A MICRO-MODEL FOR NURSING MANPOWER NEEDS

by

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INTRODUCTION

This paper describes models which have been developed under a contract from the Division of Nursing, Bureau of Health Manpower, Department of Health, Education and Welfare. The project is aimed at development and testing of models which incorporate health services utilization factors and factors affecting demand and supply for nursing manpower into a framework for determining nursing manpower needs. The models contain specific institutional characteristics and are capable of predicting demand and supply for nursing manpower at county and state levels.

Demand and supply models have been developed for four categories of health care settings: (i) acute care; (ii) long term care; (iii) ambulatory care, and (iv) community and public health. This paper describes models for predicting demand for nursing manpower in acute and long term care facilities. Definitions of acute and long term care facilities, which have been used throughout the project, are consistent with those of the American Hospital Association.

MODEL DEVELOPMENT STRATEGY

Both acute and long term care models have been divided into three sub-models as shown in Exhibit 1. The health services utilization sub-model is designed to predict the demand for health services, in patient days. The output of this sub-model serves as an input to the nursing manpower demand sub-model which converts demand for health services to demand for nursing manpower in hours, full-time equivalents or a similar measure.

In constructing the models, it was assumed that only currently available data would be used in model construction and during implementation. A prior contract awarded by the Division of Nursing resulted in the construction of a supply model which was modified for use in this project (1)*. For this reason, only the health services utilization and nursing manpower demand sub-models will be discussed in this paper. The decision analysis framework relates to reducing demand by supply resulting in a need estimate (or over supply).

EXHIBIT 1

ACUTE AND LONG TERM CARE SUB-MODELS
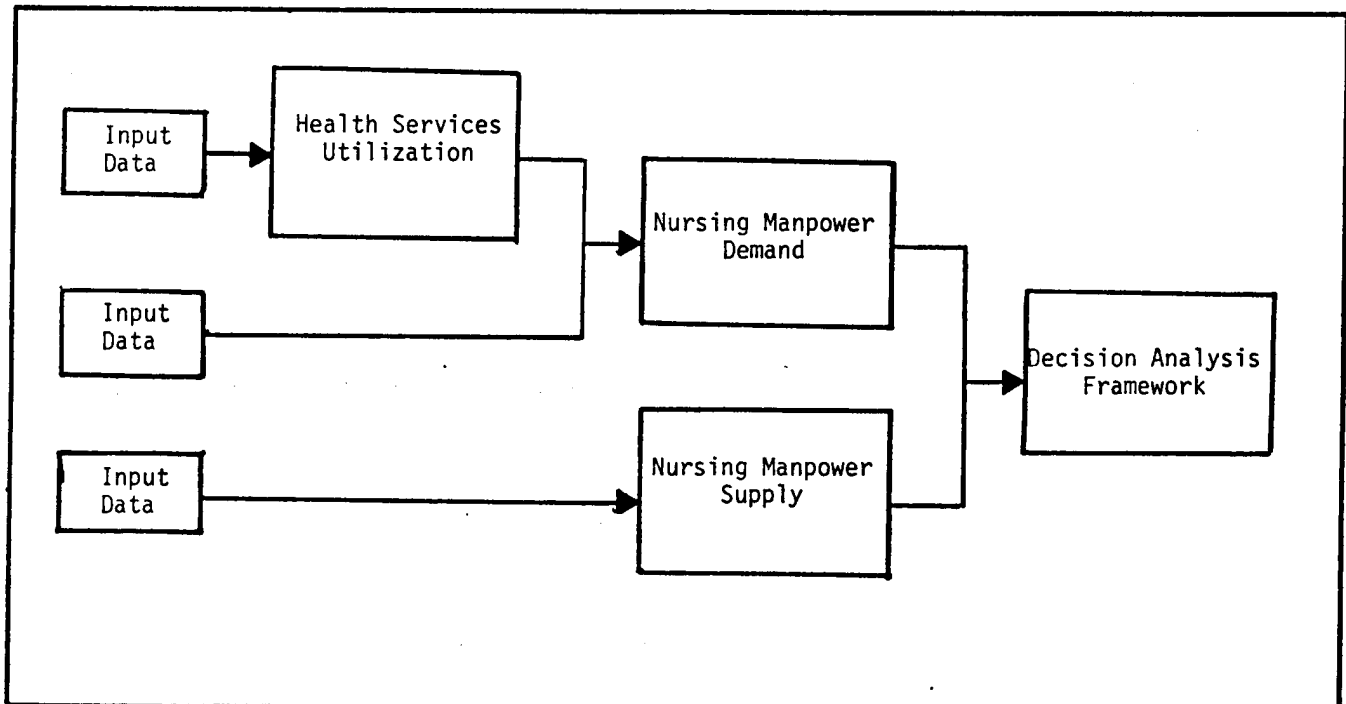
*Numbers in parentheses refer to the "References" section.

HEALTH SERVICES UTILIZATION SUB-MODELS

Categories of output for the acute care health services utilization sub-models are shown in Exhibit 2. There is only one category of care in the long term care case, patient days. The modelling process was concerned with determining what types of input data might be used as causal predictors of the desired outputs. The project attempted to come as close as possible to an exhaustive search of available data. Two major types of input data were identified and analyzed: (i) census or demographic data, and (ii) institutional data.

Acute care institutions were categorized by four major characteristics: (1) bed size; (ii) control, e.g, proprietary, governmental; (iii) level of technology, and (iv) teaching/non-teaching. Within each characteristic, there are several levels of breakdown. For example, size is divided into: (i) 0-49 beds; (ii) 50-149 beds; (iii) 150-299 beds, and (iv) 300+ beds. Technology levels were defined using an index developed by Northwestern University and

EXHIBIT 2

CATEGORIES OF OUTPUT

Medical/surgical patient days

Obstetrics/gynecology patient days

Pediatrics patient days

Psychiatric patient days

Operating room procedures

the American Hospital Association (2). Long term care institutions were categorized by bed size and control.

Step-wise multiple regression was used to develop the utilization submodels. There were several reasons for the choice of this methodology: (i) the methodology lends itself to efficient analysis of large quantities of data; (ii) highly efficient computer programs were available for interactive time shared use, and (iii) members of the project team and other researchers had successfully used this methodology in similar activities.

For each category of actue care institution, five regression equations were developed, one for each category of output shown in Exhibit 2. In many cases, insufficient data required pooling of institutional categories such as bed size. The analysis resulted in twenty different acute care models and eight long term care models. Exhibit 3 contains a listing of the independent variables which are contained in these models. The regression analysis resulted in these variables being selected as predictors out of a total of thirty-one possible census variables and forty-two possible institutional variables. In most cases, a specific model contains only four or five of the variables.

The analysis described up to this point resulted in twenty-eight causal models which will estimate health services utilization as a function of the various independent variables shown in Exhibit 3. However, the project was also concerned with making health services utilization estimates each year for a ten year period. Therefore, models were developed to make annual projections for the variables shown in Exhibit 3. Methods used varied from simple linear projections to exponential smoothing. The major limitation in choosing a projection method was data availability

EXHIBIT 3

INDEPENDENT VARIABLES
IN ACUTE AND LONG TERM CARE UTILIZATION SUB-MODELS

Census Variables

Total Population
White Population
0-5 Population
6-15 Population
16-44 Population
45-64 Population
65+ Population
Female Population
Female Population 14+
Female Unemployed
Total Aggregate Income
Aggregate Income: Earnings
Aggregate Income: Social Security
Aggregate Income: Public Assistance
Family Income: 8,000-14,900
Family Income: 15,000-25,000
Family Income: Over 25,000
School Years 13-15

Institution Variables

Number General Hospitals in Area
Total Mortality
Number MD Office
Number MD Hospital
Number Nursing Homes
Number Office Visits
Percent MD Pediatrics
Percent MD Surgical
Percent MD OB/GYN
Percent MD Other
Number Beds in Institution

NURSING MANPOWER DEMAND SUB-MODELS

The nursing manpower demand sub-models convert the demand for health services (usually in patient days) for acute and long term care institutions to demand for nursing manpower (in man-hours or full time equivalents). Demand is estimated for three types of nursing personnel: (i) registered nurses (RN); (ii) licensed practical nurses (LPN), and (iii) nursing assistants (aides, orderlies, etc.).

A recent comprehensive analysis of nursing man-hours per-patient-day provided in acute care settings has been made by Levine and Phillip (3). This study analyzes the variations in nursing manpower provided among geographical areas of the country, hospitals of varying bed sizes and other factors. While

the study results do provide some insight into the categories of acute care institutions used in this project, there are substantial differences in the categories used. The raw data from over 2,000 acute care institutions used by Levine and Phillip has been obtained and is currently being used to estimate nursing manpower demand for the categories of acute care institutions defined in this project. Where geographical differences are significant, individual estimates will be made for different geographical areas of the country.

Data such as that used in the Levine and Phillip study is not available for long term care institutions. A research project currently underway at Johns Hopkins University has estimated nursing man-hours provided in a form consistent with the three categories of nursing personnel used in this project. While the number of long term care institutions surveyed in the Hopkins study is small, it appears to be the best available data and, therefore, will be used as the basis for estimating nursing manpower demand in the long term care environment.

COMPUTERIZED SYSTEM

Computer programs have been developed to allow use of all models generated by the project in either an interactive or batch mode. The user may select models corresponding to institutions for which supply and demand estimates are to be made. The system also requires data related to each institution corresponding to Exhibit 3. Given these inputs, the system outputs include: (i) utilization, in patient days categorized to correspond to Exhibit 2; (ii) demand in man-hours categorized according to Exhibit 2; (iii) supply in man-hours

or full time equivalents, and (iv) need (demand less supply) in man-hours or full time equivalents. In the case of demand, supply and need, estimates are made for three levels of nursing manpower: RN; LPN; and assistants. All estimates are made for each year during a ten-year period.

SUMMARY AND CONCLUSIONS

The micro-model for nursing manpower needs is currently being tested and evaluated. It is clear that utilizing available data places a severe restriction on the construction of an institution specific model. For this reason, the current micro-model should be considered more reliable when aggregated to the county or state level. The modelling effort reported here has laid the foundation for the development of a reliable institution specific model.

Use of the micro-model will be focused on the county, Health Services Agency (HSA), or state level. Use at these levels requires that the health services utilization and demand models be applied to each institution within the geographical area. These estimates may then be aggregated to the appropriate level. In this way, the micro-model should play a significant role as the first major effort to construct a model for use in substate nursing manpower planning throughout the United States.

REFERENCES

1. Jones, D. C., et al, "Procedure for Projecting Trends in Registered Nurse Supply," Research Triangle Institute, March, 1975, (FR-240-1024-2), Division of Nursing, Bureau of Health Resources Development, HRA, DHEW.

2. Edwards, Mary, et al, "Further Investigation of Two Aspects of the General Services Index," Technical Paper 1, Health Services Research Center, Northwestern University, Chicago, Illinois, May, 1975.

3. Levine, H. D. and P. J. Phillip, "Factors Affecting Staffing Levels and Patterns of Nursing Personnel," DHEW Publication No. (HRA) 75-6, February, 1975.