



Original Article

Integrating Workforce Planning, Human Resources, and Service Planning

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Abstract

This paper is one in 10 in a series of papers commissioned by the World Health Organization to take stock of the state of the science of human resources for health activities in the year 2000. This paper provides an analysis of how labour market indicators can be integrated into service planning, discusses whether planning is sufficiently responsive and flexible to retain relevance and validity in rapidly changing health systems, describes different models and approaches to linking and integrating workforce planning and service planning, discusses methodological approaches to integrating planning, and examines effective approaches to the use of computer based scenario modeling to support assessment of current and future planning options. The context and broad cross-cutting themes of public sector, political, social, and macro-economic changes have been considered. Where publications exist, empirical evidence serves as the basis for this analysis and country examples have been highlighted. While strides have been made in the practice of resource planning world-wide, health human resource planning in most countries has been poorly conceptualized, intermittent, varying in quality, profession specific in nature, and without adequate vision or data upon which to base sound decisions.

Key words:

Introduction

Changes in health systems world-wide have created new challenges for health human resource planning (HHRP). The World Health Organization (WHO) has been instrumental in modifying the principles of health human resource planning by emphasizing the integration and coordination of services and human resources, and the provision of education according to a Primary Health Care model⁽¹⁾. WHO⁽²⁾ notes that provision of health care involves putting together a considerable number of resource inputs to deliver an extra-ordinary array of different service outputs. Health human resource planning should

be broad in nature incorporating the entire health workforce. Key stakeholders including health providers, planners and government policy makers must be involved in the entire planning process to facilitate acceptance of the HHRP recommendations made. Health system inputs must consider the appropriate balance between human and physical capital. Human capital decisions include the appropriate quantity, mix, and distribution of health services. Finding this balance requires continuous monitoring, careful choices given the realities of countries in which choices are being made, and the use of research evidence to ensure that population health needs are addressed effectively and efficiently. Trends in



societal factors such as determinants of health, needs of consumers, and the knowledge and skills of health providers need to be considered in planning⁽³⁾. The Canadian Institute for Health Information (CIHI)⁽⁴⁾ identified that better health is associated with greater levels of income, education, employment, better housing, supportive environment, and opportunities for early childhood development. These factors may not be under the control of departments and ministries of health in many countries. This paper will describe the extent to which integrated health human resource and service planning can and do facilitate this process in the year 2001. To achieve this end we will: (1) identify how labour market analysis can be integrated into workforce planning; (2) discuss whether planning is sufficiently responsive and flexible to retain relevance and validity in rapidly changing health systems; (3) describe different models and approaches to linking and integrating workforce planning and service planning; (4) discuss approaches to integrating the planning for different groups of health workers (multi-disciplinary/multi-profession planning); and (5) examine effective approaches for the use of computer based scenario modeling to support assessment of current and future planning options.

Background

Hall describes the health human resource process as involving three major and inter-related steps: planning, production, and management⁽⁵⁾. The focus on one component at the expense of the others will do little to ensure an effective and efficient health system. While the goal of integrated workforce planning is articulated by many, it lacks a clear definition⁽⁶⁾. In this paper, integrated health human resource planning (IHHRP) involves determining the numbers, mix, and distribution of health providers that will be required to meet population health needs at some identified future point in time. It is concerned with aggregate level resource planning processes with a longer term horizon. Hall⁽⁷⁾ has identified that intermediate IHHRP should

be concerned with the next 5-15 years and long term planning with 15-30 years. Longer range planning projections involve greater uncertainty of the planning variables in comparison to intermediate range planning^(8,9).

Service planning in many countries is generally limited to a shorter time periods. While some countries plan services with one to two year horizons there is growing recognition that this planning must occur over a longer planning horizon. Short term planning is aimed at ensuring that resources for health are allocated and managed in an efficient and effective manner. This activity is concerned with how many and what type of health resources will be allocated among different sectors and among human and physical capital such as technology, drugs, human resources, and renewing existing or planning for new infrastructure.

If done properly, both service planning and IHHRP consider an integrated human resource process and the principles that underpin good IHHRP practice also underpin good service planning. Both should be seen as part of a continuous quality improvement process which is updated at least bi-annually and where each activity informs the other. Both sets of activities should be based on evidence of best practice. Labour market analysis is a useful tool for understanding the shortfalls of previous planning decisions, the current context, and provides clues for future corrective action to be taken in all planning horizons.

IHHRP and Service Planning

To ensure system efficiency and effectiveness both planning activities should be needs based and outcome directed. Furthermore, planning at all levels requires good quality data. In describing the approaches to modeling or service planning, we make the assumption that the data that form the basis for resource planning are currently available and of good quality; that is, they are consistently reported (reliability) and that they actually measure the key variables that

must be measured to estimate human resources requirements (validity). Needs based approaches, in which resource requirements are based on estimated populations' health needs, create greater data demands than those required for supply/utilization based planning. The requirement to link to outcomes will initially create greater data challenges. To plan services and/or model human resources requirements without high quality data will only lead to unreliable estimates of future human resource needs and erroneous service planning models. Planning should be conducted when planners are confident that the data that underpins the estimates is of good quality. The WHO tool kit has assisted many countries to identify what and how to collect data for supply and utilization based approaches to modeling and planning. Formulae and data collection guidelines are detailed in the toolkit.

The State of the Art

Government planners have used various approaches to forecast health human resources (HHR) supply and demand⁽⁹⁻¹¹⁾. Through this process, traditional approaches have been further developed, and many disciplines have added unique design and analytical methods to the array of tools available to researchers. Regrettably, the wide choice of methodologies, lack of comprehensive data bases, and inaccurate projections of population growth have not clearly improved the accuracy of forecasting^(9,10,12). HHRP in most countries has been poorly conceptualized, intermittent, varying in quality, profession specific in nature, and without adequate vision or data upon which to base sound decisions^(9,10,12-14). The assumptions that underpin HHR modeling activities need to be evaluated for relevance and accuracy on an ongoing bases. The failure to conduct ongoing HHRP has led to the fragmentation of therapeutic tasks into sub-occupations^(10,15). Furthermore, HHRP has been only weakly linked to national health policies^(10,16) and population health needs^(10,17). In the United Kingdom, human resource problems are dogging the

National Health System: "Junior doctors are threatening to strike, consultants are voicing frustration, and nurses are voting with their feet. Though their concerns are less visible...other members of the profession allied to medicine are also facing major challenges. The problems have been well rehearsed but the solutions seem as far away as ever. If the healthcare needs of this new millennium are to be met, more radical approaches to collaborative work will need to be explored"⁽¹⁸⁾. Many nurses and midwives around the world are experiencing poor quality of work life, under and over utilization, geographic distribution problems, role ambiguity, and role overlap, particularly in relation to physicians^(10,19).

The efficiency and effectiveness of service delivery depends to a great extent on the effective deployment and use of personnel^(10,20). Recent findings in The World Health Report 2000⁽²⁾ suggests that there remains great variation internationally in the level and mix of health resources devoted to health care (technology, drugs, hospital beds, and human resources). In Thailand, health spending is primarily directed towards technology (e.g., CT scanners) and drugs relative to human resources whereas in Mexico and Egypt the opposite is true. However, Mexico has the highest ratio of physicians and together with Thailand, the lowest expenditure on nurses within the case study countries^(2,10). Yet Mexico reports that as many as 15% of physicians are inactive, underemployed, or unemployed. The balance among human and physical capital inputs, the mix of human resource personnel, and the distribution of resource between urban and rural settings remains a critical issue^(2,10,13). To date there remains limited evidence of the use of substitution roles among human resource providers^(10,13).

The Role of Labour Market Indicators in Planning

How can labour market analysis be used in workforce planning? Many consider that the

continuous cycles of over and under supply of health human resources world-wide reflect the inadequate projection methods used to estimate future requirements for expanding health systems and/or the failure to consider the evidence supplied by ongoing labour market trends^(6,9,12,21-23). Buchan and O'May acknowledge that migration of health professionals in and out of countries must be part of HHR planning. The potential to model international nurse flows is limited the international lack of mobility data for modeling⁽²⁴⁾. However, ethical issues arise as they relate to the global migration of the nursing workforce. For instance, some countries produce nurses simply for export while binding these

nurses to severe financial commitments to the home country. Alternatively, wealthier countries have the potential to strip the health professions workforce of poorer countries who cannot compete with the financial packages offered. Globalization and the migration of workforces have increased the need to make use of labour market indicators in planning. The International Labour Office (ILO) has played a major role in defining the Key Indicators of the Labour Market (KILM). Eighteen indicators (see Table 1) intended to monitor trends were developed based on three criteria: conceptual relevance, data availability, and compatibility across regions⁽²⁵⁾. The KILM can assist countries to examine the overall status

Table 1 International Labour Organization's Key Indicators of the Labour Market (KILM)

Participation in the World of Work	
1	Labour Force Participation*
2	Employment-to-Population Ratio*
3	Status in Employment
4	Employment by Sector*
5	Part-time Workers
6	Hours of Work
7	Urban Informal Sector Employment
8	Unemployment, Underemployment, and Inactivity*
9	Youth Employment*
10	Long Term Employment
11	Unemployment by Educational Attainment
12	Time-Related Underemployment
13	Inactivity Rate
14	Educational Attainment and Illiteracy
15	Real Manufacturing Wage
16	Hourly Compensation Costs
17	Labour Productivity and Unit Labour Costs
18	Poverty and Income Distribution

* ILO - targeting 5 or 18 indicators for world and regional estimation

of the health workforce in the broader labour market of their country, relative to countries with similar levels of development (such as OECD countries) and/or by WHO regions.

The ILO indicates the intention to focus on 5 (labour force participation rates; employment to population ratio; employment by sector; unemployment, under employment, and inactivity; and youth employment) of the 18 indicators for world comparison purposes. The capacity of countries to participate varies widely around the world. For example, in countries that have regulatory bodies mandated to collect information about their professional constituency, there are better data bases. In Canada, and the WHO European Region nursing and allied health data, population demographics, hospitals, number of beds, ratios etc are available that could provide the necessary information in each of the five designated categories by the ILO (websites: www.CIHI.ca, www.statcan.ca, www.WHO.dk). However, some countries lack data, organizational structures, technical staff, electronic infrastructure, and the financial resources for information technology and the training to support the collection of information. This is a challenge when there is a struggle in many countries to provide even the most basic of health care services. However, it is important to consider that some of the current human resource issues experienced in some countries may be due to the absence of such data and related planning. It is recognized that "sound data on the existing numbers and distribution of human resources, especially linked to data on health system performance, can contribute to the formulation of policies and plans to address health problems"⁽²⁾.

In reviewing the World Health Report 2000⁽²⁾ many problems of under and over employment, participation rates, employment by sector, and urban sector employment exist. World-wide we see numerical imbalances (too few qualified health personnel in sub-Saharan Africa versus overall surplus of physicians in Egypt), training and skill mix imbalances (as in mis-matches between available skills and needs

as in Eastern and Central Asia), and distribution imbalances (urban/rural imbalances and difficult to service areas; e.g., in Cambodia 85% of the population lives in rural areas but only 13% of health providers work there)⁽²⁾. These are examples of situations where careful analysis of labour market indicators could be useful to inform decision making. In both developed and developing countries there remain significant challenges in meeting the needs of populations outside of urban addresses. At the present time it is difficult to make comparisons among countries across all sectors, including health.

Methods

Can Planning be Sufficiently Responsive and Flexible to Retain Relevance and Validity in Rapidly Changing Health Systems?

Flexibility, relevance, and validity in planning requires both ready access to timely information that is accurate and use of appropriate conceptual and analytic techniques for planning in a rapidly changing health system. Computer based modeling eases the computational difficulties and burdens experienced in previous years. However, the component parts of these models need to be understood in order to identify the contribution of the various elements of the models to the predicted outcomes. It is important for planners to remember when planning for smaller provider groups that the smaller the group the greater the uncertainty around the estimates derived from the model. Recognizing these limitations, modeling can occur. Modelers may have no choice but to use less sophisticated analytic techniques. Excellent linkages and exchanges among key stakeholders, multidisciplinary experts (nursing, economics, computer science, epidemiology, medicine, sociology, etc.) working in collaboration with policy and administrative decision makers and planners, and the availability of accurate and comprehensive data are thought to enhance relevance, responsiveness, and acceptance of planning activities. HHRP is an interactive process and can benefit

from the experience of other sectors. However, the direct transfer of techniques must be based on careful scrutiny and a full understanding of the unit of analysis.

Health Human Resource Planning - An Overview

Integrated human resource planning involves estimating the future requirements for human resources and identifying efficient ways of providing for those requirements. There is no unambiguous 'right' number and mix of health professionals^(2,10,26). Instead, health provider requirements will be determined by broader societal decisions about the level of commitment of resources to health care, organization of the delivery and funding of health care programmes, and level and mix of health care services. Although there may always be more that could be done in terms of service delivery to meet populations' needs, whether more should be done will depend on what other things have to be forgone in order to provide the additional resources - considerations which are essentially subjective.

Assuming the role of HHRP research is to reduce uncertainty, public policy makers must weigh research based facts, along with several other factors to determine action. Yet today we know that public policy is not based on good human resource research. To add value to traditional research activities and improve "evidenced-based" decision making a number of actors including decision makers, research funders, researchers, and professionals must be involved in an interactive synergistic process. Each step in the process requires relationship building and improved communication between decision makers and researchers as well as across health sectors. Further, using evidence in decision making is a "virtuous cycle" and any weak link in the chain has the capacity to interrupt the optimal flow of research into decision making.

To complicate matters, the science underpinning HHR planning is young. Approaches to estimating human resource requirements have

been few in number and plagued with methodological and conceptual limitations. One of the key challenges has been the lack of easily accessed clinical, administrative, and provider data bases to conduct complex modeling activities such as health need and health, system and caregiver outcome data, management information systems which reflect utilization and costs. Governments require a variety of human and material resources to inform the policy decisions related to HHR. Ministries also need the following resources: visionary project leaders with epidemiological, human resource planning and modeling knowledge and familiarity with the health services being modeled. These individuals need to be situated within government structures that have responsibility for HR policy decision making and the political support and financial resources to take action on HHR decisions.

As O'Brien-Pallas⁽²⁷⁾ notes with respect to nursing resources, nurse planning does not exist in isolation from the world in which these services are delivered. Future planning models need to explicitly place the health care industry in the general context of the economy. Lavis and Birch⁽²⁶⁾ also note there is no unambiguous right way to model human resources. Instead, the conceptual basis for human resource planning will depend on the question being asked - do we want to know how many nurses or physicians are required to continue to serve populations in the way they are currently served? or how many are required to support the services required to meet all, or a proportion of the expected needs of the population? or how many are required to satisfy the expected development and plans for the future provision of health care services?

Birch et al.⁽²⁸⁾ refer to these three approaches as utilization-based, needs-based and 'effective demand'-based approaches to human resources planning. For example, the 'unit of analysis' across the different approaches is the same, e.g., physician consultations, dentist courses of treatment, and nursing hours. However, the underlying 'driver' of this measure

differs between the approaches reflecting the different ways societies think about the delivery of health care, the provision of services, the population's needs, and the commitment of society's scarce resources. In some ways, each approach builds upon the principles of the previous approach and introduces additional considerations^(10,28). Although this might be seen as enriching the applicability of the approaches to epidemiological, economic, and political realities and hence enhancing the policy relevance of the analyses, this will depend on the philosophical basis of the particular health care system being studied. For example, in societies where health care services are delivered through private markets and access to services is determined by willingness and ability to pay for services at the individual level, there would be little value in basing future nurse or other health provider requirements on the estimated needs for care of the population, or the estimated future commitment of government resources to health care, since neither of these factors will be important in determining the future deployment of available health providers. In this way, the future plans for funding, delivery, and configuration of services determines the appropriate approach to be followed.

Needs-Based Approach

A needs-based approach approximates most closely that described by the WHO. The needs-based approach estimates future requirements based on the estimated health deficits of the population as well as the potential for addressing these deficits using a mix of different health care human resources to provide effective service intervention in efficient ways. Nursing requirements are therefore an epidemiological concept, based on the age and sex specific needs of the population, that are independent of current service utilization but are interdependent with the requirements for other health human resources. Hence, this approach avoids the perpetuation of existing inequities and inefficiencies in the deployment of nursing or other health

provider services. In so far as current needs are not all met, unmet needs will be included in the estimation process. Similarly, the estimation process will not be 'contaminated' by any current inappropriate use of services.

The approach is based on three underlying assumptions: (1) all health care needs can and should be met, (2) cost effective methods of addressing needs can be identified and implemented, and (3) health care resources are utilized in accordance with relative levels of need. Although this approach has the advantage of focusing attention on the efficient use of resources within the health care sector, it ignores the question of efficiency in the allocation of resources between health care and other activities. The allocation of resources between sectors of the economy is essentially a political decision. Although needs for care might be an important input into this decision, they are unlikely to be the only input important to the decision.

A second issue that arises from the needs-based approach is that there is no a priori reason why resource requirements derived from a needs-based approach will necessarily be used to meet needs. Human resources may be used to meet demands that do not coincide with underlying needs while 'hard to reach' populations may continue to have unmet needs. In this way, even estimates based on needs-based approaches may appear to be inadequate to meet all needs - because of inefficiency in the use of nursing resources, for example - and lead to demands for further increases in nursing resources. In other words the epidemiological principles underlying the needs-based approach need to be linked to economic principles about the opportunity costs of resources, both within and beyond the health care sector.

Utilization-Based Approach

Under this approach the quantity, mix, and population distribution of current health care resources are adopted as a baseline for estimates of future requirements. The level of utilization

of HHR services is expressed in relation to the demographic profile of the population to produce subgroup-specific average rates of provider utilization. Generally, the population characteristics used are confined to age and sex, based on evidence that health care needs vary systematically by these factors.

In principle, the range of characteristics could be increased to incorporate other population characteristics related to needs. However, the confounding influence of variations in supply on variations in populations' use of services have tended to deter researchers from incorporating these factors in the utilization-based approach. Age and sex specific rates of utilization are then applied to estimates of the future size and demographic profile of the population to produce nurse requirements for the future. In its simplest form the approach is based on three broad assumptions: (1) the current level, mix, and distribution of nursing services in the population are appropriate; (2) the age and sex specific resource requirements remain constant in the future; and (3) the size and demographic profile of the population changes over time in ways predicted by currently observed trends in age and sex specific rates of mortality, fertility, and migration patterns.

It is unlikely that anyone would argue that any of these assumptions are valid. For example, Markham and Birch⁽²⁹⁾ note that practice patterns and modes of delivery are continually developing over time in ways that affect the per capita use of specific provider specific services. Indeed, applications of the approach have relaxed some of the assumptions. For example, Denton et al.⁽³⁰⁾ consider alternative assumptions about trends affecting the future demographic profile of the population. However, the underlying question being addressed remains, "how many nursing (or other provider resources) hours will the population use in the future". But as patterns of behaviour such as smoking and alcohol consumption change over time the health risks associated with these behaviours will change with consequences for the demographic

profile of service requirements. Similar arguments could be made about changes in environmental exposures, employment profiles, and many other factors associated with health risks. Markham and Birch⁽²⁹⁾ argue that the main problem arising from this approach is that from a policy perspective; it overlooks the consequences of the 'errors' arising from these assumptions proving to be invalid. Because service utilization is not independent of supply, any overestimate or underestimate of requirements will be reflected in changes in the levels of services per capita population (i.e., service intensities). Thus, current service intensities, which form the basis of the utilization-based approach, emerge from the estimating errors of the past and not the epidemiological characteristics of the present or even the current willingness and ability of the population to pay for services.

Effective Demand-Based Approach

Under the effective demand-based approach, economic considerations are introduced to complement the epidemiological principles of the needs-based approach. As Lomas et al.⁽³¹⁾ argue, fiscal resources have not historically been factored into projecting supply requirements, presumably because the forecasting task has been seen as an attempt to assess requirements based on need. Because of the social nature of healthcare need, the assumption has been made that resources could be found. However, we have seen that definitions of need are less than precise and, more importantly, that there are clear possibilities for resource trade-offs. It would be unwise, therefore, to omit fiscal resource constraints in future forecasting exercises⁽³¹⁾. The approach remains interested in ensuring human resources are deployed efficiently (i.e., in ways that have greatest impact on health needs). But by relaxing the assumption that all needs can and should be met, the approach focuses on relative levels of needs within the entire population with needs.

Under this approach, the starting point is

to estimate the future size of the economy for which nursing services as well as all other commodities are to be funded. This is then used for estimating the proportion of total resources that might be allocated to health care, and the share of this health care allocation that is estimated will be devoted to nurse or other provider resources. Clearly, epidemiological information on the level and distribution of needs in the population and the roles that nursing or other provider human resources can play in meeting those needs and the inter-dependencies of planning exercises for different health human resources. In many countries, special consideration of economic issues may have better prepared us for the ultimate swing in over and under supply of nursing personnel we currently face.

The Pakistan Story

In many countries, the regulatory body is a repository of information relating to supply and labour market indicators. In some countries the regulatory body lacks even the most basic information on its members. In Pakistan, data on both the labour force and labour market are incomplete, fragmented, and not readily available. A study carried out by Amarsi⁽³²⁾ noted, "the nursing human resource development situation is unclear". She identified that there is an excess demand for nursing personnel, but no ability to evaluate current utilization and distribution of nurses. Due to the lack of quantitative data Amarsi had to use a qualitative approach to investigate critical issues in health human resources in nursing.

A four-year program, entitled The Development of Women Health Professional Programme (DWHP), focused on the need to collect quantitative data on the nursing workforce and to develop an integrated data system. One computerized data base developed at the regulatory body provided quantitative as well as demographic information on licensed nursing per-

sonnel within each cadre of the profession. That information destroyed many of the widely accepted perceptions regarding labour force participation. Contrary to popular belief, many women continued to work in nursing after marriage and motherhood. More reliable information on the number of nursing personnel in each cadre demonstrated the gap between the number of nursing personnel reported in government planning documents (35,000) and reality (15,000) registered nurses.

The computerized data base developed at the nursing examination boards provided information on the students enrolled in basic nursing educational programs and newly qualified nursing personnel. Profiles of the student body and new graduates became available to planners. The development of a computerized data base on the labour force participation (e.g., distribution across facilities, hours of work, status in employment, underemployment, unemployment) encountered numerous problems as the information coming into the central nursing offices were unreliable and incomplete. The need for a comprehensive on-site survey of each service and educational facility in the country became an essential first step. A data gathering tool was developed and pre-tested⁽³³⁾. Once this computerized data set is functional it will be linked to the other data sets, providing a comprehensive data base readily available for planning.

Before 1995 there were no databases on the nursing labour force and no ability to forecast the number of nurses that would be needed. The situation in Pakistan demonstrates the need for an infrastructure with the capacity to gather reliable and valid data and to establish linkages with information systems on other health care providers and the changing market conditions for labour. At the same time there is considerable pressure "to upgrade human resources through continued expansion of education and health services"⁽³⁴⁾.

Discussion

Is Simulation the Answer?

O'Brien-Pallas et al. (9) have built a dynamic system-based framework which considers: (1) population characteristics related to health levels and risks (needs-based factors), (2) service utilization patterns, nurse deployment patterns, and others who provide similar or the same services (utilization-based), (3) the economic, social, contextual, and political factors that can influence health spending (effective demand-based), and (4) the population clinical and health status, provider, and system outcomes resulting from the different types of nurse and other health provider utilization. This model incorporates each of the three methodological approaches outlined earlier but places these approaches in the context of assessment of needs and outcomes of service provision. Simulations of the health system are used to provide needs-based estimates which are aimed at optimizing outcomes. The practical applications of the model are currently being tested by members of the research team.

Simulation is a powerful technique. Hall⁽⁷⁾ suggests that it allows planners to explore consequences of alternative policies, facilitates input and output sensitivity analysis, and makes it easier to involve stakeholders throughout the process. Simulations are a means to assist planners to make decisions; they are not an end in themselves. The extent to which simulation provides useful scenarios for consideration is dependent upon the quality of the data used in the model and the extent to which the variables modeled reflect the system as a whole. In tracing key challenges to the use of WHO's simulation through the 1990s, Hall⁽⁷⁾ found the following: (1) planners want short term estimates as longer term projection models are too complex for some situations due to data requirements and planners are reluctant to make "estimates", and (2) planners don't understand the concept of scenario testing and view them as outcomes rather than information to be used by planners to influence the training and deployment of health

professionals and hence avoid or reduce the probability of shortfalls or surpluses in health planning. Simulation probably offers the most useful tools for assessing substitution across and within professions and for addressing issues such as geographic distribution of health personnel.

Personnel to population ratios, population based rates, and utilization-based rates have been used as the basis of computerized simulations⁽³⁵⁻³⁷⁾. However, these are not considered to be typical simulation models. They are static models that lack the capacity to examine the dynamic relationships among inputs/outcomes. Although techniques such as production functions, linear programming, and Markov chains are attractive because the resulting models can be solved analytically, they often require significant simplification of a problem to make it fit the required form. Simulation is much more flexible, in that it can model the evolution of a real-world system over time based on mathematical or logical relations between objects and probability distributions. Rather than generating an exact mathematical solution, an iteration of a simulation generates one possible outcome. The model is run repeatedly to get an estimate of how the system will behave overall. Simulations are often used to analyze 'what if' scenarios, a capability essential for use in health system planning. While they are easier to apply than analytical methods and require fewer simplifying assumptions, simulations can be costly to implement because of their detailed data requirements.

Two commonly used approaches to assessing uncertainty in health projections are deterministic sensitivity analysis and stochastic simulation^(7,38). Song and Rathwell⁽³⁸⁾ developed a simulation model to estimate the demand for hospital beds and physicians in China between 1990-2010. Using the simulation model they compared deterministic sensitivity analysis and stochastic simulation for assessing uncertainty in health projections. The simulation model consisted of three sub-models: population projections, estimation of demand for medical services, and productivity of health resources. The out-

puts for the model included number of hospital beds and the number of physicians required for the future. They produced three estimates, including the low and high limits, and the most likely value for each variable. Their findings indicated that the stochastic simulation method uses information more efficiently and produces more reasonable average estimates and a more meaningful range of projections than deterministic sensitivity analysis. However, Hall⁽⁷⁾ cautions that detailed data requirements required for stochastic modeling usually make it difficult to use stochastic models in developing countries.

Other Approaches

More recently, Bretthauer and Cote⁽³⁹⁾ have tested a model and solution methodology for planning resource requirements in Health Care Organizations. To determine resource requirements, they developed an optimizing/queuing network model that minimizes capacity costs while controlling for a set of performance constraints, such as setting an upper limit on the expected time a patient spends in the unit. This model needs further testing. However, it may be applied to capacity planning in a variety of health care settings, including the community.

Anderson and colleagues⁽⁴⁰⁾, describe a managed care model for projecting the number of otolaryngologists required in the United States. They suggest that unless assumptions are clear, different models used for prediction of health human resource requirements will produce different results. This is a conclusion previously made by Birch et al⁽²⁸⁾ and O'Brien-Pallas et al^(41,42). Whatever method used, O'Brien Pallas et al⁽⁹⁾, Song and Rathwell⁽³⁸⁾, and Eyles et al⁽⁴³⁾ suggest that estimates for requirements will not be exact numbers but instead a range of numbers. Until further development of models occurs, sensitivity analysis will allow policy makers and planners to have different estimates of required resources from which to plan their service need and HHRP. The importance of continuously updating estimates cannot be over-

stated.

Are We Doing IHHRP Today?

There is limited indication that we have moved closer to IHHRP based modeling. The published literature since 1995 continues to stress the need for IHHRP today, but there are few peer reviewed publications which discuss the results of such studies. Grey literature from the WHO describes some of the structural and process factors that are needed for IHHRP and indicate that these activities are underway at the region and country level. The outcomes of these analysis have been hard to access despite a thorough search of the world wide web of WHO Headquarters and regional offices. Access to these findings on web pages would contribute to the science of IHHRP. While 'pre-packaged' methods for planning human resources are attractive because they offer documented methodologies for immediate action, approaches to planning must consider the goals of the exercise and the desired outcomes. Trade-offs between conceptual and analytic advances, and rigour and ease of use must be carefully considered in light of the user's situation and the future orientation of planning.

Cooper⁽⁸⁾ uses supply based statistics to display, rather dramatically, the need for integrated planning. Professions included in this exercise included physicians, and the ten most common non physician clinicians (NPC), whose roles most strongly overlap with physician services. The non physician groups included traditional NPCs like nurse practitioners (NPs), certified nursing midwives (CNMs), and physician assistants (PAs); three alternative disciplines including chiropractors, naturopaths, practitioners of acupuncture and herbal medicine; and speciality disciplines including optometrists, podiatrists, certified registered nurses anesthetists (CRNAs), and clinical nurse specialists (CNS). Many of the practitioners are being prepared for primary care roles. Projections until 2005 revealed that given supply and current enrollments

in educational programs the NPCs would increase by 68% between 1995 and 2005. This is at a time when Cooper estimates there will be a surplus of physicians in the US. If maldistribution problems of providers were corrected the potential impact of the surplus may be somewhat mitigated. The study had several methodological limitations but does point to the needs for linking national and state workforce planning with the actual production of personnel and the integration of both. The author notes that the relationships among demand for physicians and NPCs needs further evaluation. A link to needs of the population and health and system outcomes would provide the context for a thorough investigation of these issues.

In the approaches to IHHRP models that have been described in the WHO Toolkit most are utilization based or supply based approaches, which, like the Cooper study, are subject to challenges of the related assumptions. The toolkit approach to determining future requirements for integrated workforces uses among other things the ratio of other professions to the number of physicians. As health restructuring moves out of the hospital or clinic setting to non traditional service settings, the number of 'other' personnel, might need to be unbundled from the ratio of physicians in order to ensure that full scopes of practice as defined in country and professional legislation are achieved. Inefficient substitution could lead to duplication of services.

IHHRP must determine what numbers of health professional are needed to meet population health needs and examine questions such as substitution and skill levels within and between professional cohorts. The WHO⁽²⁾ states that the relative price of different skill categories should guide decisions about the most efficient mix where labour markets are functioning. No direct account is taken of outcomes of interest. The basic goal of human resource planning is to ensure that essential services are provided to populations in need. In countries where some degree of planning is possible, deskilling of the workforce needs to be carefully considered. In

the case of nursing, recent literature has demonstrated that higher skill levels are associated with reduced incidence of nosocomial infections and adverse events⁽⁴⁴⁻⁴⁷⁾. This knowledge must be balanced with country realities in the short term and goals for future planning must include the notion of the right level of professional, in the right place, to achieve best outcomes. Questions of skill level of providers must be made judiciously and consider the evidence of ongoing research.

Restructuring initiatives in many countries have been driven by fiscal policy considerations rather than realigning the system to achieve better outcomes. In the late '90s, industrialized nations faced two important challenges: the non-viability of the welfare state and demands for wide ranging services from consumers^(48,49). The resulting activities of reform were the redesign of governments with a focus on decentralization and local accountability. However, a byproduct of this process "reinventing governments and reforms" brought about job losses. Resulting initiatives to retrain and assist with job searches to enhance re-employment opportunities have led to disappointing results. For example, registered nurses and other health professional were laid off or moved to part-time employment to reduce costs. However, these planning decisions have had some unanticipated consequences. In Canada, United Kingdom, United States, and Australia, for example, nurses were laid off or became unemployed or underemployed. The media and others quickly identified there was no certainty of full-time employment upon graduation. The enrollments in nursing schools reduced as a consequence in part due to program closures and also because of a severe drop in the applicant pool as young men and women chose other career options with better employment potential. Nurses who remained in the system report concerns of unsafe practice environments and severe work overload. Given the transition period between program entry and graduation, even though enrollments have now increased in the intervening period, the impact of the reduced

production of new nursing personnel is occurring at exactly the same time the supply of nursing personnel is decreasing because of the aging nursing workforce. The potential for a severe nursing shortage exists. The ability to change public policy and the perspective of the public about nursing as a career option and, at the same time, improve the work environments for nurses to attract new nurses and retain our aging nurses, is difficult in such short time horizon. The nursing situation described above is true for other health disciplines such as physicians. Analysis of the potential impact of planning decisions ought to consider many factors which can influence both short and long term consequences.

Conclusion and Recommendations

This paper provided an analysis of how labour market indicators can be integrated into service planning, discussed whether planning is sufficiently responsive and flexible to retain relevance and validity in rapidly changing health systems, described different models and approaches to linking and integrating workforce planning and service planning, discussed methodological approaches to integrating planning, and examined effective approaches to the use of computer based scenario modeling to support assessment of current and future planning options. The context and broad cross-cutting themes of public sector, political, social, and macro-economic changes have been considered. Real country examples have been highlighted. Where publications exist, empirical evidence served as the basis for this analysis.

While strides have been made in resource planning, key themes emerge from this paper including: (1) there have been few empirical applications of the conceptual frameworks developed in the last 10-15 years, (2) integrated and discipline specific empirical applications are ongoing but do not build upon conceptual and analytic advances, (3) discipline specific studies still dominate the literature, (4) labour market indicators, if collected, play an important role in

planning for the workforce, (5) a link to outcomes is missing in many applications, (6) modest financial investments to build upon conceptual and analytic advances and data requirements may result in large payoffs that greatly exceed investments, and (7) the opportunity costs of not moving forward and relying on old methodologies need to be considered (continued reliance on primarily supply and utilization based approaches have led to cycles of over and under supply approximately every four to five years in the physician and nursing workforce). To move us into the 21st century we need to make a concerted effort to move away from old and safe approaches and embrace conceptual and analytic complexity, with a focus on outcomes and integrated planning in order to provide an efficient and effective health service for future generations.

An international virtual network must be developed and supported by interested countries for the exchange of theoretical and practical IHHRD modelling processes. Countries with similar HHR issues should join forces to build models that are state of the art and improve upon the modelling limitations of the past⁽⁵⁰⁾.

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