



## Approaches in Health Human Resource Forecasting: A Roadmap for Improvement

Sima Rafiei<sup>1</sup>, Rafat Mohebbifar<sup>2</sup>, Fariba Hashemi<sup>3</sup>, Mohammad Ranjbar Ezzatabadi<sup>4</sup>, Fereshteh Farzianpour<sup>5</sup>

<sup>1</sup> Ph.D. of Healthcare Management, Assistant Professor, Department of Health Management, School of Health, Qazvin University of Medical Sciences, Qazvin, Iran

<sup>2</sup> Ph.D. of Healthcare Management, Associate Professor, Department of Health Management, School of Health, Qazvin University of Medical Sciences, Qazvin, Iran

<sup>3</sup> M.Sc. in Nursing, Department of Operating Room, Faculty of Para medicine, Qazvin University of Medical Sciences, Qazvin, Iran

<sup>4</sup> Ph.D. of Health Policy, Health policy Research Center, Shahid Sadoughi University of Medical Sciences, Yazd, Iran

<sup>5</sup> Ph.D. of Healthcare Management, Associate Professor, Department of Health Management and Economics, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran

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### Abstract

**Introduction:** Forecasting the demand and supply of health manpower in an accurate manner makes appropriate planning possible. The aim of this paper was to review approaches and methods for health manpower forecasting and consequently propose the features that improve the effectiveness of this important process of health manpower planning.

**Methods:** A literature review was conducted for studies published in English from 1990-2014 using Pub Med, Science Direct, Pro Quest, and Google Scholar databases. Review articles, qualitative studies, retrospective and prospective studies describing or applying various types of forecasting approaches and methods in health manpower forecasting were included in the review. The authors designed an extraction data sheet based on study questions to collect data on studies' references, designs, and types of forecasting approaches, whether discussed or applied, with their strengths and weaknesses

**Results:** Forty studies were included in the review. As a result, two main categories of approaches (conceptual and analytical) for health manpower forecasting were identified. Each approach had several strengths and weaknesses. As a whole, most of them were faced with some challenges, such as being static and unable to capture dynamic variables in manpower forecasting and causal relationships. They also lacked the capacity to benefit from scenario making to assist policy makers in effective decision making.

**Conclusions:** An effective forecasting approach is supposed to resolve all the deficits that exist in current approaches and meet the key features found in the literature in order to develop an open system and a dynamic and comprehensive method necessary for today complex health care systems.

**Keywords:** Forecasting approach, Predict, Demand, Supply, Health human resources

### 1. Introduction

Health care systems are intensively dependent on human resources worldwide. Imbalance in health manpower supply and demand will have a negative effect on the quality of health services and impose high expenditures on health care systems. An oversupply may increase health care costs of the health system through provider-induced demand, while insufficient supply may cause health needs of the population to be unmet or provided with lower quality (1-3). Therefore, one of the major concerns of policy makers in health sectors is to avoid the imbalances between supply and demand of health care personnel. To have a well-functioning health care system, it is inevitable

### Corresponding author:

Fereshteh Farzianpour, Department of Health Management and Economics, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran. Tel: +98.2188989129, Email: [farzianp@sina.tums.ac.ir](mailto:farzianp@sina.tums.ac.ir)

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to have adequate number with proper performance of health manpower (1). The aim is to ensure that health manpower is available and ready to provide services in “the right place at the right time with the right skills” (2, 3). Health human resource planning involves reviewing the current supply of manpower resources, forecasting their future requirements (demand) and availability (supply), and developing strategies to ensure an appropriate balance between supply of and demand for manpower. After defining an appropriate number of health manpower needed to meet requirements for health services, it is necessary to develop some policies to keep supply and demand of manpower in balance (4-6).

To address an appropriate number of health manpower needed, there are several forecasting methods that various strengths and weaknesses (4-26). The majority is based on the supply-based approach (manpower-population ratio) for the reason of data availability. This approach with valid data on providers and population statistics can be helpful for estimating the manpower requirement for an entire country and a number of various health manpower categories. In other cases, service utilization rates were more applicable and used for estimating health manpower requirement in private sector or health systems with passive government. This approach computes utilization rate of health services in different populations. Unlike the manpower-population ratio, data availability is not a strengthening point of this approach, but similar to manpower-population ratio, the demand-based approach masks major regional imbalances. Both approaches also ignore the effects that manpower planning might have on health system outcomes and the population’s health status. The complexity and dynamic nature of health systems are other features mostly ignored in these two approaches (32, 39). They generally fail to consider real health needs of the population in manpower planning, pay little attention to demand and need factors, and are limited to demographic characteristics in estimating future requirements for health manpower. For a health care system with a large public sector active in care delivery, there are two types of useful approaches that can be applied, i.e, needs-based and the health services target approach. Planning for supply and demand of manpower consistent with regional health needs of the population is essential in these approaches. The needs-based approach seems to have a reasonable logic, because, unlike the demand-based approach, it does not consider the current level or distribution of health manpower to be necessarily adequate; instead, it emphasizes the relative health needs of the population. The health service target approach matches the supply of health manpower with the health services mentioned as a target to be met for a particular population. This is a politically-appealing approach that makes manpower planning possible at the local levels. Although there are strengths noted above for these two approaches, there are also a number of shortcomings. One of them, similar to the supply and demand-based approach, is the ignorance of the intricacy and dynamic nature of the health system and the many factors that have important roles in planning health manpower. Benchmarking is the last approach, and it relies on international or inter-homogenous health system indicators to identify health manpower requirements. Although it is easy to apply and compare manpower ratios in regions with similar health system characteristics, but, the same as all of the approaches mentioned above, it also has an important deficit. Most of them do not have the ability to capture all key factors that affect the demand and supply of health manpower. To propose a single comprehensive approach incorporating the strong points of the other methods, a comprehensive review of existing approaches must be conducted to determine their advantages and limitations. In this way, the challenges of such models would be analyzed to determine possible roadmaps for improvement.

## **2. Material and Methods**

### **2.1. Setting**

The English language databases of Pub Med, Science Direct, Google Scholar, and Pro Quest were searched to find articles related to the subject of this study. Reports also were investigated by searching the websites of the World Health Organization (WHO) and international professional associations related to workforce research. Examples for such associations include the Canadian Nurses Association and the Association of American Medical Colleges.

### **2.2. Inclusion and Exclusion Criteria**

We chose a time period from January 1, 1990, to December 30, 2014, for the search process of the study. Similar search terms, including “forecasting approaches OR forecasting methods OR predict OR project” AND “demand OR supply” AND “health manpower OR health workforce OR health human resources OR health care professionals” were used for all databases. The search was restricted to articles and reports with full text accessibility published in English. Studies including the non-clinical workforce were not incorporated in the review. Also, we did not consider studies conducted in a format of books or quantitative surveys.

### **2.3. Quality Assessment**

Existence of valid instruments and presence of inclusion and exclusion criteria were checked to ensure the quality of the study. Data were based on the search results identifying 960 articles from which 40 studies ultimately were selected after applying the exclusion criteria.

### **2.4. Data collection**

The authors designed an extraction data sheet based on the study questions. This form was used to collect data on studies' references, countries, designs, and types of forecasting approaches, whether discussed or applied with their strengths and weaknesses. For each study, two authors (SR and MA) completed the sheets independently. Any disagreement was solved through consensus.

## **3. Results**

In an initial search, 960 publications were found. Screening documents based on their titles and abstracts revealed 570 duplicates or non-relevant studies. After reviewing the full texts of the remaining studies, 317 of them were excluded because of they were not consistent with the inclusion criteria. Among the 317 studies, 175 did not meet our criteria for study subject, 18 were not compatible with the inclusion criteria of study design, 65 studied forecasting approaches among non-health workforce, and 59 provided no data on strengths and weaknesses of the forecasting approaches. Thirty-five documents also were removed due to similarity in method and data provided. Considering the reference lists of the remaining studies led to two additional publications that met our inclusion criteria and were not duplicates of the other studies. Thus, 40 studies were included in the review both from developed and developing countries.

### **3.1. An effective method in health manpower forecasting**

To date, most of the health manpower forecasting methods have not considered the complete number of dynamic variables in manpower forecasting and their causal relationships. They also lack the capacity to benefit from scenario making to assist planners and policy makers in effective decision making (27). Modern forecasting approaches must resolve all of the deficits that exist in the current approaches and meet the key features found in the literature in order to develop an open system, dynamic, and comprehensive method necessary for today's complex health care systems (17, 28, 29). Some of the key features are 1) taking into account the full range of dynamic variables affecting manpower supply and demand, 2) considering their inherent uncertainty and complex interactions, 3) having a system-level perspective with a dynamic approach, and 4) having the ability to create scenarios that are useful for policy-making purposes (27). Our study recommends using a dynamic model that has the following features (1, 22, 27):

#### **3.1.1. Incorporating all relative factors with dominant effect on manpower supply and demand:**

There are several factors that have dominant effect on manpower supply and demand (6). In order to have a comprehensive conceptual approach, as many of these factors as possible should be included. Reviewing the literature provided a number of these factors. Providing high-quality, longitudinal data around the key factors is essential in making a valid and reliable manpower forecast (17, 21, 27, 29-32).

#### **3.1.2. Monitoring trends of these factors over time:**

In most cases, models lack a complete number of dynamic variables and the possibility to attain high-quality data to investigate their trends after a while (1, 22, 27). Considering the impact of emerging technologies, socio-cultural evolution, economic changes, political incentives, demographic and epidemiological trends on health services requirement or health system capacity to meet these requirements are the examples addressing the importance of monitoring trends in affecting factors over time (17, 28, 30, 33).

#### **3.1.3. Considering complex interactions among these factors:**

Taking into account complex interactions among variables affecting manpower supply and demand is another important feature. For an instance, population size and demographic, their average income and educational level, insurance coverage, incidence of diseases, and service utilization rates are among the factors affecting demand for health manpower. Although all of these factors affect the demand for manpower, there also are several inter-relationships between the affecting factors. Population size and demographics, their average income and educational level, and insurance coverage, for example, can affect the utilization rate for manpower services in a population. Clarifying all possible interactions among variables will identify the complex nature of manpower modeling (34-37).

#### **3.1.4. Applying 'what-if' scenarios is helpful for policy making purposes:**

The ability of the model to check 'what-if' scenarios is another important factor to be considered. This feature allows planners and policy makers to explore the consequences of the alternative policies used in planning manpower, and it provides a means of assisting them to make effective decisions. The model's success in proposing

useful scenarios is dependent on the quality of the data and the proper selection of the variables for the model in a way to reflect the entire system (17, 38). Sensitivity analysis allows policy makers and planners to make different estimates of the required services and, consequently, plan for the number of manpower required (17, 34, 35, 37, 39). A system dynamic modeling approach can cover the above features. It has the ability to take into account a complete number of dynamic variables in manpower planning and to consider both quantitative and qualitative aspects. The model can be useful in better policy making for manpower supply and demand by taking into account the complexity of different contextual variables and a combination of various perspectives (17). The model also can be used for forecasting purposes in long periods of time and large number of population. The ability of the model in responding to ‘what-if’ scenarios can help planners and policy makers in making decisions more effectively in manpower planning (34-37, 39). Table 1 shows the differences between the old and modern approaches in planning health manpower (40) as compared to system dynamic (SD) modeling.

**Table 1.** Differences between old and modern approaches in health manpower planning comparing to SD model

Old approaches	Modern approaches	SD model
Static modeling	Dynamic modeling	Dynamic nature of variables considered Complex interactions among variables considered
Model specifications fixed in time	Self-learning and self-correcting	Model specifications not constant in time
Limited variables included	All complex variables included	All complex variables included
Limited feedback on projections	Continuous validation process	Feedback, time lags and delays considered
No national database	National database	National database
No minimum dataset	Minimum dataset for manpower	Extensive valid data is needed
Short term forecasting is possible	Long term forecasting is possible	Medium to long term forecasting is possible
Quantitative data are able to be modeled	Both quantitative and qualitative data are able to be modeled	Qualitative data are able to be modeled

#### 4. Discussion

This paper reviews available forecasting methods for health manpower and consequently proposes the features that improve the effectiveness of health manpower forecasting. Several conceptual approaches were introduced to forecast health manpower supply and demand (4-26, 28). Most of them were based on the supply-based approach (manpower-population ratio) for the reason of data availability. This approach with valid data on providers and population statistics can be helpful for estimating manpower requirement for an entire country and for several health manpower categories (6, 8, 12, 14, 16). In other cases, service utilization rates were more applicable and used for estimating health manpower requirement in the private sector or health systems with passive government. This approach computes utilization rate of health services in different populations. Unlike the manpower-population ratio, data availability is not a strengthening point of this approach, but, similar to the manpower-population ratio, the demand-based approach masks major regional imbalances. Both approaches also ignore the effects that manpower planning might have on health system outcomes and the population’s health status. The complex and dynamic natures of health systems are other features that mostly are ignored in these two approaches (17, 22). They generally fail to consider the real health needs of the population in manpower planning, they pay little attention to demand and need factors, and they are limited to demographic characteristics in estimating future requirements for health manpower (4-7, 9, 12, 13, 18, 20, 26).

For a health care system with a large public sector active in care delivery, there are two types of approaches mostly useful to be applied, i.e., needs-based and health services target approach. Planning for supply and demand of manpower that is consistent with regional health needs of the population is essential in these approaches. The needs-based approach seems to be reasonably logical because, unlike the demand-based approach, it does not consider the current level or distribution of health manpower to be necessarily adequate; instead it emphasizes the relative health needs of the population (5, 8, 11, 15, 19, 23, 24, 28). The health service target approach matches health manpower supply with health services mentioned as a target to be met for a particular population. This is a politically-appealing

approach that makes manpower planning possible at the local levels (8, 12, 26). Although strengths are noted above for these two approaches, there also are several shortcomings. One of them, similar to the supply and demand-based approach, is ignorance of the intricacy and dynamic nature of health systems and the several factors that have important roles in health manpower planning (13, 17, 18, 22, 26, 27). Benchmarking is the last approach, and it relies on international or inter-homogenous health system indicators to identify health manpower requirements. Although it is easy to apply and compares manpower ratios in regions with similar health system characteristics, but, the same as all of the approaches mentioned above, it also has an important deficit (10). None of the five approaches has the ability to capture all key factors affecting demand and supply of health manpower, e.g., economic, socio-cultural, political, technological, service utilization rates, incidence of disease, and other factors influencing health manpower planning. They also lack the ability to consider the dynamic interactions among the full range of variables and to make possible scenarios in response to ‘what-if’ questions (13, 18, 26, 28). We recommend developing a comprehensive health manpower model with a conceptual framework including as many of these factors as possible. Population demography, technology development, accessibility to health services, service utilization, incidents of diseases, economic, social, political factors and manpower work pattern are among the important elements that must be considered in a manpower planning model (2, 17, 21, 27, 31, 32). These influencing variables and their causal effects must be clearly identified (26). This open system and dynamic modeling is a feature mostly ignored in the existing literature. Including as many as possible of the factors related to the five mentioned approaches accompanied with high-quality data will equip our model to be optimally effective in estimating health manpower requirements (17, 28).

## 5. Conclusions

Effective health manpower planning is critical to guarantee adequate number of staff available and consequently good quality and resourceful health care services delivered to the population. To address an appropriate number of health manpower, there are a number of forecasting approaches and methods with their own strengths and weaknesses. Since there is always a challenge for selecting an appropriate approach, this paper attempted to provide an evidence-based framework to facilitate the process. The results of this study suggest that future forecasting methods should benefit from advantages of current approaches and overcome some of their main limitations. Applying a method that incorporates a wide range of factors affecting supply and demand, facilitates the collection of good quality data, monitors changing trends over time, considers the uncertainty of health systems, and has a dynamic approach is proposed as an improvement roadmap for future forecasting. System dynamics covers the above features and has the ability to take into account a complete number of dynamic variables in manpower planning and consider both quantitative and qualitative aspects. The model also will be useful in making better policies for manpower supply and demand and designing trustworthy policies for their recruitment, distribution, training capacity, and attrition purposes. Therefore, it is recommended that this method be applied in projecting the number of required workforce in today’s complex health care systems and to analyze the results of health manpower planning.

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## Conflict of Interest:

There is no conflict of interest to be declared.

## Authors' contributions:

All authors contributed to this project and article equally. All authors read and approved the final manuscript.

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