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Methodological issues in estimating and forecasting health manpower requirement

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Human resource is one of the most important components of health systems. Support for human resources planning for health ranks low on the health policy agenda of many national governments and international agencies. The aim of this study is to present various existing methodologies for estimating the health manpower requirement and forecasting approaches and to discuss some of the methodological challenges, their potential advantages, limitations and indications for their use. The most common approaches which were used for estimating man power requirement are health needs based, demand based, service targets based and health manpower to population ratio. These approaches use different assumptions and require distinct data sets for estimating requirement of human resource for health. Depending on need, health planners have modified four basic methods described above, and developed an alternative approaches for estimating as well as forecasting health manpower requirement and some of them have been discussed in details. Estimating the requirement and forecasting the health manpower is the most difficult but essential task for planners. Any assessment of the optimal number of health manpower, regardless of the specific method used, is bound to have a large range of uncertainty. Hence, any country considering requirement and forecasting of health manpower can deviate from intentions in either direction. The main concern must be to have the right number and appropriate mix and distribution of health manpower to provide quality health care service to achieve positive health outcomes.

Key words: Methods, estimating health manpower requirement, forecasting health manpower requirement, human resources for health, health work-force

INTRODUCTION

Human resource is of the critical components of health. To bring about the required changes in health outcome, health planners and decision makers have to ensure that the optimum number of health manpower is competent, at the right place and at the right time to deliver health services for the population needs, at an affordable cost (Hornby et al., 1980; Dreesch et al., 2010). Public spending on the health workforce accounts for 35 to 45%

of government health expenditure in the Asia Pacific Region (The World Health Report, 2006). Despite the large spending, and the acknowledged importance for producing good health and confronting health crises, support for human resources planning for health ranks low on the health policy agenda of many national governments and international agencies (Narasimhan et al., 2004; http://www.wpro.who.int/NR/rdonlyres/ 7C707E26-2A31-4A6B-94A7-A3D484331061/0/16_ Chapter11Healthresources.pdf). Even if an attempt is made for planning, they are grossly insufficient. This may be because of limited awareness of what manpower planning is and how it is done (Hornby et al., 1980).

Planning human resources for health is the process of estimating the required health workforce to meet future health service requirements and the development of strategies to meet those requirements (Roberfroid et al., 2009). However, the most difficult yet important aspect of health manpower planning is the estimation of require-ment or demand (Hall and Meji, 1993). The process of estimating health manpower requirement is complex, and needs consideration of policies and diverse interests of different groups. Without clear understanding of metho-dological issues for estimating requirement of health manpower, whatever approach adopted for estimating the requirement will contribute little to health system. The area which needs to be studied is replace-ment demand. It is also to be noted while forecasting for the future demand for manpower (O'Brien-Pallas et al., 2001). The purpose of current paper is to present existing metho-dology for estimating the health manpower requirement and forecasting approaches and to discuss some of the methodological challenges, their potential advantages, limitations and indications for their use.

Factors influencing health manpower requirement

Several factors influence requirement of health man-power and many of them are not under direct influence or control of health sector. All are important, yet their relative importance in planning differs depending on approach used for estimating the requirement, nature of health system, and the manpower category being consi-dered. Demographic factors like size, distribution, density, age structure, growth rate and sex ratio are most impor-tant affecting the requirement of health manpower. The demand of the health care is directly associated with the disposable income. In government setup the services are mostly free, therefore waiting time, quality of service and other such will affect the utilization of health services and consequently health manpower requirement (Hall and Meji, 1993). Educational level and awareness regarding health will directly affect demand for health care and thus will influence health manpower requirement. Health status of population is supposed to inversely relate to health demand but in reality is not very evident in the population

because of the strong relationship between socio-economic status and demand for health services. Other determinants affecting utilization of health services and consequentially affecting health manpower requirement are accessibility to health services (travel time and waiting time at health facility, convenience of appointment, the cost, eligibility for care, social and cultural barrier), resource availability, resource productivity and health care technology (Dreesch et al., 2010; Roberfroid et al., 2009; Hall and Meji, 1993).

Estimating requirement for health manpower

The logical sequence for estimating the requirement of health manpower includes assessment of current situation, data collection and analysis, definition of objec-tives and conversion of health goal into services and services to manpower. Four basic approaches proposed for estimating manpower requirement are health needs based, demand based, service targets based and health manpower to population ratio. These methods use different assumptions and have different data needs in order to estimate requirement of human resources in health sector (Hornby et al., 1980;Dreesch et al., 2010; Roberfroid et al., 2009; Hall and Meji, 1993).

The first three convert people to health service they need based on certain assumptions and health services are then converted to manpower required to produce those services. In fourth approach, people are directly converted to health manpower. The health need and service target approaches are normative, whereas the demand based approach is predictive. The normative approaches are useful if the government is proactive and have stronger control on health care delivery system and intend to take active role in shaping future development (Hall and Meji, 1993). The predictive approach is used in situations that anticipate future development without necessarily modifying them significantly (Hall and Meji, 1993; Dreesch et al., 2010). Thus estimation of number of health manpower needed will be determined by specific method adopted for estimating the requirement, as each looks differently how the health sector functions and what are the forces that control health sector (Hornby et al., 1980; Hall and Meji, 1993).

The health need based approach also called epidemiological approach seeks to find out what health service people actually need to keep them healthy. The need is defined usually by experts as number of workers or quantity of services necessary to provide an optimum standard of service and to keep the population healthy. Health service users are not involved in determining need (Roberfroid et al., 2009; Hall and Meji, 1993). Health needs to be distinguished from health wants, which reflect the service people desired, even if the professionals do not consider it necessary (Hall and Meji, 1993). This model needs information on the health status

of the population with disease prevalence, demographics and appropriate standards of care. The three major assumptions used in need based models are that all health care needs can and should be met; cost-effective methods of addressing needs can be identified and implemented; health care resources are used in accordance with relative levels of needs (Roberfroid et al., 2009; Sirikanokwilai et al., 1998).

The demand based approach also called as requirement model or the utilization based approach examines the quantity of health care services demanded by the population. The demand is defined as amount of the various types of health services that the population of a given area will seek and has the means to purchase at the prevailing prices within a given period (Roberfroid et al., 2009). Current health service utilization rate is a good measure of met demand; however, for estimating the requirement the planners must also consider the unmet demand, with certain assumption about their cost and accessibility. The population characteristics considered in this model to estimate demand could be age and sex, existing market conditions, institutional arrangements, access barriers and individual preferences. The demand can be estimated in three ways. First, from data on current service utilization, second by projections from workforce to population ratio based on the service need per unit of population and forecasting population scenario and third, assessment can be based on current and future social, political and economic circumstances, and how users, providers and employers will behave as a result of those circumstances (Roberfroid et al., 2009). The approach assumes current health manpower level and their distribution suitably met the demand for health care; the requirements of resources to met demand remainsconstant in the future; and the current demographic trends predict the future population changes (Roberfroid et al., 2009; Sirikanokwilai et al., 1998). The health need determined by experts and quality of health services is of secondary concern in this method (Hall and Meji, 1993).

The service target approach identifies targets for production and delivery of the various kinds of health services based on diverse criteria of health need, feasibility, economic demand, consumer want, and population to manpower ratio. These services are then converted to manpower needed to meet them. Components of each health activity are considered discretely for fixing service targets; therefore this approach is also called as microanalytic. The key focus is service provision, and not manpower, therefore more popular among policy makers. This approach can outline the future changes rather than just predicting them. The principal assumptions for this models are that the public health system takes active role in development and it seeks a good balance between what population needs and what they want, what technology can offer, and what society can actually deliver at any given point in time (Dreesch et al., 2010;

Hall and Meji, 1993).

The manpower to population ratio approach uses desirable or empirical ratio, based on diverse criteria. Such ratio can either be used as the primary technique for estimating requirement or it can be an outcome of calculations carried out in relation to one or other method. This approach needs population projections. Because of low cost, simplicity and easy to implement, this approach is commonly preferred by planners. However, the serious limitation is that it hardly considers how the health sector functions; it does not regard demand and supply balance as well as development and productivity, distribution of health manpower; and finally it runs at very high risk of selecting inappropriate ratios, which may have a serious policy implications (Roberfroid et al., 2009; Hall and Meji, 1993; Goodman et al., 1996).

Depending on need, health planners have modified four basic methods described above, and developed an alternative approaches for estimating as well as forecasting health manpower requirement.   Some of these approaches are discussed below.

Supply projection approach also called trend model is almost similar to demand based approach, except that the number of physicians required to match the current services given are based on likely changes in the profession rather than demand. This approach relies on physician-per population ratio and takes into account health care services currently delivered by the total pool of practicing physicians. The assumptions are almost similar to demand based approach, that is, the current level, mix, and distribution of providers in the population are adequate, the productivity of providers remain constant in future; and the currently observed trend predicts the size and demographic profile of the providers over time. There is a scope to factor in the model the possible changes in demography and the health care delivery system and to consider the professional productivity and skill mix. However, these adjustments add to considerable complexity to the model. The important limitation is that calculations are not based on the population health needs. This approach was used in many developed countries (Roberfroid et al., 2009; Sirikanokwilai et al., 1998).

Modified population to physician method first projects the future population after adjusting for deaths due to prevalent diseases. Different scenarios could be developed considering the variable growth rates of the region or country. The most appropriate growth rate scenario can be considered for estimating requirements. Later on the population to physician ratio is estimated taking into account the health care system of country and the future economic status and adjusted by adjusted global ratio. This is done by plotting the relationship between the population to physician ratio and GDP per capita. The World Bank development indicators are generally used for this purpose. By dividing the estimated population by the future population to physician ratio, future physician

requirement can be estimated. This approach was used in Thailand to project further requirement of physicians (Goodman et al., 1996).

Managed care approach relies on identifying health plans that are implemented in regions or countries that are similar to target country in their demographic and health profiles but are markedly different in their costs and deployment of health care resources. There is a possibility of obtaining the most reliable estimates because it reflects actual staffing patterns in countries that are attempting to use physicians efficiently with emphasis on productivity. Regions or countries that provide the optimum standards of services with modest number and mix of health manpower are considered as benchmark and these are used as a current best estimate for planning. Therefore this approach is also called benchmarking. The limitations of this method are that it assumes that the current staffing patterns as appropriate for the future, ignoring technological advances or any other changes in medical practice; second the staffing patterns vary considerably across managed care organizations; and the third the extrapolation methodology used in the approach. Therefore while extrapolating; adjustments are necessary for important variables that can affect the manpower requirement. This approach was used in Australia and USA (Adams and Wood, 1990; WHO, 1990).

Adjusted service target approach considers the appropriate service targets for estimating the requirement established by critically studying the current level of health services. This was further adjusted to reflect expert opinion on the standard norms of care within the known environment. The approach was used for estimating physician requirement in Canada. Important imitation of this approach is that it addresses only the physician requirement without considering the appropriate mix of manpower or potential substitution between health professionals (Peterson et al., 2004).

Modified need based approach was used in the United States in the early 1980s, by the Graduate Medical Education National Advisory Committee (GMENAC). The model used epidemiological evidence for each specialty, modified by professional opinion on the need and appropriateness of care for various conditions. GMENAC asked panels of experts in various branches of medicine to reach a consensus on norms of care for each health condition and each medical procedure. Then the "modeling panel" attempted to reconcile the resulting need estimates of the expert panels. The modeling panel further "adjusted" the expert estimates to take account of "economic, social, and behavioral constraints." The model was adjusted for incidence rates of specific conditions; percentage of the population with that specific condition who should consult a physician; rate of commonly performed procedures; percentage of procedures that should be performed by a specialist; associated inpatient and office visits per procedure; and productivity estimates/

profile of weekly workload (Roberfroid et al., 2009). Major constraints identified in the GMENAC approach are use of the Delphi technique, the future role of non-physician providers, and a lack of reliable data (http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1070178/pdf/hsresearch00034-0016.pdf). This approach was also criticized for being unscientific and subject to considerable bias as too many judgments were required and the experts did not believe that anyone would have the information necessary to make informed judgments. Another limitation of this approach was its inability to anticipate advancements in technology, new drugs, and new diseases that may affect the demand for physicians (WHO, 1990).

Variation in demand based approach was used in India by Institute of Applied Manpower and Research. They used the variation of Health Demand method to project the likely demand of doctors in public and private sector during the fourth and fifth five year plans. The regression methods were used on the available historical data to develop coefficient. In public sector, it converts public expenditure into demand for government doctors and in private sector it could convert national income estimates into the demand for doctors in private sector. These estimates were then applied to estimates of the trend of national expenditure and income to derive the probable demand for doctors (Hall and Meji, 1993).

NTTP (need, service target, time and productivity) approach was proposed to estimate the human resource requirement to deliver interventions related to MDGs. The quantity of service was estimated for 33 priority health intervention recommended by the Commission on Macroeconomics and Health, which were advocated to address the burden related to MDGs three health related goals (Dreesch et al., 2010).

Coordinated health and human resource development approach was proposed by WHO as a more comprehensive and systematic approach. The focus is fundamental changes in the philosophy of planning towards the interdisciplinary and inter-sectoral planning (Angus et al., 2000). However, this approach appears to be more theoretical rather than practical particularly in the context of the public health sector reforms and more rapidly evolving private sector in developing countries (Dreesch et al., 2010).

Combination of supply and utilization based approach allows undertaking the performance gap analysis for future taking action to make physician supply match requirement. The assumption is that the base line ratio of supply to health care ratio is considered as appropriate and used to estimate future requirement (Song and Rathwell, 1994).

Effective demand based approach complements the epidemiological need based approach by the economic consideration. This approach considers population characteristics related to health levels and risks, service utilization and provider deployment patterns and economic,

social, contextual, and political factors that can influence health service utilization and health spending (Roberfroid et al., 2009).

Effective infrastructure approach is a need based model complemented with the infrastructure consideration. The rationale is that there is little point in having a workforce greater than the physical capacity of the health system to gainfully employ or use that workforce (Roberfroid et al., 2009).

Setting of standards

Regardless of the method used, reference standards are needed for calculating manpower requirement. These standards can be derived experimentally or empirically from the past or current experience, or they may be based on professional judgment, or international experience. Trend lines can be developed showing how manpower to population ratios, productivity and other indices have changed over time and these trend lines are extended into future for estimating manpower requirement. This approach of extrapolation of past trends in future is useful in countries with a relatively passive attitude towards the distribution of health care and rapid urbanization. Situation observed in the most favored region or part of the country can be used for standard setting. However, as long as the distribution and performance of doctors are uneven in the country, this approach will always yield the current inefficiency. Comparing and using standards of other country or countries or those proposed by WHO may be of use, but an important assumption is that within the period between base year and target year, the country under consideration will attain the level of development comparable to that now observed in the other country or countries. Comparing other countries with variable level of developments can improve an understanding about what we are likely to achieve and what are the main preconditions for the same (Hornby et al., 1980; Hall and Meji, 1993.)

Other methods that can be used for developing standards are task analysis and functional analysis. In contrast to task analysis, functional analysis has broader meaning and it includes analysis of variety of inter-dependent task that constitutes and an entire segment of the health program. The starting point for both analyses is to break down the various health activities into their constituent tasks and function, the smallest unit for analysis of relevant problem. Then minimally acceptable performance standards are developed for each task or if feasible for each function; and these standards are used for estimating the manpower requirement (Hornby et al., 1980; Dreesch et al., 2010; Hall and Meji, 1993).

The relatively new method for establishing standards for professional performances is Workload Indicator for Staffing Need popularly called WISN. In this method, the available working time per year is determined for all categories of staff. Later on the activity standards are set, which is then translated into standard workload. Using this standard workload, manpower requirement is calculated. The Activity Standards for health staff are usually set by working groups of senior and knowledgeable staff with substantial experience of the work for which the standards are being set (Peter, 1998).

Supply of health manpower analysis

Although, the focus of this paper is on methodological issues in estimating manpower requirement, without a note on supply the discussion would be deficient; there-fore some issues related to supply are briefly mentioned below. Imbalance between the existing level and current and future requirement of health manpower can be assessed by undertaking gap analysis. This can be done by finding out the current supply and estimating the adequacy of supply (comparing the current supply with estimated requirement). Supply usually refers to avail-ability and characteristics of health manpower at a given time, or at a future time according to specified assump-tions about prediction, losses or use (Hall and Meji, 1993). Supply analysis has three components; firstly current supply (includes active supply – employed or seeking employment and inactive supply – potentially able to serve), secondly is to find out probable addition in the supply and finally to estimate the losses or attrition in the supply due to various factors (Roberfroid et al., 2009; Hall and Meji, 1993). Attributes for health manpower supply analysis can be magnitude, training, information requirement, feasibility of government intervention, avail-ability of traditional health manpower etc. Availability and accuracy of data is critical for supply analysis. Depending upon the manpower to be analyzed the data need has to be defined. The important realistic information needed for supply analysis are personal characteristics, training and other qualification required to perform task and job characteristics like location, timing, types and number of activities to be performed. There could be many sources of supply data, depending upon the country or region; however it can be categorized broadly into three heads as official sources, non official institutional sources (such as professional body or association) and primary field data by survey.

METHODOLOGICAL CONSIDERATIONS FOR PROJECTION OF HEALTH MANPOWER REQUIREMENT

Reliability of the models: Reliability is referred to as the capacity of a model to correctly project the health workforce deemed to be adequate at some identified future time. Models reliability can be explored by com-paring how a set of models applied to the same setting and the same period produced matching projections (Roberfroid et al., 2009).

External validity of model: Different models used for

projection of health manpower requirement give very different results. Anderson et al. (1997) reviewed and compared three methods, namely managed care, demand-utilization based and adjusted need based, for estimating the requirement otolaryngologists in the United State. The number of otolaryngologists required as calculated by the three methods varied widely. The estimates of requirement ranged from 6611 (need based approach) to 8860 (demand based approach), nearly a difference of 25%. The authors observed that in each of the models, however, it was possible to show a shortage or surplus of physicians by altering one or more key assumptions. This suggests that any conclusion about the shortage or surplus of otolaryngologists must be viewed critically (WHO, 1990). One more study on projection of the required ophthalmologist in Ontario, Canada also revealed that the four methods they had used yielded different estimates. The physician to population ratio projected 489 full time equivalents (FTE), which was considerable different from utilization based method, substitution model, and need based model which yielded 559, 526 and 585 FTE respectively (Joyce et al., 2006). This difference in the projection of health manpower requirement using various models is due to the different assumptions used by these models (Roberfroid et al., 2009; Hall and Meji, 1993).

Internal validity: Whatever approach is used, estimate will not be exact numbers but instead a range of numbers. The three sets of parameters influence the models internal validity - the quality of data available, the plausibility of projection scenario and the comprehensiveness of the model and its adjustment for the confounding and interrelated variables (Roberfroid et al., 2009; Harris, 1986)

Retrospective analysis: It involves testing the reliability of forecasting models by analyzing the success of past projections either projecting or modifying the future, i.e. reaching a balance between supplies and requirements. However this is a difficult approach, as there is usually no or very little information on whether the target was effectively realized and even when the forecast proves correct, the perception of what is an adequate supply and demand ratio may change over time. Roberfroid et al made an attempt to test the realization of projected supply headcounts for Australia, Canada, and France and observed that there was a margin of error in all the projected physician headcounts, and the error size increased with the time lag between projection and assessment (Roberfroid et al., 2009).

Regression approach: Approaches discussed above for estimating health manpower requirement are fixed and based on the deterministic approach, and can lead to uncertainty in projecting the health manpower requirement. Even if few of them used adjustment for the future trends for prediction, it is limited to only few variables that determine the health manpower requirement.

Furthermore almost all the models lack the dynamic relationship between the inputs and health outcomes. The regression approach can be considered as one of the alternative way to address this issue. This allow for adjusting effects of various parameters to the supply and requirement of the health care professionals. One can also calculate the confidence interval around the point estimates. However the major limitation of this technique is to obtain the accurate data on determinants of the health service provision and utilization. Regression models can also be a basis of indirect standardization that can be used to identify the workforce imbalance (Roberfroid et al., 2009; Hall and Meji, 1993).

Sensitivity analysis and stochastic simulation: This is useful for predicting uncertainty in projections. In sensitivity analysis, a sensitive variable is one in which even slightest change in its input value result in significant change in the outcome. In stochastic simulation, the value of input variables is randomly assigned according to their probability distribution and the outcome of the projection will also be a random variable. This process is repeated until a large number of projections have been made. The mean and the variance of the projection's outputs can then be estimated, and the uncertainty of the projections can be quantified by calculating a confidence interval. Stochastic simulation method used information more efficiently and produced more reasonable average estimates and a more meaningful range of projections than deterministic sensitivity analysis. Sensitivity analysis and stochastic stimulation can enhance internal validity of models (Roberfroid et al., 2009; Persaud et al., 1999).

Selecting the most appropriate approach

Estimating the requirement of health manpower is generally carried out with narrow mandate of making quantitative estimates of supply and needs and then manipulating one or both of these to bring them into balance (Roberfroid et al., 2009). Health manpower requirements are area specific and their solutions must be adapted to suit the specific circumstances. Therefore, health manpower planning approach must be selected systematically, in the light of availability of facilities and resource and considering the basic and national characteristics (Hornby et al., 1980). Working group must be formed, which includes health service organization, medical colleges and universities, professional bodies and other interest's group. The group must undertake the situational analysis, as the type of method to be used depends upon the situation in the country. The working group needs to understand the Governments position on critical issues like long term demographic projection, health priorities and health resources.

Furthermore, for selecting the appropriate models for estimating the current and future requirement of health certain issues like: does a genuine political commitment exist in country to provide the minimum standard of health

Table 1. Potential advantages, limitations and indications for use of the four basic approaches for estimating health manpower requirement.

	Potential advantage	Limitation	Indication
Health need based approach	•Appealing, comprehensive and easy to understand •Logical and consistent with the professional ethics of providing service based on needs and not social and economic condition. •Potential of addressing the health needs of the population using mix of health manpower •Facilitates study of productivity, utilization and staffing ratio •Can avoid the perpetuation of existing inequalities and inefficiencies •Can include unmet need in estimation process •Encourage allocation of resources where they will have the greatest effect •Promote concern about quality of care •Facilitates cost estimation •Facilitates health team planning • Useful for specific programs	•Complicated, costly and requires detail knowledge of the efficacy of the individual medical service for specific condition •Standard setting by processionals are frequently complicated by lack of consensus on optimum care and on health effect of care •May encourage the excessively detailed planning, and therefore likely to project unattainable service and staff targets well in excess of the countries' ability of provide them and/or in excess of consumer willingness to use them •Does not account for the technological developments and changes in the organization of health services, therefore it required frequent update with change in technology	Especially applicable to countries with: •Sophisticated data systems, survey capabilities and planning capabilities •Relatively adequate health service delivery system •Active government policy towards dominant public sector with strong control over manpower and health service delivery •Particularly applicable to preventive, public health, and specific health programs based on well established technology, even in developing countries lacking statistical expertise
Service target approach	•Facilitates disaggregation of components of demand with most suitable method being used for each one •Facilitates study of productivity, utilization, staffing ratio etc since the emphasis is on production of services •Relatively easy, understandable and easy to interpret •Can access interactions between variables •Facilitates cost estimation •Easily usable with other planning methods •Facilitates health team planning •Future revision is possible as new information become available •Require modest data and planning capabilities.	•Standard setting is likely to be more based on the desire rather than reality •Potentially unrealistic assumptions may be created •May encourage extensively detailed planning, especially for components of demand not subject to much control	Especially applicable to countries with: •Dominant public sector with strong control over manpower and delivery of services and active government policy towards delivery of health services •Although useful for preventive and curative services, more used for the former •Most important for lower income countries.

care to all? Is the government primarily concerned about the demand originating from private sector or is it more concerned to the health need of population? Does the government have enough means, administrative, legis-lative and fiscal to enable to implement for anticipated changes in

policy? Does the country have the enough quality data and planning expertise to project the most accurate requirement? Is there adequate provision to implement likely accelerated changes, if any, compared to past (Hall and Meji, 1993)?

There is no single best method or mix of appro-

aches to answer these questions. What is needed is the combination of the method based on the current situations and use of the method that best suited to the specific aspect of health manpower plan. The matrix in Table 1 discussed potential advantages, limitations and indications for use of

Table 1. Contd.

	Potential advantage	Limitation	Indication
Demand or utilization based approach	•Facilitates understanding of dynamic and determinants of demand •Allows disaggregation of various components of demand •Tend to produce economically realistic projection due to little changes in population specific utilization rates •Probably result in good estimates of the minimum growth of demand likely to occur and ensure that the level of future satisfaction at least equal to that of present •Some variation of this approach are quite simple •May provide useful information for comparing the economic returns from training in health occupation, with those in other field •Can anticipate changes in health practice (e.g. new surgical technique or drugs) and in health system	•Some variation requires extensive and sophisticated data. Very complicated and costly to calculate •May neglect political and societal reason for improving health services distribution and delivery •Does not necessarily take into account the quality of service or their relevance to the health problem of the country •May be difficult to interpret the rationale and result •Overlook consequence of errors arising from the assumptions proven to be invalid •Perpetuates current inequalities in utilization of health services •Assumes that any care is useful •Consider demand for mostly curative services •May produces a status quo since future population segments may have similar utilization rates as base year segment	Especially applicable to countries with: •Dominant private sector (or for private sector planning) •Passive government attitude towards delivery of services •Relatively minor imbalance in the provision of service to different segment of the population
Manpower to population ratio	•Quick and easy to use and to interpret •Data requirement usually modest and data relatively insensitive to errors within the validity of the underlying assumptions •If current health situation is reasonable satisfactory, maintenance of status quo is an useful policy •When ratio is end result of application of another, more precise method, this can be useful as short cut for short range and intermediate range planning •Can project physician number at 10-15 years with reasonable accuracy using sensitivity analysis or stochastic simulation	• Easy to select unrealistic ratio •Black box method- general used for single category and does not allow to explore interaction between numbers, mix, distribution, productivity and outcome •Base years inadequate ratio will likely to continue in target year, may show the manpower shortage •Provides little insight into the dynamic determinants and evolution of health care demand •Primary emphasis is on manpower, planners may neglect potential for improving productivity, distribution, utilization, relevance of services etc •Difficult to access feasibility	Especially applicable to countries with: •Reasonably acceptable health condition and health care delivery •A relatively stable health sector •Limited planning resources •Either active or passive approach towards delivery of health services •Either public of private sector dominance •Reasonable comparable international models is available

the four basic approaches for estimating health manpower requirement (Dreesch et al., 2010; Roberfroid et al., 2009; Hall and Meji, 1993).

Conclusion

Estimating the requirement and forecasting health manpower is the most difficult but essential task for planners. Any assessment of the optimal number of health manpower, regardless of the specific

method used, is bound to have a large range of uncertainty. Hence, any country considering requirement and forecasting of health manpower can deviate from intentions in either direction. Therefore the important issue, from public health perspective, is that it is possible to either underestimate or overestimate the requirement. An oversupply may blow up healthcare costs through a possible supplier-induced demand and may lower quality of health services provided by under-employed physicians, while an undersupplymay result in unmet health needs and possible health inequities. The main concern must be to have the right number and appropriate mix and distribution of health manpower to provide quality health care service to achieve positive health outcome.

Conflict of Interests

The authors have not declared any conflict of interests.

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