Synopsis of the Ph. D Thesis

"DEVELOPMENT OF A SIMULATION BASED MODEL FOR MANPOWER PLANNING IN HEALTH CARE"

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I. INTRODUCTION

Health care is a labour-intensive industry. Since fully automated health care services are a distant future, manpower continue to be a major ingredient for health care production and constitute the largest proportion of health care expenditure. It is remarkable that the market for manpower in health care has been relatively under-researched and under-managed even in the health system of developed countries.

The planning of supply of and demand for manpower in healthcare is a neglected topic characterized by significant methodological weaknesses which have been discussed for decades but not resolved. In India too, the case is not different. Currently there is no clear system of projecting the future supply of manpower vis-à-vis the population's need and demand.

It is noted that, Simulation modeling being carried out in some countries, particularly in Canada, has provided many insights that are practical for manpower planning. Simulation allows planners to explore consequences of alternative policies, facilitate input and output sensitivity analysis, and make it easier to involve stakeholders throughout the planning and management process.

II. SCOPE AND SIGNIFICANCE OF THE STUDY

Health manpower planning is about ensuring that there are enough health workers to meet the health care needs of the population. The aim of the planning is to provide the information and tools needed for decision makers to make informed and strategic decisions in getting and keeping the health workers that are required and making the best use of their skills within a health system that is affordable and sustainable. The traditional approach to health manpower planning has relied primarily on projecting current utilization patterns into the future, estimating the resulting requirements for increased supply in specific health professions, and then determining if currently-projected supply will be adequate to meet those requirements. A need-based planning approach on the other hand attempts to estimate future health needs on the basis of the estimated health status of the population.

III. OBJECTIVES OF THE STUDY

1. Primary Objective:

- To develop a simulation based model to estimate the gap between supply and requirement of health manpower to address the needs of the population.

2. Secondary Objectives:

- To develop a model for population projection in order to understand the demographic changes happening in the age-group population that impacts the future manpower requirement.
- To develop Simulation model for Training, Supply and Productivity to estimate the total supply of providers (general practitioners) both in consideration to productivity and without considering productivity.
- To develop a model for understanding the health care requirements of age-group population in terms of number of providers required.
- To incorporate the provision for testing different scenarios in the model to understand the impact of changing policy options on provider requirements.
- To incorporate in the model, the provision for conducting Sensitivity analysis to monitor the effect of

change in input variables on output values.

IV.

RESEARCH METHODOLOGY

1. *Research Design*

The research design adopted in this study is Simulation design. The steps followed in a simulation based research design are 1. Define the problem, 2. Introduce the variables associated with the problem, 3. Construct a numerical model, 4. Set up possible courses of action for testing, 4. Run the experiment, 5. Consider the results, 6. Decide what course of action to take.

2. *Population of the study*

The major extent of data used for constructing and validating this model are based on census and other government reports. The actual district-wise age-group population, Age-specific fertility rate, Age-specific death rate and so on with regard to the base year is taken from the census reports. The general practitioners practicing at Kozhikode district constitutes the population for the provider satisfaction survey. The people living in Kozhikode district 'with illness' and 'without illness' constitutes the population for measuring the self-perceived health status. The people of Kozhikode district approaching to different categories of hospitals for general practitioners consultation constitutes population for Service quality and competence.

3. *Sample units of the study*

- The sampling units for the General-well being index questionnaire are collected from two different hypothetical populations- Male and Female 'with illness' and 'without illness'. The sample size is 400. The sampling technique is Quota Sampling
- The sampling units for the Service quality questionnaire are obtained using Cluster sampling. The hospitals under different sectors separately form clusters. From each sector, a fixed number of clusters are selected randomly. The Sample size from each sector is 100
- The sampling units for the provider satisfaction survey questionnaire are obtained from the General practitioners practicing in Kozhikode district. The data obtained from a sample of 100, based on simple random sampling.

V. MODEL FORMULATION & DESCRIPTION

The models developed in the research assess the consequences of certain policies/events which is a type of Simulation. In this form of computer mathematical simulation, systems are replicated with mathematical models, which are analyzed using a computer. By way of Simulation, different scenarios can be constructed to answer '*what if*" type of questions. This would not suggest what should be done; rather it gives alternate views of how the future would look like?

The health manpower planning model attempts to project the manpower requirement in a specified geographical area. Even though the model establishes complex relationship between many different variables, it is made as simple as possible without ignoring any of the relevant variables. The entire model was developed in Microsoft Excel 2007. In addition to the built-in functions, two add-ins 'Risk Simulation' and 'SensIt' are also used for completing the model The model also incorporated the provision to conduct a Sensitivity analysis based on which it is possible to identify and control factors that influence the model outputs and performance.

Model comprises of the following five different modules.

a. Population Projection module- Mortality module, Fertility module and Migration module
b. Supply module
c. Productivity module
d. Training module
e. Requirement module

a. Population Projection module which comprises of three sub-modules. a) Mortality module, b) Fertility module and c) Migration module. The Cohort-component method is used for estimating the future population. Mortality module is mainly based on Age-specific death rates and this rate formed the basis of calculating the gender-wise survival probabilities and life expectancy. The number of deaths in respect of males and females were calculated separately based on the survival probabilities. The migration is projected based on the in-migration and out-migration rates obtained from the census data. For projecting the population for twenty years, migration rates are assumed to be constant. The at-risk population corresponding to in-migration is assumed to be the Indian population and the local population is considered as the at-risk population for projecting the Out-migrants. The major component of the Fertility module is Age-specific fertility rate along with the migration and mortality components. The Age-specific Death rates and Age-specific Fertility rates are projected using both ARIMA model and Simulation.

b. Supply module comprises of current stock of providers working in different health care sectors. This module has taken into account the details regarding Full-time and Part-time native workers, Full-time and Part-time migrant workers, and doctors practicing at home. The exit through migration, retirements and deaths has been incorporated in the model by linking these modules with the mortality and migration model described in the Population Projection module. Since the time duration of the job is different for the Full-time and Part-time category as well as the doctors practicing at home, the probability distribution of service time corresponding to the part-time workers, part-time migrants and the doctors practicing at home has been considered for determining the Full-time equivalents available for health service delivery. The Full-time equivalents are projected for the next twenty years.

c. Training module comprises of data pertaining to different educational institutions offering courses in health care related professions. Different professional courses such as those under graduation/diploma, post-graduation and super specialty stream are taken into consideration in the module. Also, the rate of exit due to migration, higher studies and deaths are incorporated in this module. The information related to migration and deaths are included in the model by creating a link with the mortality and migration sub-modules of the Population Projection module.

d. Productivity module comprises of the details regarding the duration of work, quality and quantity of work done by the health care professionals, Provider satisfaction level, Use of technology support in medical diagnosis, Help from other professionals etc. The data regarding service quality is obtained through a survey of recipients of health care service. Probability distribution of the same is obtained and data for projection is generated through simulation. The quantity of work is further disaggregated into direct patient care and other non-clinical activities. The productivity quotient is measured based on the above mentioned components.

e. Requirement module comprises of details regarding morbidity, Self-assessed health status- with and without illness, Self-reported rate of requirement, and treatment time distribution. The requirement module based on these variables determines the manpower requirement in terms of number of hours and in terms of number of Full-time equivalent providers.

VI. MODEL APPLICATION

The model developed using simulation model is suitable for regional manpower planning in health care, which in turn would be helpful and useful for identifying areas to be concentrated upon, even at the national context.

VII. MAJOR FINDINGS OF THE STUDY

1. The computerized model for population projection developed based on Cohort-component method is capable of projecting the demographic changes such as mortality, fertility, and migration happening in an age-group population.

2. The simulation model developed for projecting the provider supply in each category of Institutions

separately for the next twenty years. The model takes into account the graduates entry to the stock, In-migration, Out-migration, and Retirement exits. The data on supply projection obtained through the Supply module is transferred to Productivity module for determining the total supply of provider stock in terms of productivity.

3. The sub-model developed for estimating the new entrants from different medical training programmes is capable of projecting the pattern of medical graduate's entry to the provider stock in the next twenty years. The model takes into account factors such as programme attrition, out-migration, and probability of course completion in the current and subsequent years and finally graduates diverting from medical profession to do some other jobs unrelated to this profession. The projection shows that there is a great difference in the number of graduates coming out of Government medical colleges and Self-financing/private sector.

4. The Productivity based supply module developed is capable of determining the total number of providers available for health care provision after considering their productivity level. The total supply obtained through the supply module is adjusted based on their productivity level to determine the productive work hours contributed by them.

5. The health care requirement module is yet another important part of the manpower planning model, wherein the health care needs of the population are adequately portrayed. The model is capable of projecting both the required number of hours as well as the required number of full-time equivalent providers required for adequately meeting the growing health care needs of the population.

VIII. LIMITATIONS OF THE STUDY

- Data taken only from different districts in Kerala formed the basis of constructing the model. The validation has also been done by taking the data of Kozhikode district. Hence the application of the same outside this context might cause a deviation from the actual in the initial attempt. This can be rectified by conducting a similar study outside this context to identify the changes if any, persists in the behavior of the modeled variables. This will ultimately help to standardize the model.

- The financial components if included in the model will make the model more complicated, because of the high variability of those components. Hence, being an initial attempt, financial components are excluded from the study.

- Data from multiple sources are rectified in estimating model input parameter values which may not be 100% accurate.

- There is high variability in patient care requirements that is modeled with random variables.

- The only source for some model input values were obtained through expert opinion.

IX. SCHEME OF PRESENTATION OF THE STUDY

The study is reported in seven chapters. The first chapter includes Introduction, Importance of the study, and Need for the study, Scope of the study, Statement of the research problem, Objectives of the Study, Methodology, Limitations of the study, and Chapterisation and Reporting Scheme. The second chapter provides an overview of Indian Health care Industry. The third chapter presents the conceptual review. The fourth chapter covers the Review of Literature. The fifth chapter describes the structure of the model and model operation in the spreadsheet. The Sixth chapter details the assumptions underlying the model, variables used, its interrelationships, analytical framework equations, scenarios constructed, sensitivity analysis, Application of the model, Method of interpretation of results. The seventh chapter gives major findings. The chapter ends with the conclusion and scope for further research. The references and Appendices are provided at the end of the report.

X. CONCLUSION

It is a fact that in spite of the tremendous advancement in technology and science, all countries are facing challenges in health manpower, health of population being one of the major areas of concern especially in developing countries, like India. To identify the right number, kind and type of manpower required at the right location for effectively carrying out the desired activity is the objective of manpower planning. The present study appears to be a more realistic approach in the context of Indian scenario. The factors relating to Indian conditions, both expected and projected, have been taken into consideration under this study with a view to regulate the manpower supply-requirement gap, at any point of time.