for doctors, dentists, etc. Though in real life people are likely to travel further to visit the doctor than, say, to visit the dentist, the differences will not be great.

• The LOCATIONS table is too large to fit on one single screen so use the arrow or <Tab> keys to move you across the screen to complete the several data entry rows. At the far right side of the table you will note several shaded cells for estimates of the percentage of private sector discharges and visits made by urban residents. The rest of the table is filled in with computer-generated estimates that have little meaning by themselves. Refer instead to the summary estimates in the SUMDIST table.

   SUMDIST table. At last, a summary table for the distribution of services! Review the target year values for each indicator and see if they make sense. Is the urban-rural imbalance in the provision of hospital and ambulatory services acceptable? As with the other summary tables, make notes as to what you like, what you don't like, and what you don't believe (due to faulty data or unrealistic assumptions), so that you can later revise your model accordingly.

You have now completed all the required and optional modules except the easy one used to make an intermediate year projection. If you don't want to make such a projection skip to Part IV since you can always come back to the intermediate year module later. Alternatively, if you want to know approximately where your country or region should be in, say, five years, as it progresses towards a target year 20 or 30 years in the future, then proceed to the next section.

Intermediate year projection (InterYr page)

This module makes it possible for you to develop an intermediate year projection, part way between your base and target years. In health workforce planning we need a long projection period to give us enough time to see the potential effects of actions that take
a long time to implement, but we also need guidance as to where we should be in the next 3-5 years. The intermediate year projection module makes this shorter term perspective possible.

**YEARDATA table**. Enter into the one shaded cell an intermediate year that is less than the target year. Immediately below this cell the computer displays for your convenience the projection period to the target year, and the intermediate projection period. The last row shows the calculated ratio of the intermediate projection period to the full projection period.

**INTERREQ table**. This table is a duplicate of the REQuirements table except that the projections are to the specified intermediate year. This table is based on an assumption that is simple but potentially misleading, ie, that the annual rate of change between the base and target years will be constant through the projection period. A simple example will illustrate this point.

- Assume you have made a 30-year projection and that during that period doctor requirements will increase from a base year value of 1000 up to a total of 3000. You now make a five-year intermediate projection. The computer calculates the annual compound growth rate that would increase a value from 1000 to 3000 in 30 years (which is 3.73%), and then uses this annual growth rate to calculate how many doctors would be required in five years. The result, 1201 doctors, is then entered in the INTERREQ table, and the same procedure is used for each of the other occupational categories.

The calculations are easy but depending on the resource being projected, may be very much in error. With doctors the training period is usually at least five years so the actual output of doctors is essentially unchangeable for at least that amount of time and often quite a bit longer. If, in the above example, the doctor supply is increasing at close to 4% per year, no problem; the intermediate projection will be roughly on target. However, if the current annual output of new doctors is similar to annual losses and hence the supply remains the same from year to year, then it will probably take at least 10 years to expand medical school outputs enough to start making progress towards the target year requirements of 3000. In summary, the intermediate projection can only tell you where you should be on a straight line path between the base and target years; it cannot take into account the inevitable lag periods required to change training program outputs or to revise construction plans.

The above limitation is important but does not eliminate the value of this module. The supply projection model makes it possible for you to test the effects of different strategies for changing the training program intakes and outputs of health personnel. By combining the versatility of the supply projections with the general guidance provided by the intermediate year projection module you can explore the costs and benefits of different paths toward an improved health system.
**INTERCOMP table.** The INTERCOMP table is a duplicate of the COMPARE table in the core requirements module. If desired, you can enter your supply model projections for the main occupational categories in the shaded column and compare these with the requirements projections. As described earlier, you may need to interpolate the projections provided in the supply model to match the selected intermediate year. If your intermediate requirements projection is for some multiple of five, eg, 5, 10, 15, etc., and assuming you used the same base year for the supply and requirements projections, then you can use the supply projections directly as they come from the computer. If your intermediate year projection is for, say, 7 years, then you can use the INTERYR table in the Supply model to interpolate between the 5- and 10-year supply projections in order to develop a 7-year projection.

**SUMYEAR table.** The last table in this module is a duplicate of the SUMREQ table, and shows the various changes in the population-to-workforce ratios that would occur assuming linear progression towards the target year. For the reasons noted above, interpret these values with caution. In some cases near term changes may be already probable or attainable with minor policy changes, while in others it may take many years to accomplish significant changes in the output and retention of personnel.

The intermediate year module does not now include summary tables for any of the three other optional modules (economic feasibility, production and distribution of services). You can make individual calculations if you wish, using the same basic assumptions regarding the interpolated rate of change from the base to the target year, but as before, make sure to take into account likely delays in the implementation of policies that would bring about the desired changes.

With this last module you have completed all the tables for making a single requirements projection. The requirements model makes it possible to compare several alternative projections for the same geographic region or health system, or combine projections for different geographic regions in order to make a consolidated projection. However, before spending time comparing or combining projections, make sure first that your projection meets the test of `common sense'. In brief, is the projection free of significant data errors, are the assumptions realistic, and are the results in a generally favorable direction? Part IV considers these critical questions.

**Part IV. VALIDATION AND RESOLVING MISMATCHES**

The introductory section of this documentation emphasized the point that both the supply and requirements models will need to be successively revised and refined before
they can be used for policy analysis. With your first projection now complete, you will need to do the following five tasks:

- Correct any data entry errors
- Verify that major assumptions are reasonable
- Make sure the requirements projection is economically feasible
- Compare several alternative projections in order to select the preferred one(s)
- Make final adjustments to bring your supply and requirements projections into balance

This part outlines how you can carry out these five tasks. Although you could undertake the first four tasks in almost any sequence you want, until you become more familiar with the two models we strongly suggest you go in the sequence described below. Additional information identifying and resolving problems with your requirements model is provided in Appendix G.

**Finding errors**

Not infrequently errors may arise due to entering a number incorrectly. For example, 10.2 may be entered as 102, or 358 entered either as 35 or as 368. Major errors such as adding or dropping a decimal place will usually be easy to find since if the number has much impact on the final projections, it will result in an unexpected and probably unreasonable answer. As you review the five SUMMARY tables, and indeed many of the other computer-generated tables, note all results that are unexpected or unreasonable and then check back in the tables upon which the unexpected value depends and if you find an error, correct it. This process won’t catch all data entry errors but at least it should find the big ones. The smaller ones will probably become apparent at the next stage.

Once you have corrected any obvious errors you should probably print out your full set of tables since this will greatly help the next stage of your review. The tables can be printed individually in the supply model and either individually or by module (using the Print Core, Print Econ, etc., buttons on the Info page) in the requirements model. The printer setup screen must be correct for your computer so if this is the first time you have printed please refer to Part I, on Printing.

**Validating assumptions**
Even if you have corrected a few rather large errors you will still probably have some results that appear unexpected or unreasonable. Using both the computer and your printed copies of all the tables you can now start tracking them down. First, identify all the key assumptions and check once again to make sure they are reasonable, and then make any necessary adjustments. These key assumptions, and the tables where they can be found, are listed below. Appendix D provides additional information on the potential impact of each major variable on the projection, the degree to which errors in each assumption can affect the final results, and indicates which variables you should change in order to achieve desired health system outcomes.

Key assumptions [Table(s) where they are located]

- Base year population and growth rate estimates (DEMOgraphic)
- Base year workforce supply estimates (SUPPLY)
- Base year work location characteristics (HOSPital, AMBUlatory, PRIVHOSP)
- Target year population per work location (HOSPital and AMBUlatory)
- Target year staffing norms (HOSPSTAFF, AMBUSTAFF, PRIVSTAFF)
- Public sector expenditure growth assumptions (ECONTEST)
- Public sector health worker income assumptions (INCOMES)

All of the above estimates and assumptions are especially important but target year assumptions about the population per work location deserve special attention. These assumptions are important because they determine the number of target year work locations of each type that will be required, and these in turn determine the number of health workers required.

An example can illustrate this point. Let's assume your country had a base year population of 10 million and a projected 30-year target year population of 20 million, and that you are considering the requirement for public sector district hospitals. Further, assume that in the base year there were 20 district hospitals, with an average of 100 beds each, for a total of 2000 beds and a nominal population per hospital of 500,000 (10 million population divided by 20 hospitals). If you make your target year projections using the same average population per hospital of 500,000 you will require 40 district hospitals (ie, 20 million divided by 500,000). And, if you change the average population per hospital by very much, the number of hospitals required will change accordingly. For example, if the average population is decreased to, say, 350,000, the number of hospitals required increases to 57, or 42% more.

As you can see from this example with only one of the 14 different public sector clinical work locations, it would be easy to over-estimate the degree to which a country can simultaneously improve the accessibility of all or most of its health facilities. Accordingly, check carefully your assumptions regarding the rate at which your country
can realistically improve the ratio of different types of health facilities to the population served, and adjust your estimates as appropriate.

Let's assume that you have now checked (and revised as necessary) all the major data input estimates and assumptions and that they appear, on first review, as reasonable. The next step is to see if they result in an economically feasible projection.

**Achieving economic feasibility**

Now comes the moment of (perhaps) painful truth. As an example, let’s assume you have checked for and eliminated data errors and clearly unrealistic assumptions. You go to the ECONTEST table to check the economic feasibility and to your surprise, find red number “135%” in the row labeled “computed annual % change (T-Y / B-Y) in personnel expenditures,” indicating that according to your scenario assumptions public sector personnel will cost 35% more than the funds available to pay them. What can you do?

Your first action should be to review your two key economic assumptions. Is the annual rate of real income growth (INCOMES table) reasonable? For most developing countries it should be between 0.5% and 1.5% unless population growth is slow and economic growth is rapid. And is the assumed annual rate of funds available to pay for personnel reasonable? For most countries this should probably be no more than 1% higher, and often quite a bit lower, than the rate of GDP growth. Experiment with different assumptions for the incomes and funds variables and see by how much you would have to vary one or both of them to bring the value in cell Q9 close to 100%. Since long range feasibility testing is far from an exact science, any value between about 85% and 115% can be considered “in balance”, but much beyond these limits should receive further attention.

With only one number to change (cell Q5, labeled “Assumed average annual % change (0.0) in funds available to pay personnel”), it is easy to try different growth rate assumptions for the “funds available” variable. The incomes variable, since it is applied to up to 15 different occupational categories, is a bit more complicated. Proceed as follows:

1. Go to the INCOMES table and put the cell pointer somewhere around row 20. Use either the <Ctrl> D macro split the screen, or use the Window|Split command, click the Synchronize box (so that the check mark disappears and the split window is unsynchronized), and then click the Horizontal command. Now click the lower screen and go to the ECONTEST table, and use the arrow to go down the table until red bold-faced row is visible. Click again the upper screen so that you now have the INCOMES table above and the ECONTEST below.
2. Review the upper screen with the INCOMES table. Note the values in the % CHANGE OVER PERIOD column (H) and see by how much you have assumed incomes will increase over the projection period. Write this average % change number down. For example, a 1% annual growth rate assumption will increase incomes by 35% in 30 years, and a 1.5% rate will increase incomes by 56%.

3. Now try entering different values in the shaded ADJUSTMENT FACTOR cell until you bring the feasibility test value in the lower screen close to 100%. Note again by how much you had to change the adjustment factor to achieve both some improvement in the economic feasibility of your projection and a reasonable increase in the target year salaries over the base year salaries. An example will clarify this important, and rather complicated step. Let's assume that your 30-year projection model had only three occupational categories, doctors, nurses, and auxiliaries, that your INCOMES table adjustment factor was at the default value of 1.00, and that you had assumed an annual salary growth of 0.9% per year for doctors, 1.1% per year for nurses, and 1.2% for auxiliaries, rates which were designed to achieve a more equitable salary distribution. You note in the last column of the INCOMES table that these three annual rates of income growth, maintained over a 30-year period, will result in a 31%, 39%, and 43% increase, respectively, for the three occupational categories at the end of the period. You then did the economic test and found your cost projection, as shown in the ECONTEST table, was too high. You then changed the adjustment factor to 0.93, and achieved the desired cost balance. Looking again at the right-hand column you note that the percent changes in incomes over the period are now 22%, 29%, and 33%, respectively. You write these numbers down and then re-enter 1.00 in the adjustment factor cell and, by experimentation, find the annual rates of increase for each category that will result over 30 years in total increases of approximately 22%, 29%, and 33% for the three categories. These annual rates are about 0.66% for doctors, 0.85% for nurses, and 0.95% for auxiliaries. Summarizing, what you have done is to use the adjustment factor to find out the approximate amount of change needed, and then make the necessary adjustments in the assumed growth rates. If you didn't have the adjustment factor feature, it would be a long trial-and-error process to make changes in up to 15 different annual growth rates.

A note of caution! The annual growth rate assumptions and the adjustment factor provide an easy but potentially hazardous way to make your requirements projection economically feasible. By changing either the individual growth rate assumptions or the adjustment factor you can reduce or increase the projected rate of real salary increase for all your health worker categories and thus make your requirements projection fit within your projected health sector budget. If your projection is for an extended period, the impact of a change of even 0.1 can make a significant difference. For example, annual real increases of 1.0%, 2.0%, and 3.0%, sustained over 30 years, will increase real target year incomes by 35%, 81%, and 143%, respectively, as compared with the base year. Even a 0.1% increase will increase real incomes by about 4% over 30 years. But, real life won't allow countries to increase real incomes over an extended
period of time either much faster or much slower than the increase in the per capita income. This is especially true since the health sector is part of the much larger public sector, and hence health worker salaries can’t get very far ahead or behind comparable salaries in other parts of the public sector and these, in turn, must bear some reasonable relationship with salaries paid in the private sector. Your annual real income assumptions should therefore remain conservative, probably between 0.5 and 2.0 at the outside, unless your country is projected to increase its per capita incomes very rapidly or almost not at all. More realistically, your growth rates should probably lie between about 0.7 and 1.5.

4 You can now either unsplit the screen with the Window/Split/Clear command or preferably, leave it as a split screen while you test the effects of changes in other tables on the feasibility test. In this latter case, use the <F5> key to go to the other data input tables of interest, and what the effects of your changes on the lower, ECONTEST screen.

As a final illustration, let’s assume you have the most realistic incomes and funds values possible and your feasibility test still suggests the public sector workforce is costing too much. To bring it into balance you will now have to change other variables. Variables that have the greatest effect are contained in the DEMOgraphic, HOSPital, AMBUlatory, HOSPSTAFF and AMBUSTAFF tables, and to a much lesser degree, the ACADemic and PUBHEALTH tables. In essence, public sector personnel requirements will be reduced if any of the following three variables is reduced, either singly or in combination: population growth rate; ratio of health facilities to population; and average staff per health facility.

Staffing norm changes should be done with care, and for the most part should not be very large, since a large change would make it necessary for you to go back into the productivity sections of the model and change all those assumptions too. For example, assume that your target year regional hospitals are designed to have 500 beds and 100 doctors to meet the needs for both inpatient and ambulatory patient care, and that you estimate that with this medical staff complement the hospital can have a projected average bed turnover rate of 25 discharges per year and provide about 200,000 ambulatory patient visits per year. With these assumptions you could probably increase the number of doctors to about 115 or decrease them to 85 without having to change all your productivity assumptions. But if you made much bigger changes you will probably have to go back into the productivity tables and change all your input assumptions. This may be desirable final stage refinement for your model but you should avoid this during the early stage of adjustment.

As a final step for this part of the review, check to make sure that your projected numbers of non-clinical public health and academic personnel appear to be reasonable and, if not, make the necessary adjustments in their tables. In the PUBHEALTH table you can use the ADJUSTMENT FACTOR cell to rapidly test the effects of different
annual rates of change in the non-clinical public health workforce on the resulting percentage of such personnel in the target year workforce. As with the INCOMES table the procedure is as follows: make changes in the ADJUSTMENT FACTOR until you have a desired proportion of public health personnel in the target year; note and write down the resulting INDEX VALUES, which will indicate the projected change for each occupational category relative to the base year; set the ADJUSTMENT FACTOR back to 1.00; change the values in the ASSUMED CHANGE PER YEAR column so that the index values approximately match those that you have written down.

Next, GOTO the ACADemic table and make any desired adjustments in the two columns ENROLMENT CHANGE PER YEAR and (Target Year) STUDENTS PER FTE. When finished, review the bottom two rows in the REQUIREMENTS table. Unless your country has some unusual circumstances or definitions, you will probably find in this table that your academic personnel account for about 1-3% of the entire health workforce and non-clinical public health personnel account for 2-10% of the workforce, depending in large part on the number of public health programs that are independent of clinical facilities, eg, public health institutes, malaria, environmental protection, etc.

By now let us assume you have a projection that looks reasonably good in terms of both its economic feasibility and the balance between the different types of clinical work locations. We can now make the final adjustments, resolving supply and requirements mismatches!

The next section outlines how you can resolve mismatches between your supply and requirements projections. However, before proceeding to this step you may wish to compare several different alternative projections for the same geographic region, or perhaps combine provincial or state projections in order to develop a national projection. If you wish to consider these operations proceed first to Part V, which describes how you can use the COMBINE spreadsheet to accomplish these tasks.

**Resolving supply/requirements mismatches**

At last, and assuming you have already used the Compare spreadsheet described in Part V, if desired, you now come to the final stage of model adjustment, bringing the supply and requirements projections into balance! You could have made these adjustments earlier but since they can be very time-consuming we strongly recommend that you delay this process until you are reasonably satisfied with one or several alternative requirements projections. Let's assume you made three alternative projections for the North Province, called NORTH1, NORTH2, and NORTH3, and that you selected a preferred requirements projection, which is NORTH2. It is now time to factor in supply feasibility considerations into your final selection. Proceed as follows:
1 Load your preferred NORTH2 spreadsheet and make any further refinements that you consider appropriate in the target year input tables. In short, get the NORTH2 projection into the best shape possible and rename it NORTH, if it is to now be your master file.

2 Next, GOTO the COMPARE table in your NORTH spreadsheet and, if necessary, make any further revisions to your supply estimates that appear to be indicated. These supply estimates should be based on the first round of projections using the supply projection model, discussed in Part II of this documentation. These supply projections will normally be either based on existing trends and capacities, or on an assumed steadily increasing production of health workers approximately parallel with that of the population increase. Using doctors as an example, you might have a supply projection that projects the future supply of doctors based either (1) on the assumed continuation of current patterns of doctor training and loss rates, or (2) on a steadily increasing supply of doctors at a rate a bit above that of population growth.

3 Compare the baseline supply projections with your preferred requirements projections and examine the estimated surplus or shortage in the last column. Continuing with the doctor example, let us suppose that you find that your baseline supply projection indicates there will be about 4200 active doctors available in the target year to meet an anticipated requirement for 5100 doctors, for a shortage of 900. To close the gap you can either increase the supply, decrease the requirements, or use a combination of increased supply and decreased requirements. The major policy options for achieving each objective are as follows:

- **Increase supply.** You can go back to the supply model and change any or all of the primary input assumptions affecting supply. The most important assumptions, and those that can be most easily changed, are the entering class size and the percentage that graduate (if your assumptions were relatively low). Also important, though probably less easy to change, are the projected loss rates following graduation for both past and future graduates. Less important, and less subject to change, are the male-to-female sex ratio of the students and the number of in- or out-migrating graduates. Potential constraints on increasing class size are the number of qualified students who can be attracted into a medical career. If you can readily increase the supply to close the 900-doctor gap, fine; but if not, try decreasing doctor requirements.

- **Decrease requirements.** It may sound strange to talk about decreasing requirements but we need to recall that a requirements projection is just as subject to human values and assumptions as is a supply projection. Workforce requirements are not written in stone and indeed you came this far by analyzing several different requirements projections. You should therefore review your requirements projections to see if there is a way you can reduce them. The most important options include: reducing somewhat the numbers of work locations (by
changing the assumed average population per location) that require lots of doctors, eg, large, specialized hospitals; and lower staffing densities for doctors, perhaps moderated by delegating some doctor functions to other categories of personnel, eg, nurses, assistant doctors, etc.

4 By now you probably have a good idea of what you must do, which can be summarized as follows. First, get your best estimate of requirements and confirm that it is economically feasible. Second, compare the requirements and baseline supply projections for each major occupational category to see if there is a significant mismatch. Do not bother, at least for now, with numerically small categories or those that require little or no health-related training, eg, lower level administrative and other support personnel. Third, review and revise the supply and/or requirements projections as necessary to bring them into approximate agreement. Fourth, congratulate yourself on a complicated job well done, and now you can begin the long process of getting agreement among all the different interest groups and developing a strategy for implementation. And fifth, remember that your revised and approved supply and requirements projections are useful for guiding decisions for only the next two or three years. After several years you will need to update your projection models with new data, take into account intervening events and changing assumptions, and restart the planning process once again!

Part V. COMPARING AND COMBINING PROJECTIONS

Part IV described how to review a single requirements projection for a nation or subnational unit, and to check it for data errors and unrealistic assumptions. At this point you may find it useful to:

(1) Compare up to nine scenario projections for a single geographic area or health system, with each projection based on different planning assumptions, or to...

(2) Combine multiple subnational projections, based either on different geographic areas or on different health care systems, in order to produce a national requirements projection.

Part V describes how these two optional procedures may be done, using the Compare spreadsheet.

Comparing alternative projections (Compare page)
Let us assume that by following the instructions in Part IV you have developed a requirements projection for a country, province or health system that you believe has minimal errors and is economically feasible. There are, however, many ways a health sector can be organized that are consistent with sound economic, demographic and health-related planning assumptions. For example, one projection could give special emphasis to the hospital sector, another to the ambulatory care sector, and yet another to preventive services. Indeed, there is almost an unlimited number of economically feasible projections one could develop depending on the relative emphasis given to one or another component part of the health sector. Accordingly, at this point you may find it useful to compare your first projection, based on its own unique set of assumptions, against other projections developed in a similar way but with other sets of assumptions. To compare several alternative projections proceed as follows:

1. Complete your first requirements projection and save the data set with the BDT extension in the usual manner. Click the \textit{Save for compare/combine} command at the top of the spreadsheet and enter a DOS-type name of no more than eight letters and numbers to your first alternative; press <Enter>. You should choose a name that reminds you and others of the underlying assumptions used in the scenario. Examples might be HOSPEMPH, AMBUEMPH, URBANEMP, RURALEMP, FASTGROW, SLOWGROW, etc., which indicate which types of facilities or subsectors are receiving emphasis, or you could use the names of the authors of the several projections.

\textbf{IMPORTANT NOTE!} Whenever you compare or combine requirements projections each of the files must list the \textit{same} occupational categories (eg, doctors, nurses, dentists, etc.) in the \textit{same} sequence. Therefore, if you are planning to develop a national projection based on a number of different provincial or other subnational projections, you should establish in advance a common list of occupational categories, and enter them into the spreadsheets in the same sequence. If, for example, North province listed doctors first, and East province listed nurses first, then the Combine/Compare spreadsheet would provide you with erroneous information.

2. Using the first scenario projection as your template spreadsheet, and \textit{without changing any base year estimates whatsoever}, make changes in your target year assumptions. Base year values are now “past history” and once you have the best estimates possible, do not change them in your alternative scenarios. Save the second scenario’s data set under a different name and then use the \textit{Save for compare/combine} command as described in (1) above to save it. The Compare spreadsheet can handle up to nine alternative scenarios so repeat this process for additional alternatives if you wish.

3. Use the \textit{File/Open} command to open the Compare spreadsheet. You may do this with or without first closing the Require spreadsheet. Click the \textit{Setup} command and select \textit{Compare}. Enter the names of at least two and up to nine requirements data sets in the spaces provided and click OK. The names must be exactly as previously saved or otherwise the computer will indicate that it cannot make the comparison. You do not
have to enter the \textit{bdt} extension since this is done automatically by the computer. After a few seconds of calculations the computer will display the COMPARison table on the Compare page and you will see the results of your projections compared to the base year values, which were taken from the first data set. You may review and print this table in the usual way, using the print button on the Info page. To save this data set comparison for future use you must save the entire Compare bwb spreadsheet. While you may save the spreadsheet using the Compare filename, it is better that you use another name such as COMPARE1, COMPARE2, etc., so that you leave the Compare spreadsheet in its original form. Use the \textless F1\textgreater key while your cell pointer is on the COMPARison table for additional instructions.

Much could be written about the process of reviewing and selecting a preferred projection but this is not the place to do it. The options are virtually without limit and though the types of selection criteria will be reasonably similar from country to country --- coverage of care, quality of care, balance between hospital and ambulatory care, balance between curative and preventive services, economic, technical and administrative feasibility, national values and political considerations --- the relative importance attached to each criterion will vary widely among countries. About all that can be said here is that both planners and policymakers will have an easier time discussing the options and making their choices if they have first specified their selection criteria for each one. This dialogue among planners, policymakers, the many interest groups affected by the health sector and the public at large, may require many weeks or months before a consensus is reached. We hope you have been able to include numerous opportunities for consultation with these diverse groups so that by the time you reach this stage of the projection model, you will have a reasonable degree of support for your efforts.

\textbf{Combining multiple projections (Combine page)}

In some countries it may be desirable to combine multiple subnational requirements scenario projections into a single national projection. This situation could arise either because the country is large and health workforce planning is done on a subnational basis, or alternatively, that individual projections must be made for different health care systems, eg, Ministry of Health, Social Insurance health system, Armed Forces health system, etc. The Combine page makes it possible to aggregate the results of multiple projections. For this feature to function properly and provide you with valid numbers you \textit{must} observe the following precautions.

\begin{itemize}
  \item \textbf{Identical core inputs.} The SUPPLY tables in all of the projections must use the \textit{same} occupational categories listed in the \textit{same} sequence; the OCCUPREF tables must list the \textit{same} providers of visits (eg, doctors, nurses, etc.) in the \textit{same} sequence, and use the \textit{same} classification of personnel by level; and all projections must use the \textit{same} base, intermediate, and target years. The Compare spreadsheet
\end{itemize}
cannot check for and warn you about any differences in these parameters.

- **Avoid double-counting.** Avoid any overlap or duplication of values that will be combined. For example, the base year supply of each category of health worker must be the FTE supply that corresponds only to that province or health system, and the base year population must also correspond to either to the population in the province or to the beneficiary population eligible to the health system. In essence, to have valid indices and projections you must show a "combined" base year population that equals the actual base year population for the region or nation that is being planned for. Similarly, the combined base year supply of health workers must equal the actual supply of health workers. You may, however, assume different rates of population and economic growth.

Once you are ready to develop a combined projection, proceed as follows:

1. Complete and save the data sets for each of the requirements projections that you wish to combine. For each data set, use the Save for compare/combine command and enter a unique DOS-type file name that does not exceed eight letters and numbers; click OK. If making a national projection you would probably want to have filenames based on the provincial, state, or health system names. Close any open requirements or supply files so as to not overburden your computer’s memory.

2. Open the Compare spreadsheet, click Setup and select Combine. Enter the names of up to six of your data sets in the six blanks open to you. If you do not have more than six data sets, click OK and review your combined projection on the Combine page. If you have more than six data sets to combine, click the More projections? command, click the OK command twice (slowly, to allow the computer to interpret the command properly), and then enter the additional data set names. Continue this procedure with each set of six data sets. When you have entered all the data sets you wish to combine, click OK and review the results. The optional yellow box at the top of the COMBINE table is available for identifying information about your model. For example, you could enter the range of provinces or health systems that have been combined, the name of the geographic area (eg, country name, North Region, etc.), and the type of projection it represents.

Upon completion of data retrieval the Combine page will have two tables that are similar to those contained in the Require spreadsheet. The COMBINE table is similar to the SUMMARY table while the NEEDS table is similar to the REQuirements table. The tables may be printed in the usual way, using the buttons on the Info page.

At last! You have come to the end of these very lengthy and, at times complicated, instructions for the model. As noted earlier, very simple models omit many important variables that affect how the health sector operates, and more comprehensive models quickly increase data requirements and model complexity. Compared to some of the
models used in highly industrialized countries, the World Health Organization models are much less demanding of data requirements and computer skills, but they are certainly not simple afternoon exercises. As you gain experience with these models we hope you will find them versatile, relatively easy to modify, and above all, helpful in assessing workforce policy options open to your country. The appendices that follow will provide you with additional information that can help you make best use of your projection models.
APPENDICES

Annotated Table of Contents

Appendix A. **Glossary of planning terms.** Provides a glossary of terms commonly used with reference to the development of human resources for health.

Appendix B. **Occupational categories and work locations.** Provides a list of possible names for different occupational categories and types of health facilities.

Appendix C. **Questions and answers about the projection models.** Provides answers to commonly asked questions concerning the projection models and the data requirements for these models; also lists the upper and lower ranges of expenditures and productivities within which most countries will be found.

Appendix D. **Achieving desired outcomes.** Describes each major input estimate or planning assumption, and indicates the potential magnitude of the variable's effect on model outputs; provides guidance to making reasonable assumptions about the future, and to assessing the potential for data output errors due to data input errors; indicates the variables you should change in order to achieve desired health system outcomes.

Appendix E. **Relevant topics, appendices and guidelines.** Provides a list of topics, appendices and guidelines contained in the computer files of the document entitled, *HUMAN RESOURCES FOR HEALTH: A Tool Kit for Planning, Training and Management*, that are of relevance to developing a strategic plan for the development of human resources for health.

Appendix F. **Sample letter describing a new health workforce study.** Provides illustrative text that could be adapted for use in a letter or memo to persons interested in or affected by a survey and/or study of human resources for health.

Appendix G. **Troubleshooting the projection models.** Suggests ways to identify and resolve some of the more complicated problems you may have with your projection models.

Appendix H. **Template data collection work sheets.** Provides blank tables for the collection and recording of input data. These tables can be photocopied and used using it in the projection models.

Appendix I. **Computer commands and troubleshooting.** Provides summary explanations of how to perform many common tasks, and suggestions about how to resolve computer-related problems that may arise.
Appendix J. **Supply model figures, tables and graphs.** Provides printouts of the tables contained in the supply model. (This appendix is not provided in the HRH ToolKit version but can be produced by printing the tables produced by the demonstration dataset.)

Appendix K. **Requirements model figures, tables and graphs.** Provides printouts of the main data and reference tables contained in the requirements model. (This appendix is not provided in the HRH ToolKit version but can be produced by printing the tables produced by the demonstration dataset.)

Appendix L. **Combine spreadsheet figures, tables and graphs.** Provides printouts of selected tables produced by the COMBINE file for use in comparing several alternative projections for the same geographic region, and for combining projections for multiple geographic regions. (This appendix is not provided in the HRH ToolKit version but can be produced by printing the tables produced by the demonstration dataset.)

Appendix M. **Step-by-Step Model Instructions.** Provides detailed step-by-step instructions about the models that can be used either by an individual user or in a classroom training session; includes illustrative exercises based on the demonstration data sets.

Appendix N. **Instructions for the Microsoft Excel model.** This brief document describes how to load and manipulate the base features of the Excel version of the models. It does not duplicate the far more detailed instructions available in the present document.
Appendix A. Glossary of planning terms

Many of the below terms are used in this document and/or in the various spreadsheet tables, and other terms, though not used here, are relevant to the planning of human resources for health.

APPLICANT, QUALIFIED: an applicant who meets the standards for acceptance into training, whether or not accepted into the training program

APPLICANT: a person who applies for training in a health discipline

BASE YEAR: the most recent year for which adequate data are available upon which to base the projections

CERTIFICATION: the act of verifying and documenting (through a certificate) either that a health worker has completed a course of study and is eligible to work, or that a health institution (hospital, clinic, etc.) can operate

COHORT: group of students, graduates, or other persons identified at a point or period in time, and followed over time, eg, graduates from the class of 1980

DATABASE PROGRAM: a computer software program that permits the storage, retrieval and manipulation of numerical and textual information.

DISCIPLINE: the field of study, eg, medicine, nursing, psychology, administration, biology

ENROLMENT: the total number of students in a training institution or program, or in a specific class (first year, second year, etc.) of students

FORECAST: an attempt to predict future events; implies greater certainty and less manipulation of variables than a projection or scenario

FOREIGN (national or graduate): as used in the projection models, refers to a person of foreign nationality and/or foreign training who is in the country either as a permanent resident or for training; many countries also use the term `overseas' to denote foreign

FTE (full-time equivalent, or whole-time equivalent): the amount of working time normally provided by a person who is full-time, time which can be provided either by one person or several persons working part-time and whose time adds up to the equivalent of a full-time worker
GRADUATE: a person who has completed formal training for a health career

HEALTH WORKER: a person working full- or part-time in health-related work; the term is usually applied irrespective of previous training, paid or volunteer status, or whether the work is carried out in the public or private sector

HUMAN RESOURCES FOR HEALTH: all persons working to promote, protect or restore health, whether paid or not, or formally trained or not

INCREMENTS, or ADDITIONS TO THE SUPPLY: both terms refer to new health personnel that have been added to the workforce through training or direct hire; NEW GRADUATES refers solely to health personnel added to the workforce through training

LICENSED / LICENTIATE: a person whose qualifications have been reviewed by an appropriate authority and who as a result has been licensed for provide specified services

LOSSES, ATTRITION, or WASTAGE: health personnel permanently lost to the workforce for any reason including death, retirement or transfer to other occupations or areas

MODEL, DETERMINISTIC: a model in which there is a specified, non-random relationship between inputs and outputs as, for example, a doubling of student intakes, with all other variables held constant, will result in a doubling of school outputs

MODEL / MODELING: an attempt to represent by physical, mathematical, graphical or other means what is happening in the real world for purposes of analyzing, testing or predicting the effects of change

MODEL, RUN-TIME: a computer model that contains both the application software and the actual files that make it useful; with a run-time model users do not require a separate application program such as Lotus 1-2-3 or Excel in order to use the model

MODULE(S): unit(s) of training materials, programs, buildings, or plans which fit together in some predetermined and functional way, eg, course or workshop modules, clinic or service planning modules, computer projection modules

NATIONAL (citizen): a person who is a citizen of the country under consideration

NORM or STANDARD: the observed or intended practice or pattern of behavior, eg, four doctor visits per hour, two nurse hours per bed-day

OCCUPATIONAL CATEGORY: type of health worker as, for example, professional nurse, dentist, physician, auxiliary nurse, laboratory technician
PERSONNEL: same as `health workers’, though often used with special reference to salaried staff

PRODUCTION: refers to the production (or training) of health workers; also, the production of goods or services

PROJECTION: an estimate of a future situation based on certain stated assumptions about the future and on past patterns of performance, utilization, etc.

REGISTERED: a health worker, facility or program that has been duly recognized by the authorities

SCENARIOS: alternative views of what the future could look like, assuming the specified planning assumptions are fulfilled; scenarios may be more or less realistic, but they are never wrong, since they are not predictions of what will actually happen

SENSITIVITY: the degree to which one variable changes in relation to another variable, eg, a 5% increase in variable A results in a 1% increase in variable B

SIMULATION: actions designed to duplicate as much as possible a real event or system, eg, a student doctor pretends to be a patient for purposes of training; a planner studies by means of a model the relationship between the supply of and demand for health services

SPECIALTY: a field of medicine, nursing, administration or other basic discipline in which a person has particular expertise

SPREADSHEET: a system, now usually electronic, for data storage and retrieval which permits the display, tabulation and manipulation of diverse data

STAFF: same as `health workers’, though generally used with reference to salaried persons

STUDENT LOSSES/WASTAGE: percentage of entrants to a training program who do not complete the program

STUDENT, ENROLLED: student enrolled in any year of a course of studies

STUDENT, ENTRANT: student newly entered into a course of studies

SUPPLY, ACTIVE: health personnel who provide part- or full-time service; also known as `economically active supply'
SUPPLY, CURRENT: supply data that refer to the current or most recent reporting period

SUPPLY, INACTIVE: health personnel who, by virtue of training, age and other factors, could provide service but are not doing so

SUPPLY: the actual or potential availability of health personnel to provide services

TARGET YEAR: a future year for which a projection or scenario has been made

TEACHING PERSONNEL, FACULTY: persons who teach health workers, whether part- or full-time; may also include research personnel

TEACHING PERSONNEL, STAFF: those who provide support to faculty of a technical, administrative or service nature

TEMPLATE: a table or form that can be adapted and then duplicated for use in a given planning situation

TRAINING, POSTBASIC: short- or longer-term training after completion of the initial training program, eg, specialization following completion of basic medical or nursing training

TRAINING PROGRAM: a set of activities designed to prepare students to perform specific tasks and functions; this term is used instead of school or university since some training programs are outside of these institutions and some universities or schools train multiple categories of health workers

VARIABLE, DEPENDENT: any reality or event whose condition is determined by another (or `predictor') variable, eg, symptoms of poisoning (dependent variable) result from exposure to a toxic substance; often referred to as the `outcome' variable

VARIABLE, INDEPENDENT: a variable not affected by other variables under consideration, eg, gender, age; an independent variable is often called a `predictor’ variable. It can be used as the basis for forecasting future events such as utilization, morbidity, etc.

WORKFORCE (HEALTH): refers to the health workers actively engaged in the provision of health services
Appendix B. Occupational categories and work locations

This appendix presents a list of the major occupational categories and work locations found in the health sector. For many occupational categories there are specialist, assistant, auxiliary and/or aide levels which could be added, preferably starting with the primary title and then followed by the assistant level denomination, e.g., DOCTOR, ASST. In some cases alternative titles or relatively similar occupational categories are listed on the same line. By reviewing this list before deciding which occupational categories and work locations to use in the projection models, users can help avoid significant omissions or complications in the later reorganization of the data. The terms actually used should be in accord with those in common use in the country for which projections are being made.

Occupational categories. These are familiar titles. The terms used in the supply and requirements tables should be limited to about 11 characters, including spaces. The requirements model allows projection of ambulatory visits by up to three occupational categories, and preferably the titles used for these categories should be somewhat shorter. This is because titles will also be printed by the computer as column headings. The long list of possible medical and nursing specialties is listed for convenience but the requirements model can only accept up to 9 medical and 9 nursing specialties, with the 10th row assigned to “all other specialties.” A possible specialty listing for doctors of medicine might include the following: generalist; general internal medicine; medicine subspecialties; general surgery; surgical subspecialties; anesthesiology; pediatrics; obstetrics and gynecology; public health; all other specialties. The supply model could also be adapted for projection of specialties, in groups of five. Further suggestions as to how this can be done are presented in Appendix C.

MEDICAL PERSONNEL
Doctor; medical officer
House officer; resident; registrar
Physician assistant; assistant doctor

--- Internal medicine specialties

Allergy
Cardiology
Clinical hematology
Clinical immunology
Clinical pharmacology
Clinical physiology
Clinical toxicology
Endocrinology
Gastroenterology

General medicine
Geriatric medicine; gerontology
Infectious diseases
Medical genetics
Medical oncology
Nephrology
Neurology
Nuclear medicine
Physical science
Respiratory medicine
Rheumatology

--- Surgical specialties

Cardiothoracic surgery
Colorectal surgery
Ear, nose and throat surgery
General surgery
Head & neck surgery
Maxillofacial surgery
Neurosurgery
Oral surgery
Orthopedic surgery
Pediatric surgery
Plastic surgery
Urology
Vascular surgery

--- Other specialties

Administrative medicine
Anesthesiology
Dermatology
Emergency medicine
Laboratory medicine
Obstetrics & gynecology
Occupational medicine
Ophthalmology
Pathology
Pediatrics
Primary care (or General practice, or Family medicine)
Psychiatry
Public health & preventive medicine
Radiation oncology
Radiology
Rehabilitation medicine
Sports medicine
Tropical medicine
Venereology
Other specialties and unclassified

NURSING AND MIDWIFERY PERSONNEL

Nurse; nurse practitioner; nurse clinician; nurse-midwife
Nurse auxiliary; enrolled nurse; nurse aide; nurse assistant; licensed practical nurse
Midwife; auxiliary midwife; midwifery aide; public health midwife
Traditional birth attendant (TBA)

TECHNOLOGISTS, TECHNICIANS, THERAPISTS
Audiologist; Speech pathologist
Cytotechnologist
Laboratory technologist; laboratory technician
Nuclear medicine technologist; technician
Occupational therapist; OT assistant; OT aide
Physical therapist; physiotherapist; PT assistant; PT aide
Psychologist
Radiation therapy technologist; RT technician
Radiographer; x-ray technician
Recreational therapist
Respiratory therapist; respiratory technician; respiratory assistant
Social worker; psychiatric social worker; social worker assistant/aide

PUBLIC HEALTH PERSONNEL
Biostatistician; statistician
Chronic disease specialist
Communicable disease specialist
Community health worker
Environmental health specialist; sanitary engineer; sanitarian
Epidemiologist
Family planning/population specialist
Gerontology/long term care specialist
Health planner
Health economist
Health administrator / manager
Health educator; health promotion specialist
Health information systems/informatics specialist
Health services researcher
Malaria control specialist
Maternal and child health specialist
Mental health specialist
Nutritionist; dietician
Parasitologist
Public health nurse
Sexually transmitted disease specialist
Social worker
Veterinarian public health specialist
Virologist

**ORAL HEALTH**
Dentist
Dental assistant, or auxiliary; extended duty dental assistant
Dental hygienist
Dental technician

**ALLIED HEALTH PERSONNEL**
Administrator; assistant administrator
Community health worker, aide, or auxiliary
Health center aide; health post aide
Health promotion worker, aide or auxiliary
Medical records technician; medical records librarian
Medical records administrator
Nutritionist; dietician; dietetic technician
Optometrist; optician
Pharmacist; pharmacy assistant; pharmacy technician
Podiatrist
Veterinarian

**Work locations.** The terms used in the supply and requirements tables should be limited to 7-10 characters since these terms will be automatically inserted as column headings in the appropriate tables. To accommodate seven types of institutions the columns are necessarily rather narrow. Possible abbreviated terms that are within an arbitrary character limit are listed at the left-hand margin but users may specify other terms to meet their national needs.

**CLINICAL WORK LOCATIONS THAT PROVIDE INPATIENT CARE**
NatlHsp --- National (acute care) hospital (usually for tertiary care, and often attached to a medical school)
MentHsp --- Mental hospital, psychiatric hospital
SpecHsp --- Specialized hospital, eg, for cancer, neurological diseases, etc.
InfChsp --- Infectious disease hospital, tuberculosis hospital
PedsHsp --- Pediatric hospital
MatyHsp --- Maternity hospital
ChroHsp --- Chronic disease hospital, long-term care hospital, or convalescent home
RegHsp --- Regional (acute care) hospital (often for tertiary care)
DistHsp --- District (acute care) hospital (generally for secondary care)
MiliHsp --- Military hospital
HCtr-A --- Health center (if with beds); also HCentre

Note: All private sector hospitals, including those owned and operated by churches, industries, other not-for-profit organizations, and investor or doctor-owned for-profit hospitals are considered as a group.

If the country has pre-defined hospital levels or types....

Hosp-A --- Hospital type (or level) `A', `B', etc.
Hosp-1 --- Hospital type (or level) `1', `2', etc.

CLINICAL WORK LOCATIONS WITHOUT INPATIENT CARE

HlthCtr --- Health center (if without beds); alternatively
HCtr-A --- Health center type A, type B, etc.
HPost-A --- Health post, type A, Type B, etc.
PolyCli --- Polyclinic (generally urban) that is not located in a hospital
MCHClin --- Maternal and child health clinic or post

NON-CLINICAL WORK LOCATIONS. The requirements model provides two tables for non-clinical public health workers and for academic personnel. These tables make it possible to include personnel based in work locations that meet two conditions: (1) they employ substantial numbers of health workers of the occupational categories included in the model; and (2) the health workers in these programs are, for the most part, not based at either hospitals or clinics. The documentation section describing these tables indicates what types of organizations might meet these criteria.

Appendix C. Questions and answers about the models

This appendix provides answers to commonly asked questions concerning the projection models and about the data requirements for the supply and requirements models. At the end of this appendix are some typical Rules of
Model uses, limitations and general questions

What can the models do? -- The models can project the likely supply of and requirements for health workers based on alternative scenarios of how the health system might evolve in the future. Each supply model file projects up to 5 user-specified occupational categories at five-year intervals for a total of 30 years; multiple files can be developed to accommodate more than 5 occupations. The model takes into account such variables as school intakes, school graduation rates, net cross boundary flows of recent graduates, and loss rates following graduation according to gender and time period. In the requirements model users can specify any target year, up to 15 different occupational categories, and can test the effects of changes affecting five major sets of work locations where health workers are employed, i.e., public sector hospitals, public sector clinics, training institutions, non-clinical public health services, and the private sector. Both models also make it possible to test the potential economic feasibility of each projection, and the requirements model projects the possible production and distribution of services.

What are the models' limitations? Alone, the models are not, and cannot be considered, a strategic health workforce plan. They are a tool for helping policymakers make decisions -- nothing more, and nothing less. They show the potential workforce supply and requirements, costs, and production of services according to differing sets of assumptions. Policymakers can then consider the advantages and disadvantages of each scenario as a basis for deciding on a preferred course of action. The models can help with the planning process, but their outputs are not a 'plan' in any sense of the word, since a plan must not only specify the objectives and their underlying assumptions, but also how to attain the desired objectives. Besides this fundamental consideration, the models have limited utility for short-term projections (<5 years), small populations (<100,000), or program-specific planning. They cannot project budgets, and they do not take into account qualitative measures of health system performance. Such variables as 'quality', 'cost-effectiveness', and health status must be addressed by other means.

Why use long planning periods? Only by using a projection period of 10-30 years is it possible to consider the potential costs and benefits of substantial changes in the number, mix and geographic distribution of health facilities and personnel. With a short-term projection it is not feasible to test the merits of any significant health system changes. The requirements model can
make intermediate year projections based on the longer range projection scenario.

This question can be answered in more detail by contrasting shorter-term planning, which often involves micro-analysis of the situation and can be likened to looking through a microscope, with longer-term planning, which is like looking through a telescope. The projection models seek to provide planners and policymakers with guidance regarding (1) the rate at which the health sector can grow consistent with a country’s ability to support it, and (2) with guidance regarding the approximate numbers and mix of the different categories of health personnel and of work locations. Detailed measures of productivity, efficiency, qualitative performance, and assessments of morbidity and mortality are all highly relevant for shorter-term planning but are not realistically possible over a longer term of, say, more than about five years. Since there is usually a long lag period between making decisions to change the number, qualifications or deployment of health personnel, one must extend projections out for at least 10 years and preferably longer. However, it is unrealistic to try to anticipate the details of how such personnel will be actually utilized that many years ahead; many of tomorrow’s health system administrators will be different from those of today and they will face significantly different problems. The central tasks for planners and policymakers are to set in motion policies that will provide future administrators with a reasonable and affordable mix of personnel. Today’s administrators must make use of a workforce that in its majority was trained 5-40 years ago, often in inappropriate quantities and/or with inappropriate skills. Our task is to reduce these constraints for future administrators to the greatest extent possible.

**How often should the models be updated?** Every 2-3 years should be sufficient. Model updates will be much easier and quicker than to complete them the first time.

**What year should be the base year?** The base year is the most recent year for which reasonably complete information is available; in most cases this will be the most recent complete calendar or fiscal year.

**What are full-time equivalents?** Most health worker estimates should be expressed in full-time equivalents, ie, FTEs. Two half-time or three third-time workers are equal to one FTE. A FTE is one person working the average number of regular service hours per day or per week, eg, 7-8 hours per day, and perhaps 35-45 hours per week, not counting time spent 'on-call' time during nights and weekends.

**What about unknown values?** WHAT SHOULD I DO IF I DON’T KNOW HOW TO COUNT OR ALLOCATE A VALUE? If you will be attending a workshop on the computer models, bring the facts or estimates as you
understand them to the next workshop and we will help you determine the best way to accommodate them, and if you are not participating in a workshop, review the appropriate documentation for ideas as to how you can come up with realistic estimates. Almost always you will be able, perhaps with the help of persons familiar with the situation, to set upper and lower bounds of possible values. These are values that most informed persons consider very likely to encompass the true value, if it could be known. For example, well informed private sector physicians might estimate that it is very unlikely that the average doctor spends more than 85% of his time attending to patients, or less than 65%. With these boundary limits, you can then try alternative best guess estimates within these boundaries to see how they effect the projections and the potential errors they might introduce. In virtually all cases you will find it better to make a reasonable estimate, which can be improved over time, than to leave the cell(s) blank.

My totals don't add up. The spreadsheet has been programmed to display most numbers only to the nearest whole number, whereas the computer actually records numbers with much greater accuracy. Thus, for example, two numbers displayed in the spreadsheet as 2 + 3 may in fact be 2.465372 + 3.384293 in the computer. These numbers round off to 2 and 3 in the spreadsheet but the computer calculated total of 5.7 will be displayed as 6 in the spreadsheet.

Demographic questions

How can I make long-term population projections? No one can make consistently accurate demographic growth projections decades into the future. However, population is by far the most important single variable that affects health sector requirements and one must make a reasonable estimate of population growth. Though precise rates are not possible, rapid changes in the growth rate are unlikely, especially in the absence of vigorous efforts to reduce fertility and/or major disasters or migrations. The safest approach is to project the best estimate of demographic experts for the first decade and then use informed guesses as to the reasonable evolution of the growth rate thereafter. For countries with a high growth rate (over 2%) a moderate reduction of at least several tenths of a percent is probably reasonable since these rates cannot be sustained indefinitely. All population estimates should be rounded to the nearest 1000, eg, a population of 12,345,678 should be entered as 12346.

Economic questions

What currency should be used? Your expenditure and income estimates should always be in current (base year) monetary values, and your target year projections should make no provision for inflation, which cannot be
predicted. Observe carefully whether monetary estimates are to be entered in units (as in the INCOMES table), or millions (as for expenditures).

**GDP or GNP?** (This question is applicable only if you choose to complete the lower section of the ECONTEST table.) All economic estimates (GDP, public sector, public health sector, incomes, etc.) should be expressed in the same currency units, preferably adjusted to the base year. If the gross domestic product (GDP) is not available the gross national product (GNP) can be used. Public sector expenditures should preferably include payments on the public debt, since they are charges against total public sector revenues.

**What are public sector expenditures?** These include salaries, drugs, supplies, equipment and contract labor and services and if possible, should exclude major capital investments. These latter expenditures are best excluded from your model since these may fluctuate widely from year to year and hence complicate the interpretation.

**How can I determine public sector incomes?** Public sector salaries for newly graduated and hired personnel, and for those at the end of their careers just before retirement, can be obtained from the official salary scale. You may wish to adjust these estimates upwards to take into account other major non-paycheck costs of public sector employees, including pensions, medical benefits, bonuses, and other benefits such as free housing, etc. If there are several different public sector salary scales for different segments of the public sector (eg, Ministry of Health, Armed Forces health system), the scale applicable to the largest number of public sector personnel should be used. ‘Average’ salaries should be your estimate of the average of all public sector employees of the specified occupational category, taking into account the approximate age, seniority structure and salary gradient applicable to that category. By way of illustration, assume the following for laboratory technicians: A typical beginning salary of 10,000 per year; a salary gradient that typically increases by about 2,000 for every five years of service until reaching 18,000 at 20 years of service and then increases another 2,000 to a maximum of 20,000 at 30 years of service and stays the same thereafter. If the laboratory technician workforce is quite young and the majority have less than 10 years of service, the average salary could be estimated at approximately 14,000.

More important than making precise estimates of the average amount earned is making a good estimate of the *relative* amounts earned by the different occupational categories, eg, doctors earn four times the lowest income, nurses earn two times, etc. An alternative to estimating the current average annual income of each occupational category is to use the average starting income for a health worker newly employed. If incomes rise at approximately the same
percentage rate for all categories, the starting income will provide a good estimate of the relative incomes.

**How can I determine private practice incomes?** The requirements model does not require or project private sector incomes, either from salaries or the private practice of medicine, dentistry, etc. The underlying assumption of the income component of the model is that government is cr incomes and the relationship these have to public sector revenues. However, the model can use approximate gross base incomes from private practice for up to three different user-specified practitioners. These would typically include at least doctors and dentists, and perhaps midwives or pharmacists. The income model is described in the documentation regarding COSTS table. Users specify up to three occupational categories working in private practice for which they would like to estimate the number of services produced and, if desired, gross moneys obtained from these services. The results shown in the lower two-thirds of the COSTS table is based on estimates of the following variables, illustrated by reference to doctors:

- Number of FTE doctors working in private practice
- Average hours worked per year per FTE doctor
- Average percentage of time spent attending to patients
- Average patients seen per hour of practice
- Average fee charged per patient

These estimates do not take into account, or only very crudely, income obtained from providing care to hospitalized patients, or from other activities besides seeing patients. It must also be recalled that private practitioners will charge quite different fees depending on their degree of specialization, location, type of service, and the patient's ability to pay.

Though the resulting income estimates are necessarily very rough, they may help suggest the degree to which private and public sector pay scales are similar. In most countries private sector pay rates will be considerably above those received in the public sector, and if the difference becomes too great without major compensating non-cash public sector benefits (eg, retirement, housing, training, vacation, maternity and sick leave) it may be difficult for public sector employers to retain their staffs.

As a final observation, it should be relatively easy to generate the necessary input estimates for private practice. This can be done by consulting a few knowledgeable doctors, dentists, midwives, etc., preferably those with part-time government employment who also have part-time private practices. Ask them for their (1) best guess estimates, (2) their maximum estimates, and (3) their minimum estimates of each of the several variables listed above. The maximum
and minimum estimates are those values that encompass the likely true values of each variable, if they could be known. For example, if the 'best guess' estimate of the average number of patients per hour is 5, this might be bracketed by 6 and 3.5, meaning that your informant thinks it highly unlikely that the average value would be above 6 or below 3.5. The average estimates should be used in the model and the maximum and minimum estimates will provide you with a sense of the potential for error.

**How can I figure in foreign financial assistance?** The description given for the ECONTEST table provides details for those countries that receive a substantial amount of their recurrent budget from foreign sources. This provision makes it possible for such countries to make their projected estimates of moneys available in the public sector more realistic.

**Requirements questions**

**Must I complete all model components?** No! The model has a core module and several optional ones (economic feasibility, production of services, distribution of services, and intermediate year projection). You must complete the core module but the others can be completed according to data availability and interest. The core module includes tables that make it possible to estimate specialist requirements; this section is optional.

**What about changing morbidity and mortality patterns?** If major changes in morbidity and mortality patterns due to aging or changes in disease prevalence are anticipated, you can make appropriate changes in the size, geographic distribution, characteristics of the health facilities, and in the staffing norms for each type of facility, to better meet these new conditions.

**Economic feasibility test.** This test indicates the degree to which the public sector requirements projection is likely to be economically feasible, based on your assumptions about economic, health sector, and staff salary growth. The economic module cannot be used to project budgets. Since the model is designed for strategic, longer range planning, data inputs are not sufficiently precise for budgeting, nor does the model take into account inflation and many other short term factors that affect budgets.

**Relative importance of input variables.** For determining requirements: population growth, health facility numbers and characteristics, and staffing norms. For determining costs: population growth, health facility numbers and characteristics, staffing norms, the average rate of growth in public sector salaries, and the proportion of high cost health workers. For determining economic feasibility: those variables that affect costs and the assumed rate of
growth in personnel expenditures, and the proportion of the health sector allocated to personnel.

**New health worker functions.** The model accommodates up to 15 different-specified occupational categories but does not say anything about the assumed functions of each category in either the base or target year. Accordingly, you may wish to develop your target year staffing norms based on the assumption that there will be significant changes in the roles and responsibilities fulfilled by at least some of your occupational categories. A hypothetical example can illustrate how this might work. Assume that in the base year of your country the dental assistant category was trained in a three-month course to be a chair-side assistant to a qualified dentist and to have no independent responsibilities for providing basic dental services. The number and distribution of base year dental assistants would have been based on this limited scope of practice. Now assume that by the target year it is planned that this category will receive one year of training and that dental assistants will have the skills necessary to perform simple fillings, extractions, and other basic procedures, and to work somewhat independently of a dentist. Target year staffing norms, as recorded in the HOSPSTAFF and AMBUSTAFF tables, would be based on these expanded functions.

**Fractional staffing norms.** This is entirely possible though will probably not be justified for larger facilities such as hospitals and polyclinics. However, if you anticipate that, on average, smaller facilities such as health posts or health centers will employ, say, 1.5 FTE of a given occupational category, this may be entered as 1.5 in the appropriate staffing norm table(s). Even if the decimal place does not appear on the table, the fractional value is used by the computer to make the necessary calculations. The use of fractional staff may be especially appropriate in the case of small rural facilities that receive weekly or bi-weekly visits by a doctor or nurse, eg, one half-day visit per week to a health post by a doctor would mean a doctor staffing norm of 0.1 FTE.

**Primary health care emphasis.** This would be done by increasing the number of work locations that emphasize PHC (eg, health centers, health posts), and by improving their geographic coverage, staffing standards, and assumed allocation of staff time among the various functions and tasks. For example, in the base year you might have an average of one primary health center per 50,000 population, and then plan for a target year average of one center per 30,000.

**Health worker outputs.** Although visits and discharges are major service outputs of the health system, they are by no means the only outputs and they certainly represent only a small part of the public health and preventive services offered by a modern health system. However, to try to list all the major service
outputs of such diverse categories as, say, technicians, therapists, nutritionists, public health, environmental health, and community health workers would make the model extremely complex without necessarily adding to its utility for long range sectoral planning. Moreover, many countries would likely have great difficulty providing data on such service outputs.

**Ambulatory visits.** A visit refers to a contact between a specified type of health care worker such as a doctor, dentist, or midwife, and a ambulatory patient for the purpose of promoting, protecting or restoring the patient's health. Visits may occur in a variety of ambulatory care settings such as a hospital clinic, health center or post, or other type of free-standing ambulatory clinic. The visit may involve only a very brief followup check or a complete examination and treatment. The definition of a visit is whatever your country considers a visit for statistical purposes. In the frequent situation where a `visit' involves one patient being seen by two or more providers, eg, a doctor, nurse, midwife, and auxiliary, the visit should be counted only once, and should be attributed to the highest level of provider or the one who provides the most substantial service, at your choice. The `visit' is a rough indicator of the volume of ambulatory services provided but obviously includes many different types of services. A visit solely for an immunization should probably not be counted since it will greatly inflate the total number of visits and give a false impression of the true magnitude of the services provided. Doctor visits to hospitalized patients should not be counted.

**Changing types of work locations.** For the base year list only those types of work locations that are already present, leaving one or two columns vacant for the new types of work locations you would like to plan for in the target year. Then include the proposed names for these `new' types of work locations in your listing for the target year.

**Staffing norms based on districts.** For example, assume that in the base year you listed the numbers of small hospitals, health centers and health posts for the delivery of services to the rural population but that your country plans to provide services based on health districts serving an average of 150,000 person for the rural half of the national population. Each district in this new scheme is to include a variety work locations. In this case you could complete the tables as follows, adjusting the service area populations so they take into account only the rural half of the population.

1. In the Rural District Hospital column in the HOSPital table enter a target year average service area population per hospital per 150,000 in the rural half of the national population.

2. In the AMBUlatory table, group all ambulatory services into one single `HlthDist' column with an average service area population of 300,000, which will
result in one rural health district per 150,000 rural population. The average staff density for all district-level ambulatory services together would be entered in the appropriate HlthDist column in the AMBUSTAFF table.

**Small occupational categories.** Supply and requirements projections for such categories as information system analysts, operations research specialists, microbiologists, toxicologists, chemists, nuclear medicine physicists, sanitary engineers, and the like should be made separately, apart from the models. While these categories could be included in both the supply and requirements models, their inclusion would limit the number of other, much more numerous (and hence more costly) categories that can be listed. Moreover, these specialized professionals often come from training institutions outside of the health sector and their requirements are not apt to be as closely linked to any given type of work location as are the more traditional health worker categories.

**Projecting specialist requirements.** For doctors and nurses you can use the tables HOSPSPEC, AMBUSPEC, and REQSPEC to project up to 9 specialist categories plus “All other specialties.” Though the models come with suggested categories, you can change the nine listed ones to meet your own needs and terminology. The STAFF1, STAFF2, and STAFF3 tables in the Utility page will be of assistance in developing these norms. As you prepare specialist norms you should be careful to observe two major precautions. First, be sure that you use specialist staffing norms for each type of work location that, in the aggregate, exactly add up to the same number of doctors you had proposed each location. For example, if your general model used a staffing norm of 10 doctors for a district hospital, then your specialist model should also have 10 doctors, divided up among the several specialties. Second, either leave the private sector section staffing norms with zeros or preferably, make rough estimates of the specialty distribution that is likely to evolve in the private sector.

It will probably not be realistic to attempt long-range scenario projections for more than the nine named medical and nursing specialist categories since the numbers will be quite small and subspecialty roles and functions are subject to much change over time. However, if you want to make more detailed projections of medical and/or nursing specialists you can open another requirements file for this purpose. Specialist scenario projections for other occupations besides medicine and nursing can be made using separate model files dedicated to a single occupation. Taking the example of dentists you would open a requirements file for dentists and then list up to 15 dental specialties in the SUPPLY table. You would then proceed to complete the rest of the file in the usual way, using the HOSPSTAFF, AMBUSTAFF, ACADemic, PUBHEALTH and PRIVSTAFF tables to enter the number of specialists of each type required for each type of work location.
**Expatriate doctors.** Expatriate doctors should be counted the same as national doctors if they are in fact working as doctors, instructors or medical administrators. If the proportion of expatriate doctors is high, eg, say more than 20%, and if you anticipate that this proportion is likely to diminish significantly in the future beyond that caused by normal retirement, you should consider using a higher than normal attrition rate in your projection of the supply of doctors, at least for those age groups that include most of the expatriate doctors.

**Health workers not in named locations.** The requirements model will accommodate health workers in up to 14 different public sector clinical work locations, up to 15 different types of academic institutions, and in non-clinical public health locations. These should accommodate the great majority of health workers but there may be a few that are outside of these locations. Requirements for these personnel can: (1) be estimated independently of the model, or (2) included in a separate requirements spreadsheet model, used only for these categories of personnel.

**Must I use the same occupations in both models?** No, though generally these two sets of projections should, for the most part, overlap, at least for those with substantial health-related training. You will manually transfer the supply projections made for each category to the COMPARE table in the requirements spreadsheet. Since service and support personnel often account for at least 20% of the health workforce you may want to include them as a single category in the requirements projections, but it would not make sense to attempt a projection of their supply since they are a very diverse group, they are usually not trained by the health sector and in any event, their training is either on-the-job or in very short courses.

**What about community health workers.** The preferred method is to include them in the staffing norm for the facility that pays, supervises and/or otherwise supports their work. For example, if the average health center has three satellite health posts, each staffed by a single resident community health aide, the health center staff complement can include these three aides. Alternatively, you can list a separate work location for health posts. You should probably not try to list a separate work location for unpaid or minimally paid community health workers or health promoters. While this could be done, it will use up one of your seven public sector ambulatory work location options and because of their minimal or non-existent pay, such personnel will not weigh significantly on the health budget. Requirements for this type of personnel can best be estimated by separate analysis.

**Classifying teaching personnel.** If their primary responsibility is teaching, you should classify them as teaching personnel, even though they also render substantial patient service and/or are conducting research. Alternatively,
you could count them as part of the clinical staff. The essential point is to avoid double counting teaching personnel in both the clinical and teaching work locations. While it is theoretically possible to distribute instructor time in the model according to function, eg, 15 FTE instructors who spend one-third of their time (5 FTEs) providing service and two-thirds (10 FTEs) to teaching and research, this attempt at greater accuracy is probably not meaningful and has the potential to complicate data interpretation.

**What about indigenous health workers?** Both the supply and requirements models could include such personnel but unless they meet at least three criteria, you should leave them out. The criteria are: indigenous health workers receive at least a substantial part of their health-related training in public sector programs; they are a numerically large group; and their incomes are largely obtained from public sector sources.

**How do I count students who provide health services?** Students of all types should not be included in the clinical staffing norms, even though they render some service. Medical interns who have not yet received their full authorization to practice can either be counted as `students' and left out of the staffing norms, or included in the doctor staffing norms, whichever is easier. Probably the best alternative is to count them as doctors and hence part of the regular staff as soon as they are fully licensed to practice, even though they are in a postdoctoral specialty program, and to not count them in the staff complement while they are still completing their undergraduate training requirements. All options have difficulties but model utility is not significantly impaired whichever method you choose.

**Researchers.** For most low income countries the percentage of the health workforce involved in research is not large (perhaps 1-2%), and is almost entirely limited to doctors. Nevertheless, the requirements model can take such personnel into account. Researchers who work primarily in an academic work location should be included with academic instructors and administrators in the ACADemic table, and those working primarily in a non-clinical public health institution such as a National Institute of Health, should be included along with other staff in the PUBHEALTH table. By this means the small, but very important research component can be fully accommodated in your projections.

**Administrators.** Administrative personnel of all levels are an important but rather more complex occupational category than are most of the health-related occupations. Although relatively numerous, accounting for at least 5% to 10% of the health workforce, they present the planner with several problems: most training in higher level administration is given outside of the health sector in a wide variety of programs; and administrative personnel encompass such a broad range of skills that they are hard to count, much less categorize.
Accordingly, for purposes of the models most users may find it advantageous to (1) exclude administrators from the supply projections and (2) consider including at least some of them in the requirements projections. Unless a good operational definition can be used for `administrator', a supply projection will have little meaning and in any event, since the health sector will use only a small proportion of a nation's cadre of trained administrators, supply projections of the output of administrative training programs will not be useful. However, for projecting requirements it will probably be useful to allocate at least one and perhaps two of the occupational categories to administrators. If two categories are used one might be for high level administrators, with the equivalent of a university education in a field relevant to administration, and the other to mid-level administrators with, say, at least one year of post-secondary school training in administration. The rest of the administrative personnel, eg, clerks, secretaries, receptionists, could either be omitted or included in a `service and support' category, perhaps labeled as Others.

**Classifying social insurance health systems.** For purposes of the model you can consider them either public or private but you will probably be best advised to include them as part of the public sector. As a matter of definition, social insurance health systems are normally considered public sector if they have been created and/or authorized and regulated by public authorities, even if most or all of their funding comes from worker and employer contributions. If the insurance systems are reasonably large and with many beneficiaries, their inclusion with the public sector has the further advantage of giving you more work location options to consider.

**Classifying the military health system.** The military and police health facilities are part of the public sector and should be included, perhaps in separate columns in the HOSPital and AMBULatory tables.

**What about large independent health care systems?** One way to address this problem is to use a separate requirements spreadsheet for each health care system, just as you could use a separate spreadsheet for each province. You could then use the COMBINE spreadsheet to combine the projected requirements for your several health systems in order to develop an aggregate national projection. If you decide on this option be sure to enter the beneficiary population, economic and expenditure estimates of each health system, and not the national estimates. Thus you might have a Ministry of Health system that provides care for an estimated 30% of the population, a salaried employees' system that provides care for 25% of the population, and so on, to 100%. You should include the private sector, academic and public health components only once, preferably on the Ministry of Health spuble count your population, health worker, or work location estimates.
What about different public sector salary levels and staff norms?
This is a problem but a manageable one. Make your salary and staffing estimates for the MoH sector and, more approximately, for the other components of the public sector, eg, the military or social insurance health systems. If these latter, higher cost, higher staffing level components are, on balance, a small part (eg, <10-15%) of the total public sector, increase slightly (<5%) the averages used for the MoH subsector. If they are a substantial part of the public sector, increase the averages somewhat more. In other words, make an approximate upward adjustment of the public sector averages so that they represent a very approximate **weighted average** of the several different components of the public sector. Though the numbers won't be precise, these estimates will not seriously affect the projections. An example will illustrate how this income adjustment might be made. Assume that FTE doctors in the MoH service have an average annual gross income of 10,000, and those in the Armed Forces health system average 12,000. Further assume that there are about 10 FTE MoH doctors for every one Armed Forces doctor. The weighted average public sector doctor salary is thus 10,181, rounded up to about 10,200, ie, 10 x 10,000 + 1 x 12,000 = 112,000/11 doctors = 10,181. In practice it is not even necessary to do the arithmetic since an informed and reasonable guess will not significantly prejudice the economic feasibility test.

Supply questions

**What if I don’t know the base year supply?** If you cannot estimate the base year supply of a occupational category within ±10% of the probable true value, and if the category accounts for more than about 5-7% of the total workforce, you should consider excluding the category from your model until you have a better estimate. Major errors in the base year supply estimate can result in comparable errors in the projected surplus or deficit, which in turn will affect training requirements.

**Cohorts.** A cohort is a group of persons selected according to some criterion, eg, year or years of graduation from a health training program, and followed over time. For example, those who graduated during the period 1980-84 are members of a five-year cohort of graduates.

**Should I project support personnel?** Probably not for the reasons stated above, with the one exception of auxiliary nursing personnel. Auxiliary nurses usually represent a very large and relatively homogenous occupational category, and since they should probably be included in your requirements projection it would be desirable to include them also in the supply model. Moreover, this category will account for a significant portion of your overall expenditures.
Repeating students. Do not take them into account when calculating either the entering class or the graduation rate. Several examples will clarify this point. Entering students. If the first year class of medical students has a total enrolment of 125, including 100 who are entering for the first time and 25 who are repeating the first year, count only the 100 new students as the entering class. Graduates. If 100 entering students in 1985 leads to, say, 70 graduating students three years later in 1988, the graduation rate is 70%. Unless there are major and sustained changes in the percentage of students who are `repeaters’, they can be ignored. For practical purposes it doesn't matter much if the 70 who graduated in 1988 are all from the 1985 entering cohort or whether most are from this cohort, plus some from the 1984 entering class, plus some from 1983 and even earlier. And even if there are substantial and sustained changes in the repetition rates, they are not apt to affect more than one or two graduating classes over a several decade period, and hence will not weigh heavily in the projections.

What if there is no medical school in the country. You have two choices, equally acceptable. One is to not list a medical school and instead use the NET ANNUAL FLOW OF... row in the supply model TRAINING table to indicate the approximate number of new graduates or licentiates that come into your country annually from overseas sources. The other alternative is to use the ALL SCHOOLS... sections as if you had an entering enrolment of, say, 4, or 5, or 6 persons. For this latter option, you may then either enter an assumed graduation rate, or enter an annual intake that is equal to the number of returning graduates and enter 100% as your assumed graduation rate.

What about instructors of a different discipline from the students? This is especially true in medical schools where there are basic science faculty, eg, anatomists, biochemists, microbiologists, and in some technical level schools where most instructors have higher qualifications than those they teach, eg, nurses teaching nurse auxiliaries. For several reasons the model cannot take these instructors into account. First, it would require making provision for a wide variety of disciplines that would greatly complicate the model. Second, most countries would have difficulty getting detailed information on the disciplinary qualifications of all their instructional faculty. Third, and most importantly, this information would add almost no value to the projections. All instructional faculty together will probably not amount to more than 3-5% of the health workforce, at the most, and the instructors you are most interested in are those in the higher level professions, where most of the faculty are of the same discipline as their students, eg, medicine, dentistry, nursing, and pharmacy. Moreover, the model makes no attempt to project requirements for biologists, chemists, toxicologists, educators, etc., since the total number required nationally of each discipline will greatly exceed the requirements of the health sector alone.
What are reasonable loss rates? Your point of departure is the default values given in the tables for males and females. Consult with those informed about the occupational category under consideration and either increase, or more probably, decrease the retention rates used for the occupation. Unless you have actual data on retention rates from the occupation you can probably round off the retention rates to the nearest 5%. Very likely most mid-level categories, eg, technicians, therapists, can be given the same retention rates, that is, do not try to be too precise in your estimations for each individual occupational category.

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Typical ranges for input and output data

Countries have important differences but they also have many similarities. Listed below are typical ranges within which most countries will find themselves. Much of the economic, demographic and staff ratio information is based on data provided in the *World Development Report 1993: Investing in Health*, published in 1993 for The World Bank by the Oxford University Press. Values outside of these ranges listed in this section are not necessarily `wrong` or in error but do warrant special attention. You should first determine whether there has been an error in the original data or in the data entry, and if the data are correctly entered, to then determine whether the value is acceptable.

Ambulatory care indicators

**HEALTH CARE PATIENT CONTACTS PER YEAR** -- The number of patient contacts provided by a health worker spending full-time in ambulatory care can vary widely from country to country, and can be changed according circumstances. The following formula illustrates how to estimate annual contacts: 1600-2200 hours worked per year, times 60-80% of health worker time actually spent with patients, times 3-6 patient contacts per hour, equals a maximum range of 2,880 to 10,560 contacts per health worker per year. A typical annual calculation might be as follows: 365 days minus 104 weekend days minus 10 national holidays minus an average of 10 sick days minus 10 vacation days minus an average of 6 study leave and related days = 225 work days x 7.5 nominal work hours per day = 1688 work hours per year x 60% of working hours seeing patients = 1013 hours actually seeing patients x 4.5 patients per hour = 4560 patients per year. Each of these values could be higher or lower in a given country depending on many factors but the result will probably not be much outside the 4000 to 7000 range. The 60% variable assumes that about 40% of the nominal work time in consumed in activities other than direct
patient care, eg, medical record review, talking with other staff, travel time during
working hours, personal activities and coffee breaks, waiting for patients, staff
supervision, etc. The preferred range for full-time equivalent doctors and dentists
in ambulatory care is probably between 5,000 and 6,000. Much more than this
suggests low quality care, and much less suggests inefficient use of personnel
and/or low number of hours worked per year.

DOCTOR CONTACTS PER CAPITA -- Low income countries range from
less than 0.4 up to 3 contacts per year, with urban residents usually receiving at
least 50% more than rural residents, and sometimes as much as 3-4 times as
many contacts. Industrialized countries average 4-7 contacts, occasionally rising
to more than 10 contacts per year.

DENTIST CONTACTS PER CAPITA -- In low income countries these
may range from almost none up to about 0.5 contacts per year. Industrialized
countries may exceed two contacts per year.

HEALTH WORKER CONTACTS PER PREGNANCY -- Depending on the
nature of the health care system, the type of provider (doctor, nurse, midwife),
and service norms, this may average from 1-2 contacts per woman per
pregnancy up to 7-10.

Hospital indicators

The principal indicators are: bed capacity; occupancy rate; average length of
stay; discharges per bed-year (or, bed-turnover rate); and staff per bed. *Bed
capacity* refers to the design or operating number of beds; the more beds, the
greater the variety of services that can be offered and usually the greater number
of staff available per bed. *Occupancy rate* is the average percentage of beds
occupied during the reporting period. A large tertiary care hospital can operate
best in the 85-90% range and small hospitals should optimally average around
70-80% occupancy. The occupancy rate is a quick and partial indication of the
operating efficiency of the installed capacity. A very high occupancy rate leaves
little margin for the normal seasonal fluctuations in disease incidence and
severity, and a low occupancy rate means that the installed hospital capacity and
perhaps the staff complement are not well utilized. *Average length of stay* is the
average number of days per hospitalized patient. Longer stays suggest sicker
patients, patients who live at a distance from the hospital and who can't be
discharged promptly, more specialized services, a lower percentage of short-stay
maternity patients, and/or low hospital efficiency. Low efficiency can be due to
poor use of clinic and/or diagnostic facilities, low intensity hospital services,
and/or delayed patient discharge. *Bed-turnover* indicates the average number of
patients served per year by one bed. *Staff per bed ratio* is the total number of
staff divided by the total number of beds. Ratios vary from less than 1.0 staff per
bed to more than 4-5 staff per bed in very large, specialized hospitals that also serve as teaching and research facilities. Ratios will also vary according to the relative size of the ambulatory clinics dependent on the hospital, including in some cases clinics that are located at some distance from the hospital.

**LARGE SIZE ACUTE CARE HOSPITAL** -- Such hospitals often serve as a national referral center and perhaps as a teaching hospital; they usually serve the sickest patients, including many who come from a distance, and they usually have a large outpatient clinic with many specialized services. Typical values: 500-1000 beds; 85-95% occupancy rate; 10-20 days average stay; 20-25 discharges per bed-year; 1.5-3.0 staff per bed, up to 4-6 staff per bed in industrialized countries.

**MEDIUM SIZE ACUTE CARE HOSPITAL** -- These often serve as a regional referral hospital with most specialty services represented and with a large outpatient clinic. Typical values: 250-500 beds; 80-90% occupancy rate; 8-15 days average stay; 22-28 discharges per bed-year; 1.3-2.0 staff per bed.

**SMALL SIZE ACUTE CARE HOSPITAL** -- These often serve as a district hospital with first level referral ambulatory and inpatient services. Typical values: 50-250 beds; 70-85% occupancy rate; 5-12 days average stay, depending largely on the proportion of maternity cases and ability to discharge patients promptly when no longer needing hospital care; 24-30 discharges per bed-year; 1.0-1.5 staff per bed.

**CHRONIC DISEASE HOSPITAL** -- These hospitals are often quite large and serve a national population. Typical values: 100-1000 beds; 90-97% occupancy rate; 50-100 days average stay; 2.5-5 discharges per bed-year; 0.7-1.1 staff per bed.

**MENTAL (OR PSYCHIATRIC) HOSPITAL** -- Typical values: 100-1000 beds; 90-97% occupancy rate; 50-150 days average stay; 1.5-5 discharges per bed-year; 0.7-1.1 staff per bed.

**HEALTH CENTER OR SMALL RURAL HOSPITAL WITH BEDS** -- Typical values: 5-20 beds; 60-75% occupancy rate; 3-7 days average stay; 30-60 discharges per bed-year; 0.8-1.2 staff per bed, with the higher ratios in situations where there is a large ambulatory care and community services component.

**HOSPITAL BEDS PER 1000 POPULATION** -- Low income economies average 0.5-2+ beds per 1000. By region, India is slightly under 1.0 and Sub-Saharan Africa is slightly over 1.0, China exceeds 2.0, Latin America and the Middle East are about 2.5, most high income countries are 6-8, and Eastern Europe exceeds 10. These numbers usually include mental hospital and
convalescent beds which, ranging from a small percentage in low income countries to almost half of the beds in high income countries.

**PATIENT DISCHARGES PER 1000 POPULATION** -- 15-50 per 1000 for low income countries, and up to 150 or more per 1000 for high income countries. The proportion of deliveries occurring in hospitals and bed turnover rates affect the rates substantially.

**Health personnel indicators**

**DOCTORS PER 1000 POPULATION** -- Approximately 0.1 doctors per 1000 in Sub-Saharan Africa, 0.4 in India and 1.4 in China, 0.3 in other Asia and islands, 1.3 in Latin America, 1.0 in the Middle East, 4.1 in Eastern Europe, and 2.5 in market economies.

**NURSES AND MIDWIVES PER PHYSICIAN** -- Approximately 5:1 in Sub-Saharan Africa, 2:1 in market economies, 1.5:1 in the Middle East, 1:1 in Latin America, about 0.5:1 in India and China, and 3:1 in other Asia and islands. Interpretation of these numbers is complicated by the reality that countries use differing definitions for `nurses' and `midwives' such that in some cases these include less that fully trained personnel.

**Public sector health personnel indicators**

**HOURS WORKED PER YEAR** -- Values for the following illustrative formula for a full-time equivalent health worker vary widely from country to country, and can be changed according circumstances. Formula: 365 days, minus 52-104 weekend days, minus 8-12 national holidays, minus 10-15 paid leave days, minus 3-6 sick days, equals 292-228 work days. From these values must be subtracted average days lost due to maternity leave, study leave, in-service education, etc. Most countries are probably in the 200-230 range.

**DOCTOR-TO-NURSE RATIO** -- 1:1 up to 1:3, with preference for substantially more nurses than doctors. Professional nurses can provide a large portion of first level care, are essential to effective hospital care, and can make high cost medical staff much more effective.

**NURSE-TO-AUXILIARY NURSE RATIO** -- 1:1 to 1:5, with preference for more trained auxiliary or assistant nursing personnel than fully qualified nurses, especially in low income countries. With time the proportion of qualified nurses should rise. The word `trained' is underlined to emphasize the importance of having auxiliary personnel who are explicitly trained for their duties, since without such training their utility may be very limited.
NON-HEALTH TRAINED PERSONNEL AS PERCENT OF TOTAL HOSPITAL PERSONNEL -- 15-30%. This category may include persons with a great deal of training, eg, computer personnel, biochemists, physicists, senior administrators, sanitary engineers, to those with minimal or no training beyond their general education, eg, cooks, drivers, clerks, cleaners, orderlies, etc.

DISTRIBUTION OF PERSONNEL BY LEVEL -- For low income countries the distribution of health personnel by level of training should resemble a pyramid, with perhaps 20-30% at the highest level (eg, doctors, dentists, pharmacists), 30-40% at the middle level (nurses, technicians, therapists), and 40-50% at the support level (auxiliaries, assistants, clerical, kitchen staff, etc.). Most supporting staff will require pre- or in-service training, and vigorous supervision, to ensure adequate performance. As the country situation improves economically, the percentage at the upper two levels should increase and support level personnel reduce somewhat, though they will always represent a substantial part of the workforce.

HOSPITAL-BASED PERSONNEL -- 35-70% of the total public sector workforce, with preference for lower values. Since hospitals typically provide a great deal of ambulatory care, and the proportion of time spent by hospital-based personnel on ambulatory and public health services varies widely depending on country norms, one must use caution in the interpretation of any given number.

CLINICAL PERSONNEL, EXCLUDING ACADEMIC AND NON-CLINICAL PUBLIC HEALTH PERSONNEL -- 85-95% of the total public sector workforce, with preference for 85-90%.

NON-CLINICAL PUBLIC HEALTH PERSONNEL -- 3-6% of the total public sector workforce, depending on where public health personnel are based. A much higher proportion of the workforce will typically fulfill public health and preventive responsibilities, but many of them are based in hospitals or clinics. In the projection model non-clinical public health personnel refers to health workers employed by the central Ministry of Public Health, provincial and district level public health departments, a National Institute of Health, and major public health programs not based in ambulatory or hospital facilities.

ACADEMIC AND RESEARCH PERSONNEL -- 2-5% of the total public sector workforce, depending in substantial part of the size of the training capacity for higher level personnel, on faculty-student ratios, and on the amount of medical research.

Demographic and economic indicators
Note: All of the demographic and economic indicators reflect long-term (10+ years) rates. Short-term rates can be considerably higher or lower than long-term rates. Some economic indicators are provided even though they are not used in the models since they can help provide perspective to the economics of the health workforce and of the health sector.

**POPULATION GROWTH RATE** -- 1-3% annual growth rate, generally (and eventually) declining with time. Annual population growth in low income economies averaged 2.2% during 1970-80, and 2.2% during 1980-91, and is projected to average 1.8% during 1991-2000. Middle income economies had similar values for the 1970s and 1980s, and are projected to average 1.5% in the 1990s. Low and middle income countries are projected to average a 1.3% growth rate during the period 2000-2030, except for Sub-Saharan Africa, which is projected to grow at 2.4%. A few countries exceed 3% or have a negative rate.

**URBAN POPULATION** -- Low income countries averaged 18% in 1970 and 39% in 1991, middle income countries averaged 46% and 62%. The proportion of the population living in urban areas will likely rise over time.

**GROSS DOMESTIC PRODUCT (GDP)** -- Real (uninflated) GDP growth rate, 2-6%, and rarely up to 8-10%, though these very high rates are seldom sustained for more than a few years. Average rates by income categories for 1980-91 were: low income countries, 6.0% (China and India averaged 7.5%, other low income countries averaged 3.7%); lower middle income countries, 2.7%; middle income countries, 2.7%; upper middle income countries, 2.1%; severely indebted countries, 1.7%; and high income market economies, 2.9%. By geographic regions: Sub-Saharan Africa, 2.1%; East Asia and the Pacific, 7.7%; South Asia, 5.4%; Europe and Central Asia, 1.5%; Middle East and North Africa, 2.1%; Latin American and the Caribbean, 1.7%. Some countries report only the GNP (gross national product). For purposes of the models and except for very unusual country situations either the GDP or GNP can be used. The GDP/GNP is an estimate of the value of all goods and services produced by a country in one year and is an indicator of relative wealth. Annual fluctuations can be great but over an extended period of time, the average growth rate will seldom exceed 5-6%.

**REAL PER CAPITA GDP GROWTH RATE** -- 1-3% per year, depending on the GDP growth rate and on population growth. May be as high as 5-7% in some countries, though rarely for more than several years, and is often negative in countries with a high population growth rate and low GDP growth rate. If GDP increases at 3% and the population increases at 3%, there will be no additional money per capita with which to improve salaries unless there is a shift from some sectors of the economy to other sectors of the economy. Average per capita growth rates by income categories for 1980-91 were: low income countries, 3.9%
(China and India averaged 5.6%, other low income countries averaged 1.0%); lower middle income countries, -0.1%; middle income countries, 0.3%; upper middle income countries, 0.6%; severely indebted countries, -1.0%; and high income market economies, 2.3%. By geographic regions: Sub-Saharan Africa, -1.2%; East Asia and the Pacific, 6.1%; South Asia, 3.1%; Europe and Central Asia, 0.9%; Middle East and North Africa, -2.4%; Latin American and the Caribbean, -0.3%.

**TOTAL PUBLIC SECTOR AS % OF GDP**: Central government expenditures as a percent of GDP are highly variable, ranging from 15% to 35% for low income countries, rising up to 50% for a few high income countries; the public sector share of the GDP tends to rise with time. Estimates may have substantial errors due to over- or more commonly, under-estimation of the size of the private sector, and to problems in distinguishing between current and capital accounts.

**PUBLIC HEALTH SECTOR AS % OF GDP** -- According to the 1993 World Bank report, weighted 1990 estimates for total, public sector, and private sector expenditures as a percentage of the GDP, were: Sub-Saharan Africa, 4.5, 2.5, 2.0; India, 6.0, 1.3, 4.7; China, 3.5, 2.1, 1.4; other Asia and islands, 4.5, 1.8, 2.7; Latin America and the Caribbean, 4.0, 2.4, 1.6; Middle East, 4.1, 2.4, 1.7; formerly socialist economies of Eastern Europe, 3.6, 2.5, 1.0; established market economies, 9.2, 5.6, 3.5. In summary, low income countries average around 4% of GDP on health, with about half of that coming from the public sector. These averages rise with time, and rise sharply in market economies, with the U.S. now exceeding 14%, far above the next highest value of about 9%. In low income countries private sector expenditures can often exceed government expenditures, even though the volume of services provided and the number of persons working in the private sector is much smaller than in the public sector. The reasons are several: substantially higher costs per service rendered, high volumes and high cost drugs, and a large indigenous health sector.

**PUBLIC HEALTH SECTOR AS % OF PUBLIC SECTOR** -- See preceding paragraph; 3-12+%, and rarely over 15%; this percentage tends to rise over time. Low income countries tend to average 3-5%.

**PUBLIC HEALTH SECTOR PERSONNEL INCOMES AS A % OF PUBLIC HEALTH SECTOR EXPENDITURES** -- 50-80%, though for most countries, 65-75% is desirable. Major factors that may tend to increase or decrease the percentage include: ratio of personnel to other expenditures; relative proportion of high and low salaried health workers; degree to which salary costs also include the full costs of pension and other benefit costs; and the degree to which the expenditure budget can distinguish between salaries and service contract payments to individuals and organizations. If personnel
expenditures exceed about 80% there may be insufficient funds for drugs, supplies, equipment, vehicles, building maintenance, and the purchase of services, and if much less than 60%, there may be inadequate money for personnel and/or a low salary gradient.

PUBLIC SECTOR SALARY GRADIENT -- The average FTE income of the best paid occupational category, usually doctors, can typically range from 3 to 6 times the average for the lowest paid occupational category. If the salary gradient is too high possible effects are difficult recruitment and retention of trained auxiliary and support personnel, and/or excessive costs of the health workforce. If the gradient is too low, approaching a flat gradient, possible effects are inadequate incentive for professional categories to enter public service, poor retention rates for higher level categories, and little incentives for personnel to improve their skills and performance.

PUBLIC SECTOR ANNUAL RATE OF CHANGE IN REAL INCOMES -- Many, many factors help determine the rate of change over time in real (uninflated) salary incomes for public health sector personnel. The major external factors are the rate of real GDP growth, minus the rate of population growth. In summary, if the GDP growth averages 4% per year and the population growth averages 2.5% per year, real incomes could `theoretically' grow at about 1.5% (4 - 2.5 = 1.5) per year. Life is never this simple and in reality real incomes change substantially, up and down, from year to year, in response to economic cycles, political variables, periodic public sector corrections, competitive forces in relation to the private sector, the inflation rate, and other factors, and the growth rates may vary widely for different segments of the population. Except in countries with low population growth rates and high economic growth rates, long term changes in real incomes will probably average 1-2%. The requirements model makes it possible to take into account the likely effect of income growth on the economic feasibility test.
Appendix D. Achieving desired outcomes

**Introductory Note.** This appendix consists of three sections that can help you use your models for constructing alternative health system scenarios and achieving desired policy outcomes.

Section A comments on how to develop estimates or assumptions for each major input variable in the core requirements module and suggests the potential magnitude of the variable’s effect on model outputs. Familiarity with this section will help you to make reasonable assumptions about the future, and to assess the potential for data output errors due to data input errors. The table in which each set of input variables is entered is listed in brackets [ ]. B-Y and T-Y refer to base and target years, respectively.

Section B is a table that shows what effect an increase in each major input variable will have on each output variable. This information will help you understand the relationships between inputs and outputs.

Section C indicates what input changes in the requirements and supply models would be needed to produce a variety of desired health system outcomes.

Input variables to the other optional modules (specialist requirements, services, distribution, and intermediate year projection) have no impact whatsoever on the core requirements projection. They make it possible to convert the projected workforce requirements into requirements for specialists, the potential production of inpatient and ambulatory services, the geographic distribution of these services, and to the interpolation of the requirements projection to an intermediate target year.

**Section A. Impact of variables on requirements**

**HEALTH PERSONNEL REQUIREMENTS (CORE) MODULE ---** This module projects for any period of time the requirements for up to 15 user-specified health workers (HW) categories by number, sector, and work location. It also produces various indicators of the changed relationships between health workers and population.

**ACADEMIC PERSONNEL, B-Y [ACADemic] --** Base year estimates of the number of FTE instructors, administrators, and researchers of the same occupational category as the students are entered here. They should be made only for higher level personnel. You can either base your estimates on the
approximate numbers of such personnel, or estimate the approximate B-Y ratio of students-to-instructor, and then calculate the probable number of instructors. Since academic personnel typically account for only 1-3% of the higher level occupational categories, and essentially no persons in the auxiliary and support categories, even substantial input errors are likely to have only a small (<3%) effect on projected workforce requirements.

ACADEMIC ENROLMENTS, ANNUAL % INCREASE [ACADemic] -- For a first approximation, use a growth rate 1-3% higher than the population growth rate. This can be somewhat lower if there is an adequate B-Y supply in the category, and higher still if the category is either in short supply or has an especially high loss rate. Refine each estimate only after bringing your supply and requirements projection into approximate balance and then noting the annual increase in enrolments called for in the SUPPLY model. Errors will affect the projected number of T-Y faculty and will have only a small (<3%) effect on projected workforce requirements.

ACADEMIC ENROLMENTS, B-Y [ACADemic] -- Estimates should be developed of the total number of students enrolled in all years of study in all training programs in each discipline in the high- and mid-level personnel. You should use values similar to those used in the SUPPLY projection model, and make estimates only for high- and mid-level personnel. Errors will affect the projected number of T-Y faculty and will have only a small (<3%) effect on projected workforce requirements.

ACADEMIC STUDENTS PER INSTRUCTOR RATIOS, T-Y [ACADemic] -- Target year ratios of students per FTE instructor should be developed for mid- and high-level personnel, taking into account the observed B-Y ratio and a reasonable degree of improvement over the projection period. T-Y students/FTE instructor ratios for mid-level personnel will probably be between 10-to-1 and 15-to-1, and for high-level personnel, from about 10:1 down to as low as 5:1 for doctors. Errors will affect the projected number of T-Y faculty and will have only a small (<3%) effect on projected workforce requirements.

POPULATION, B-Y [DEMOgraphic] -- Even substantial B-Y errors in the B-Y population are likely to have a relatively small effect on projected requirements as long as B-Y health worker supply estimates are reasonably accurate and the population growth rate is reasonable. Population estimate errors will, however, affect the calculated population-to-health worker ratios.

POPULATION GROWTH RATES [DEMOgraphic] -- Assumptions are developed for the annual growth rates during the 1st, 2nd, and 3rd thirds of the projection period. The first estimate, based on the recent past, will likely be reasonably accurate but subsequent ones may become increasingly uncertain,
especially in countries with rapidly changing growth rates. The likely direction of
the growth rates will usually be evident and, except for large changes in
immigration or emigration rates, are likely to decline. Most countries will have
rates between 1% and 3% and errors are unlikely to exceed 0.3% to 0.5%.
Every 0.1% error in the assumed annual growth rate that is sustained over a 10-
year period will result in a 0.9% error in the projected population, and will affect
the projected requirements by the same amount. Regular updates of the B-Y
estimates and projection assumptions will make major policy errors unlikely.

T-Y POPULATION PER HOSPITAL and NUMBER OF HOSPITALS,
[HOSPital] -- The assumed T-Y population per hospital will result in the projected
T-Y number of hospitals. With the B-Y values for each type of hospital as a point
of departure, you can test the effects of T-Y assumptions that would increase,
decrease, or maintain the population per hospital ratio. Your assumptions can
thus result in changes in the relative numbers of hospitals and of beds according
to type of hospital. The optional section of this table can help you determine
what portion of the national or regional population will actually be served by each
type of hospital facility. Though such changes occur slowly, over time they can
be accomplished through policies affecting hospital distribution, construction,
rehabilitation, and conversion to other types of health care facilities. The effects
on the projected requirements can range from large to small depending on the
magnitude of the changes proposed, the reasonableness of the proposed
targets, and the characteristics of each type of facility. In essence, if your
assumptions are unrealistic, they will result in similarly unrealistic projections.

T-Y POPULATION PER AMBULATORY WORK LOCATION and
NUMBER OF WORK LOCATIONS, [AMBUlatory] -- The assumed T-Y population
per clinic will result in the projected T-Y number of clinics. With the B-Y values
for each type of clinic as a point of departure you can test the effects of T-Y
assumptions that would increase, decrease, or maintain the population per clinic
ratio. The optional section of this table can help you determine what portion of
the national or regional population will actually be served by each type of
ambulatory facility. Your planning assumptions can thus result in changes in the
relative numbers of clinics. Though such changes occur slowly, over time they
can be accomplished through policies affecting clinic distribution, construction,
rehabilitation, and conversion. The effects on the projected requirements can
range from moderate to small depending on the magnitude of the changes
proposed and the characteristics of each type of facility.

B-Y PRIVATE SECTOR, HOSPITALS, HOSPITAL BEDS, DISCHARGES
and OCCUPANCY RATE, [PRIVHOSP, BASESERV] -- These estimates have no
effect on projected workforce requirements but are necessary if you wish to
project the potential production of hospital discharges in the private sector.
PRIVATE SECTOR, HOSPITAL BED GROWTH RATES [PRIVHOSP] --
These estimates have no effect on projected workforce requirements but can make it possible to project the possible production of private sector hospital discharges. Your assumption should be based on the observed percentage annual change over the past few years, adjusted up or down to take into account the potential effects of public sector policies affecting the private sector and the likely evolution of health insurance policies. If the public and private sectors are in reasonable equilibrium private sector growth is likely to be close to or, if average disposable incomes are increasing rapidly, somewhat exceeding the urban population growth rate.

PRIVATE SECTOR, B-Y INDEPENDENT AND SALARIED FTES
[PRIVSTAFF] -- Estimate the number of FTE personnel working in private sector hospitals and organized clinics. Most of these personnel will be mid- and support-level personnel and unless the private sector is large, estimates of support level personnel can be very approximate. In the absence of data, private sector salaried personnel can be reasonably estimated by using public sector bed-to-staff ratios for comparable hospitals, adjusted up or down to take into account likely differences between the public and private sectors. The effect on projected requirements will be in proportion to the size of the salaried public sector. For example, a 10% error for a private salaried sector that represents 10% of the total workforce will result in a 10% error in the projected requirements for the private salaried sector and a 1% error in the projected requirements for the total workforce. However, if the total health sector B-Y supply estimates are correct, there may be little or no error in the projected total health sector requirements. Error effects will be of greater importance for the higher level categories.

PRIVATE SECTOR, ASSUMED ANNUAL CHANGE IN FTE SALARIED STAFF [PRIVSTAFF] -- Your assumption should be somewhat in excess of the assumed growth rate for private sector hospital beds since staffing norms in the private sector will probably improve over time. For example, if beds are assumed to increase at an average rate of 3% per year, staff might be assumed to increase in the 3.2-3.5% per year range. You may wish to assume differential rates for selected categories, depending on likely trends. Error effects will be in proportion to the size of the private hospital sector, which is usually small.

PRIVATE SECTOR, FTE INDEPENDENT PRACTITIONER ANNUAL % CHANGE [PRIVSTAFF] -- The B-Y estimate of private sector independent practitioners is computer-determined by subtracting your estimate of private sector salaried personnel from the estimate of total private sector personnel, and will probably include only doctors, dentists, pharmacists, and perhaps midwives. Your assumed annual rate of change should probably be somewhat above the assumed urban population growth rate, adjusted up or down to take into account
likely public sector policies affecting the private sector, and the projected rate of
growth in real disposable incomes. Error effects will be in proportion to the
number of private independent practitioners, and probably will be small. For
example, if there are 1000 B-Y FTE independent practice doctors out of a total
supply of 10,000 doctors, an assumed annual rate of change that subsequently
proves to be in error by 1% will result in about a 2.6% error in a 30-year
projection of total workforce requirements.

PUBLIC SECTOR HOSPITALS: B-Y BEDS, DISCHARGES, and
OCCUPANCY RATES, BY TYPE [HOSPital] -- These assumptions have no
effect on projected requirements but are useful if you wish to project hospital
services in the SERVICES module.

PUBLIC SECTOR HOSPITALS: T-Y BEDS PER HOSPITAL, AVERAGE
LENGTH OF STAY and OCCUPANCY RATE, BY TYPE [HOSPital,
HOSPSERV] -- These assumptions have no effect on projected requirements but
are required if you wish to project hospital services in the SERVICES module.
Assumptions about the average number of beds per hospital have no effect on
projected requirements but are important assumptions since they will affect your
proposed staffing norms. You can use this input to increase, decrease or
maintain the same the average size of each type of hospital.

PUBLIC SECTOR HOSPITAL FTE STAFF NORMS, T-Y [HOSPSTAFF] --
These assumptions have a major impact on the projected requirements. In most
situations your initial proposed norm should be based on staff positions that
would be created for a new hospital of the same size as proposed, modified: (1)
to correct for any perceived constraints due to lack of funds and/or personnel
surpluses or shortages that would constrain the near-term staffing of a new
hospital; (2) to take into account anticipated changes in morbidity patterns,
technology, and demographic characteristics, and (3) to reflect any desired
changes in staff deployment and patterns of utilization. Inappropriate staffing
norms will have a small to substantial effect on the resulting projections,
depending on the magnitude of the changes proposed for the future, and the size
and number of facilities in each category.

PUBLIC SECTOR AMBULATORY FTE STAFF NORMS [AMBUSTAFF] --
Ambulatory staffing norms have a significant impact on the projected
requirements. They should be developed using the same procedures as for
hospital staffing norms. Inappropriate norms will have a small to moderate effect
on the resulting projections, depending on the magnitude of the changes
proposed for the future, and the size and number of facilities in each category.

PUBLIC HEALTH PERSONNEL, B-Y [PUBHEALTH] -- Public health
personnel not included in the staffing norms of clinical work locations, usually
accounting for substantially less than 10% of the workforce, are entered in this
table. As long as such personnel are not omitted from the B-Y supply, errors of
inappropriate allocation (to a clinical work location) will not have a significant
impact on the projected requirements.

PUBLIC HEALTH PERSONNEL GROWTH RATES [PUBHEALTH] --
Annual growth rates for non-clinical public health personnel should usually
exceed the population growth rate and perhaps be close to the urban growth
rate. They will be affected by the rate of economic growth and governmental
policies regarding public health services and the public sector. The actual rates
will vary somewhat for the different occupational categories. If non-clinical public
health personnel account for 10% of the entire workforce (probably a maximum),
then a 1% error in the projected growth rate over 30 years will result in about a
2.6% error in the T-Y requirements.

SUPPLY OF B-Y HEALTH PERSONNEL [SUPPLY] -- B-Y supply
estimates have a small to major impact on projected requirements, depending on
the types of personnel under consideration. A 10% error in the B-Y estimate of
the number of FTE persons working in academic programs, non-clinical public
health institutions, or in the private sector will result in a 10% error in the T-Y
projections. However, a 10% error in the estimated number of persons working
in the clinical public sector will have no effect on the projected requirements
since these are determined by multiplying assumed staffing norms times the
number of T-Y work locations of each type. However, since training policies are
based on the difference between the B-Y supply and T-Y requirements, an
incorrect B-Y supply estimate could lead to erroneous conclusions about the
numbers of persons that need to be trained.
Section B. Summary effects of increased inputs on outputs

INPUT VARIABLE EFFECTS OF AN INCREASE IN THE INPUT VARIABLE

DEMOgraphic table

Projection period --- A longer period makes it easier to assume major changes in the health care system and increases the ability to visualize the long-term effects of such changes

Population growth rate --- Increases the number of work locations and total personnel requirements proportionately; most HRH and service indices will remain the same; economic feasibility will likely decrease

Urban population --- A changing balance in the urban-rural population distribution can affect the projected urban-rural distribution of service utilization, depending on the assumed distribution of urban-rural patients attended by each type of work location; does not affect projected requirements, production of services, or economic feasibility

HOSPital table (T-Y inputs for a specified type of hospital)

Population per hospital --- Reduces the number of hospitals in relation to population; reduces personnel requirements, bed-to-population ratio, and service outputs; increases economic feasibility

Beds per hospital --- Increases output of hospital discharges and increases the bed-to-population ratio; does not affect personnel requirements unless parallel changes are made in staffing norms

Occupancy rate --- Increases output of hospital discharges; does not affect costs or personnel requirements

AMBUlatory table (T-Y inputs for a specified type of clinic)

Population per clinic --- Reduces number of clinics in relation to population; reduces personnel requirements and service outputs; increases economic feasibility
PRIVHOSP table (T-Y inputs)

Annual % change in beds  --- Increases the number and proportion of private sector beds, and of private hospital discharges; does not affect personnel requirements unless parallel changes are made in the growth rate of salaried private sector personnel; does not affect economic feasibility
INPUT VARIABLE --- EFFECTS OF AN INCREASE IN THE INPUT VARIABLE

HOSPSTAFF, & AMBUSTAFF tables

Staff norms --- Increases staff per location, total staff requirements, and decreases economic feasibility

PRIVSTAFF table

Self-employed FTE growth rate --- Increases number and proportion of independent practice personnel; increases private sector visits; does not affect economic feasibility

Salaried FTE growth rate --- Increases number and proportion of salaried private sector personnel; does not affect production of services or economic feasibility

PUBHEALTH table

Assumed % change per year --- Increases number and proportion of non-clinical public health personnel; decreases economic feasibility

ACADemic table

Enrolment change per year --- Increases number and proportion of academic personnel; decreases economic feasibility

T-Y students per FTE --- Decreases number and proportion of academic personnel; increases economic feasibility
INPUT VARIABLE --- EFFECTS OF AN INCREASE IN THE INPUT VARIABLE

ECONTEST table

Average % change in available funds --- Increases economic feasibility

Average % change in GDP* --- Increases economic feasibility

Public sector % of GDP* --- Increases economic feasibility

Health sector as % of public sector* --- Increases economic feasibility

Health personnel as % of health sector* --- Increases economic feasibility

% of foreign funds* --- Decreases economic feasibility (based on domestic funds only)

*These variables are not part of the ECONTEST table but they would affect the assumed % change in expenditures for public sector personnel

COSTS table

Average B-Y fee per visit --- Increases private sector B-Y and T-Y incomes; does not affect economic feasibility

Average % change in fee --- Increases private sector B-Y and T-Y incomes; does not affect economic feasibility

INCOMES table

Income growth rate --- Decreases economic feasibility

Income gradient --- Decreases economic feasibility as income gradient increases
HOSPERSERV & AMBUSERV tables

Hours worked per year --- Increases output of ambulatory visits; does not effect staff requirements, costs or economic feasibility

Average hospital stay --- Decreases hospital discharges; does not affect staff requirements or economic feasibility

% change per year in institution-based services --- Increases output of institution-based private sector visits; does not affect staff requirements or economic feasibility

% of staff time attending patients --- Increases output of ambulatory visits in both public and private clinics; does not affect staff requirements, costs or economic feasibility

Patients seen per hour --- Increases output of ambulatory visits in both public and private clinics; does not affect staff requirements, costs or economic feasibility

Hours worked per year --- Increases output of private sector ambulatory visits; does not affect staff requirements, costs or economic feasibility

Average fee per visit --- Increases expenditures on private visits; does not affect economic (private sector) feasibility

LOCATIONS table

% discharges & visits to urban residents --- Increases per capita utilization rates for urban residents and correspondingly decreases them for rural residents; does not affect staff requirements or economic feasibility
Section C. Achieving desired policy outcomes

This section indicates what input changes in the requirements and supply models would be needed to produce desired health system outcomes. The outcomes are listed in CAPITAL LETTERS, followed by the variable changes that would result in these outcomes (and the relevant input tables where these variables may be found). Always keep in mind the distinction between (1) assumptions of what will happen (eg, the probable loss of X% of each entering class of students during their course of study), and (2) assumptions of what could happen if certain actions were taken (eg, a reduced student attrition as a result of better student selection and subsequent advisement during studies). The former represents a passive assessment of what is likely to happen in the absence of planned changes, ie, a forecast, while the latter represents a proactive effort to bring about change. Changing model inputs may produce the desired outputs but to make these outputs into reality could require many and sustained complementary actions that are not a part of the model.

**REQUIREMENTS MODEL**

To **INCREASE AVERAGE HOSPITAL SIZE** -- increase average bed capacity and/or preferentially increase the proportion of large hospitals (HOSPital table)

To **DECREASE AVERAGE HOSPITAL SIZE** -- decrease average bed capacity and/or preferentially decrease the proportion of large hospitals (HOSPital table)

To **INCREASE HOSPITAL BED PRODUCTIVITY** -- increase hospital staffing standards (HOSPSTAFF table) that would allow for more ambulatory services prior to hospitalization of elective patients and more intensive in-patient care once they are hospitalized; increase the average bed occupancy rates (HOSPital table) and/or decrease average length of stay (HOSPSERV table)

To **INCREASE THE BED-POPULATION RATIO** -- decrease the population per hospital and/or increase the average hospital bed capacity (HOSPital table)

To **INCREASE THE DISCHARGES PER 1000** -- decrease the population per hospital and/or increase the average hospital bed capacity (HOSPital table); increase the average bed occupancy rates (HOSPital table) and/or decrease average length of stay (HOSPSERV table)

To **PREFERENTIALLY INCREASE AMBULATORY SERVICES** -- decrease the population per clinic proportionately more (AMBUlatory table) than the population per hospital (HOSPital table), and/or assume staffing standards appropriate to relatively larger hospital-based clinics (HOSPSTAFF table) and clinics without
beds (AMBUSTAFF table); increase percentage of time spent with patients, of patients seen per hour, and/or hours worked per year (HOSPSERV, AMBUSERV tables)

To **PREFERENTIALLY INCREASE RURAL HEALTH SERVICES** -- decrease proportionately more the population per hospital type and/or clinic type that predominantly serves the rural population, than those that serve the urban population (HOSPital, AMBULatory table); assume a higher proportion of rural residents served (LOCATIONS table)

To **INCREASE PRIMARY HEALTH CARE** -- decrease proportionately more the population per hospital type and/or clinic type that provides primary care (HOSPital, AMBULatory table), than those that provide specialized care

To **INCREASE HOSPITAL ACCESSIBILITY** -- decrease proportionately more the population per small hospital(s) and/or clinic(s) than those that are large, since for equal costs there can be more small units than large units, and hence greater accessibility (HOSPital, AMBULatory tables)

To **INCREASE HEALTH SYSTEM AFFORDABILITY** -- give preference to smaller hospitals and clinics, which tend to have lower staff costs per unit of service (HOSPital, AMBULatory tables); decrease staffing densities and/or delegate downwards selected functions (HOSPSTAFF, AMBUSTAFF tables); emphasize ambulatory care over hospital care (AMBULatory, HOSPital tables); shift services to the private sector (PRIVHOSP, PRIVSTAFF tables); reduce rate of expansion of health facilities (HOSPital, AMBULatory tables); reduce rate of income increase (INCOMES table); increase percentage of public sector allocated to health and/or of the health sector allocated to personnel (ECONTEST table)

To **DECREASE HEALTH SYSTEM COSTS** -- see INCREASE HEALTH SYSTEM AFFORDABILITY section

To **INCREASE AVERAGE LEVEL OF STAFF QUALIFICATIONS** -- increase preferentially staff densities for mid- and high-level staff (HOSPSTAFF, AMBUSTAFF tables)

To **INCREASE PERCENTAGE OF WORKFORCE IN PUBLIC HEALTH** -- increase the annual projected growth rate in the number of public health personnel in the selected occupational categories (PUBHEALTH table)

To **INCREASE THE QUALITY OF PERSONNEL TRAINING** -- decrease the number of students per full-time equivalent instructional staff in selected occupations (ACADemic table)
To **ACCOMMODATE AN AGING POPULATION AND/OR INCREASE IN THE PREVALENCE OF CHRONIC DISEASE** -- decrease preferentially the population per hospital and/or clinic type(s) that provide services to an aging population (HOSPital, AMBULatory tables); increase staffing norms in these work locations appropriate to the types of services they are expected to provide (HOSPSTAFF, AMBUSTAFF tables); introduce new types of work locations or programs (eg, extended care facilities, home care programs table) appropriate to the care of the elderly or of chronic diseases (HOSPital, AMBULatory tables)

To **PREFERENTIALLY INCREASE PRIVATE SECTOR SERVICES** -- increase the rate of growth of private beds (PRIVHOSP table) and/or of private salaried and independent practice personnel (PRIVSTAFF table); slow the rate of growth of public sector hospitals (HOSPital table) and ambulatory work locations (AMBULatory table)

To **DECREASE THE PUBLIC SECTOR SALARY GRADIENT** -- use slower rates of real income growth for high income personnel than for lower income personnel (INCOMES table)

To **INCREASE THE PUBLIC SECTOR SALARY GRADIENT** -- use higher rates of real income growth for high income personnel than for lower income personnel (INCOMES table)

**SUPPLY MODEL**

To **INCREASE THE PROJECTED SUPPLY** -- increase first year student intakes, and/or decrease intra-school losses, and/or increase the proportion of male graduates (TRAINING table); decrease post-graduation losses (RETENTION or top part of GRADUATES table)

To **DECREASE THE PROJECTED SUPPLY** -- decrease first year student intakes, and/or increase intra-school losses, and/or decrease the proportion of male graduates (TRAINING table); increase post-graduation losses (RETENTION or top part of GRADUATES table)
Appendix E. Relevant WHO ToolKit resources

This appendix provides a list of topics, appendices and guidelines contained in the computer files of the document entitled, *HUMAN RESOURCES FOR HEALTH: A Tool Kit for Planning, Training and Management*, that may be of special relevance to developing a Strategic Plan for the Development of Human Resources for Health. These references will complement use of the computer-based models for projecting workforce supply and requirements.

A word of caution: The topic reference numbers, and occasionally the topic titles, are subject to change. As new topics are added between existing ones, the number given below may shift slightly either up or down. When searching in the ToolKit for a topic, use the number given below and if the desired topic does not appear, use the <PgDn> or <PgUp> keys to inspect the adjacent topics to see if it now has a new number. Good luck!

TOPICS....................

2*3 COMMON PLANNING PROBLEMS AND OBSTACLES
2*4 PLANNING THE PLANNING
2*5 ASSESSING THE PLANNING ENVIRONMENT
2*6 INVOLVING OTHERS IN THE PLANNING PROCESS
2*8 STAGES IN THE PLANNING CYCLE
2*9 GENERATING IDEAS AND CHOOSING PRIORITIES
2*10 OVERVIEW TO A ONE YEAR NATIONAL PLANNING STUDY
2*13 IDENTIFYING DATA SOURCES
2*14 IDENTIFYING HUMAN RESOURCES PROBLEMS
2*15 IDENTIFYING POLICY OPTIONS
2*16 COMPLETING FIRST PLANNING ESTIMATES
2*19 TEN COMMANDMENTS OF HUMAN RESOURCES PLANNING
3*1 REQUIREMENTS CONCEPTS AND DEFINITIONS
3*2 ALTERNATIVE APPROACHES TO ESTIMATE
3*3 UNDERLYING ASSUMPTIONS ABOUT THE FUTURE
3*8 REQUIREMENTS BASED ON HEALTH SERVICE TARGETS
3*12 SURVEY PRINCIPLES AND METHODS
4*1 PROJECTING SUPPLY: BASIC PRINCIPLES
4*2 SUPPLY CONCEPTS AND DEFINITIONS
4*3 SUPPLY DATA REQUIREMENTS AND SOURCES
4*4 SUPPLY OF POTENTIAL ENTRANTS INTO HEALTH TRAINING
4*7 WORKFORCE GAINS: TWO TYPES OF ESTIMATES
4*8 WORKFORCE LOSSES: COHORT ANALYSIS
5*3 METHODS FOR ASSESSING PRODUCTIVITY
5*4 METHODS FOR DETERMINING THE MIX OF HEALTH WORKERS
5*5 METHODS FOR DETERMINING STAFFING STANDARDS
7*1 PLANNING MODELS: DEFINITIONS AND TYPES
7*2 DESIGNING AND CHOOSING MODELS: BASIC PRINCIPLES
7*3 COMPUTER-BASED MODELS AND PLANNING
7*5 BASELINE AND ALTERNATIVE PROJECTIONS
7*6 `WHAT IF?' QUESTIONS
8*2 TESTING PROJECTION VALIDITY
8*4 TESTING PROJECTION FEASIBILITY: GENERAL PRINCIPLES
8*5 METHODS FOR TESTING PROJECTION FEASIBILITY
8*6 RESOLVING QUANTITATIVE MISMATCHES: AN OVERVIEW
8*7 CHANGING SUPPLY VARIABLES
8*8 CHANGING REQUIREMENTS VARIABLES
12*14 PROMOTING COORDINATED HEALTH WORKFORCE POLICY
14*2 PRINCIPLES OF INFORMATION SYSTEM DESIGN

APPENDICES..................

A*3 EXAMPLES OF HEALTH WORKFORCE ISSUES AND PROBLEMS (3 pp) -- Provides a list of the types of issues and problems that might be found in a country, and which could help stimulate problem identification and priority ranking

A*4 PLANNING AT THE PROVINCIAL OR DISTRICT LEVELS (3 pp) -- Outlines and proposes useful content for a health workforce plan at the sub-national level

A*9 DATA COLLECTION TABLES FOR WORKFORCE PLANNING (20 pp) -- Provides template tables for the collection of basic health workforce data

A*43 PLANNING CONCEPTS AND DEFINITIONS (8 pp) -- Provides a comprehensive glossary of terms used in health planning, training and management.

A*44 USEFUL INFORMATION FOR HUMAN RESOURCES PLANNING (14 pp) -- Lists information that should be considered for possible collection and use in a workforce study; comments on the relative value of each item of information and suggests precautions in data collection and analysis.

A*54 QUESTIONNAIRE FOR MEASURING NURSING JOB SATISFACTION (6 pp) -- Presents a well documented and validated questionnaire to measure the job satisfaction of hospital nurses that was developed in the USA; could be used as a source of questions for similar studies in other countries.

GUIDELINES..................
Health workforce planning. Includes three guidelines that: (1) Make step-by-step suggestions for the design and conduct of an abbreviated one-year study to assess the quantitative and qualitative aspects of human resources for health; (2) Describe how a rapid, inexpensive three-month review of the health workforce situation might be carried out and provides various template materials for use in such a review; and (3) Describes how a rapid, inexpensive three-month review of the health workforce situation might be carried out and provides various template materials for use in such a review.

Workload Indicators of Staffing Need. Describes a method for calculating workload indicators for use in setting norms, comparing the staffing adequacy of dissimilar facilities, and for planning staff requirements. This method has been field tested in several countries and WHO will soon publish a 200-page detailed manual for field use.

Functional Job Analysis. Describes a method for analyzing job functions in order to improve training, strengthen job planning and design, and facilitate the recruitment, selection, training and supervision of personnel. WHO hopes to commission the preparation of a detailed manual for field use.
Appendix F. Sample letter introducing a workforce study

This draft provides illustrative text that might be included in a letter or memo to persons potentially interested in or affected by a survey and/or study of human resources for health. This could be signed either by the senior official with overall responsibility for the project or perhaps by the person(s) responsible for project implementation. The draft presented below is written as if it were to be sent to senior division heads and to be signed by the Director General, Permanent Secretary, or Minister of Health. The text should, of course, be modified as appropriate to the addressee, the person who is to sign it, and to the country situation. Some optional phrases are listed in brackets [..].

[Organizational letterhead]

Date
Dear __________________:

I am writing to bring to your attention a project that will likely be of interest to you [....and to your colleagues / organization / association], and to solicit your collaboration as may be appropriate.

By direction of [name of council, committee, or other body responsible for the project], it has been decided to carry out over the course of the next _____ months a project designed to result in a Strategic Plan for the Development of Human Resources for Health in [country or province name]. This project has the following major objectives:

- To describe and project the likely supply of all major categories of health personnel
- To describe and project, according to several alternative strategies, the likely requirements for all major categories of health personnel
- To assess the potential costs, service outputs, benefits, and economic feasibility of the alternative requirements projections, and
- To develop a strategic plan -- along with accompanying recommendations for implementing policies, investments and actions -- for the further development
of our health workforce.

I hardly need emphasize to you the importance of having a trained and motivated workforce, in adequate numbers and in appropriate locations, to the satisfactory operation of health services in [country or province name]. Moreover, this workforce accounts for well over half of our total health expenditures and if it expands either too rapidly or with an inappropriate mix of health personnel, the impact on the economy can be serious. In view of the problems we continue to experience with regard to the supply, distribution and utilization of health personnel, our efforts to develop a Strategic Plan are timely and of high priority.

This project will be carried out by [name of responsible unit] under the general direction of [name of permanent or ad hoc body responsible for project oversight]. The supply and requirements projections will take into account both the public and private sectors, and will consider both quantitative and qualitative factors. Project staff will be working in close cooperation with [name of international bodies, if appropriate], and will be making use of projection methods developed by the World Health Organization. I have asked the [name of responsible unit] to work closely with all government units, training institutions, professional associations, and other organizations likely to be relevant to this project, and to keep them informed of progress. During the next several months they will likely contact you to obtain your help with the study, and I hope you can provide them with your active support and collaboration.

We at the Ministry [Department] of Health are enthusiastic about this important project and look forward to the resulting report.

Sincerely,

Name
Title

Enclosures [if appropriate]
Appendix G. Trouble-shooting the projection models

This appendix lists some of the more complicated problems you may encounter once you load and test your model. Though some of the points addressed are also covered in the basic documentation, should you get into problems you may find it more convenient to check them out this appendix. This appendix considers substantive data input and output problems. Appendix I considers the more common computer-related problems.

OCCUPATIONAL CATEGORIES; WHO TO INCLUDE? Your inclusion criteria are somewhat different for the supply and requirements models.

- For the supply model include only those categories that are reasonably large and which require specialized health-related training. Doctors, nurses, and technicians obviously meet these criteria, while computer programmers and system analysts, chemists, microbiologists, clerks, and service personnel do not. In the latter category, the number of microbiologists is likely very small and their training is largely outside the health sector, and while clerks are numerous, they do not require significant specialized training. Because of their numbers, auxiliary nurses should probably be included even though their training is usually only a year or less.

- For the requirements model, the inclusion criteria can be more inclusive. The main criterion for inclusion is numbers; if an occupational category accounts for at least several percent or, in larger countries, at least a few 100 persons, whichever is smaller, then it may be worth including. If the category does not meet the size criterion, there may be other reasons for inclusion. The main point is that requirements projections of very small occupational categories are best handled by pencil and paper and should not clutter up your model. Two additional considerations are important. First, you should always combine all occupational categories that have a common health-related discipline such as nursing or medicine. Thus all doctors should be in single category and not listed according to specialty (which can be considered in the specialist tables), and all persons with the basic discipline of nursing should be in single category and not under separate listings such as staff nurse, nurse-midwife, psychiatric nurse, or nurse supervisor. Long range planning primarily seeks to inform the planning of basic health careers such as medicine and nursing, and not the planning of postbasic specialties.

- You may find it advantageous to combine some large but very heterogeneous categories. Examples include one or two levels of administrators, perhaps one or two levels of technicians, and `all others'. This last category could
include many different types of occupations without explicit health-related training such as clerks, orderlies, cleaners, kitchen staff, maintenance and grounds personnel, drivers, etc. This category is large and though personnel will have relatively low salaries, it may account for a significant portion of the budget.

OCCUPATIONAL CATEGORIES: HOW TO LIST THEM? Think out carefully, in advance, in what order and with what titles you want to list the occupational categories. Develop your list and the order of listing the categories on paper before entering the labels in the computer! As you enter the data it will become increasingly difficult to change them. Consider the following:

• Place in the upper part of your list those categories that are relatively expensive and/or numerous and/or require longer training;

• Place similar or related categories next to each other if possible, eg, doctors and doctor assistants, nurses and nurse auxiliaries, etc;

• Consider using the same sequence of occupational categories in both the supply and projection models;

• Lastly, provide occupational category names that will be readily understood by anyone in your country, since the tables may be seen by many persons not familiar with planning.

STAFFING NORM TABLES: Remember that all of the target year staffing tables ask for average staffing, by occupational category, for each single work location of the stated type. For example, if you have five district hospitals, the assumed target year staff listing should be the average staff in each hospital. If you use the total staff for all five hospitals the projection will be based on the result of multiplying five hospitals by the total staff required for all five hospitals combined, and hence will result in a five times overestimate.

WORK LOCATIONS: HOW TO NAME THEM? See Appendix B for suggested work location names. Be sure they are short, explicit, and self-explanatory to anyone familiar with your country’s health system. It will help to put them in some logical order, perhaps progressing from largest to the smallest facilities.
Appendix H. Template data collection work sheets

The ten forms in this set can be used to collect input data for most components of the supply and requirements models. Several types of estimates are best developed at the time of loading and running the models and are not asked for here. Do not write on these forms directly, but use them as a master set from which you can make copies. Some forms must be duplicated a number of times to accommodate (1) different occupational categories for the supply model, and (2) different types of health care facilities (hospitals, clinics, etc.) for the requirements model. The forms are listed below, together with brief indications as to their use. ‘FTE’ refers to full- or whole-time equivalent personnel, i.e., two half-time doctors equal one FTE doctor. The supply and requirements models must use FTEs since training programs and supply must ultimately be expressed as the number of persons, and not the number of staff positions, which could be much greater. More detailed instructions are found in footnotes to the tables. The projection models are flexible and the full documentation (not included in this appendix) suggests various ways that reasonable estimates can be made of otherwise unavailable data. Therefore, provide only those data items that are readily available.

Supply Data Form A. GRADUATES (3 pages). Complete one form for each occupational category for which you wish to make a supply projection. If you do not have readily available information on the number of graduates by year, sex, and origin (national or overseas), provide such information as is available. The supply model is designed to work with either detailed or summary data.

Supply Data Form B. TRAINING, (2 pages). Complete one form for each occupational category. Note that Form B requests information on the current and projected total training capacity of all training programs combined for each specific occupational category.

Supply Data Form C. RETENTION. Complete one form for each occupational category. If cohort and sex specific retention rates are unavailable (and this will be the case in the vast majority of countries), you can use either the default rates or aggregate annual loss rates, e.g., 4% lost each year from the supply of active health workers.

Supply/Requirements Data Form D. DEMOgraphic-ECONtest (1 page). This form provides the basic demographic and economic estimates and assumptions used by the models. The demographic information is essential, while the economic data are only necessary if you wish to test the economic feasibility of the requirements projections.
Requirements Data Form E. OCCUPation and INCOME estimates (2 pages).
The first part of this required form records the (up to) 15 occupational categories
to be projected. Consider carefully which occupations you wish to include, and
the order in which they will be listed in the requirements model since this listing
will be duplicated automatically by the computer in all other tables. If desired,
your last category could be 'All others', a catch-all category that combines all
other health sector personnel not individually projected, for example, computer
programmers, statisticians, engineers, clerks, drivers, cooks, cleaners,
mechanics, receptionists, orderlies, etc. The second part of the form, covering
income estimates, is only necessary if you wish to test the economic feasibility of
your requirements projection.

Requirements Data Form F. HOSPital, AMBUlatory, PRIVHOSP (1 page).
Complete one set of these required forms for each of up to seven types of
hospitals, up to seven types of ambulatory facilities, and for all private sector
hospitals together. If desired, you can also provide data on the output of visits by
up to three different occupational categories, eg, doctors, dentists, and nurses or
midwives. Data on the production of visits will not affect the requirements
projection but can be used to estimate the approximate target year production of
such services.

Requirements Data Form G. BASESERV, HOSPSERV, AMBUSERV,
PRIVSERV. This optional form should be completed if you wish to calculate the
potential production of visits and annual incomes of up to three different types of
independent practitioners working in the private sector. Reasonable estimates
can be easily made for most variables and they can be readily changed to test
their sensitivity to the input assumptions.

Requirements Data Form H. HOSPSTAFF, AMBUSTAFF. These required
forms make it possible to project the requirements for clinical staff. The detailed
notes on the form outline how hospital-specific or clinic-specific staffing norms
can be developed.

Requirements Data Form I. PUBHEALTH institutions & programs. This
required form will make it possible to estimate the approximate number of
personnel of each occupational category required to staff non-clinical public
health programs, including public health research institutes. Examples of such
programs or institutions include the Ministry (or Department) of Health, local
public health units, a National Institute of Health, public health laboratories not
associated with clinical facilities, a national environmental program, and a
malaria program. Public health personnel based at a clinical facility such as a
hospital or clinic should be counted among the staff of that facility in Form H.
Requirements Data Form J. ACADemic personnel. This required form makes it possible to estimate the approximate number of personnel of each occupational category required to staff training programs and educational institutions. Estimate the number of FTE academic personnel employed in the base year in all medical schools, in all nursing schools, etc. `Academic personnel' includes instructors, academic administrators (deans, directors, etc.), and researchers who are primarily working in an academic setting, and who are of the same discipline as the students, ie, doctors in medical schools, nurses in nursing schools, etc. Combine both public and private sector training programs.

Requirements Data Form K. MEDICAL AND NURSING SPECIALISTS. This optional form provides input data that will make it possible to estimate the requirements for medical and nursing specialists.
Supply Data Form A. GRADUATES, #1

Work sheet for __________________ (Occup. category)

TOTAL NUMBER OF GRADUATES OR LICENTIATES BY YEAR AND SEX

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/ LICENSURE

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--- Make the best estimates you can for as many years back from the base year as is possible. If you have actual data on graduates and overseas licentiates, good!! If you have approximate estimates, fine! And if you have estimates of the approximate numbers, but not of the gender distribution, divide the total numbers according to your best estimate of the male-to-female ratio. If you only have rough estimates of the numbers trained by decade, distribute these by year throughout each decade, with perhaps a few less towards the start of a decade and a few more towards the end, eg, if about 500 nurses were trained during a given decade it might be best to assume about 40 per year, on average, at the start rising gradually to about 60 per year at the end.
Supply Data Form B. TRAINING, #1

Work sheet for _________________ (Occup. category)

TOTAL NUMBER OF GRADUATES OR LICENTIATES BY YEAR AND SEX

Photocopy and complete one of these forms for each occupational category for which you wish to make projections. This information is used in the TRAINING table in the supply model.

________ Number of training programs (including both public and private institutions) for this category now operating in your country or region

________ Years of training normally required to get a degree or certification, excluding elective postbasic specialty training

ALL THE BELOW QUESTIONS REFER TO ESTIMATED BASE YEAR VALUES FOR ALL TRAINING PROGRAMS COMBINED FOR THIS OCCUPATIONAL CATEGORY

________ Total number of entering first year students

________ % of current entering students who are expected to eventually graduate

________ Total number who graduated in the base year

________ % of all graduates who were male

________ Estimated net annual flow of new graduates into or out of your country or region. This entry seeks to adjust the training output estimates up or down to take into account the reasonably permanent gains in your planning area due to qualified recent graduates who were trained elsewhere, minus the losses in your planning area due to qualified recent graduates who migrate to other areas. Use a + or - sign to show the direction of the net migratory flow.

________ Number of full-time equivalent instructors, training program administrators and researchers who are of the same discipline as the students in this occupational category, eg, doctors working in medical schools, nurses working in nursing schools. Since many instructors are part-time, you will need to convert the instructional staff into approximate FTEs.
Supply Data Form B. TRAINING, #2

Work sheet for __________________ (Occup. category)

TOTAL NUMBER OF GRADUATES OR LICENTIATES BY YEAR AND SEX

_______________________________________________________

THE BELOW QUESTIONS REFER TO ESTIMATED TARGET YEAR VALUES FOR ALL TRAINING PROGRAMS COMBINED FOR THIS OCCUPATIONAL CATEGORY

________ Projected number of entering students in both public and private sector training programs

________ % of target year entering students expected to eventually graduate

________ % of graduates likely to be male

________ Projected net annual flow of new graduates into or out of your planning area

________ Desired number of students per FTE instructor of the same discipline as the students; include in FTE time for program administration and research.

_______________________________________________________

NOTES: Data entries on this form will be used to project the future output of health workers. A separate copy of Form B should be completed for each occupational category for which you wish to make supply projections, and the data entries should refer to the intakes, losses, and outputs of all training programs combined, eg, if there are 10 nursing schools, then the intakes, etc., recorded here should refer to all 10 nursing schools. Your estimate of the number of FTE instructors can be very approximate and based on an assumed average staffing per school or program.
Supply Data Form C. RETENTION

Work sheet for ________________ (Occup. category)

ESTIMATED RETENTION OF MALE GRADUATES

<table>
<thead>
<tr>
<th>Years since graduation / licensure</th>
<th>% of past / % of future</th>
<th>Default values</th>
</tr>
</thead>
<tbody>
<tr>
<td>50-54</td>
<td>_____ / _____</td>
<td>25%</td>
</tr>
<tr>
<td>45-49</td>
<td>_____ / _____</td>
<td>50%</td>
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<tr>
<td>40-44</td>
<td>_____ / _____</td>
<td>75%</td>
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<tr>
<td>35-39</td>
<td>_____ / _____</td>
<td>84%</td>
</tr>
<tr>
<td>30-34</td>
<td>_____ / _____</td>
<td>87%</td>
</tr>
<tr>
<td>25-29</td>
<td>_____ / _____</td>
<td>90%</td>
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<tr>
<td>20-24</td>
<td>_____ / _____</td>
<td>92%</td>
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<tr>
<td>15-19</td>
<td>_____ / _____</td>
<td>94%</td>
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<tr>
<td>10-14</td>
<td>_____ / _____</td>
<td>96%</td>
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<tr>
<td>5-9</td>
<td>_____ / _____</td>
<td>98%</td>
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<tr>
<td>0-4</td>
<td>_____ / _____</td>
<td>99%</td>
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</table>

ESTIMATED RETENTION OF FEMALE GRADUATES

<table>
<thead>
<tr>
<th>Years since graduation / licensure</th>
<th>% of past / % of future</th>
<th>Default values</th>
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<tbody>
<tr>
<td>50-54</td>
<td>_____ / _____</td>
<td>25%</td>
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<tr>
<td>45-49</td>
<td>_____ / _____</td>
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<td>15-19</td>
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<tr>
<td>0-4</td>
<td>_____ / _____</td>
<td>99%</td>
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NOTES: This table is for the estimated retention rates in active service for this occupational category. The above default values assume that 99% of all graduates will still be actively working in the health field 0-4 years following graduation, declining to 25% for those who graduated 50-54 years earlier. ‘% of past grads.’ refers to the activity rates for those who graduated prior to the base year; ‘% of future grads.’ refers to your anticipated rates for future graduates. The default values are toward the upper range of what can be expected. You can either use these rates, or propose different ones. Do not try to estimate occupation-specific rates for every category but prefer instead to use similar rates for all or most categories of technical, auxiliary and support personnel. Alternatively, you can estimate the approximate percentage of the active supply of health workers lost each year due to death, retirement, and out-migration, eg, 4%, 3.6%, etc.
Supply/Requirements Data Form D. DEMOgraphic-ECONTEST

IDENTIFYING INFORMATION FOR _______________ (name of country)
____________________________________________________________

_________________________ Type of projection (7 characters maximum); if you have alternative sets of demographic and economic assumptions you can designate each projection by a different name
199____________ Base year of the projection, ie, most recent year for which there are reasonably complete data
____________ Target year of the requirements projection (the supply projection is automatically 30 years). We recommend projecting requirements at least 20 to 30 years ahead; intermediate projections can be made

DEMOGRAPHIC ESTIMATES

____________ Base year population (000s)
________.____% Annual population growth rate (0.0), over the first third of the projection period
______.____% Annual population growth rate (0.0) over the second third of the projection period
______.____% Annual population growth rate (0.0) over the last third of the projection period

ECONOMIC GROWTH ESTIMATES

______.____% Average annual change (0.0) in public sector expenditures on personnel

NOTES for Form D: Use a conservative estimate for the projected average annual population growth rate. The current growth rate will probably be appropriate for the next few years and perhaps even for the first third of the projection period. If the growth rate is currently moderate to high (>2%), you should probably assume it will decline in the future, especially if it has already started to decline or there are policies directed at reducing the growth rate. For a country with, say, a 2.5% annual growth rate now, reasonable assumptions might be for average growth rates of 2.4%, 2.1%, and 1.9% during the next three decades. All countries will (and must) eventually experience growth rate declines and you will need to consult with demographic experts to develop reasonable assumptions for the future. --
- The best guide to projecting the average annual change in real (ie, in constant and not inflated currency) public sector expenditures on personnel is the average annual change of the past 10-15 years, adjusted to take into account anticipated changes in the gross domestic product, in the size of recurrent (excluding capital investments) annual expenditures on the entire public sector, the public health sector, and in the portion of public health sector expenditures allocated to salaries. Unless major increases or decreases are anticipated in public health sector expenditures on personnel, the average annual change over an extended period of time will probably be slightly higher (0.1-0.4% higher) than the projected growth of the gross domestic product.
### Requirements Data Form E. OCCUPation and INCOME estimates

#### Requirements Work sheet for _______________ (country/region)

<table>
<thead>
<tr>
<th>OCCUPATIONAL CATEGORY (Up to 11 characters)</th>
<th>ESTIM. BASE YEAR FTE ACTIVE SUPPLY</th>
<th>AVERAGE FTE PUBLIC SECTOR INCOME/YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Public sector</td>
<td>Private sector</td>
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#### NOTES for Form E:
List the names of the up to 15 occupational categories that you wish to include in your requirements model, and for each category, the estimated active FTE public and private sector personnel, the average base year gross annual FTE public sector income. The income estimates are optional and will be used only if you wish to test the economic feasibility of your requirements projection. For these estimates it is not important that you have a precise value, which would be hard to calculate, but only that the relative values are reasonably good, i.e., the ratio between doctors, nurses, dentists, auxiliaries, etc., is reasonable. Put all income estimates in terms of full-time equivalents, i.e., what would the average FTE doctor, dentist, etc., working in the public sector earn. If different components of the public sector, e.g., Ministry of Health, health facilities operated by local government, military hospitals, have different pay scales, make an approximate weighted estimate, giving more weight to the pay scales of the larger employers.
Requirements Data Form F. HOSPital, AMBULatory, PRIVHOSP, #1

Requirements Work sheet for _______________ (country/region)

PUBLIC SECTOR HOSPITALS (Categorize all public sector hospitals in up to seven categories, eg, national, regional, district, mental, chronic, specialized, and health centers with beds.)

<table>
<thead>
<tr>
<th>PUBLIC HOSPITAL TYPE (name)</th>
<th>NUMBER OF HOSPITALS</th>
<th>NUMBER OF BEDS IN TYPE</th>
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<tbody>
<tr>
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</table>

_______________ Estimated total number of patient discharges from all public sector hospitals combined in the base year

PRIVATE SECTOR HOSPITALS (Base year)

_______________ Number of hospitals

_______________ Number of private hospital beds

_______________ Estimated average bed-occupancy rate (%)
Requirements Data Form F. HOSPital, AMBUlatory, PRIVHOSP, #2

Requirements Work sheet for _______________ (country/region)

PUBLIC SECTOR AMBULATORY CLINICS AND CENTERS (Categorize all public sector clinics and centers in up to seven categories, eg, polyclinic, health center, health post, MCH center, etc.)

<table>
<thead>
<tr>
<th>PUBLIC CLINIC TYPE (name)</th>
<th>NUMBER OF CLINICS CENTERS, &amp; POSTS</th>
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</table>

AMBULATORY PATIENT VISITS (ATTENDANCES) IN THE BASE YEAR

_______________ Estimated total number of _________*visits (or attendances) from all public sector hospitals, clinics, centers and posts combined in the base year

_______________ Estimated total number of nurse _________* visits (or attendances) from all public sector hospitals, clinics, centers and posts combined in the base year

_______________ Estimated total number of _________* visits (or attendances) from all public sector hospitals, clinics, centers and posts combined in the base year

*NOTES for Form F: You may, if you wish, specify up to three different categories of health workers for whom you would like to estimate the target year production of ambulatory visits. Examples might include doctors, dentists, and nurses or midwives, or some other category.
Requirements Data Form G. BASESERV & COSTS

Requirements Work sheet for _______________ (country/region)

BASES FOR ESTIMATING SERVICES BY INDEPENDENT PRACTITIONERS

<table>
<thead>
<tr>
<th>ASSUMPTION</th>
<th>OCCUPATIONAL CATEGORY*</th>
</tr>
</thead>
<tbody>
<tr>
<td>(FTE=full-time equivalent)</td>
<td>#1  #2  #3</td>
</tr>
</tbody>
</table>

BASE YEAR ESTIMATES

FTE practitioners in independent, ie, unsalaried private sector practice ___ ___ ___

Average hours worked per FTE per year ______ hours

% of hours attending patients ___ ___ ___

Visits per FTE per hour (0.0) ___ ___ ___

% of `urban' patients ___ ___ ___

Average expenditure per visit ___ ___ ___

----- TARGET YEAR ASSUMPTIONS ----- 

Average annual increase in FTE practitioners per year (0.0) ___ ___ ___

% of hours attending patients ___ ___ ___

Visits per FTE per hour (0.0) ___ ___ ___

% of `urban' patients ___ ___ ___

NOTES for Form G: Use this form to enter your base and target year estimates for visits produced by the (up to) three private sector independent practitioner categories for whom you are estimating visits. These three categories must be the same for whom you are estimating public sector visits. Visit costs should be in the national currency and reflect your estimate of the national average for a visit. If some of your occupational categories do not provide visits in the private sector, enter a zero (0). Your assumed annual percentage increase in the number of independent practitioners will usually be similar to the rate of increase in the urban population, perhaps adjusted to take into account the expected change in per capita disposable income and/or government policies affecting private practice.
Requirements Data Form H. HOSPSTAFF, AMBUSTAFF

Complete one work sheet for each type of public sector clinical work location ---

Work location type

<table>
<thead>
<tr>
<th>AVERAGE STAFF PER UNIT IN THE TARGET YEAR</th>
<th>OCCUPATIONAL CATEGORY (Use the same categories, listed in the same order, as in Form E)</th>
</tr>
</thead>
<tbody>
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<td>1</td>
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NOTES for Form H: Use this form to enter your assumptions regarding the average number of FTE staff of each of (up to) 15 occupational categories in each type of public sector clinical health facility in the target year. If necessary, you may enter FTE staff numbers to one decimal place (0.0). As an illustration, assume you are completing the form for a facility type you have named 'DistHsp' (referring to public sector district hospitals with an average capacity of 125 beds, plus clinics and associated public health program). You should enter in this form the number of FTEs of each occupational category that would be a reasonable staff complement for the average district hospital in the target year. Your initial estimate might be based on the staff complement that would be proposed for a new 125-bed district hospital due to be opened several years hence. You could then adjust the number assumed for each occupational category either up or down to 'correct' for distortions in the present staffing patterns due to staff shortages or surpluses, to inappropriate training, or to inadequate funding that does not permit full staffing levels. This would then be your first staff complement assumption, which can then be easily changed to develop alternative scenarios.
### Requirements Data Form I. PUBHEALTH institutions & programs

<table>
<thead>
<tr>
<th>FTE STAFF</th>
<th>ANNUAL % CHANGE</th>
<th>OCCUPATIONAL CATEGORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>IN THE BETWEEN (Up to 15; use the same categories, B-Yr &amp; in the same order of listing, as T-Yr were used in the previous tables.)</td>
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</table>

**NOTES for Form I:** Use this form for public sector health personnel working in institutions or programs not based in or linked to a clinical facility. For the base year estimate the total number of FTE staff of each type that were working in the Department of Health, district health departments, national institute(s) of health (for research), environmental health, etc., as long as they were not based in clinical facilities such as hospitals, clinics or health centers. For the target year estimate, indicate the approximate annual rate at which you think each category should reasonably increase (or decrease) during the interval between the base and target years. This will usually be at least as fast as the estimated population growth rate, plus increments to take into ac-clinical public health workforce might be somewhere between 4% and 6%. The growth rate for individual categories might be either more rapid or slower than for all categories as a whole.
Requirements Data Form J. ACADemic personnel

<table>
<thead>
<tr>
<th>OCCUPATIONAL CATEGORY</th>
<th>BASE YEAR TOTALS</th>
<th>PROJECTED T-Y TOTALS</th>
<th>ANNUAL RATIO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of Enrollments</td>
<td>FTEs of same occup.</td>
<td>% INCR.</td>
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<tr>
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<td>training programs</td>
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<td>STUDENTS</td>
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<td>ROLMENT / FTE</td>
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NOTES for Form J: This required table provides input data for the requirements model. You should complete this information only for the longer, more expensive, higher level programs, eg, doctors, dentists, pharmacists, nurses, and perhaps the higher technician levels. You may complete this table for as many of the (up to 15) selected occupational categories as you like, but it will have little meaning for most administrative, service and support categories since they either do not require specialized training or it is obtained outside of the health sector. ‘FTEs of same occup’. refers to the approximate number of FTE instructors, administrators and researchers who are of the same occupational category as the students in the training programs, eg, FTE doctors employed by medical schools, FTE nurses employed by nursing schools, etc. ‘Target year ratio of students per FTE’ refers to the desired ratio of students to FTE instructors (and training program administrators) of the same discipline as the students.
Appendix I. Computer commands and troubleshooting

If you are a beginner with this system you will want to refer to this appendix often until you become familiar with managing spreadsheets. The first page contains brief instructions for common tasks, including most of those introduced in Part I. The next several pages provide additional details on each of the icon buttons on the task bar, listed in sequence from left to right. You may find it useful to photocopy these several pages and keep them next to your computer. The last part provides instructions for coping with some of the problems you may encounter with the program.

---

LIST OF COMMON COMMANDS
HRH Projection Models

CALCULATE: Edit|Settings|Recalculation|Automatic (or Manual) to set default value
COPY BLOCK: select source cell or block, <Ctrl> C, specify top left cell of destination, <Ctrl> V
DISPLAY TWO SPREADSHEETS AT SAME TIME
  Window|Tile, use mouse to move between files, use upper right minimize bar to close unwanted file
  Window|Cascade, use mouse to move between files, use upper right minimize bar to close unwanted file
EXIT PROGRAM: File|Exit, or Green Door and Footsteps button
FILE OPEN: File|Open or <Ctrl> O, select file, <Enter>
FILE SAVE: File|Save or <Ctrl>S, <Enter> (to replace current file)
FILE SAVE AS: File|Save As, enter new filename, <Enter>
FILE CLOSE: File|Close, save data set first
FILE DELETE: delete from HRH directory using Windows Explorer
FIND text or formula: select search area; click magnifying glass button; specify item; click Find Next
FORMULA: select cell; press yellow and red Fx button to see formula
GRAPH SELECT: Graph|select View or Print
HELP FOR SPECIFIC TABLE: With cell pointer on desired table, press <F1>
HELP MENU: <F1>, or `?', or Help, select Index and enter table name or command
MOVE CELL POINTER: arrow keys; <Tab> or <Shift> <Tab> to move one screen to right or to left
  <Home> highlights top left cell (A1) on current page
  <End> <Home> selects lower right corner of the non-blank part of the page
  <F5>, enter name of desired cell or table, <Enter>
PAGE CHANGE: Click name tabs with mouse, or <Ctrl> <PgDn> or <Ctrl><PgUp>
PAGE SETUP: click File/Page Setup or white page setup button; For Margins, Options, Orientation, Size
PRINT TABLE: File|Print or printer button, specify table, <Enter>
PRINT GRAPH: Graph|Print, select graph
PRINTER SETUP: File|Printer Setup.
RECALCULATION: When in Manual setting, press yellow & red button next to Get Version button
WIDTH (of a column): mouse double arrow over column divider, drag divider with mouse
WINDOW SPLIT (easy method): With cell pointer at the desired split location, press <Ctrl> D.
WINDOW, DISPLAY: Window|Tile (panels, multiple displays) or Window|Cascade (overlapping panes)
WINDOW, SPLIT HORIZONTAL: Window|Split|click Synchronize|click Horizontal|OK
WINDOW, SPLIT VERTICAL: Window|Split|click Synchronize|click Vertical|OK
WINDOW, SPLIT SYNCHRONIZE: Window|Split|click Horizontal|OK (Top & bottom panes move together)
WINDOW, UNSPLIT: *Window|Split|Clear, or Window Unsplit* button
ICONS USED BY THE WHO_HRH MODEL

WHO_HRH MODEL MENU & TASK BARS. The top section of the HRH models has three bars that go the full width of the screen. The uppermost blue **status bar** displays the name of the loaded file, eg, HRH - [SUPPLY.bwb, REQUIRE.bwb]. Next comes the **menu bar** with words such as *File, Edit, Go To, Graph, Save for compare/combine, Data, Window, and Help*. Each of these provides a pulldown menu with more choices, to be described when first introduced in the model documentation. Below the menu bar comes the **task bar**, with small square **icons** or **buttons**. A short description of each button’s function is displayed near the lower right portion of the computer screen when the cell pointer is over the button. From left to right the buttons and their functions are:

- **Get Version** [a small spreadsheet with an inward pointing arrow]: Use the *File|Get Version* command to insert previously prepared data into the model.

- **Recalculation** [red mathematical symbols with a yellow arrow]: *Edit | Settings | Recalculation* controls the timing of spreadsheet recalculation. The default calculation setting for the WHO models is *Automatic*. If your computer is slow, specify *Manual* and then use this button to force recalculation.

- **Restore formula results** [gray button with @su, etc. on it]: A formula’s result can be temporarily changed by simply typing a value into the cell. It will be displayed in red to remind you of the temporary nature of this value but in all other respects the replacement value will be used until it is cleared with this button.

- **Attach a note** [yellow button with red and blue lines]: Can be used to attach a note to a cell. This note will only be saved if you save the (.Bwb) file; it is not saved in data (.Bdt) files. See the complete manual for instructions.

- **Reset to allow input** [yellow button with a blue # on it]: If you have inadvertently entered a formula in an unprotected cell you cannot eliminate it without using this button. To restore the cell to its original unprotected and unfilled state, put the cell pointer over the cell and press this button.

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**This button requires a more detailed explanation.** Spreadsheet application programs such as Lotus 1-2-3, Quattro Pro and Excel allow users to enter a small formula in an unprotected cell to calculate a number. For example, assume you wanted to calculate 7*153. In the normal spreadsheet you could enter this simple formula and the result, 1071, would be displayed and either the formula, or a re-entered 1071, would be used in the
spreadsheet for further calculations. Unfortunately, this is illegal here. If attempted you will find that you cannot now enter another formula or delete the 7\*153 formula, and any other number you enter will also appear in red. You cannot even eliminate the formula with the File|Clear Data command. The only way to clear the 7\*153 formula from that cell is to press the yellow "#" button, which will eliminate the formula and return the cell to "0". Due to the problems you will encounter we strongly recommend against entering a formula in any unprotected cell!

**One important caution!** The # button will insert a "0" whenever it is selected, **even if the cell is protected.** You could thus delete a part of the distributed model. If you do, your only solution is to close the spreadsheet without saving and then re-open it, thus returning you to the spreadsheet as it was when it was last saved.

- **See formula** [yellow with "Fx" on it]: Press this button with the cursor on a cell to reveal the underlying formula or text in the cell. This way you can trace the logic and interrelationships between the various data inputs.

- **Find button** [gray magnifying glass]: This button may occasionally be useful to find text in a cell or label. Formula results are not examined. Click the button; select the table or part of the page where you would like to find a word or phrase; enter the text you would like to find; click *Find Next*; note in the Current Cell line of the dialog box the cell address for the location where the text is found.

- **Unsplit screen** [white with a red diagonal bar]: Unsplits the screen.

- **Edit page layout** [page with arrows]: Uses the *File|Page Setup* command so that you can enter or change Headers, Footers, Titles, Margins, etc., before printing.

- **Print a table** [printer icon]: Asks you to specify a table you would like to print. For tables on an Occup page in the Supply model append the Occup page number to the table name. For example, if you wish to print the TRAINING table on the Occup2 page you would enter *training2*.

- **Save version** [small spreadsheet with an outward facing arrow]: Uses the *File|Put Version* command to open the Put Version menu so that you can save a data set. If you wish to save your data under an existing name, click the name, click OK, and then Replace or Backup. If you wish to save your data under a new filename, enter the name in the upper box and click OK. No filename extension is necessary.
- **Exit application** [green door with footsteps]: Use to exit the application. **Always click "No"** on the small dialog box unless you really intend to save the complete .bwb file, a process that is slow and will replace your Supply, Require, or Combine master file.

- **Context sensitive Help** [yellow ?]: Provides the full Help file for Microsoft Windows commands, Visual Baler commands, and for the WHO_HRH tables. Click Search to open the full list, type the first few letters of the desired index entry, and click the desired entry. An easier method to access help for a specific table is to place the cell pointer anywhere on the table and then press the <F1> key. You can scroll down the information or, by clicking and dragging the top bar, move it to a better location. Press <Esc> or click off the help display to close the Help window.
**PROBLEMS AND TROUBLESHOOTING**

**COLUMN WIDTH IS TOO NARROW FOR NUMBERS** — Column widths in the two projection models have been set to accommodate the likely data inputs and outputs of most countries, but may not be appropriate for some situations. For example, in some columns numbers in the millions will not fit in the standard column width of nine spaces, in which case the computer will display them as **********. In such a case you can easily change column widths by placing the mouse over the line that marks the division between two adjacent columns and then, when the double arrow appears, click the left mouse key and drag the column divider in the desired direction. The same procedure may be done with rows. These changes will not be permanent unless you save the entire, 1+ MB model using the *File|Save As* command. This command will present you with a box that asks for a filename. If you click the existing Require.BWB filename you will overwrite the original HRH runtime model that was given to you. Unless you are very sure of what you are doing we suggest you enter a new name for your altered model, and the computer will automatically give it a BWB file extension. This way you can always return to the original model if necessary.

**COPY** — You may occasionally want copy text from one unprotected cell to another using the standard Windows procedure. Select the cell or block to be copied; use the <Ctrl> C or right mouse click command to copy the material; paste the copied material in the new location using <Ctrl> V or right mouse click command. *Never, never, never* try to copy from a protected cell to an unprotected cell since if you do your input will be write-protected. If this should happen your only remedy is to immediately close your active file without saving and re-open it.

**COMPUTER IS TOO SLOW** — If you find that the program runs slowly on your computer it may be due to a slow central processing unit or insufficient memory. Two remedies may help the situation:

(1) If you have insufficient computer memory, close all unneeded windows after saving their contents.

(2) If your computer is slow, you may wish to disable the automatic recalculation feature. This feature automatically recalculate all affected formulae with each new data input. Use the *Edit|Settings|Recalculation|Manual* command. When in this setting, the computer will recalculate values based on new inputs only when you press the red and yellow recalculation icon with the small +-x symbols on it.

**OCCUPREF TABLE** --- In the section in which the occupations for which visits are calculated are entered the “row number” refers to the row number column in
the top section of the table and not the spreadsheet row number to the left side of the screen.

**POW ERROR MESSAGE** --- During the early phase of development with the requirements and compare modules several instances of “POW: domain error” were encountered. These have been fixed. However, if more are encountered the problem is usually on the InterYr page and leaving the intermediate year field blank will prevent the error. Of course this also makes the InterYr page inoperable. Report this problem to the World Health Organization or to Thomas L. Hall at the address indicated on the cover page, and include a diskette with the *PutVersion* dataset currently in use when the POW message occurred along with an indication of the action that led to the error message.

**PRINTING PROBLEMS** --- A graph will print with correct sizing if, before you print in any session, you select *Graph/View* from the edit menu. In that window select *File/Page Setup* and specify “half page” and “landscape” in the appropriate places. Each type of printer and configuration must be correctly identified for your system. Refer also to your hardware manual for detailed assistance.

**PROJECTIONS TABLE** --- The shaded cross-hatched cells below this table which can be used to split the window between the projection table and the other tables on an Occup page cannot be used without first clearing the split window (either use the window clear button icon or *Window/Split* on the edit bar). This is a system restriction and violation can cause the screen to freeze, in which case the model must be reloaded.

**TRAINING TABLE** --- The training table provides an imprecise description of the actual educational experience for each occupation. For each five-year cohort after the base year the output of the cohort is defined by the number that entered the first year of studies during the same five-year period. Thus the output for the five-year cohort ending in 2001 will be the annual intake during the years 1997, 1998, 1999, 2000, and 2001, minus the assumed wastage. For a one or two-year course of studies this introduces little error, but for those occupations that require three or more years, this can introduce some error when entering enrolments are undergoing rapid change. In effect, if enrolments are rapidly increasing the TRAINING table could overstate output, and if they are decreasing, it could understate output. Over the extended projection period typically used, 20-30 years, these errors will be small and by adjustment of the assumed training intakes, can be reduced even further. To make more precise projections the model would have to obtain annual intakes for each calendar year and then project, year by year, the outputs from these intakes, lagged by the normal number of years of study. For example, to project the number of doctors graduating in 1998, and assuming a five-year course of studies, one would need to know the first year intake in 1994 and the graduation rate for that entering
cohort. To design a TRAINING table that could accommodate pre-base year student intakes, different normal training periods, and which would “lag” outputs by the number of years of study would have added a degree of complexity not justified by a slightly greater projection accuracy.
Appendix J. Supply model figures, tables and graphs

This appendix includes printouts of selected tables, graphs and figures from the Supply model, materials that will be useful for training and demonstration purposes. Model input and resulting output values are from a demonstration data set for a fictitious country, Southland. The data are contained in the file demosup.bdt, which is provided with the model. The base and target year growth assumptions, retention and loss rates, and training intakes and outputs in this simulation model are purely hypothetical and have no relation whatsoever to what would be typical in a real country.

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[NOTE: These tables and graphs are provided in the paper manual provided by WHO at a workshop but are not available on diskette or in these instructions since they are produced by the HRH program itself, in a software language not convertible into Word. They can be printed using your Baler models software.]
Appendix K. Requirements model figures, tables and graphs

This appendix includes printouts of selected tables, graphs and figures from the Require model, materials that will be useful for training and demonstration purposes. Model input and resulting output values are from a demonstration data set for a fictitious country, Southland. The data are contained in the file demoreq.bdt, which is provided with the model. The base and target year growth assumptions, distribution of work locations, and staffing standards used in this simulation model are purely hypothetical and have no relation whatsoever to what would be typical in a real country! The target year assumptions are intentionally designed to produce a health sector that is economically infeasible.

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[NOTE: These tables and graphs are provided in the paper manual provided by WHO at a workshop but are not available on diskette or in these instructions since they are produced by the HRH program itself, in a software language not convertible into Word. They can be printed using your Baler models software.]
Appendix L. Combine spreadsheet figures, tables and graphs

This appendix includes a printout of the COMPARE table, which makes it possible to compare up to nine alternative projection scenarios, and of the NEEDS table, which will combine projections for multiple health systems or provinces to generate a national projection scenario..

[NOTE: These tables and graphs are provided in the paper manual provided by WHO at a workshop but are not available on diskette or in these instructions since they are produced by the HRH program itself, in a software language not convertible into Word. They can be printed using your Baler models software.]
Appendix M. Step-by-Step Model Instructions

**HUMAN RESOURCES FOR HEALTH (HRH) PROJECTION MODELS**

*World Health Organization*

*January 2001*

**STEP-BY-STEP INSTRUCTIONS FOR USING THE MODELS**

This step-by-step guide will lead you through the main features of Version 3.0 of the VisualBaler HRH supply and requirements scenario projection models. (Although the Microsoft Excel version differs somewhat from the VisualBaler version, the tables are virtually identical.) The first section describes how to install and load the runtime models, the second one provides a tour of the supply model, and the last one, of the requirements model. Each major step is separated by a centered line. Follow the steps in order and review the supply spreadsheet first. Later on, once you are more familiar with the program, you can proceed through the models in any sequence desired. Each row is numbered to facilitate reference to specific sections when these instructions are used in a teaching session.

**Getting started**

- Install the HRH projection models on your hard disk by inserting disk #1 in the disk drive and following the instructions on disk #2. (In some versions, three diskettes are required.) We suggest accepting the proposed Program Group, HRH, but you may give it another name if desired. The total program will occupy approximately 7 megabytes of hard disk space.

- You may review the README file now or later. It provides a summary of the basic instructions for loading and operating the models program.

- In Windows95/98/2000 you can create a shortcut for loading the models program by clicking with the right mouse key on the red and yellow toolkit icon and, while holding the key depressed, dragging the toolkit to your desktop.
display. Release the key and then with the left button, click *Create Shortcut Here*. You can now click and drag the toolkit icon in the usual manner to place it in a convenient location on your desktop for use in loading the program.

Getting around the models

This section briefly outlines how to move around the spreadsheet models and provides certain cautionary notes. Most of these instructions are repeated when you are first asked to take the action. Throughout these step-by-step guidelines we use the convention of putting in *italics* all computer commands and row or column labels, and in **boldface** font words or terms requiring special emphasis. Suggestions for improving these guidelines will be appreciated and should be sent to the address at the end of this document.

- **Parts of the screen display.** There are three bars at the top of the display and one at the bottom. From the top down they are: blue caption bar which shows the name of the model that has been loaded; the pulldown menu bar (*File, Edit, etc.*); the icon bar, which has icon buttons designed specifically for the HRH model; and at the bottom of the screen, the page tab bar which shows the various "pages" in the model.

- **Loading a model.** After loading the HRH program, click the desired Supply, Require, or Combine model, and then *OK*.

- **Closing a model.** If you wish to close one model so that you can open another, use the *File|Close* command and then the *File|Open* command. If you wish to exit the HRH program, click the *green door with footsteps* icon toward the right side of the icon bar. When asked if you wish to save the BWB file, answer *No*! Do not answer *Yes* since this will result in saving the large (>700 KB) file along with any changes or data you have placed in it.

- **Loading a data set.** Click the *small spreadsheet with an inward pointing arrow* icon near the top left of the icon bar, and select the desired *bdt* data set file, ie, *demo-sup.bdt* for the supply file, and *demo-req.bdt* for the require file. The bdt files are typically less than 20 KB in size and provide only the numbers and text that go in the yellow, unprotected cells. This icon performs the same tasks as would the *File|Get Version* command.

- **Saving a data set.** These step-by-step guidelines do not ask you to save any data sets. However, if you wish to save your own simulation data set, click the *small spreadsheet with an outward pointing arrow* icon on the right half of the icon bar. Enter a new filename not exceeding 8 characters, click
OK, and then OK to the next dialog box. This icon performs the same tasks as would the File|Put Version command. Do not save either the demo-sup.bdt or demo-req.bdt demonstration data sets since you may thus introduce changes which will conflict with the numbers given in these instructions.

- **Clearing or re-loading a data set.** You may clear a data set by using the File|Clear Data command. Alternatively, you can load another data set or re-load the same set by clicking the Get Version icon; this will automatically replace the existing data set with the new one. **IMPORTANT NOTE:** If your numbers start to disagree with those given in this document it probably means you have changed an input variable but forgot to return it to the original value. You can always return to the original data set by re-loading the demo-sup or demo-req data set with the Get Version icon. For this reason you should never save one of the demonstration data sets.

- **GOTO a page.** Along the bottom of the screen are page tabs, eg, Info, Occup1, etc., in the supply spreadsheet, or Info, Core, Econ, etc., in the require spreadsheet. Access a page by clicking its tab. You can also turn the pages to the right by pressing <Ctrl> <PgDn>, and to the left by pressing <Ctrl> <PgUp>. To put the cell pointer on cell A1 of a page, press <Home>.

- **GOTO a table.** There are three ways to access, or "GOTO" a table: (1) Use the Go To..|pagename|tablename command on the menu bar; (2) Press <F5> and then enter the desired table name; (3) Click the desired light-blue table name located either on the appropriate Info page or at the bottom of the previous table in the series.

- **Seeing a formula.** With the cell pointer over the desired white, write-protected cell, click the yellow Fx icon. Click OK to close the displayed formula.

- **Splitting a screen.** Place the cell pointer on the row or column where you would like to split a table. Click the Window|Split|Horizontal/Vertical command, and then uncheck the Synchronize box. If you do not uncheck this box, when you move either the upper or lower screen, the other screen will move in tandem. The macro <Ctrl> D can perform the above task more quickly. Place the cell pointer on the row where you would like to split the screen; press <Ctrl> D; use the mouse or <F6> key to place the pointer on the desired screen.

- **Clearing a split screen.** Click the white icon with a red diagonal slash in the icon bar.
• **Getting help.** With the cell pointer anywhere within the boundaries of a table, press the <F1> key. You can move the help screen in the usual way and close it with the <Esc> key. You can also access help files for Windows, Baler, and the WHO models by clicking the yellow ? icon.

• **Gaining access to the top of a table (Mouse shown with a diagonal line across it).** Some of the tables are quite long and hence are not fully displayed on a single screen. The HRH program "freezes" the titles on many tables so that as you scroll down the table, you can continue having the table headings displayed at the top. Occasionally this will result in a situation where your mouse cell pointer appears on the upper part of the screen as a mouse with a diagonal line through it, and you are unable to enter data. You can demonstrate this situation to yourself in the supply model by using the pulldown menu command Go To../Occup1/Retention. To clear this situation use the Windows/Titles/Clear/OK command, or access the table using one of the other methods available to you.

**SUPPLY**

The HRH supply model....

• Projects the active supply of health personnel, that is, health workers who are working in the health field

-- Users can specify up to five occupational categories on one supply spreadsheet. Additional spreadsheets can be used to project as many different categories as desired, five at a time.

-- Projections are made for 5, 10, 15, 20, 25, and 30 years and intermediate year projections are possible

-- Two methods for projecting losses are available, depending on data availability

-- Training and loss rate assumptions can be easily varied

-- In- and out-migration flows across provincial or national boundaries can be taken into account

-- Summary statistics, ratios and figures are provided
• Combines projections of up to five occupational categories on each supply spreadsheet

• Can make a simple test of economic feasibility; the requirements model can make a more complex, and realistic, test of feasibility

The supply model spreadsheet consists of eight pages....

• The Info page records basic identifying and demographic data applicable to all five occupational categories

• Five Occup pages, one for each of five occupational categories; you do not have to complete all the pages and you can use a separate supply spreadsheet for additional sets of five occupations

• The Region page which (1) combines the five projections in one table, (2) provides a simple economic feasibility test, and (3) makes possible a supply projection to an intermediate year other than the default five-year intervals.

• The Program page, which contains programming code and which requires no user attention.

The supply model also comes with a simulated data file (demo-sup.bdt) for demonstration and training purposes.

Supply projections are based on...

   Existing base year supply of active personnel

   plus

   Additions (new graduates and in-migration)

   minus

   Losses (deaths, retirements and out-migration)

   equals

   Target year supply of active personnel

Load the supply model by double clicking the red and yellow toolkit button, select Supply, and click OK. When preparing a supply projection model you will need to
provide basic identifying and demographic data on the Info page. This includes:

- **Date**
- **Country and projection name**
- **Base year of the projection**
- **Base year population size**
- **Projected population growth rate by decade**

To help you get acquainted with the supply file we have provided a demonstration data set, called *demo-sup.bdt*, which will be used in the remainder of this step-by-step description. Load this file by clicking the small *Get Version* button with the inward pointing arrow near the top left of the screen, and then select *demo-sup.bdt*. (For your information, the *Get Version* button in the toolbar accomplishes the same task as the *File*/*Get Version* command in the menubar.) Note the information provided on the Info page, including the list of five occupations at the bottom of the screen.

- **GOTO** the Occup1 page, for Doctors. You can "Go To" a page either by clicking the appropriate tab at the bottom of the screen or using the `<Ctrl>` `<PgDn>` keys to turn pages to the right, or `<Ctrl>` `<PgUp>` to turn them to the left. All five Occup pages are the same, though in the simulated data set each contains the supply projection of a different occupational category.

- **Note** the yellow shaded cell with the word *Doctors* entered. If you entered a different category in this cell it would change the labels on all the tables on this page. Review the display for this page, which is typical of all Info pages. Under **TABLE NAME** are four light blue words (*GRADUATES, RETENTION, TRAINING, PROJECTIONS*) and to the right of each name is the table title. When the table names are in light blue you can double click on them to go directly to the desired table. You can also go to another table by clicking the *Go To* command in the pulldown menubar and then selecting the desired page and within that page, the desired table. Note the cross-hatched blue box with a black border around it in cell D18. This *Print tables* box can be clicked later if you are connected to a printer and wish to print all the tables on this page, but do not click it now.

- **GOTO** the GRADUATES table by double clicking CELL 11A that displays in light blue the word *GRADUATES*. Note that the GRADUATES table is in two parts.

  -- The top, small boxed section that displays the label *Less precise method* applies the simpler, **Annual Loss Rate method** of projection. With this
method you assume a fixed annual percentage loss to the active supply of \textbf{past} graduates during each five-year period, a rate that will usually be between 2\% for a young, rapidly growing workforce, and 5-10\% for a predominantly female workforce that is experiencing relatively high loss rates. The RETENTION table, described below, will apply to \textbf{future} graduates. Use this upper boxed section if you lack reasonably complete information about the number of graduates over the past 30-40 years and/or you have no idea of likely cohort-specific loss rates. If you enter any number (other than 0) in row 7 under the number of male or female active health workers, the computer will use this upper table to project the base year supply to the future. The annual loss rates you assume will likely be somewhere between 2\% and 10\%, the lower values applying to young and rapidly growing occupations, and the higher ones to predominantly female occupations and/or those with a high turnover rate and a short worklife.

-- The lower, much larger table labelled \textit{More precise method} shows the number of graduates, national and overseas, by gender, over the past 40 or more years. Many countries may not have information in this detail but reasonable estimates can often be made, as described in the full documentation.

Before leaving this table, place the cell pointer anywhere within the boundaries of this table and press the \textless F1\textgreater key to see the on-line help notes. The \textless F1\textgreater key can be used in this way to obtain help with any of the tables in the model. Press the \textless Esc\textgreater key or click outside the help panel to return to the table.

• Use the \textless PgDn\textgreater key to go to the bottom of the GRADUATES table and then double click the button for the RETENTION table. The RETENTION table allows you to use the \textbf{Cohort method of projection} by assuming cohort retention rates for both past and future male and female graduates. By way of explaining this table, look at row 10, starting at the far right column. The \textbf{default} rate of 25\% indicates that 25\% of male graduates who completed their training 50-54 years earlier will still be found in the active workforce. In cell Q7 the number "95" has been entered, indicating that the user assumes that the actual retention rate for \textbf{future} graduates is 95\% of the default rate, resulting in the number 94 in cell Q20. In cell O7 the number "90" has been entered, indicating that for \textbf{past} graduates the retention rate is assumed to be only 90\% of the default rate. Yellow columns are available to enter occupation and country-specific rates, if available. To use this table you have three options: (1) Use the \textbf{default rate}, based on high retention rates observed among U.S. physicians; (2) assume a fixed \textbf{\% of default rate}, eg, 95\%, or 102\%, in which case the default rates are decreased or increased as desired; or (3) enter your own, data-based estimate of the cohort rate. The computer
will look first to #3, then to #2, and if no numbers are in either of these columns, then to #1, the default rate. The cohort retention rates are in two sections, for Past graduates and for Future graduates. If you complete the lower section of the GRADUATES table and you have no number (other than 0) in the upper section, then the supply of past graduates will be projected using the cohort rates for graduates up through the base year. If you have a number in the upper section, then the base year supply will be projected using the Annual Loss Rate method. The supply of future graduates will be based on the cohort retention rates assumed for future graduates, whichever method is used.

- **GOTO** the TRAINING table by double clicking the button on the bottom of the RETENTION table. Review the rows and follow the logic. Values given for the 1st year class and the % who graduate make it possible to project the number of graduates. The % males makes it possible for the computer to take into account different retention rates for males and females. The years of study entry makes it possible to calculate total class size, adjusted downward for intra-school losses. The net annual flow of foreign and out-of-area graduates makes it possible to adjust the annual increments for the net annual flow of graduates into or out of the planning region or country. Only assumed permanent losses should be counted here, and not graduates who leave or come for short-term postbasic studies, which are taken into account by either the annual loss rates or cohort retention rates. Lastly, the bottom section makes it possible to calculate the likely requirements for faculty of the same discipline as students, that is, doctors teaching medical students, nurses teaching nursing students, and so on.

- **GOTO** the PROJECTIONS table and review the row labels and the red-numbered row 27 with the projected active supply, by five-year period. If there was no number or only a "0" in the upper section of the GRADUATES table you will see all the cells filled with numbers in the top section of the PROJECTIONS table, indicating that the computer used the number of past graduates and the cohort-specific retention rates to project the supply of persons graduating up through the base year.

- The supply model displays graphically projections for each occupational category and for all of them together. Click the Graph/View/Occup1 command, and then enlarge the display by clicking the small square box in the upper right hand corner of the graph that has a black bar across the top. Note that the left vertical scale (Health Workers) applies to the red and blue lines, while the right scale (Population per worker) applies to the green line. Since the blue line indicates the number of persons trained after the base year, it will always start at zero in the base year and will always be lower than the red line, which is the total supply of health workers. The blue line will...
have special significance if a new type of training is introduced around the time of the base year since it will indicate how quickly the workforce will acquire the new skills. Click the small "X" at the top right of the graph to close it.

- GOTO the Region page and review the three tables, SUPPLY, COSTS, and INTERYR.

  -- SUPPLY summarizes all five supply projections; note the summary values in rows 23-24 and 28-29. Both the supply and requirements models make frequent use of index values, a convention that makes it possible to quickly compare rates of change in variables expressed in widely differing units (eg, millions, thousands, hundreds). Since the base year is set at 100, you can subtract 100 from any subsequent year's index value to obtain the percentage change. For example, if population rises to an index value of 210 and the health workers to 252, this means population has increased 210 - 100 or 110%, and the health worker supply, 152%.

  -- COSTS can be used to make a rough test of economic feasibility. You will soon see how the four main assumptions regarding changes in available funds, salaries, percent of full-time equivalent personnel (FTE) in the public sector, and relative incomes can affect public sector costs.

  -- INTERYR makes it possible to project to an intermediate years, other than one of the stated five-year intervals.

Now let's try some supply projection tasks using the demo-sup.bdt data set. If not already loaded, use the Get Version icon to load demo-sup.bdt.

- GOTO the Occup1 GRADUATES table. Put the cell pointer on any cell in row 16 and split the screen by pressing <Ctrl> D or clicking Window|Split|Horizontal and then un-checking the Synchronize box. A click in the latter box unsynchronizes the screen so you can put different tables in the upper and lower screen. Click anywhere in the lower screen and then use the Go To..|Occup1|PROJECTIONS command in the menubar to display the PROJECTIONS table. You should now have the GRADUATES table in the upper screen and the PROJECTIONS table in the lower screen. If necessary, press the down arrow key until row 27 with the red figures is visible at the bottom of the lower screen.

- Click the Males cell (cell I-7) in the upper screen and enter 3000. Do not use a comma (,) either here or anywhere else in the model since commas are entered automatically by the computer. Note that all the numbers in the upper part of the lower screen are now zeros, indicating that the cohort
method is no longer being used. Enter 2000 in the Females cell. Note that the combined total supply of 5,000 in the base year (row 17, lower screen) decreases with time to 2,005 over the 30-year period.

- Enter the number 6 under the year 2010 in the upper screen, indicating an assumed 6.0% annual loss rate during the period 2006-2010, and note in row 27 of the lower screen that the projected total supply for the year 2025 is now 9,443, down from 9,734, and the number of past graduates is 1,714, down from 2,005. Re-enter 3.0 under the year 2010 and delete the 3,000 males and 2,000 females. Your projection will now use the cohort method based on the past number of graduates and licentiates shown in the lower section of the GRADUATES table.

- With the cell pointer in the upper screen, GOTO the RETENTION table. Click the lower screen and with the down arrow, scroll down until the red row 27 is visible at the bottom of your screen. Note that the total supply in 2025 (cell AK27) is 10,303. Click cell Q7 in the upper screen and replace the number 95 with 80; note that the total supply now drops to 9,718. This drop is the result of changing the retention rates for future male graduates from 95% of the default rate to 80% of the default rate. The default rate is the approximate rate you could expect in a country with a high rate of retention over time. Replace the 80 with 95 in cell Q7; the total supply returns to 10,303.

- You can use the default rates, or a percentage increase or decrease of the default rates, or your own rate, if available. To demonstrate using your own rate, enter 70 in cell P17 in the upper screen and note that the target year supply drops to 10,169, reflecting the lower retention rate entered for future doctors 15-19 years following graduation. Delete the number 70 to return to the original projection of 10,303.

- With the cell pointer in the lower screen use the up arrow to display the upper portion of the PROJECTIONS table and note that you now have the age/cohort structure of past graduates as well as for future graduates. Row 36, Average age of workers, also has some meaning since it can calculate the approximate average age of the workforce based on the numbers active in each five-year cohort.

- Using yet another method of selecting a table and with the cell pointer in the upper screen, press <F5> and enter the word TRAINING. You are now in the TRAINING table, which determines how many new graduates will be entering the workforce. Click cell W9 in the upper screen, enter 640 (twice the 320 value), and note the increase in the total supply from 10,303 to 11,445, the effect of increasing student intakes to 640 during the five-year period 2001-
[NOTE: The TRAINING table makes an important simplifying assumption that somewhat reduces the accuracy of the projected numbers of new graduates. This assumption is that the number of first year students entering in each five-year cohort, minus the assumed losses, is also the number of graduates during the same cohort. In reality, especially for occupations that require three or more years of study, most persons entering in any one five-year period, will actually graduate in the next five-year period. With stable student intakes the errors will be negligible. Without correction, with rising intakes the projection may tend to overestimate output and with falling intakes, it may underestimate output. By adjusting intake assumptions appropriately, these errors can be minimized. For example, if base year intake was 100 students in a 5-year program of studies, and this was to be increased to 150 per year starting one year later, you should leave cell V9 at 100 and enter 150 in cell W9. This would reflect the reality that the increased intake would not result in increased output until five years after the base year.]

- Click cell X13 in the upper screen and replace the value 47 with 20; note the total 2025 supply decreases slightly from 10,303 to 10,287, due to the smaller percentage of male graduates. In this demonstration data set males are assumed to have a 5% higher retention rate than females.

At this point let's go back to the original data set and try some illustrative tasks. To make sure you have the same starting values use the File|Get Version command to re-load the demo-sup.bdt data set. You should now see a projected 2025 supply of 10,303, in the lower screen and the top part of the TRAINING table should still be in the upper screen.

- Click the lower screen and use the down arrow to put row 25 (New grads =) at the top of the lower screen. Click the upper screen. Change the student intakes in row 9 starting from column V to achieve a target supply of about 9,000 by the year 2010 (column AH, lower screen), and only about 9,500 by the year 2025. The values in column U are only to remind you of the approximate values that existed in the base year and do not have an effect on the projections. Enter in the spaces below the student intake values that would produce a target supply of about 9,000 by 2010 and 9,500 thereafter.


-- To achieve these targets you will have to increase student intakes substantially during the first several five-year periods and then to avoid overshooting the 9,500 target, to reduce intakes sharply thereafter. While
these large changes would neither be easy or desirable, they illustrate how you can use the model to attain almost any proposed target supply.

-- To view the effects of your changes, click the Graph|View|Occup1 command to see a graph of your supply projection. You can enlarge the graph by clicking the small square box in the upper right corner that has the line across the top of it, and then close the graph by clicking the "X" box.

- Click the Get Version button, select demo-sup.bdt to restore the original values. In the upper screen press <Home> and click RETENTION to display the RETENTION table. If a 95% (of default) retention rate for future male graduates will result in a 2025 supply of 10,303, what will be the supply in that year if the retention rate is 100% of default (______) or 90% of default (______)? In this way you can test the sensitivity of the different output values to changes in the input values.

We will now look at the combined projections and economic feasibility test in the supply model.

- Click the Clear screen button with the red diagonal bar on it to clear the split screen and re-load the demo-sup.bdt data set. Click the Region page tab at the bottom of the screen. If the cell pointer is not at the top left of the screen, press the <Home> key.

- Click the light blue SUPPLY cell to display the SUPPLY table. Briefly review this table again and then click the COSTS cell to display the COSTS table. Note that Staff costs show an index value of 309 (cell T15) as compared with an Available funds value of 281 (cell T14). This indicates that costs have increased at a slightly faster rate than funds, though given the many uncertainties in long range projections the 10% difference can really be considered acceptable.

- Try the following: Enter 1.5 in cell N5, for the Average annual % change in real public sector salaries. Now projected staff costs are 358, well above available funds. Re-enter 1.0.

[NOTE: All money projections are in terms of real, or uninflated money with the same approximate purchasing power as was the case in the base year. The underlying assumption is that government, over the long run, will try to adjust salaries to keep up roughly with inflation. Long range projections of inflation rates cannot be made.]

(1) In cell N4, what Average annual % change in available real funds for
personnel would be necessary to equal the rise in costs? (___.__%) Re-enter the original value of 3.5.

(2) In cell P11, what percent of all full-time equivalent (FTE) doctor time could be supported in the public sector on the funds available from a 3.5% annual increase in funds? In other words, if 70% of doctor time is in the public sector in the base year, what percent could be paid for in the target year such that staff costs would be close to the 281 value for available funds? (______%) Re-enter the original value of 65 in cell P11.

- Note the Relative Incomes column (Q). If you replace the relative income of 4.0 for doctors (meaning that doctors earn four times what the lowest of the five income categories earns) with 7.0, staff costs go down from an index value of 308 to one of 291. Since the percentage of doctors in the workforce declines from 34% to 25% over the 30-year projection period, their relative weight in the projection declines and their high relative incomes count for less in the projected staff costs. Conversely, if doctors earn a relative income of 2.0, then staff costs increase to 329, since now most of the occupational categories are in the 2-3 range. Re-enter the 4.0 value for doctors' relative income.

You now have a general idea of how the economic feasibility test works. The computer multiplies the number of base year health workers in each occupational category by the percentage assumed to work in the public sector, by the relative salary values. In the case of doctors this means: 5,490 base year doctors are multiplied by 70% and the resulting number is multiplied by 4.0. The five occupational totals are then summed, and the total becomes the base year staff costs. The same calculations are then made for the target year, eg, 10,303 target year doctors x 65% x 4.0. The calculated base year staff costs are assumed to be the same as the base year available funds. Target year available funds are then calculated by applying the assumed average annual percentage change (cell N4, or 3.5% in the demo-sup.bdt data set) to the base year available funds divided by staff costs. Target year costs are divided by base year costs, and the result multiplied by 100 to get the index value for target year costs. The same procedure is used with target year funds and base year funds. Cells T14 and T15 then show the results, and the user can determine whether costs and funds are increasing at similar or dissimilar rates.

[NOTE: Each supply spreadsheet can project only five occupational categories, far less than the total number that make up the health workforce. Since the simple economic feasibility test used in the supply model does not include the entire health workforce, the potential for test errors will increase to the extent that there is large variability in the rate of increase experienced by different occupational categories. The feasibility
test used in the requirements model should be the preferred method for testing scenario projection feasibility.]

Lastly, GOTO the INTERYR table. Enter 2003 in the single shaded cell, Z4. You now have the interpolated supply to the year 2003.

**CONGRATULATIONS!** You have now completed a review of the main features of the supply model. Close the model by clicking the green door with footsteps icon on the toolbar and **VERY IMPORTANT, be sure to click No when the dialog box asks if you want to save changes to SUPPLY.BWB.** If you had clicked Yes you would have saved your entire supply spreadsheet, with the demonstration data in it. To regain the empty file you would need to re-load the HRH program from your master diskette.

_______________________________________________

**REQUIREMENTS**

The HRH requirements model....

- Projects the active (that is, **working in the health field**) requirements for health personnel in the public and private sectors
  
  -- Users can specify up to 15 occupational categories on one spreadsheet

  -- Projections can be made for any period (20-30 years are recommended) and for a country, province, region, or health system

- Provides five optional modules to assist with decisionmaking

  -- Test of economic feasibility of the projection

  -- Potential production and per capita utilization of hospital and ambulatory care services

  -- Potential urban/rural distribution of services

  -- Requirements for up to 9 named categories of medical and of nursing specialists

  -- Projections to an intermediate projection year

- Provides many summary tables, graphs and utility tables to help with common
planning tasks

- Makes side-by-side comparisons of multiple alternative scenario projections based on the same base year estimates
- Combines projections made for different provinces, regions or health systems in order to produce a national projection

The requirements model spreadsheet consists of nine pages....

- The *Info* page lists all the tables and graphs
- The *Core* page contains the 15 core input and output tables
- The *Econ, Serv, Dist, InterYr, and Utilities* pages together contain the 16 input and output tables of the optional modules and the utility tables
- The *Program* page contains programming code and requires no user attention.
- The *Translate* page, which provides two summary tables with open labels so that users can enter labels in the local language

The requirements model also comes with a simulated data file (*demo-req.bdt*) for demonstration and training purposes.

Requirements projections are based on a variant of the target-setting method in which users specify, by means of various indicators, assumed or desired changes in (1) the numbers, characteristics and geographic distribution of hospitals and clinics, (2) staffing densities, (3) relative growth rates of the public and private sectors, and (4) growth rates for the public health and academic sectors.

Load the requirements model by double clicking the red and yellow toolkit button, select the Requirements model and click OK; you should now be on the *Info* page. If the cell pointer is not at the top left of the screen, press the <Home> key. To help you get acquainted with the requirements file we have provided a demonstration data set, called *demo-req.bdt*, which will be used in the remainder of this step-by-step description. Load this file by clicking the small *Get Version* button with the inward pointing arrow near the top left of the screen, and then select *demo-req.bdt*. Scroll down the page and note the listing of various modules and their tables. By double clicking a light blue table name in column A you can immediately go to that table. The cross-hatched boxes (*Print ... tables*)
located to the right lower section of each module make it possible to print out all
the tables of the specified module with a double click.

Before reviewing the model in some detail and doing exercises, let’s take a quick
look at the three main output tables. These tables will give you better sense of
how the model can help with decisionmaking.

- On the Info page, double click the REQUIREMENTS table name. This table
  presents target year requirements projections for each of the specified
  occupations and their distribution by work location.

- GOTO the COMPARE table by clicking this word at the bottom of the
  REQUIREMENTS table. This table compares projected requirements with
  supply, the latter generated by the supply model.

- GOTO the SUMMARY table by clicking Go To.../Core/Summary in the
  pulldown menu at the top of the spreadsheet. This menu can be used to
  access any table in model. Note the comparison of base and target year
  values as you scroll down the long table. This table captures the key values
  from many other tables to provide you with a reasonably complete view of
  how the projected scenario compares with the base year situation.

Now that you have seen some of the model’s outputs, let’s see what input
estimates and assumptions are required to produce them. We will now make a
more systematic tour of the model and try a few exercises.

**Core module**

GOTO the DEMOGRAPHIC table on the Core page. Note that this page is similar
to the demographic table in the supply model except that it allows you to specify
the target year of your projection and asks for the estimated base year
urban/rural distribution of the population and the assumed target year of
distribution. The first four letters are capitalized in the DEMOGRAPHIC table name,
indicating that when you specify a table name for printing or other actions, all you
need to enter is the capitalized letters and not the full word. This convention is
used throughout the WHO models.

- In the DEMOGRAPHIC table note the planning assumptions. The population
growth rate is assumed to drop from 3% to 2% over the 30-year projection
  period, though it will still be high. During this period the population will grow
  from 10,000,000 (the last three zeros are omitted) to almost 21 million. The
urban population is assumed to rise from 35% to 50% of the total population. The resulting calculated urban and rural growth rates are shown at the bottom. To see what would result with a longer projection period, enter 2095 in cell A4 (Target year), thus making this a 100-year projection. The population now rises from 10 to 118 million, and if the projection is extended to 1000 years, a short time in the history of human existence, the population would reach 525 quadrillion. Obviously, all countries will be obliged to slow population growth to replacement levels in the near future if they wish to avoid demographic catastrophe. Re-enter the year 2025 in cell A4. Below the bottom line of each table is a suggestion as to which table should next be accessed. The proposed sequence will be useful when first completing the requirements spreadsheet, but once filled, users can access tables according to their particular needs.

- **GOTO** the SUPPLY table by clicking the light blue table name at the bottom of the DEMOGRAPHIC table. In this table you specify the occupational categories, the estimated base year supply of each category, and the estimated number of full-time equivalent personnel in the private sector. The occupation names will be entered by the computer in many of the remaining tables. With the cell pointer anywhere in this table, press the <F1> key to see the on-line help notes. The <F1> key can be used in this way to obtain help with any of the tables in the model. Press the <Esc> key or click outside the help panel to return to the table.

- **GOTO** the OCCUPREF table. This table, abbreviated from "OCCUPation REFerence," tells the computer in which row it can find doctors, in which row it can find nurses, and so on, in order to make special calculations regarding the workforce composition, and the row locations of up to three different occupational categories that provide ambulatory visits, eg, doctors, dentists, nurses. The bottom section of this table makes it possible for the computer to determine the proportion of the workforce that can be considered high, mid- and support level personnel.

- **GOTO** the HOSP table. Note the seven types of hospitals (including a bedded Type A health center, abbreviated Hlth Ctr-A) that are assumed, the calculated base year (B-Y) population/hospital ratios (row 10), and the proposed target year (T-Y) ratios (row 16). The summary statistics in rows 19-22 show that in comparison with the B-Y, the T-Y will have a reduced percentage of beds in national hospitals, a increased percentage in regional and district hospitals, and a considerably improved national beds/1000 population ratio (1.7 to 2.4 beds/1000). Starting in row 24 is an optional table that allows you to estimate the average population actually served by each type of facility, ie, the catchment population or service area population. Detailed instructions on the uses and limitations of this optional table are
provided in the manual. Finally, review the boxed note at the bottom of this table.

-- To see how table inputs affect the model, replace the 2500 value in cell K16 with 1000. Do not use a comma (,) either here or anywhere else in the model since the commas are entered automatically by the computer. By changing cell K16 you have changed the ratio of large national level hospitals from one per 2.5 million population to one per 1.0 million. Since the last three zeros are omitted, 2500 actually equals 2.5 million and 1000 equals 1.0 million. By changing the theoretical ratio of Population(000) per hospital (row 10), you have:

(1) increased the number of hospitals from the original value of 8.4 in cell K13, to 21

(2) increased the percentage of public sector beds in national hospitals from 14.5% to almost 30% (cell K20)

(3) and increased the beds per 1000 from 2.4 to 2.9 (cell Q22)

Re-enter the original value of 2500 in cell K16.

-- Since this and a similar table for ambulatory health facilities are major determinants of public sector staff requirements, let's stop a moment to show how they work. In the demo-req.bdt data set there were 3 large national hospitals in the base year. Since the base year population was 10 million, this gives a ratio of 3.333 million population per hospital. Note that this is a "theoretical ratio," which has nothing to do with the actual population served by an average hospital. In the target year it was assumed that this ratio would be reduced to 2.5 million per hospital which, when divided into the projected population of 20.9 million, means a "requirement" for 8.4 hospitals. This number, 8.4, is then multiplied by the assumed average staff (HOSPSTAFF table) of each occupational category required for an average national-level hospital to obtain the projected total staff required for this type of hospital. In cell K15 it is assumed that the average national-level hospital will have 900 beds, the basis for developing the appropriate staffing norm. The same logic is used for each of the seven hospital types (including their outpatient clinics), and for each of the seven types of ambulatory facilities without beds. The totals for the various facility types are then summed to determine the required number of public sector clinical personnel. The full documentation goes into this process in much more detail and considers such details as fractional (eg, 8.4) facilities, catchment populations, methods for developing the various planning assumptions, etc., but this will provide you with a basic understanding of
this part of the model.

- GOTO the AMBULATORY table and observe the major improvements proposed in the target year population per location ratios in row 11, consistent with policies to strengthen primary care, especially for the rural population. The average population per location drops from one per 12,000 to one per 9,000 (cells Z13-14), and the number of ambulatory facilities increases threefold from 819 to 2,436 (cells T13-14), as compared with a doubling of the population.

- GOTO the PRIVHOSP table and note the assumed 4.0% annual change in the number of private hospital beds. This rate is slightly higher than the calculated growth in the urban population (3.9%) that was shown at the bottom of the DEMOGRAPHIC table (and which is reproduced at the bottom of the PRIVSTAFF table). No one can predict what the growth rate of private sector beds will be but in the absence of major government policies either promoting or slowing growth of the private sector, a growth rate close to that of the urban sector will probably not be in much error. Moreover, since private sector beds usually represent only a small portion of total beds, errors will not have great impact on the final projections. Unlike the HOSPITAL table, the PRIVHOSP table makes no attempt to project private hospitals according to size or characteristics. In most countries private hospitals will be relatively small (<200 beds) and long-range prediction of hospital characteristics and staffing in relation to size would be pure speculation.

- GOTO the HOSPSTAFF table and review the proposed T-Y staffing standards. These standards are purely hypothetical for purposes of this simulation, and should not be regarded as desirable standards for any given country or type of facility! Note the summary statistics at the bottom of the table which shows how staff are distributed among the various facilities and the FTE staff available per bed. As might be expected, larger acute care hospitals have higher ratios than smaller hospitals. The Type A health center that has inpatient beds (referred to as Hlth Ctr-A) has a relatively high ratio (1.4 staff per bed in cell P93) due to an assumed relatively high number of auxiliary and public health staff allocated to the ambulatory and community outreach programs.

- Use the Go To../Specialists/HOSPSPEC pulldown menu command to display the HOSPSPEC table and review the optional module that makes it possible to project requirements for up to nine (plus All other specialties) of user-defined medical and nursing specialists. Note in column K that the 170 doctors and 280 nurses assumed for the average 900-bed national hospital are distributed among various specialties.
• GOTO the AMBUSTAFF table. Note that the proposed staffing standards are expressed to one decimal place since some clinics are assumed to use part-time staff that visit different facilities on a rotating basis, e.g., a doctor visiting the average rural clinic for one half-day clinic session per week would represent 0.1 FTE doctor-time.

• GOTO the PRIVSTAFF table and review the logic of these estimates. The Total FTEs values come from the SUPPLY table. In column AD (Total B-Y) of the PRIVSTAFF table you must estimate the number of self-employed FTEs, which will usually apply only to independent practitioner categories such as doctors, dentists, pharmacists, and perhaps a few midwives and technicians. The computer calculates B-Y salaried staff FTEs (column AG) by subtracting values in column AD from those in column AC. Annual change assumptions will usually be close to and perhaps somewhat above the urban population growth rates unless the country anticipates major public sector policies affecting private sector growth. Since you will probably use similar growth rates for the salaried and independent practice categories, precise estimates of the proportion of personnel in each group is not necessary.

• GOTO the PUBHEALTH table. The red note at the bottom of this table indicates the kinds of personnel to be counted in this table. The assumed annual percentage change in the public health category will usually be well above the population growth rate, possibly above the urban growth rate, and the rates will vary according to occupational category. Exceptions to this norm would be in situations where the Ministry of Health is grossly overstaffed or the economic growth rate is very low or negative. Once you have reasonable differential growth rates for the various categories, you can then use the Adjustment factor to adjust up or down, in parallel, all categories together. This will be useful later on when you are fine tuning your projection. For now, try entering 2.00 in cell AK73 and observe the effect on columns A0 (Adjusted FTE numbers) and AQ (index values). Re-enter 1.00 before leaving this table.

• GOTO the ACAD table and note the logic of the model to project teaching personnel and the boxed note at the bottom of the table. The annual enrolment changes (column AW) shown on this simulation are probably too low since the population is increasing at an average rate of 2.5% annually. Note the substantial improvements assumed in the T-Y ratio of students per FTE instructor (column AX) as compared with the B-Y ratio (column AV). Try changing the assumptions regarding the annual change in medical student enrolment (cell AW75) or students/FTE (cell AX75) and observe the resulting changes on instructor requirements. Leave the values at 1.1 and 7.0 when
you leave this table.

- GOTO the REQSPEC table and note the distribution of doctors and nurses according to specialties. This capability of the model can help greatly to guide postbasic specialist training programs.

- GOTO the REQuirements table. This computer-generated table summarizes the projected requirements based on earlier estimates and assumptions. The results are displayed graphically by selecting Graph/View on the menubar, and then selecting HWNUMBER. Note the other graphs that are also available for viewing.

- GOTO the COMPARE table. Later on, when you develop a projection for your own country, you can enter the projected supply (from the supply model) in this table and note the calculated surplus or deficit in each occupational category.

- GOTO the SUMREQ table, which provides many useful summary comparisons between the base and target years. Index values are provided so that the percentage changes can be calculated by subtracting 100 from the index value. In some cases a higher index value reflects improvement (e.g., health workers per 1000), while in others a lower value reflects improvement (e.g., population per health worker). Scroll down to review the whole table.

You have already seen the SUMMARY table, which combines in one display summary information from this and other summary tables.

ECONomic module

This optional module makes it possible to test the economic feasibility of each projection. Even when some of your input estimates are quite uncertain, this module can provide useful guidance regarding the likely feasibility of your projections. Appendix D, Section 2 (Summary effects of increased inputs on outputs) in the full documentation indicates the relative importance of errors in each input variable on the model outputs. The module can be completed quickly and then refined as improved data become available.

- Use the Go To..|Economic|INCOMES pulldown menu to display the INCOMES table. Note that the table requires estimates of the average annual FTE public sector income of workers in each occupational category, and the assumed rates of real income growth. The relative accuracy of the several income estimates is much more important than their absolute
accuracy. In other words, if the relative incomes shown in column B are reasonable, it doesn't matter much if all incomes are estimated on the high or low side of what is actually the case. In this simulation it is assumed that the relative income, or what might be termed the income gradient, shown in column C of 7.5:1 (ie, doctors earn 7.5 times what the lowest paid category earns) is too great, and hence the planning assumptions assume that doctor and dentist incomes will increase more slowly (1% per year) than other incomes, with the result that the target year gradient is somewhat reduced (to 7.1:1). In many countries it will not be possible for health authorities to change the relative incomes earned by the different occupational categories since salary policy is made outside the health sector, and in any event, differential rates of salary growth must usually be introduced gradually and with care due to the potential for controversy. Note again the use of an Adjustment factor in cell A6 that makes it possible to change all incomes up or down in parallel to test the effect of different rates of income growth on costs. We will demonstrate use of this factor shortly.

• GOTO the COSTS table. The upper section is entirely computer-generated and for various reasons, eg, inflation, cannot be used to project actual budgets. It is used by the computer to complete the economic feasibility test. The optional lower section makes it possible to estimate private sector incomes obtained from fees for a hypothetical health worker spending full-time in the care of ambulatory patients. These income estimates, while useful, have several important limitations, specifically: they are average incomes and therefore cover a broad range according to practitioner location, type of service, and specialty; they are FTE incomes, even though many practitioners work only part-time in private practice; they are gross incomes derived from patient visits, and hence are considerably higher than what is actually received by practitioners, since part of these earnings must be spent on such items as rent, utilities, supplies, equipment, support staff; and they are based only on fees derived from ambulatory patients and do not include income received from the sale of medicines, attention to private inpatients, and other services. Even with these significant limitations, however, the income estimates can help suggest the possible magnitude of the public-private sector income differential and its potential effects on the recruitment and retention of public sector professionals.

• GOTO the ECONTEST table and review the upper section through row 9. The result of the economic feasibility test is shown in red in cell Q9. In this case, the value of 149% indicates that projected costs are 49% greater than projected funds and hence the projection scenario, even though attractive, is quite a bit too expensive. If funds and costs are in balance, the test value will be close to 100%, if funds exceed costs it will be <100%, and if costs exceed funds, >100%. The key input value in this upper section is the assumed
average annual % change in funds available to pay public sector personnel (cell Q5). Try entering numbers in Q5 to determine what rate of increase will result in a feasibility test value of about 100%? Note the proper value here, (__,__), and then replace it with the original value, 4.7.

- Now let's look at the optional lower section of the table. This can help you develop a realistic assumption for the rate of growth of funds to pay for public sector health personnel. Note that the red output value in cell S32 (4.7%) of this section is the same as that used above in cell Q5. The shaded cells in rows 14-19 have estimates of base year GDP and expenditures, and the assumed annual change in the GDP during the projection period. Note that planning assumptions in cells S23-S25 call for: increasing from 15% to 18% the percentage of the GDP allocated to the public sector; increasing from 4.7% to 5.0% the percentage of the public sector allocated to health; and decreasing from 85.7 to 70.0 the percentage of the public health sector allocated to health personnel. The first two assumptions are consistent with the prevailing patterns of national development (at least in countries with rising per capita incomes), and the last one seeks to correct the tendency in many countries to spend too much on personnel, with consequent underspending on drugs, equipment, supplies, and maintenance. With these values the computer calculates the resulting average annual growth rate of personnel expenditures of 4.7%. Recalling the value you calculated above for cell Q5 that would make the projection scenario feasible, determine the following values. After answering each question, re-enter the original value before answering the next question. To be economically feasible.....

-- The assumed 4.5% annual GDP growth rate would have to increase to ____.__%

-- The assumed 18% of the GDP allocated to the public sector would have to increase to ____.__%

-- The assumed 5% of public sector expenditures allocated to health would have to increase to ____.__%

-- The assumed 70% of public health expenditures allocated to personnel would have to increase to ____.__%

From this small exercise you can see how each of the major economic assumptions affects the average growth rate of funds available to pay personnel. You can also appreciate the magnitude of the change that would be required in any one variable to make the demonstration projection feasible, a change that would clearly be unrealistic in most countries. A combination of smaller changes might, however, make it
possible to approach feasibility, especially if matched by changes that reduced costs. The simulation data set was intentionally designed to show a major improvement in the provision of services that, on further analysis, would be economically not feasible. We will briefly review the remaining optional modules and then return to the important question of feasibility, and how the model can be used to bring supply and requirements, and costs and funds, into balance.

**SERVices module**

This optional module makes it possible to project the potential production of hospital days, patient discharges, and ambulatory visits by up to three categories of health personnel that would result from your requirements projection. The word potential is emphasized to highlight the reality that the projected production of services is based on explicit assumptions regarding health worker productivities, and the implicit assumption that the future population will actually seek and use these services.

- Recall, or if desired, GOTO the OCCUPREF table and review the text. In that table we had specified that we would like to calculate the ambulatory visits produced by doctors, dentists, and nurses.

- Use the Go To..|Services|BASESERV pulldown menu to display the BASESERV table. Most countries will be able to provide estimates of the total number of hospital discharges and ambulatory visits in the public sector, and assumptions about hospital and clinic productivities are used to estimate the number of private sector discharges and visits. The full-time equivalent number of hours can be calculated using the HOURS table in the Utilities page.

- GOTO the HOSPSERV table and review the various assumptions used to estimate the target year production of services. The target year bed occupancy rate was assumed in the HOSPital table. Note that the assumed average percent of hospital-based doctor time actually spent attending ambulatory patients is 50% or less. Hospital doctors also attend hospitalized patients, provide support services (e.g., laboratory, pathology, radiology, administration) not involving direct patient contact, and spend time in consultations with other staff, inservice training, and the like. A reasonable assumption will be that as hospital size and complexity increase, the percent of doctor time spent actually with ambulatory patients will decrease as will the number of patients seen per hour. The bottom section of this table provides the basis for projecting private hospital discharges.
-- The interaction between length of stay and occupancy rates make it possible to project the number of discharges. Try increasing substantially the assumed average target year length of stay in national hospitals (cell J7) and observe the effect on the three cells immediately below cell J7. Re-enter 12 in cell J7.

-- Ambulatory visits are estimated using the relationships:

\[
\text{Patients seen per worker per year} = \text{Patients seen per hour} \times \frac{\text{Number of FTE workers in each clinic type}}{\text{Number of patients seen per year}}
\]

- GOTO the AMBUSERV table and note the similar estimates generated for public sector ambulatory facilities not based in hospitals. For example, looking at column S for the Poly Clinic type of facility, it is assumed that full-time equivalent doctors average 1700 work hours per year, they spend 70% of this time attending patients at an average rate of five patients per hour for a total of 5,950 patients per FTE doctor per year, and 41,600 patient visits per polyclinic per year. At the bottom of that table in the section starting in row 33, are assumptions for estimating the production of visits by the private sector. Projections of services produced by independent practitioners are made using the same formula as was used for public sector workers. By linking the private sector estimates of patient visits to the COSTS table the computer can calculate the average annual FTE income from patient visits.

- GOTO the SUMSERV table to review the summary results of this module. Some of these results are also displayed on the AMBUSERV and HOSPSERV graphs, displayed by selecting Graph/View on the menubar, followed by the desired graph.

**DISTRIBUTION module**

This optional module makes it possible to estimate the approximate geographic
distribution among urban and rural residents of the hospital and ambulatory services produced. The calculated rates are based on assumptions regarding the relative utilization by urban and rural residents of different types of services in different types of facilities. The estimates will be much more useful as indicators of the likely urban-rural service gradient given the various planning assumptions, than as indicators of the actual number of services received by urban and rural residents. The full documentation goes into some detail about how to define urban and rural, and how to estimate the distribution of services. No countries will have actual data on the proportion of urban and rural patients served by each type of hospital or clinic, but reasonable estimates can easily and quickly be made of these variables to within perhaps 15% of the true values. This level of accuracy should be adequate to provide policymakers some guidance regarding the likely urban-rural gradient in the provision of services based on their planning assumptions. Since all countries have an urban-rural imbalance in the provision of health services the challenge is not to eliminate it, but to ensure that it doesn't become excessive; the requirements model can help in this task.

- Use the Go To...[Distribution]LOCATIONS pulldown menu to display the LOCATIONS table. Although the table is very large, only rows 13 and 15 require data inputs, and all the rest are numbers calculated by the computer for use in the SUMDIST table. Use the right arrow key to see the right side of this table. The underlying assumptions used in the demonstration data set are as follows:

  -- Patients are likely to travel farther for serious illness requiring hospitalization than for ambulatory care. According to this assumption if all patients attended by a hospital were classified by residence, one would find a higher proportion of rural residents among hospital discharges than among ambulatory patients. Thus in the demo-req data set it is assumed that for national-level hospitals urban residents accounted for 90% of all hospital discharges and 95% of ambulatory visits.

  -- For most countries, the smaller the public sector hospital the higher the proportion of rural residents, since small hospitals are usually located in relatively small population centers. However, since virtually all hospitals with, say, 50+ beds will be located in towns, the majority of their patients are still apt to be urban residents. These assumptions are reflected in cells E13 and E15 for district hospitals, where urban residents account for 75% of all discharges and 85% of all ambulatory visits.

  -- Small rural facilities such as health centers and posts will have a low proportion of urban residents. Depending on how urban and rural are defined, this proportion may approach zero.
-- Most private sector patients are assumed to be urban residents, occasional exceptions being for countries with a substantial number of health facilities operated in rural areas by churches or agricultural enterprises.

• GOTO the SUMDIST table and review the summary calculations. In earlier versions of the WHO-HRH model we attempted to compare base and target year urban and rural utilization rates but the uncertainties were too great so now the model is limited to only the target year.

**Intermediate year (INTERYR) projection module**

This optional module makes it possible to interpolate a target year projection back to a user-specified intermediate year. The WHO projection models are based on the assumption that health personnel planning must **plan long, act short, and update often** (ie, every 2-3 years). This means that the projection period should be for at least several decades, since it takes that long to make significant changes in the numbers and distribution of higher level personnel, but policies based on these projections are likely valid for only several years before requiring reassessment and update. The requirements model therefore makes it possible to develop an intermediate year projection that can provide some guidance as to where a country should be, say, five years in the future, based on a 20- or 30-year target projection. The phrase **some guidance** is important since the intermediate year projection has one major limitation. Of necessity it is a straight-line interpolation between the base and target years, and hence cannot take into account two important considerations, lag periods and phasing.

**Lag periods** refers to the unavoidable delay that occurs between taking a decision, say, to increase medical school enrollments, and the production of new doctors. By interpolation a country with 1000 doctors in the base year should have 1500 doctors within five years if it plans to have 3000 by a target year 20 years in the future, ie, 25% of a 2000-doctor increase. This may be possible if the base year medical school output is already high, but if the output barely covers losses, a major expansion would be necessary and this would not start having effect for at least 7-10 years.

**Phasing** refers to the relative priority given to different parts of an integrated HRH plan over time. For example, during the first few years priority might be given to nurse and technician training, while later on, to doctor and dentist training. These phasing differences cannot readily be incorporated into the computer model. Accordingly, though the ability to make an intermediate year
projection is useful, adjustments will need to be made in the calculations presented in the SUMYEAR table.

- GOTO the YEARDATA table, which requires only specification of the desired intermediate year.

- GOTO the INTERREQ table, which is similar to the REQ table except that it shows interpolated requirements projections to the intermediate target year.

- GOTO the INTERCOMP table, which compares the projected requirements with the projected supply. The supply projection would have to be developed from the HRH supply model.

- GOTO the SUMYEAR table, which provides similar indices as did the SUMREQ table.

- You have now completed a review of the requirements tables. We will now review ways in which users can adjust their projections to make them economically feasible.

**Achieving economic feasibility**

Entering data into the requirements model is only the first step in developing a projection; next come the tasks of testing model sensitivity to input errors, to exploring the effects of alternative planning assumptions, and to bringing the preferred projection in line with economic realities. This section illustrates how you can make the public sector portion of your projection **economically feasible**. You have already seen in the supply model exercise how changes in variables affecting the funds available to pay for personnel can radically change the feasibility of a projection scenario. We will now consider changes that affect **personnel costs** as a way of bringing costs and funds into balance. The three ways of reducing costs are to reduce average target year incomes, reduce the number of health personnel, and change the mix of health personnel in favor of lower cost personnel. The impact of each variable will be examined independently, in isolation of changes in other variables, though in real life matching supply, funds and requirements will involve changing multiple variables and not just one alone.

To make sure you get the same numbers as are listed below, use the Get Version button to re-load the demo-req.bdt data set. This will overwrite any numbers you entered earlier but forgot to replace with the original number.
• **Reducing incomes.** GOTO the ECONTEST table and split the screen at row 11 (Window|Split|Horizontal and uncheck Synchronize). Press <F6> or click on the lower screen to put your cell pointer there. GOTO the INCOMES table. The Adjustment factor in cell A6 of the lower screen should equal 1.0 and the target year costs as a percentage of funds should equal 149% in the upper screen (cell Q9). Note in the lower screen that real incomes, as shown in column H, increase over the 30-year period from 35% to 52%, based on assumed average annual income changes ranging from 1.0% to 1.4% (column D).

-- Determine what adjustment factor number will bring the 149% down to <110%, thus making the projection feasible? (______). The adjustment factor makes it possible to change all target year incomes at once, in the same proportion, rather than having to change each one individually. The values in column E are each multiplied by the adjustment factor in cell A6 to obtain the values observed in column G.

-- What will this do to the percentage change in real incomes over the projection period? (Lower the % change / Raise the % change) Do you think this change will be acceptable to the public sector workforce? (Yes / No) Re-enter 1.00 in the adjustment factor.

-- What will be the economic feasibility value if doctor incomes increase by only 0.5% per year? (____%)

-- Projected auxiliary nurse requirements are almost three times than for doctors, and the proposed rate of income growth for auxiliaries is 1.4% as compared with 1% for doctors. If you reduce the annual increase in auxiliary nurse incomes by half, to 0.7, will the savings be more or less great than for doctors? (More / Less) You can see with this exercise how the large income differences between the two occupations affects costs.

• **Reducing personnel by decreasing facilities.** Public sector personnel can be reduced by reducing the number of institutions, by reducing staffing norms, or both. In the lower screen GOTO the HOSPital table and place the cell pointer on cell K16.

-- What will be the economic feasibility value (cell Q9, upper screen) if you keep the same population per national hospital ratio of 3333 in the target year (cell K16) as in the base year (cell K10)? (____%) This ratio means that there is one national hospital per 3.333 million population. Re-enter 2500 in cell K16.
-- There are many more district hospitals than national hospitals. If you enter the same target year population per district hospital ratio (417 in cell M16) as in the base year, will the savings on costs be more or less than would be obtained in the case of the national hospitals? (More / Less). Re-enter 250 in cell M16.

-- It is interesting to note that if you replaced all the values in K16 through Q16 with the same values that you see in row 10, the economic feasibility value would drop from 149% to 121% and the public sector beds-per-1000 population would remain at 1.7. Clearly, the increased number of hospitals is a major factor in increasing costs, but not the only one. In contrast, if you equalized the target and base year population per clinic ratios in the AMBulatory table, the economic feasibility value would decrease from 149% to 136%, a significant drop but not as much as by reducing the number of hospitals.

• **Reducing personnel by decreasing staff norms.** GOTO the HOSPSTAFF table. Note in row 91 that regional hospitals have the greatest numbers of staff (cells L91-92). If the assumed norm of 60 doctors per hospital (cell L75) were cut in half, what would be the economic feasibility value? (____%) Re-enter 60. What would be the economic feasibility value if you cut in half the nurses per regional hospital (cell L78) from 100 to 50? (____%) Re-enter 100.

• GOTO the DEMOgraphic table. What would be the economic feasibility value be if a more rapid decline in the demographic growth rate could be attained, assuming 3.0, 2.0, and 1.0 in the three decades instead of 3.0, 2.5, and 2.0? (____%) Re-enter the original values and unsplit the tables with the red slash icon.

From these few Require spreadsheet exercises you have an appreciation of the many variables that can affects public sector costs. As noted above, no one variable would, by itself, make the projection economically feasible, and the political costs of trying to put most of the burden for cost savings on one or several variables might be high. In practice multiple changes would be made, whether the projection scenario is too costly or too low, to find a better balance between costs and funds. Major considerations will be the balance between: the public and private sectors; the different hospital and clinic numbers, types and distributions; high, medium and low income personnel; and the assumptions used regarding average changes in real incomes, available funds, and staffing norms.

Before leaving the Require spreadsheet, GOTO the Utilities page and using the <Tab> or right arrow key, scroll across the page to see the many utility tables
that are available to help you with various planning tasks. The HOURS, BEDS, STAFF1-3, VISITS, NORMS, MATERNAL, AND AMBUTARGETS tables will probably be the most useful.

**COMPARE: Comparing and combining projections**

We shall conclude our tour of the HRH models with a brief review of the Compare spreadsheet. The Compare spreadsheet makes it possible to...

1. **Compare** one projection for a single geographic area (or health care system) with others for the **same** area (or same system), with each projection based on different planning assumptions, or to...

2. **Combine** multiple subnational projections, based either on different geographic areas or on different health care systems, in order to produce a national requirements projection.

- Open the Compare spreadsheet (*File/Open/Compare*) and if necessary, press the <Home> key to place the cell pointer at the top of the Info page. Note that you did not have to close the Require spreadsheet first and indeed both spreadsheets are now open though only Compare is displayed.

  -- **GOTO** the COMPARisons table. This is an exact copy of the SUMMARY table in the Require spreadsheet. No values are shown since no alternative projections have been made and almost all of the cells are write-protected, thus making it impossible to load a demonstration data set.

  -- **GOTO** the COMBINE table, which combines data from as many different subnational requirements projections as your computer can manage, and calculates the SUMMARY table values for the entire country. When using the combine feature of the model you must be careful to avoid double-counting or omissions. Specifically, the province-by-province totals for base year population, numbers of hospitals and clinics, health workers, services, etc., must exactly equal the estimated base year national total, since otherwise, the target year projection would be over- or underestimated.

  -- **GOTO** the NEEDS table. When combining data sets, this table will show the intermediate and target year distributions and numerical requirements for health personnel in the entire country.

- It is now time to exit the program. The easiest way is to click the green door icon in the toolbar. When it asks whether you would like to *Save changes in COMPARE.BWB* and then in *REQUIRE.BWB*, click **No**! If you clicked **Yes**, 

you would save the large bwb file with all the data now in it and the only way to be sure of getting back your original file would be to reload it from your master diskette.

**Once again, CONGRATULATIONS!** You have now reached the end of this step-by-step demonstration of the two models, and it is time to proceed on your own, with your own country data. You should be sure to review in detail Part IV (Validation and Resolving Mismatches) in the full documentation, which has many suggestions regarding ways to detect errors and to bring your own supply and requirements projections into balance.

The models were prepared for the World Health Organization by Thomas L. Hall, Dept. of Epidemiology and Biostatistics, Univ. of California, San Francisco, CA 94143-0560; Fax: 415/476-6014; e-mail: thall@epi.ucsf.edu.
Appendix N. Instructions for the Microsoft Excel models

Welcome to the World Health Organization's health workforce scenario models. These spreadsheet programmes have been produced by WHO’s Department of Organization of Health Services Delivery (OSD) to help Member Countries plan their Human Resources for Health (HRH). With these models you can develop alternative scenarios of how the health sector might, or could, develop. By comparing these scenarios, you can analyze the possible effects of different assumptions on HRH supply, requirements, training, costs, productivity, and distribution. Two approaches are possible, a longer-term (15-30 years) and a shorter-term (5-15 years) one. This version is in the form of Microsoft Excel97 workbooks. This document provides a brief overview to the models, how they work, and how to load and enter them. It does not provide detailed instructions since almost every table has a help file which can be accessed by pressing the <?> icon button when the cell pointer is within the boundaries of the table. The sections are:

BRIEF DESCRIPTION OF THE MODELS
HOW TO LOAD AND USE THE MODELS
FOR FURTHER INFORMATION

BRIEF DESCRIPTION OF THE MODELS

OVERVIEW -- In 1992 the World Health Organization first commissioned the development of a micro-computer-based models to project supply of and requirements for human resources for health (HRH). Designed to assist countries with the development of long-range (20-30 years) strategic human resource development plans, the HRH model makes it possible to test the likely effects of alternative scenario assumptions affecting supply, requirements (including for specialists), costs, and the provision of services. Planners and policymakers from more than 60 countries have received training in the model and it is beginning to be applied in some of them. In 1998 the HRH model was joined by a new and simpler intermediate-term model designed to help planners with projections of 5 to 15 years’ duration. Previously available as run-time, standalone, applications in VisualBaler, the models have now been converted to MS Excel97. Basic characteristics and outputs of the long- and intermediate-term models are summarized below.

COMMON FEATURES -- Both models:

- develop projections based entirely on user-defined inputs
- accommodate varying levels of data inputs depending on availability
• project supply up to 30 years and requirements to any year
• can test the likely economic feasibility of requirements projections
• take into account requirements for both the public and private sectors
• include optional modules
• provide graphs and extensive data summaries to facilitate interpretation
• use split computer screens to visualize input effects on outputs
• provide context sensitive on-line help for all tables
• have task-specific icon buttons to facilitate use
• come with a simulated data set for use in demonstrations and training
• come with many utility tables to help with planning tasks
• are provided on file-compressed diskettes that may be freely and legally copied. They require MS Windows (v. 95 or 98) and MS Excel97 or higher.

SUPPLY -- The long range supply model consists of a single spreadsheet with seven sections that accommodates up to five user-specified occupational categories. Thirty- and intermediate-year projections are developed with losses calculated by either the detailed cohort method or simple average annual loss rate method. Additional spreadsheets can be used for additional categories. Each supply spreadsheet includes a section that combines data for all five categories and a simple test of economic feasibility.

The intermediate range model integrates supply and requirements projections on the same spreadsheet and can accommodate up to 20 occupational categories. Losses are projected either using the simpler average annual loss rate method, or by the year-by-year stock and flow method, appropriate for use in individual health facilities or small health systems. Both models project health worker numbers and ratios and instructor requirements, and can take into account cross-border (provincial or national) flows of personnel as well as of new graduates.

REQUIREMENTS -- The long range requirements model consists of a single spreadsheet with seven sections, and a second spreadsheet which makes it possible (1) to compare up to nine alternative requirements projections for the same health system, and (2) to combine multiple subnational requirement projections. The requirements model can accommodate up to 15 different occupational categories and takes into account five different types of work locations where health sector staff may be found. These locations include: 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. In addition to the numbers of health workers required by the scenario, optional outputs include the number of medical and nursing specialists,
the per capita production of services, the urban-rural distribution of services, and the economic feasibility of the scenario.

The intermediate range model can develop a requirements scenario for up to 20 occupational categories and offers three alternative methods of projection. The simple *ratio method* starts with a projection of doctors and then makes it possible to achieve a desired ratio of other occupational categories to doctors. The somewhat more complex *locations method* is similar to that used in the HRH model but requires less input data and produces less detailed outputs. For those wishing to plan based on a specified target for the production of health services, the *services utilization* method can be used. Both models provide a wealth of summary statistics to help users make realistic assumptions, locate errors, and interpret scenario projections.

_____________________________________________

**HOW TO LOAD AND USE THE MODELS**

**INSTALLING THE MODELS.** A standard Windows installation is required. If desired, you can place a shortcut icon on your terminal. Right mouse click on the file StartHRH, create a shortcut and drag it to your desktop. You can change the icon to a toolbox, installed in your directory, through the *Properties* dialog box, shortcut page.

**OPENING THE PROGRAMME.** After the HRH Projection Models have been installed on your computer they can be accessed by double clicking the StartHRH workbook in the installation directory or the small red and yellow HRH Toolbox icon, if you have created it. You will be presented with a message box that asks you to open an Excel file in the directory in which your HRH models program is kept. After clicking on any Excel model file you will be see a dialog box that offers you five model program options: long range supply; long range requirements; long range comparisons / combinations; intermediate range supply and requirements; and intermediate range comparisons / combinations. Clicking the desired program will load it on the computer. On the spreadsheets only yellow shaded cells will accept user input. Normally the model has no numbers in these shaded cells. If the selected model already has numbers in the shaded areas (because it was saved with data), clear the cells using the eraser button on the menu bar. Proceed through the spreadsheet tables as appropriate, entering data in the shaded areas. If you are in doubt about a number, enter a reasonable guess; you can easily change it later. With experience and by referring to the Help topics and utility tables you will be able to improve your model over time.

**LOADING DATA**  If you want to work with a data set already saved in a
previous session, use the button with a small grid and an arrow pointing towards the grid. Find the directory in which you saved your data and select the desired data set. A demonstration data set can be selected for use in training. The demonstration data set filenames are: *Demo-sup* (for the long range Supply file), *Demo-req* (for the long range Require file), *Demo-inter* (for the intermediate range file). If you wish to make changes in a demonstration data set we strongly suggest you either not save or, if you wish to save it, that you save it with a different name. This way, every time you load the provided demonstration data sets you will have complete and consistent data.

**MOVING AROUND THE SPREADSHEET.** A mouse click on the named tabs shown across the bottom of the screen will “turn the pages” of the model. The Info page, which is the first one in each model, lists all the tables on that spreadsheet. A click on the button corresponding to a desired table will move you to that table. Alternatively, you may proceed through the model in the suggested sequence by clicking on the "Go to table" button just below the left lower corner of each table (except the Utility tables). You can, of course, go through the model in any sequence. The cell pointer may also be moved around the spreadsheet page(s) with the mouse or the standard keyboard movement keys. Data will not be affected by any cell pointer movement.

The ToolBar displays a series of specialized icon buttons for use with the models as well as the standard Microsoft icons used for opening, saving, cutting, pasting, and other common functions. If you place the cell pointer over a icon without clicking it the function of that icon will be displayed.

**GETTING HELP.** On-line help can be obtained at any time by clicking on the button with a blue “?”. Pressing the <Esc> key will return you to the table. For information on a table first place the cursor within its boundaries. The <F1> key will provide you with the standard Microsoft help dialog box.

**SAVING DATA.** You should save your data set: (1) immediately after completing the first Info page on a new projection; (2) every 10-20 minutes while you are entering data; and (3) immediately before exiting the HRH programme. Every few days you should also save your files to a diskette. To save your data: Click the ToolBar button which has a small grid with an arrow pointing away from it; select the desired directory and enter your filename, then click “OK”.

Each model has a slightly different customized toolbar and therefore you must restart the HRH models (after saving your data and closing the spreadsheets) to work on a different module. For example, if you are working with the long range *Require* file and now wish to make a comparison of several data sets, exit *Require*, exit the HRH programme, and then restart the HRH system, choose the *Compare* file and proceed to make the comparisons.
CHECKING CELL FORMULAE. To review the contents of any cell place the cell pointer over the cell and click once; the contents -- text, number or formulae – will be displayed in the standard Excel manner near the top of the screen. If a formula is displayed you can note it down and then trace the logic. The Program page requires no user input and should not be changed.

EXITING THE PROGRAMME. At the end of a work session save your data once again (unless you are using a demonstration data set). Then click the “X” button on the upper right corner of the window. When the dialog box asks you if you “…want to save the changes made to…(filename)” answer “no.” If you were to save a file with data in it the next time you loaded it the data would be there. Do the same for the underlying StartHRH spreadsheet. Except as noted below regarding making changes to the core spreadsheet, you will normally want to keep the spreadsheets Supply, Require, Compare, HRHIInter, and Cominter unchanged.

CHANGING THE SCENARIO MODELS. Two types of changes can be made; the first is easy, the second could present you with significant problems.

(1) Changes affecting only write-protected cells. You may wish to translate the column and/or row labels to your own language or perhaps change a formula found to be in error (please let us know about the error so it can be fixed in the master program!). Click the commands, Tools / Protection / Unprotect sheet, make the desired changes, and then be sure to click, Tools / Protection / Protect sheet / OK, so that you re-protect the sheet to avoid the risk of later inadvertent changes. Once you are satisfied that you have made the desired changes, erase any data in the unprotected cells and save the entire spreadsheet under a new filename, thus keeping your original WHO file unchanged.

(2) Changes affecting the shaded, data entry cells. User data is saved into and reloaded from workbooks that are exact images of the unprotected data cells. Data is cleared from them using addresses relative to the table in which they appear. If you move, add or remove open cells there will not be a match between the data loaded or saved and the files into which they are loaded or saved. If despite this problem you would like to add a table or change some of the existing open cells, you may do so following the instructions above regarding unprotecting and protecting the worksheets. Once changed, save the entire file, complete with its new data set, under a different name. This way you will have both your new file and new data for review and use.
FOR FURTHER INFORMATION

The models were prepared for the World Health Organization by Thomas L. Hall, MD, DrPH, Dept. of Epidemiology and Biostatistics, Univ. of California School of Medicine, 500 Parnassus, MU #425 West, San Francisco, CA 94143-0560, USA -- Work: 415/502-7204 (direct), Fax: 415/476-6014; E-mail: thall@epi.ucsf.edu. For information regarding availability and use of the models contact: Department of Organization of Health Services Delivery (OSD), (Attention, HRH Scenario Models), World Health Organization, 1211 Geneva 27, Switzerland (Fax: 41-22-791-0746).

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