DOCUMENT RESUME

ED 132 355 CE 008 865

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TITLE Methodological Approaches for Determining Health Manpower Supply and Requirements. Volume II. Practical Planning Manual.
INSTITUTION Nathan (Robert R.) Associates, Inc., Washington, D.C.
SPONS AGENCY National Health Planning Information Center (DHEW/PHS), Rockville, Md.
REPORT NO DHEW-HRA-76-14512; HRP-000-7378
PUB DATE 76
CONTRACT HRA-230-75-0067; HRA-230-75-00073
NOTE 206p.; For a related document see CE 008 864

EDRS PRICE MF-$0.83 HC-$11.37 Plus Postage.
DESCRIPTORS *Employment Projections; Health Occupations; *Health Personnel; Health Services; Labor Market; *Labor Supply; *Manpower Needs; Manuals; *Research Methodology; *Statistical Analysis

ABSTRACT

This second of a two-volume monograph, which describes and evaluates various methods used to determine present and future health manpower supply and requirements, is intended to contribute to planners' understanding of the state of the art and to the improvement of health manpower planning. The methodologies presented, chosen after a review of the documents identified in the Inventory of Health Manpower Planning Activities of 1973 in the Bureau of Health Manpower, are considered practical with regard to the resources available to state and local health planners. This volume is a practical manual that describes the methodologies step-by-step, including questionnaire samples and selected tables for estimating health manpower supply and requirements. A list of tables and a bibliography are also included. (Volume I provides the analytical perspective including definition of terms, discussion of concepts that underlie the methodological approach, and discussion of the uses and limitations of health manpower statistics within the context of the subject area.) (WL) -

HRP-000 7378

Methodological Approaches For Determining Health Manpower Supply and Requirements

VOLUME II
Practical Planning Manual

U.S. Department of
Health, Education, and Welfare
Public Health Service
Bureau of Health Planning
and Resources Development
Division of Planning Methods and Technology
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DHEW Publication No. (HRA)76-14512

Foreword

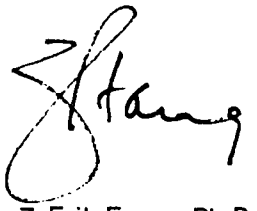
The purpose of this monograph is to describe and evaluate various methods used to determine present and future health manpower supply and requirements. The methodologies presented were chosen after a review of the documents identified in the Inventory of Health Manpower Planning Activities of 1973 in the Bureau of Health Manpower. Documents selected for their methodological content were then analyzed in detail. The authors also provided supplementary material by researching other references and information sources.

This monograph does not address the full range of methodologies that may be used in overall health manpower planning; rather, it is limited to the specific subject of estimating manpower supply and requirements. It deals only peripherally with related manpower issues that affect supply and requirements, such as labor productivity, task delegation, and geographic and specialty distribution.

The methodologies presented are practical and can be implemented with the resources available to state and local health planners. Theoretical or more complex methodologies commonly used at the national level have been deliberately excluded.

The monograph is presented in two volumes. The first volume provides an analytical perspective, the definition of terms, the factors that determine supply and requirements, the concepts that underlie each methodological approach, and the uses and limitations of health manpower statistics within the context of the subject area. The second volume is a practical manual that describes the methodology step-by-step, including questionnaire samples and selected tables for estimating health manpower supply and requirements.

It is hoped that this monograph will contribute to planners' understanding of the state of the art and to the improvement of health manpower planning.



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Preface

The National Health Planning Information Center, a component of the Division of Planning Methods and Technology, Bureau of Health Planning and Resources Development, is currently publishing two series of monographs on health planning.

The first series, of which this two-volume monograph is a part, involves health planning methods and technology. Future monographs will also include detailed descriptions of pragmatic methods developed and used by practicing health planners in a variety of locations and situations. The overall purpose is to provide health planners with suggestions for methods and procedures that can be adapted to their own health planning environment and experience.

The second series includes monographs on health planning information, as well as general and topical bibliographies of the health planning literature and reference works to current programs, to individuals, and to institutions involved in health planning.

Copies of all monographs published by the National Health Planning Information Center can be purchased from:

The National Technical Information Service
5285 Port Royal Road
Springfield, Virginia 22161

Acknowledgments

This second monograph, *Methodological Approaches for Determining Health Manpower Supply and Requirements*, was prepared by Robert R. Nathan Associates, Inc., of Washington, D.C. The monograph is presented in two volumes, *Analytical Perspective* (Volume I) and *Practical Planning Manual* (Volume II).

The report on which this monograph is based was originally entitled "Critical Review of Methodological Approaches Used To Determine Health Manpower Supply and Requirements." The report was funded under HRA Contract No. 230-75-0057.

The project team for Robert R. Nathan Associates was directed by Harriet M. Kriesberg. The report was written by Ms. Kriesberg, John Wu, Edward D. Hollander, and Joan Bow. Advice in the preparation of the report and review of the final manuscript were provided by an outside panel of practicing health planners. The panel consisted of Irene H. Butter of the School of Public Health, University of Michigan; Lewis Dars of the New Jersey Department of Higher Education; and Thomas L. Hall of the School of Public Health, University of North Carolina.

Mary C. McGuire of the Bureau of Health Planning and Resources Development, Health

Resources Administration, DHEW, served as project officer for the contract. The entire project was under the direction of Frank A. Morrone, Jr., of the Division of Planning Methods and Technology, DHEW. Jack Lass of Aspen Systems edited and revised the final manuscript prior to publication.

The authors express their deep appreciation and gratitude to all the above-mentioned persons and especially to Hyman K. Schonfeld of the National Research Council. Mr. Schonfeld kindly volunteered to review the sections of the monograph that dealt with the health needs approach. While acknowledging their indebtedness to all of the contributors who made this monograph possible, the authors wish to assume full responsibility for any deficiencies in the contents.

CONTENTS

PRACTICAL PLANNING MANUAL

I. General Description of Methodologies Used

Introduction

Unplanned and unfocused studies of health manpower requirements and supply yield a meaningless collection of statistics. The relevancy of the study findings and of the policy conclusions is a reflection of the attention paid initially to defining the objectives of the study in the light of the problems that need to be addressed.

While all manpower studies are intended to reduce uncertainty and error, the overall objectives of estimating requirements and supply may vary from the comprehensive to the specific, the immediate to the long run, the ideal to the practical. For example, manpower studies may be undertaken to provide input to a health systems plan, identifying "the number, type and location of the area's health resources";[1] to estimate the impact of changing population on manpower requirements; to identify the number and type of health manpower needed to implement a new health program, to review and comment on the certificate-of-need applications.

No one study or general data base will satisfactorily answer the range of issues that face the

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1 P.L. 93-641, Sec. 1513(b)(D).

health planner, nor will he be able to start *de novo* with every problem to which he must respond. The planner must become adept at analyzing the problem and data requirements; identifying relevant information; integrating, distilling and improvising to provide the necessary inputs for his study; and manipulating the statistics in a logical, rational fashion to produce reliable estimates.

The state-of-the-art at present requires that the planner rely on reasonable assumptions for a number of important variables in his estimating process because no precise figures are available. Issues such as labor productivity and price elasticity of demand are critical but have not been satisfactorily measured. As a result, any estimate of supply and requirements must be viewed with reservations, no matter how skillfully derived or ingeniously executed. All estimates at some point rely on informed judgment and therefore represent an approximation of reality.

Analytical Framework for Manpower Studies

All manpower studies, whether of requirements or supply, have an analytical framework that outlines the steps to be followed. Logically, one would proceed in the following fashion:

1. Clearly define the problem and underlying issues and policy choices. The study findings should enhance the planner's understanding of the nature of the manpower problems in his area.

2. Define the manpower to be measured — doctors, medical laboratory personnel, all allied health workers, health-related workers. The manpower classification scheme must relate to the problem the planner is addressing. If, for example, the problem concerns a new clinic to house an alcoholic, drug abuse or mental health program, then psychiatrists, psychologists and social workers are the appropriate group to study, while, if this program deals with a massive inoculation effort of the type undertaken when the polio vaccine was introduced, primary care physicians and nurses are the indicated occupations.

When one is deciding upon the manpower that is to be measured, the interrelatedness of the job content of health care workers must be kept in mind. Doctors and dentists have historically been the core independent occupation in the health industry, with nurses as their dependent assistants. Today, the proliferation of specialties and occupations has created an increasingly complex relationship of complementarity and substitutability among health occupations.

3. Determine the relevant labor market and medical service area of the study. In most studies, the fact that data are available by geographic boundaries based on political subdivision or the census definition of standard metropolitan statistical areas has determined the area of study. The National Health Planning and Resources Development Act of 1974 calls for the establishment of health service areas (HSA's) "appropriate for the effective planning and development of health services . . . coordinated with the boundaries of areas designated . . . for professional standards review organizations, existing regional planning areas, and state planning and administrative areas."[2]

4. Determine the relevant time period. The target date may be the present or anywhere from one to several years in the future. The length of training time may vary, according to the profession and skill level, from one to 11 years after high school. The starting date of a new program that will alter consumer demand or the scheduled opening of a major facility that will need to be staffed may be other considerations. The relevant time period is determined by the problem addressed, taking into account the time required to produce the types of health manpower under study. In general the longer the projection period, the less reliable the estimate.

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2. P.L. 93-641, Sec. 1511. See Chapter II of Volume I for a discussion of the concepts of relevant labor market and appropriate health service area.

5. Formulate the assumptions regarding the future in terms of the total environment. The planner must envision the size and demographic characteristics of the population; general economic conditions, especially gross national product; number of persons in the labor force and the unemployment rate; and changes that will occur in the delivery system to create a more coherent structure and to adapt to the comprehensive care financing of a National Health Insurance program. Whatever the assumptions are, they should be made in as precise terms as possible and should be explicitly presented in the report. Failure to do so may lead to misinterpretation and misuse of the study findings.

6. Identify the precise information needed and investigate the availability of secondary data. Distinguish the essential from the optional data requirements, recognizing that the differentiation is based on the problem definition and the methodology used. The data search may produce information not previously known and thus lead to a reformulation of the problem, the assumptions and the data requirements. Secondary data are sometimes inconsistent or noncomparable; the planner must decide on the techniques to be used to overcome these difficulties. If, for example, the historical record is based on several time series that are not continuous, the coverage and definitions underlying each series should be studied to determine how to link them. The use of secondary data typically saves time and cost, but it requires careful scrutiny and at times laborious adjustments. When secondary data do not exist, proxy measures that can be used in their stead should be sought.[1] If secondary or proxy data are not available, and the data are essential for the study, primary data collection is necessary. In that case, identify the sources of information and the appropriate respondent

[1] See the discussion of proxy measures in Chapter II, and the data that may be useful as proxy measures in Appendix B

7. Select the methodological techniques to be used for collecting primary data and for statistical analysis. No one technique can be recommended across the board. The planning agency must consider the advantages and disadvantages of the alternative methodologies that are described in detail in Chapters III and IV and the resources at the planner's disposal.

8. "As a general principle, any means of alternative independent projection is worth pursuing as a check against the systematic projections and to get some sense of the range of error in the latter. Many cross-checks should be built into the system itself . . . ."[4] All statistical computations should be checked at least once, preferably by someone other than the person who originally computed them. Whenever possible, prepare estimates using more than one methodology. Try for a range of estimates, not a single statistic, by adopting several sets of assumptions to learn how they affect the projections of supply and requirements and to make the study results more useful. Evaluate the accuracy of the results. Measure the reliability of the estimate statistically. Validate the estimates, if possible, by comparing them with other independently obtained figures.

The General Classification of Types of Studies

Census Survey of Target Population[5]

A census is a complete enumeration of a population. The principal steps in the planning and execution of a census are:

1. State the objectives of the census as clearly as possible. It is easy to forget them when one is

4 Goldstein, Harold M., "Methods of projecting supply and demand in high level occupations." Paper presented at the Annual Convention of the American Statistical Association, Philadelphia, September 8, 1965. Washington, D.C.: American Statistical Association, 1965.

5 This section on census and sample surveys draws on and closely follows Cochran, William G., *Sampling Techniques*, 2nd ed., pp. 1-2, 5-8, 10-11, 72-73. New York: John Wiley & Sons, Inc., 1963.

engrossed in details, and then to make decisions that thwart the objectives.

2. Define the population about which information is wanted: the target population (for example; physician health manpower in the United States: health manpower providing primary care in a city). The definition of the target population may present no problems, but borderline cases may arise. It is best, therefore, to define practically who is and who is not a member of the population. The definition must be usable in practice: the enumerator must be able to decide in the field, without much hesitation, whether a doubtful case belongs to the population; a respondent must be able to comprehend who is to be included in his response.

3. Pin down the data to be collected by designing the plan of analysis. One must be sure to gather all the data relevant to the objectives of the census and necessary for the analysis; no essential data should be omitted. However, one must guard against asking for more information than is needed. The longer the questionnaire, the more likely are errors and omissions; and the quality of answers to important as well as unimportant questions may be lowered.

4. Determine the methods of measurement. There may be a choice of measuring instruments and of methods of approach. For instance, data about a person's health may be obtained from statements that he makes or from a medical examination. The survey may employ a self-administered questionnaire; an interviewer who reads a standard set of questions without deviation; or an interviewing process that allows the interviewer to probe as much as he thinks necessary. The approach may be by mail, by telephone, by personal visit or by a combination of the three. Preliminary to the taking of the census, the construction of questionnaires or record forms on which the questions appear and on which answers are to be entered should receive major

attention. With simple questionnaires, the answers can often be precoded and later routinely transferred to mechanical equipment. For the construction of good record forms, it is necessary to visualize the final summary tables that will be used for the analysis.

5. Pretest the measuring instrument and the method of approach. It has been found useful to try out the questionnaire and the field methods on a small scale. Such a trial nearly always results in improvements and may reveal unsuspected trouble spots. For example, one may find that the cost will be much greater than expected, that a question is ambiguous, that the ordering of questions is difficult for the respondent to follow, and so on.

6. Organize the field work. In a major census there are many problems of administration. Personnel must receive training in objectives of the survey and in the methods of measurement to be employed and must be adequately supervised. It is invaluable to introduce a procedure for early checking of the quality of the returns. Plans must be made for handling nonresponse.

7. Summarize and analyze the data. The completed questionnaires have to be thoroughly edited to amend recording errors, to delete data that are obviously wrong and to follow up for nonresponses. Tabulations, which lead to the estimates, are then performed. Different methods of estimation may be available. Data from a census should cover all the units of the target population and should be comparable over time and space.

Sample Survey

Administrators, often familiar with censuses, are inclined to be suspicious of samples and reluctant to use them in place of censuses. Although this attitude is now less prevalent, it may be useful to list the principal advantages of sampling as compared with complete enumeration. Briefly, these are reduced costs, greater speed, greater scope, and greater accuracy. If data

are secured from only a small fraction of the population. the cost is bound to be smaller than if a complete census is attempted. For the same reason. the data can be collected and summarized more quickly with the sample than with a complete count. If highly trained personnel or specialized equipment must be used to obtain the data. samples may be practicable and a complete census may be out of the question. A sample may actually produce more accurate results than will a complete enumeration. Higher quality personnel. reduced workloads. more careful supervision of the field work. and quicker processing of results become feasible in a sample survey.

Many of the principal steps in the conduct of a census are repeated in the conduct of a sample:

1. A clear statement of objectives is necessary.

2. The target population must be defined. The population to be sampled should coincide with the target population. Sometimes, however, it happens that the sampled population has to be more restricted than the target population. If so, it should be remembered that conclusions drawn from the sample apply to the sampled population. Judgment about the extent to which these conclusions will also apply to the target population must depend on other sources of information.

3. One must verify that all the data are relevant to the objectives of the sample survey and that no essential data are omitted.

4. At this juncture, one takes a step that was not required in planning a census: the specification of the degree of precision wanted in the results. The results of sample surveys are subject to some uncertainty because only part of the population is being measured. Uncertainty can be reduced by larger samples, but these cost either more time, more money or both. The specification of the degree of precision is the responsibility of the person who is going to use the data. Many administrators are unaccustomed to thinking in terms of the amount of error in estimates that is

consistent with making sound decisions; someone with a knowledge of statistics can often help.

5. As in the conduct of censuses, there may be a choice of measuring instruments and of methods of approach to the population: self-administered questionnaire vs. interview; mail vs. telephone contact, and so on.

6. Next, one must take another principal step that does not occur in a census: before the sample is selected, the population must be divided into parts that are called sampling units. These units must cover the whole of the population, and they must not overlap, in the sense that every element in the population belongs to one and only one unit. Sometimes the appropriate unit is obvious; at other times there is a choice of unit. In a sample of hospital employees, the unit is the hospital; for physicians statewide, the unit might be the county medical society. The construction of this list of units is called a frame. It is often one of the major practical problems of a sample survey.

7. A sample may be drawn in a variety of ways. One can select haphazardly, call for volunteers, or select by simply using one's judgment. Under the right conditions any of these methods can give useful results, but the difficulties are that one has no basis for correcting for bias or for specifying the confidence limits of the estimate. To be able to do this, one must use probability sampling designs: simple random sampling, stratified random sampling, systematic sampling, cluster sampling, double sampling, or any of numerous other strategies.

8. In the planning of a sample survey, a decision must be made about the size of the sample. This decision is important. Too large a sample means a waste of resources, and too small a sample diminishes the utility of the results. The principal steps involved in the choice of the sample size (n) are as follows:

   a. Keeping in mind the significance of the estimate for the planner's use and the objec-

tives of the study, one must find some equation which connects (n) with the desired precision of the sample. The equation will depend on the content of the statement of precision and on the sampling plan. One of the advantages of probability sampling is that it enables this equation to be constructed.

b. The equation will contain as parameters certain unknown properties of the population. These must be estimated in order to solve the equation.

c. Data are often published for certain major subdivisions of the population. Desired limits of error are set up for each subdivision. A separate calculation is made for the size of sample (n) in each subdivision, and the total (n) is found by addition.

d. More than one characteristic is usually measured in a sample survey. If a desired degree of precision is prescribed for each of them, the calculations could lead to a series of conflicting values of (n), one for each item. Some method of reconciliation must be found.

e. Finally, the chosen (n) must be appraised to see if the resources are available to take a sample of this size. This appraisal requires an estimation of all the costs, labor, time and materials required.

9. All of the remaining steps of the sample survey are familiar from the census: the pretest, the organization of the field work, and the tabulation and analysis of the data.

Economic Model Building [6]

The prospective builder of economic models must be able to spot persistent relationships (correlations) among relevant variables and to identify

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6. The discussion is based on Lowry, Ira S., "A short course in model design," (in) Berry, B.J.L. and Marble, D.F. eds., *Spatial Analysis*, pp. 53-64. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1968. The article is addressed to urban planners; however, the main steps apply to health manpower planners as well.

An excellent introduction to mathematical model building is Beach, E.F., *Economic Models: An Exposition*. New York: John

causal sequences. Then he must write in mathematical notation a logical framework within which the variables of interest, the dependent or endogenous variables, stand at the end of a causal sequence, and the prime causes, the independent or exogenous variables, are at the other end. For instance, $y = f(x, z)$; y, the dependent variable, is a function of x and z, the independent variables; $a = f(r, s, t)$; a, another dependent variable, is a function of r,s,t, other independent variables; and so on. The logical framework may include dozens of equations; at this point, the model builder borrows from the theorist.

Although "theory" and "model" are often used interchangeably, a distinction can be drawn. The theorist's overriding aims are logical coherence and generality. He is ordinarily content to specify only the conceptual significance of his variables and the general form of their functional interrelationships. The theorist derives interesting and empirically relevant propositions from the smallest set of postulates possible.

The model builder is interested in the application of a theory to a concrete case. He is constrained, as the theorist is not, by considerations of cost, of data availability and accuracy, and of time. Above all, he is required to be explicit, where the theorist is vague. Things that "succeed," however mysteriously, get substituted for the theorist's elegant constructs.

The theoretical "borrowings" of the model builder are clearest from the set of structural relations he chooses as the framework of his model. An articulated model will consist of a set of propositions of the general form, $y = f(x,z \ldots)$. These propositions include all the variables in which the model builder is interested and specify the ways in which variables act upon one another.

Wiley & Sons, Inc., 1957. Another excellent book for the fitting of both single equation and simultaneous equation models is Johnston, J., *Econometric Methods*, 2nd ed. New York: McGraw-Hill Company, 1972. This is very much a teaching text; however, it assumes an introduction to statistics.

Propositions can be classified in terms of their content as technological, institutional, behavioral, or accounting. This is always useful for models relating to policy issues. The model builder is bound by rules of consistency (there can be no contradictory propositions) and coherence (there must be as many independent propositions as there are variables). Within these rules the expert model builder has a wide leeway.

The theorist is satisfied with the general forms shown above, or with these forms plus a few constraints and restrictions. The model builder must be much more explicit, specifying the exact functional forms of his structural relations; for example, $y = a + bx + c\ (1/z)$. He must also fit his variables *(x,z)* and parameters *(a,b,c)* from empirical sources.

Once the model builder has settled on a theoretical perspective, designed a logical framework, and postulated the existence of enough empirical relationships to permit an attack on his problem, his next task is to "fit" the model. This task means (1) giving the variables mentioned in the model precise empirical definition, and (2) furnishing numerical values for the model's parameters. A variable conceived in general terms must be related to an available statistic. Often a variable included in the model because of its theoretical significance may not be directly observable in the real world; so, a suitable proxy must be chosen.

If the model can be formulated as a set of simultaneous linear equations, "econometric" methods can be used to find values for all parameters of the model. Alternatives to an econometric fit can be described generally as "heuristic" methods. For example, the model is partitioned into smaller systems of equations — some containing perhaps a single parameter — so that the parameters of each subsystem can be fitted independently. Methods of obtaining estimates of the various parameters in these subsystems may vary considerably. A model ordinarily contains parameters whose function is nominal, and a

model builder may simply assign an arbitrary but plausible value to such a parameter. Trial and error methods can be used to find a set of parametric values which seem to work. Finally, model builders sometimes resort to "human" parameters. At the appropriate point in the operation of the model, intermediate or preliminary results are scanned by persons with the necessary expertise who are asked to alter these outputs based on their experience in the field; the altered data are then fed back to the computer for further processing.

Fitting a model is like the manufacture and assembly of a new piece of machinery. A team, guided by engineering drawings, shapes each component and installs it in proper relation to other components. Along the way considerable redesign, tinkering and adjustment of parts are done; but eventually the prototype is completed. Still a question remains about the prototype (model): Will it really work? Will the computed manpower predictions be plausible by intuitive standards? It is important to realize that it is extremely difficult to establish clear and objective standards for the results of a model.

In conclusion, in the process of model building the participants invariably find their understanding increased. The necessity of framing questions carefully does much to dispel the fog of sloppy thinking.[7]

Data Analysis[8]

Much statistical analysis is done with the aid of only a few very simple measures as described below.

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7 A description and inventory of 56 health manpower models are available in U.S. Department of Health, Education, and Welfare, Bureau of Health Resources Development, *An Analysis of Health Manpower Models*, 2 vols. Rockville, Md.: U.S Department of Health, Education, and Welfare, 1974.

8. U.S. Department of Labor, Manpower Administration, *Handbook for Manpower Planners. A Census Use Study*, Part I pp. 84-85. Prepared by the U.S. Department of Labor and the

MEAN: represents an average of a set of data calculated by dividing the sum of all data in a set by the number of data items in the set. For example, if your children had ages of 3, 5, 6 and 8, then the average or mean age is

$$\frac{3 + 5 + 6 + 8}{4} = \frac{22}{4} = 5.5$$

MEDIAN: represents the middle value of a set of data. If the set contains an odd number of data items, the median is equal to the central data item. But, if the set contains an even number of data items, the median is equal to the average of the two central data items. For example, if five children had ages of 4, 5, 7, 8 and 10, then the median age is 7; if four children had ages of 4, 5, 7 and 10, then the median age is 6.

MODE: represents the most frequently occurring value in a set of data. For example, 20 is the mode for the following set of data; 20, 40, 10, 15, 20 and 20.

RATIO: expresses the size of one number in relation to another number. A ratio is obtained by dividing the number which serves as the basis of comparison into the number which is being compared to it. For example, 140 is twice as large as 70; thus the ratio of 140 to 70 is 2. Likewise, 70 is one-half the size of 140; thus the ratio of 70 to 140 is 0.5.

PROPORTION: a ratio in which the size of one number is compared to the size of a total number. For example, if the rural population of an area is 30,000 and the urban population is 10,000, then the proportion of the total population which is rural is 0.75 or 30,000/(30,000

U.S. Department of Commerce, Social and Economic Statistics Administration. Washington, D.C.: U.S. Government Printing Office. 1973.

+ 10,000) = 0.75. Proportions are usually multiplied by 100 and expressed as percentages (e.g., the rural population is 75 percent of the total population).

RATE: a ratio of one thing to another in a specified period of time. In calculating a rate, the numerator is the number of events which occurred during an even period and the denominator is the population in which the events occurred. For example, if the number of unemployed persons in a town is 225 and the labor force is 5,175, then the unemployment rate is (225/5,175) x 100 = 4.3 percent.

Measures of the Reliability of the Estimate

No method or equation (no matter how good) for estimating the values of a variable will produce correct estimates every time. If, on the whole, the estimates are close to the actual values of the variable, the method of estimation is thought to be a good one. A means for measuring the reliability of such estimates (i.e., how "good" the estimates are overall) is necessary. The standard error of estimate is such a measure of reliability. It is not a measure of how "wrong" our estimates are. Rather, it is a measure of the difference between the actual values of the variable and the corresponding estimated (or computed) values. As such, it gives an idea of the dependability of the estimate overall. The greater the divergence between actual values and estimated values, the greater is the standard error. A single actual value can be compared with its estimate to determine if it is within ± 1, ± 2 or ± 3 standard error of the estimate. About two-thirds of the actual values will fall within ± 1 standard error of the estimated values, about 95 percent within ± 2 standard error, and practically all within ± 3 standard error.

The Chi-square (X^2) is another measure of reliability, used most frequently in manpower studies to determine if there is reason to believe that the particular classifications (groups) involved in a portion of the study are homogeneous with re-

spect to some particular characteristic. For example, suppose we compare the incidence of a particular disease, during some time period, on persons of four different age groups. We would like some way of ascertaining whether the differences in the incidence of the disease between age groups might be significant or accidental. If the incidence is attributable merely to chance, we could classify all four into one age group. The X^2 test tells the probability that these differences are due to chance. The hypothesis that the four groups are homogeneous with respect to the incidence of this disease can be accepted or rejected in light of the size of the probability and the importance of not making an error (i.e., rejecting a true hypothesis or vice versa).

The Chi-square test has other applications in manpower studies. The X^2 test may be used, for example, in sampling to test for significant differences between the sample variance and the population variance or between two sample variances.[9]

The t-test is another way of testing the reliability of an estimate. It indicates whether, at a particular level of significance, there is sufficient reason to believe that one variable can be explained by (or is dependent upon) another variable.

Any statistical test has meaning only with respect to the specific level of significance under which it is performed. The level of significance controls the stringency of the test. For example, suppose a t-test is performed to determine if there is reason to believe that the dependent variable

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9 Information on general statistical measures and methods is available in standard statistics textbooks, such as Croxton, F.E., Cowden, D.J. and Klein, S., *Applied General Statistics* Englewood Cliffs, N.J. Prentice-Hall, Inc., 1967. For a discussion of econometric methods, see Johnston, J., *Econometric Methods*, 2nd ed. New York: McGraw-Hill Company, 1972. Applied statistical methods for manpower forecasting are presented in Morton, J.E., "On manpower forecasting," (in) *Methods for Manpower Analysis*, No. 2. Kalamazoo, Mich:W.E. Upjohn Institute for Employment Research, September 1968.

(e.g., manpower supply) can be explained by an independent variable (e.g., wage level or training slots). The hypothesis assumed for the purpose of the test is that no such relationship exists. If the test is performed at a five percent level of significance, five out of 100 true hypotheses would be rejected in the long run; at a one percent level of significance, only one out of 100 true hypotheses would be rejected in the long run. The purpose of the test and the use to which its results are to be put must be considered when determining how high a level of significance is necessary.

The t-test can also be used to determine at what level of significance there is reason to believe that one variable can indeed be explained by another variable. Perhaps at a one percent level of significance, this relationship does not seem to hold, but if we are willing to accept a five percent level of significance, perhaps such a relationship does seem reasonable.

Estimating Procedures

A variety of methods of analysis may be used for estimating. Among these procedures are trend analysis based on time series, regression and correlation analysis.

Trend Analysis Based on Time Series

A time series is a set of chronological data which records the change in the size of some variable at successive time intervals (yearly, quarterly, monthly, etc.). Several time series are of interest in health manpower studies: for example, numbers of graduates of medical schools; personal income data; population size for a particular state or region. Most time series follow some kind of pattern as they change in the long run. The pattern is called a trend. Trend analysis is important to projections since past trends can be expected to continue or to change in a predictable fashion, barring unforeseen events.

There are two important reasons for looking at time series. One is merely to observe how a variable has changed over time and whether it has deviated from the trend. Such observations may

assist the planner in formulating his assumptions regarding the future. Second, it may be necessary to quantify the trend itself and attempt to project it into the future. It is sufficient for the first purpose to collect time series data, graph them, and observe the general characteristics of the trend. If, however, the object is to project the future, a mathematical formula is needed to express the nature of the trend precisely.

Trend analysis proceeds in a sequence that begins with data collection and ends with a fitted trend line and estimating equation:

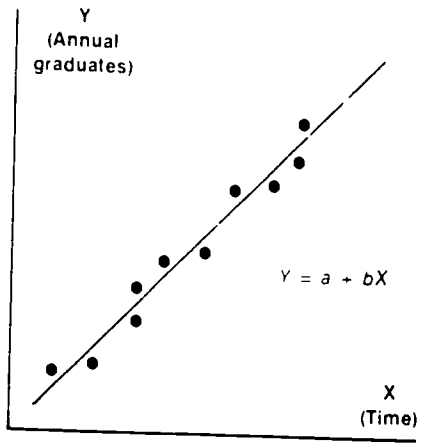
Step 1 in trend analysis is the collection of chronological data (time series) for the desired variables. Care must be exercised with regard to the nature and quality of the data.

Step 2 is to plot the data collected for a single variable on graph paper. The resulting set of points is called a scatter diagram (see Fig. 1). The approximate shape of the curve formed by the time series can usually be determined from the scatter diagram by inspection.

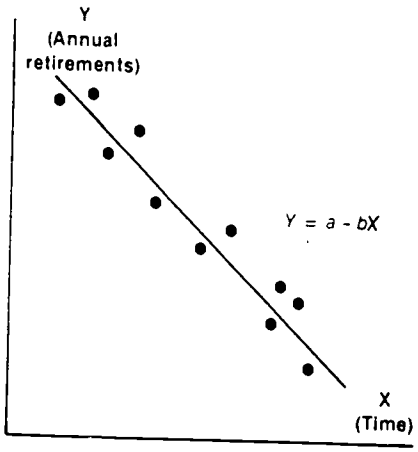
Scatter diagrams in A and B of Fig. 1 show straight line trends; they are said to form "linear curves." The linear curve in A of Fig. 1 shows that the number of annual graduates has been increasing by a constant amount each year. The linear curve in B of Fig. 1 shows that the number of annual retirements has been decreasing by a constant amount each year. The scatter diagram in C of Fig. 1 shows that population has been increasing over time, but the time series does not form a straight-line trend. The exponential trend curve, $Y = ab^X$, shown in C of Fig. 1, seems to fit the scatter diagram better than a straight-line curve because population has been growing at (approximately) a constant rate, not by a constant amount.

Step 3 is to "fit the curve" with a mathematical equation once it has been determined from the scatter diagram how the trend can best be approximated. The method of least squares is most fre-

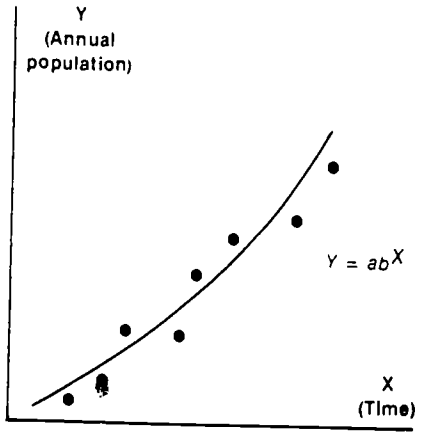
Fig. 1. Sample Scatter Diagrams



A



B



C

quently used to do this, when a straight line is a good fit. This method produces $Y = a + bX$ where Y is the variable to be estimated, X is time, a and b are constants. The method of least squares is said to yield the closest fit of a line to the actual values, since it provides an equation such that the sum of the squared difference between the true values of Y and the estimated values of Y is minimized. With values for a and b determined by the least squares method, the value of Y, the dependent variable, can be estimated when values are assigned to X, the independent variable. The time series trend equation estimates how the dependent variable, Y, has changed over time. Thus, the independent variable, X, is always time.

As we have seen, not all scatter diagrams of time series approximate straight lines. They may form many different kinds of series curves that can be expressed in terms of mathematical equations. Trend fitting is tailored to the form of curve that is described by the data.

Regression Analysis

Trend analysis is actually a specific form of regression analysis. Regression analysis involves the formulation of an estimating or regression equation which describes the relationship between two or more variables, thus making it possible to estimate one variable based on another.

In regression analysis, the variables have a special relationship to each other. The variable to be estimated, Y, is called the dependent (or explained) variable (as in time series trend analysis). The independent (or explanatory) variable is the one used as the basis for estimation; it is thought of as a determinant of the dependent variable. The main difference between trend analysis and regression analysis lies not in the method of analysis used, but in the fact that the independent variable in regression analysis may be any quantity (not just time) which seems to be closely related to the dependent variable. There is often more than one independent (explanatory) variable per

regression equation. Table 1 gives examples of the relationship between variables that might be used in a regression analysis.

Table 1. Examples of Relationships Between Dependent and Independent Variables

Regression	Dependent variable	Independent variable
I	Y = expenditures for physician, dental and hospital services	X_1 = family income X_2 = size of family X_3 = type of health insurance coverage X_4 = degree of urbanization X_5 = number of families covered by Medicaid (zero price services available)
II	Y = service utilization rate	X_1 = age of population X_2 = sex of population X_3 = race of population
III	Y = labor force participation rates of females	X_1 = ages of children X_2 = husband's income

A problem arises in using regression analysis in health manpower studies since many of the independent variables (e.g., family income, size, race) are interrelated and the effect of this interrelationship reduces the accuracy of the estimates of the dependent variables.

The basic steps undertaken in trend analysis are applicable in regression analysis as well. A scatter diagram, a pictorial representation of the nature of the relationship between two variables, is prepared. The simplest relationship that can exist between two sets of variables is a linear

relationship; when this is the case, their scatter diagram approximates a straight line. The equation of such a straight line is $Y = a + bX$, where Y is the dependent (explained) variable, X is the independent (explanatory) variable, and a and b are constants (as in trend analysis). The straight line which is the "best" fit for a scatter diagram is called the regression line (simple regression line), and its equation is called a simple linear regression equation. This equation is usually found by the use of the least squares method, as in trend analysis.

If there is more than one independent variable, the linear relationship can be described by a multiple linear regression equation of the form

$$Y = a + b_1 X_1 + b_2 X_2 + \ldots b_n X_n$$

where:

$$X_1, X_2, \ldots X_n$$

are the independent variables. Again, the method of least squares is recommended for estimating the values of the constants

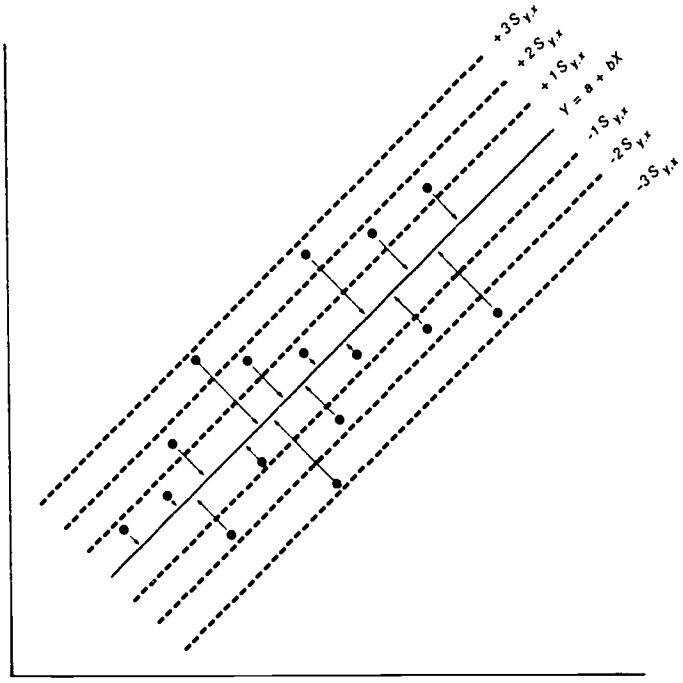
$$a, b_1, b_2, \ldots b_n.$$

As in the case of trend analysis, not all relationships between variables are linear. Techniques exist for determining nonlinear regression equations.

The reliability of the estimating (regression equation) needs to be tested to get some idea of the "goodness" of the fit of the regression line to the actual values plotted in the scatter diagram (see Fig. 2). The standard error of estimate (Symbol $S_{Y,X}$) may be used. In regression analysis, the value of the standard error of estimate represents the magnitude of the dispersion of observations around the estimated regression line. It gives an indication of the amount of dispersion in the dependent variable, Y, which the re-

gression line does not account for, and there is a measure of the reliability of the regression equation to estimate Y. The basis of the standard error estimate is the difference between each actual value of Y and the corresponding estimated value of Y. The greater the divergence between actual values and estimated values, the greater is the standard error of estimate. The reliability of any one specific estimate is given by how far the regression line lies in terms of $S_{y,x}$, i.e., within $\pm 1 S_{y,x}$, $\pm 2 S_{y,x}$, $\pm 3 S_{y,x}$.

Fig. 2. Scatter Diagram Showing Standard Error of Estimate



Correlation Analysis

Correlation analysis is closely related to regression analysis as well as to measures of reliability of estimation, such as the standard error of estimate. Correlation analysis involves measuring the adequacy of the estimating equation in explaining the dependent variable. As such it is another type of test as to the reliability of the estimating equa-

tion. It has the advantage of being independent of the units of the original data, and it can be applied to simple and multiple linear regression equations and to nonlinear estimating equations as well.

All of the variability in the values of the dependent variable, *Y*, is measured by the sum of the squares of the deviations of the *Y* values from their mean.[10] Part of this variation is explained by the regression line. The rest of the variation is left unexplained by the regression line. The coefficient of determination, R^2, measures the proportion of the total variation in the dependent variable that is explained by the use of the regression equation. For example, if $R^2 = 0.857$, the regression equation used explained 85.7 percent of the total variation in the dependent variable, *Y*. If $R^2 = 0.325$, only 32.5 percent of the total variation of *Y* has been explained.

The coefficient correlation, *R*, is the square root of the coefficient of determination. The correlation coefficient varies from -1 through 0 to +1. The + sign indicates a positive relationship; i.e., as *X* increases, *Y* decreases. The sign of *R* can thus be determined from the scatter diagram directly. The absolute size of the correlation coefficient indicates roughly the degree of the relationship. When there is no relationship whatsoever, the correlation coefficient (*R*) is 0. An absolute value of 1 (+1 or -1) indicates the strongest relationship possible (i.e., the points of the scatter diagram lie on a regression line).

As has been mentioned earlier, the t-test, a test for reliability of an estimate, is used to determine whether at a specific level of significance there is reason to believe that one variable can be explained by one or more other variables. Specific to correlation analysis, the t-test can be performed to answer such questions as: Does the value of *R* differ significantly from zero? Does the value of *R*

10. Total variation $= \Sigma(Y - \bar{Y})^2$ where *Y* is the dependent variable and $\bar{Y}$ is the mean of the values of the dependent variable.

differ significantly from a specified value other than R? Do two values of R differ significantly from each other? When dealing with nonlinear curves, the t-test could be used to test whether the nonlinear coefficient of determination, R^2, is significantly larger than a coefficient based on a linear equation. This would give an indication as to whether the nonlinear regression equation is really a better estimating equation for the dependent variable, Y, than a linear regression equation would be.

Sensitivity Analysis

Sensitivity analysis is an important intermediary step between the supply and requirements estimates and the planner's decision on alternative policies or programs. It permits an appraisal of the estimate and of the procedures used in a special way. By means of a sensitivity analysis, the planner can learn how responsive his final estimate is to changes in particular variables, the seriousness of possible errors in any variable upon the estimate and what impact alternative policies under consideration may have on projected supply and requirements.[11]

Sensitivity analysis involves three major steps: The first is to select those input variables and their adjusted values that are to be used in the sensitivity analysis; the second is to decide on the criteria for the degree of change that will be considered high, low or moderate sensitivity; and the third is to measure the amount of change in the final estimate that results from a change in input variable. Specifically, the planner applies his methodological approach several times, each time varying one variable while holding all others constant, and each time recording the effect of this variation on the final estimate of requirements or supply.

The selection of the variables to be used may be made to test alternative proposed policies, the

11. Sensitivity analysis is similar in concept to the idea of elasticity of supply and demand.

implications of assumptions or the effect of data adjustments. The degree of change that will be considered "sensitive" may be some percentage, such as ± 10 percent, of the original final estimate. The measurement of the amount of change is done, as we have said, by varying one input only and calculating the final estimate. If the outcome is a change in the final estimate within the selected ± 10 percent, we have an estimate that is not sensitive to this variable; if greater than ± 10 percent, the estimate is considered sensitive.

Having performed a sensitivity analysis, the planner is better equipped to interpret the results of his methodological approach and to make a more thoughtful policy recommendation. For example, let us assume that the planner has projected the supply of primary care physicians in 1980 and has decided to do a sensitivity test on the effect of first-year enrollment in medical schools. The results of the test are that the final supply estimate is insensitive to changes in the size of the first-year class in medical schools. The planner then decides that increasing the number of schools or the size of classes is unlikely to produce the desired result: an increased supply of primary care physicians. A more detailed, step-by-step example of a sensitivity analysis is carried out in Chapter III in the description of the service targets approach.

The Delphi Method: Eliciting the Opinions of Experts[12]

At some point in all studies of supply and requirements, the planner falls back on expert opinion. The use of professional judgment may be an explicit element in the methodological design, or

12. For further information, refer to Brown, Bernice B., *Delphi Process: A Methodology Used for the Elicitation of Opinions of Experts*. California: The Rand Corporation, 1968; Dalkey, N.C., *Predicting the Future*. California: The Rand Corporation, 1968; idem, *The Delphi Method: An Experimental Study of Group Opinion*. California: The Rand Corporation, 1969; and Reicher Nicholas, *Delphi and Values*. NTIS Pub. No. AD693002. Springfield, Va.: National Technical Information Service. 1969.

it may be an alternative of last resort. In measuring present requirements, the manpower/population ratio and health needs approach direct the planner to experts for their judgment of the appropriate standard. The service target and economic demand methods require inputs on such factors as manpower staffing and productivity, for which no measurement may be available; in such cases, the planner should turn to the experts. The same situation may be faced in the measurement of supply; data gaps will probably exist for significant aspects of current and future supply.

Since all projections of supply and requirements incorporate assumptions about the future, the planner may seek the help of experts in formulating them. The assumptions underlying all projections are based upon judgments of the future and, as we have pointed out, the validity of the projections reflect how accurately the assumptions describe the future. The Delphi method was developed by the Rand Corporation for the express purpose of using the intuitive judgments of professionals and developing a consensus about the future.

The Delphi approach enlists the participation of a panel of experts in a structured program of mail interviews which involves a round of questionnaires, accompanied after the initial response by feedback on the views of the experts in the panel. Each succeeding round permits the individual expert to alter his views to come within closer range of other opinions or to explain the rationale behind his divergent opinion. A minimum of three rounds is needed. The interviews are conducted by mail and at no time are the panelists brought face-to-face.

Several assumptions are implicit in the Delphi method: First, that the views of a group are superior to that of any single advisor; second, that the Delphi procedure of group exchange by eliciting separate answers and explanations and feeding back anonymous responses is better than committee meetings with the likelihood of unfavorable

face-to-face interactions; and third, that the opinions of experts will converge with repeated assessment and exchange of views around a central value.

The following steps should be followed in the Delphi method:

Step 1. Select your experts with care and limit the number according to the time and money available for the design, distribution and analysis of the series of questionnaires. A Delphi panel may be as few as six or more than a hundred. Request their participation in the Delphi panel, explaining what will be required of them.

Step 2. Design the first-round questionnaire, requesting estimates of the future, if possible in numerical terms, e.g., the staffing pattern of physician assistants to physicians, by specialty — 0, 1, 2, and so on.

Step 3. Mail the questionnaire and ask for the response within a fixed period of time. Analyze the results of this first round; if numerical responses were feasible, compute median values and the interquartile range of responses.[13]

Step 4. The second-round questionnaire contains the questions asked in the first round plus the information obtained in the analysis of the first-round responses. Request that the panelist revise his earlier estimate in the light of the feedback information, if he so desires. Should his answer lie outside the interquartile range, ask him to explain and justify his estimate. Analyze the answers of the second round.

Step 5. The third round again feeds back to the panelists the median and interquartile values given in round two, plus the rationale of extreme positions. All feedback comments are anonymous. Again, the panelists are asked to reconsider their estimates, in the light of the additional

13. The interquartile range is the interval containing 50 percent of the responses.

information on the views of other members, and to revise their estimates if they would like. Explanations for extreme positions — that is, outside the interquartile range — are requested.

Step 6. The fourth and succeeding rounds repeat the process described above.

By means of the Delphi method the planner may elicit opinions of experts who are widely scattered geographically. It combines their different opinions and allows for an exchange of views. At the same time, it overcomes the inherent problems in conference interactions dominated by an overriding personality or a bandwagon effect. The process of interaction, with anonymous information feedback and estimate reassessment, produces a consensus that represents more thoughtful viewpoints.

Unfortunately, little is known of the validity of the Delphi results and whether the final estimates are in fact close to the truth. Nor do we know the size of the group or the number of rounds that is optimum. It is possible that the reasoning and justification fed back to the panelists may spread misinformation. In addition, the planner should be aware that he may be embarking on a project that could take weeks or months, depending upon his design and the cooperation of his panelists.

II. Operational Suggestions

Study Plan and Dry Run

In studies of manpower requirements and supply, as in other situations, one should keep in mind that haste makes waste. A study plan that sets down the work program in detail, that establishes a time schedule for each task and allocates costs within the framework of a budget, is invaluable. The time taken to prepare a study plan, including a work program, a time schedule and a budget, is well spent and brings rewards in the quality, timeliness and efficiency of the final product.

Another procedure that is worthwhile is a trial or dry run of the study. One "walks through" the phases of the study, stating the objectives, identifying data sources, structuring and filling in dummy tables, doing a sample of statistical computations. The objective is to identify the difficulties likely to be encountered and to face and resolve the problems in advance.

The dry run will serve multiple purposes. The result will be an improved plan of study that more realistically describes the tasks, time and cost of the effort. It will pinpoint the data gaps and incompatibilities. It should also make clear the technical problems that have to be met and alert the planner to call upon experts for technical assistance early in the study program. The dry run should help the planner assure himself that the allocated funds are sufficient to complete the study, and if not,

they should motivate him to modify his study objectives and procedures. Not least, the dry run will force the planner to think through his underlying assumptions, and the study will be immeasurably improved if the planner makes the assumptions explicit. It is wondrous, indeed, how many assumptions must be made during the course of a study and how invisible they become as the work proceeds, although they play a major role in the results and the proper interpretation of the study findings.

One more operational suggestion with regard to the underlying assumptions may be offered. The planner may improve the usefulness of the study if he considers at the start the policy implication of his findings and develops several sets of assumptions that will lead to a range of estimates. It may be particularly useful if the alternative assumptions illuminate the "sensitivity" of the results to differences in assumed values of variable factors, so that one may detect those elements in the situation to which particular attention must be paid. The program recommendations that result from the study findings will flow in part from the assumptions that underlie the estimates. The planner is in a position to build into his study the options on alternative manpower mixes, for example, and to clarify for program planners the import of these choices in terms of manpower requirements and supply.

Shortcut Techniques

Since time and cost constraints are among the biggest obstacles faced by the health planner, shortcut techniques should be considered as long as they do not compromise the usability of the results. The use of secondary data sources, for example, in lieu of collecting data from primary sources is both a time and cost saver. The planner should be a scavenger, acquiring, distilling, integrating and synthesizing bits and pieces of relevant information from everywhere, secure in the knowledge that the time and money he saves by

using secondary sources can be put to good use in other phases of the study.

In his search for secondary sources, the planner should be on the lookout for proxy measures. A proxy, by definition, acts for or serves in place of another. Proxy data therefore are substitutes for needed but unavailable statistics. Proxy measures may be specific to geography, time or subject matter; for example, national or state data in lieu of local area data; most recent available figures instead of current figures; variables of similar characteristics or behavior substituted for others more difficult to measure.

For example, in estimating manpower requirements, it is unlikely that the local planner will find area data on health care utilization by type of care and by population group, or data on income elasticity of demand or supply productivity, and so on. In the estimation of manpower supply, local area data for labor force separation rates or mortality rates are also unlikely to be available. In such cases, national or state data may be adopted or adapted, based on assumptions about comparability of the populations of the two areas. With regard to time discontinuities, the most recent data may possibly be used as a proxy, with due regard for the constancy over time of whatever is being measured. Proxies for subject matter variables, such as labor-force participation rates for nurses in lieu of labor-force participation rates for the occupation under study, may be available. When a planner uses proxy data, he should assure himself, as with any secondary source, of its quality and its applicability for his use.

When no secondary data exist, the planner must collect the data himself from respondents who have the information. His preference should be to undertake a sample survey rather than a census survey, since it is possible to draw a sample that will enable him to produce a final estimate of supply or requirements that will fall within the range of reliability that he specifies. There appears to be a reluctance among some health plan-

ners to use sampling and a strong bias in favor of the census approach. The planner should explore the alternatives carefully. While the census approach may appear to be more understandable, definitive and reliable, experience has shown that there are no guarantees that all respondents will be reached or will answer. If the planner has no rational basis for adjusting for nonrespondents, the census survey may not be more accurate than a sampling survey, only more costly. In both cases, the steps (aside from sample design and selection and the weighting of responses) are identical. But the size of the operation in a sample survey is a fraction of that of a census. In either case, technical expertise is needed.

If, for very good reasons, the decision is made in favor of a census, the wise planner incorporates a sample survey into the framework of the study as a safeguard and as a device to collect more detailed information from a select few. The universe study asks a few basic questions; the representative sample is subject to intensive questioning. A census study can bog down, taking longer or proving more difficult than anticipated. The sample within the census offers protection against a total loss that would result from a poor response.

One of the important initial decisions in the conduct of a survey is the identification of the proper type of respondent to provide the type of information sought: individuals, employing organizations, educational institutions, government agencies, and so on. Theoretically, one should address one's inquiry to the best-informed source. Practically, one should go to the respondent who can give the most information for the least cost. These two propositions lead to the conclusion that institutions and organizations are the preferred respondents; individuals, the second or third choice. However, the final decision must take into account the nature of the information sought. For example, data on personal characteristics — age, sex, address, educational attain-

ments — would appear to require the individual as respondent; however, the possibility that the licensing boards or certifying bodies would release this type of information should be explored first. It is to the planner's advantage to gather the information he needs, first, from secondary sources and, second, from as few knowledgeable respondents as possible.

In designing the study, the planner may find it helpful to divide the study plan into component subject areas: doctors, dentists, pharmacists, etc.; core practitioners and allied health personnel; workers in ambulatory and institutional care; nurses in hospitals, medical offices, schools, industry and other employment. Although the planner must adhere to the same basic concepts and definitions, he does not have to proceed methodologically in the same way throughout the study. He may alter his methodology for each component, depending upon data availability, planning staff expertise, the relative importance of the sector and the financial resources allocated to the total study. One very important advantage to disaggregating is that assumptions about the future may be adjusted according to the logical developments in each sector. The final estimate aggregates the best possible estimate for each sector.

III. Detailed Description of Alternative Requirement Methodologies

Health Manpower/ Population Ratio Method

The traditional and most widely used methodological approach to estimating health manpower requirements is the health manpower/population ratio method, often referred to as the personnel-to-population method or fixed population ratio.

Health planners use this method to characterize the current manpower situation, to assess the adequacy of the present supply of health manpower, to study the geographic distribution of health workers, and to determine the number of personnel that will be required to provide the community with health services in the future that are equivalent to a national, regional, minimal or optimal level.

Data Requirements

The basic idea underlying the manpower/population ratio method is that population size is the major determinant of manpower requirements. Thus, data that are essential for the application of the method are: (1) area population statistics, and (2) the desired ratio of manpower to population.

A key data element is the ratio that represents the appropriate number of personnel per unit of population. Planners have relied upon the current or historical relationships existing in their own or

other communities in the state or nation, or upon the judgment of experts.[1]

Refinements of the approach disaggregate the population by area and demographic characteristics and the number of personnel by detailed manpower categories — physicians, dentists, nurses, physical therapists, and so on. The method can be further elaborated by varying the ratio in different time periods in recognition of some expected change; for example, an increase in manpower productivity.

General Description

In its simplest form, the manpower/population ratio method determines requirements by multiplying population by the selected ratio:

Manpower requirements = population X designated ratio

Current requirements are calculated by multiplying present population by the selected ratio; future requirements by multiplying projected population by the designated ratio.

A variant of the method reverses the ratio and studies population relative to manpower, that is, the number of people to be served by each individual health worker.

Underlying Assumptions

The manpower/population ratio method assumes that changes in the size of the population will require an equally proportionate change in health personnel to assure adequate care. For this to be true, all other conditions affecting the demand for services — demographic shifts, socioeconomic conditions, prices of medical services, the level of third-party financing and so on — and all other factors affecting supply — manpower productivity, the organization of the delivery system, technological change, relative factor prices — are either unchanged or must work together in such a way that the relationship of popu-

1. See the discussion on the Delphi method at the end of Chapter I for one approach to obtaining a consensus among experts.

lation size and manpower requirements is not altered.

What we are imagining for the future is a health care industry so structured that population growth produces a proportionate increase in the demand for services and, moreover, that changes of an equal proportion in the quantity of manpower will result in an exactly matching percentage change in the provision of services to meet the demand.

Step-by-Step Description

Let us consider this hypothetical situation: The problem the planner faces requires that he estimate how many primary care physicians his community needs this year and how many it will require in 1980 — a priority issue in his area. The estimates are part of an overall assessment of the present and future supply of health manpower, and will be used to establish priorities among alternative programs.

From secondary sources, our planner acquires:

1. Current area population 100,000
2. Projected 1980 population 110,000
3. Current number of physicians practicing in the community per 10,000 population ..... 12 physicians per 10,000 population
4. The ratio of physicians to population in the United States, adjacent states, and his state for selected years in the past decade are studied. The choice of the desired ratio for this community ..... 15 MD's per 10,000 population, or 15/10,000 = 0.0015

The computation is simple:

Current status = 100,000 population X (12/10,000) = 120 physicians

Present requirement = 100,000 population X (15/10,000) = 150 physicians

Future requirement = 110,000 population X (15/10,000) = 165 physicians

Strengths and Weaknesses of the Method

The simplicity of the method is its greatest advantage. Relative to other methods, data requirements are minimal, and the statistics are easily obtained; the estimates can be prepared in short order at low cost; the methodology requires modest staff expertise. It is useful as a descriptive device, as an input to more sophisticated methodologies, as a validation of estimates derived by other means, and as a datum to be used in producing more thoughtful judgments.

The weaknesses of the method are serious and may be overriding. Inevitable changes in the future involving socioeconomic conditions, technological and biomedical advances in health care and the configuration of the delivery system are ignored, although they affect the amount of services the population demands and the amount of services health personnel will provide. To ignore these changes and focus on population growth may be feasible in the very short run, but it is perilous for long-term projections. It has been pointed out that "manpower/population ratios do not take into account the variations in the size of service areas for a particular type of manpower as the population density changes."[2] Furthermore, it is

2. U.S. Department of Health, Education, and Welfare, Bureau of Health Resources and Development, *The Delineation of Economic and Health Service Areas and the Location of Health Manpower Education Programs*. p. 149. Washington, D.C.: U.S. Government Printing Office, 1974.

untenable to assume that a fixed relationship of manpower to population is appropriate for any length of time other than the immediate. But even if the assumption about a fixed ratio of manpower to population is relaxed and changes in the standard ratio are allowed during the projection period, thus obviating some objectionable aspects of this methodological approach, the particular ratio chosen may be suspect—whether it be designated by expert opinion or by the standard found in another area. In fact, if the designated ratio is based on a standard higher than that existing in the planner's community, the conclusion that a shortage exists is built into the methodology and is inevitable.

Aside from the unrealistic nature of the underlying assumptions, local health planners may encounter a data problem. Population and manpower data may not be published for the relevant labor market or health service delivery area. Available data may not apply to the manpower categories under study, or may use varying occupational titles and different job descriptions. In addition, data gaps may make it difficult or impossible to develop a time series from which to study historical relationships in order to select a ratio.

With this methodological approach, as with the others, the strengths and weaknesses must be weighed in terms of the options and circumstances that face each planner. Severe criticisms can be leveled against the ratio method, but its use in many instances reflects the fact that more satisfactory approaches may not be feasible. In fact, most studies use the manpower/population ratio at some point.

Reference

Bognanno, Mario F., Jeffers, James R. and Siebert, Calvin D., *Health Manpower Resources: Patterns and Trends — A Study of Health Manpower in Iowa.* Iowa City: University of Iowa, 1970.

Service Targets Method

The service targets method focuses on the services produced by health personnel and the

volume of services to be provided to health care consumers as the central determinants of manpower requirements.

It is through the transfer of health care services that manpower requirements and the population's demand for health care are linked. Occasionally referred to as the "normative approach," this method has as key parameters the norms or standards of the services required by the community and the services produced by health personnel. Thus, the methodology quantifies the public's health demands and health manpower's outputs.

Problems Addressed

The service targets approach may be especially suitable when the planner is preparing an estimate of health manpower requirements for his community as part of a comprehensive health plan. He recognizes that he cannot plan for manpower (or for facilities) without a knowledge of the services to be provided. He conceptualizes the delivery system and the services his community has or will have (as in Fig. 3), and estimates the health personnel required to provide various types of service — preventive care, ambulatory care, emergency care, inpatient (acute) care, long-term care.

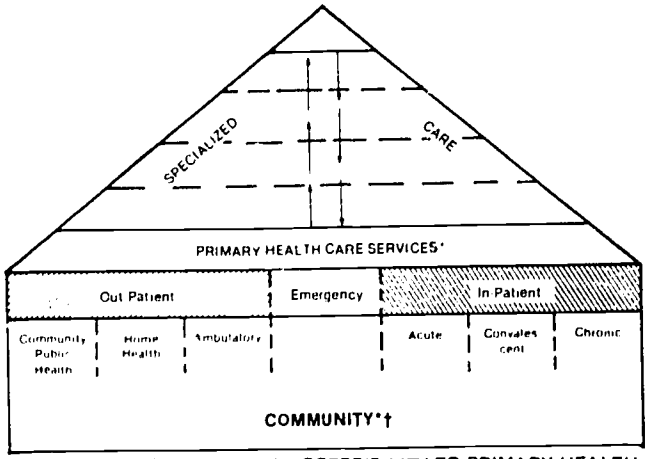
At another time, the planner may have to focus his attention on the weakest link in the delivery system in his community, perhaps identified by a health planning task force as emergency care or primary medical care or preventive dental care. His estimates will refer, therefore, to the kinds of manpower that are used to deliver these services.

Data Requirements

Data essential for the service targets method are: (1) population, (2) quantitative standards or norms for health services, (3) work assignments and staffing patterns followed in the provision of services, and (4) manpower productivity.

Population figures are available through the census; however, they may need to be tailored to the health service area. The health service norms are attained from experts' opinions or from utiliza-

Fig. 3. Conceptualized Comprehensive Health Services Delivery System [3]



† COMMUNITY CONSTITUTES ACCESSIBILITY TO PRIMARY HEALTH CARE WITHIN TIME CONSTRAINT OF ONE HOUR.
*PHYSICAL & MENTAL HEALTH

tion statistics. Similarly, information on work assignments and staffing patterns may come from professionals or task analysis studies. Manpower productivity may be estimated in various ways.[4]

General Description

The logic behind the service targets method reasons (1) the community has so many people; (2) each person in the community requires so much service; (3) each health worker provides a certain proportion of service per hour, day or week; and (4) each person works a specified number of hours, days or weeks a year. Put the pieces of the puzzle together in the proper order and the picture of manpower requirements appears.

In its simplest form, the calculations underlying the service targets approach to manpower requirements are:

3. Adapted from U.S. Department of Health, Education, and Welfare, Division of Comprehensive Health Planning, *Guide to Comprehensive Health Planning*, prepared by Arthur Young & Company. Washington, D.C.: U.S. Government Printing Office, 1974.

4. See the discussion of manpower productivity in Chapter III of Volume I.

$$\text{Manpower} = \frac{\text{population} \times \text{services per person}}{\text{manpower productivity (average output per unit of time)}}$$

In a mathematical format, the formula is:

$$M_{rt} = \frac{V \times P \times a}{q}$$

or $\frac{N \times a}{q}$,

where:

- M_{rt} = manpower requirements for an occupational category in year t;
- V = standard for quantity of services required per year;
- P = population, current or projected;
- N = $V \times P$ = total number of services per year for a given population;
- a = standard of manpower staffing, or proportion of the service provided by this health occupation;
- q = standard productivity of a specific type of manpower (such as number of visits per year).

Underlying Assumptions

The major assumption is that appropriate standards or targets for the quantity of services demanded and produced can be determined. Implicit is the belief that the experts have sufficient knowledge or the planner has suitable statistics upon which to set the norms. The value judgments that underlie the choice of standards — more services in preventive care, less in specialized care — should be made explicit.

Step-by-Step Description [5]

Case Study One

Let us begin with a simple case study, limiting ourselves to one type of service. The problem to be solved is the number of optometrists required in Maryland in 1980.

1. Let us assume a state population of 4,700,000.
2. The service target is 13 visits to optometrists per 100 persons (0.13 per capita visits per year), a standard slightly higher than the national average obtained from the National Health Survey.
3. Assume that each optometrist in 1980 will follow the scheduling recommended by the school of optometry and see two patients per hour, i.e., 16 patients per day.
4. Assume optometrists work five days per week, 50 weeks a year, a total of 250 workdays per year.
5. To solve the service target equation of manpower requirements, we plug in the statistics:

Manpower requirements =

$$\frac{4{,}700{,}000 \times 0.13}{16 \times 250} = \frac{611{,}000}{4{,}000} = 152.8 \text{ optometrists}$$

6. We are aware that alternative assumptions are reasonable regarding each variable in our equation — population, service target, productivity, and staffing pattern. To test the sensitivity of each variable and estimate requirements based on alternative sets of assumptions, we proceed with a sensitivity analysis.[6] For example, let us change the productivity measure by adopting the scheduling that is closer to the current prevailing rate of productivity. Let each optometrist in 1980 see only nine patients a day, and let all other variables remain unchanged.

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5. The case studies were adapted from the report of the Maryland Council for Higher Education, *A Projection of Maryland's Health Manpower Needs Through the 1980's*. Baltimore, Md.: Maryland Council for Higher Education, January 1969.

6. See the discussion of sensitivity analysis in Chapter I.

The projected 1980 optometrist manpower requirements become:

$$\frac{4,700,000 \times 0.13}{9 \times 250} = \frac{611,000}{2,250} = 271.6$$

This figure is about 78 percent higher than the first estimated figure of 152.8, and the difference is due to the change in productivity. Suppose that the estimated supply of optometrists in 1980 is 240. Under the first higher productivity assumption, one would have to conclude that there would be a surplus; under the second assumption of lower productivity, one would expect a shortage. Thus, the final estimate is said to be very sensitive to the assumption on productivity, and the accuracy of this measure is vital to the reliability of requirements estimate.

Case Study Two

The maldistribution of physicians has been identified as a serious problem in the state, and the planner would like to know whether the distribution of doctors will be better or worse in 1980.

1. Re: 1980 population: Three independent sets of population projections were studied; the one selected is a conservative estimate, below the projections of the regional planning commission and the U.S. Census Bureau, and was prepared by a demographer in the state planning office.

2. A service target was set for each of the five regions in the state for physicians practicing in private offices. The standard of office visits was based upon data collected in the National Health Survey. Since the NHS provides national data, the rates of physician visits per capita for each of the regions in the state were determined by means of a multiple regression analysis, with family income, race, age distribution and percent of rural population as independent variables. The calcu-

lated rates varied among the regions from 3.9 in a rural area to 5.5 in a metropolitan suburb. [7]

3. Productivity was calculated by dividing the current demand for physician services for the state and for each region (using statistics from the National Health Survey as proxy data) by the number of physicians in private practice. Services were defined to include telephone consultations and home and clinic visits as well as visits to the physician's office. This index of productivity was validated by information from other independent sources. The assumption is that physician productivity will not change significantly between the time of the National Health Survey, 1967, and the target year of our projection, 1980. [8]

4. Staffing pattern: The proportion of primary care services provided by the physician was not investigated in the report from which this case study is taken. In effect, the planner assumed that all of the services given in the doctor's office were performed by the MD. (We will relax this assumption in Case Study Three).

5. The estimating computation is shown in Table 2.

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7. The same study produced estimates of physician requirements in hospital teaching and administrative service. The hospital sector estimate was based on a variant of the manpower/population ratio method, using hospital beds as the population. The estimate of physicians in the teaching and administrative setting was determined by trend analysis.

8. An alternative method for estimating productivity is: *Medical visits per week* X *average weeks worked per year* = *average visits per year*. The alternative method is given in Press, Paul M., "Estimating appropriate physician supply" (mimeo), table 17, p. 60. For a discussion on the definition and measurement of output, see Reinhardt, U., "A production function for physician services," (in) *Review of Economics and Statistics*. pp 57-58. February 1972.

Table 2. Estimating Computation for Physician Requirements, 1980

Region	1980 population (1)	Service norm (visits per capita) (2)	Productivity standard (visits per doctor) (3)	Primary care physician requirements in 1980 (1) x (2) ÷ (3)
I.....	2,508,000	5.1	5,400	2,369
II.....	332,000	4.8	5,400	295
III.....	1,400,000	5.5	4,500	1,711
IV.....	145,000	3.9	8,000	71

Case Study Three

Let us alter the assumption on staffing patterns and add an average of one physician assistant to each doctor's office staff. Let us further assume that 30 percent of the primary care services delivered in the doctor's office could be provided by the physician assistant (See Table 3.)

Table 3 shows, for example, that in region I the 30-percent increase in the productivity of a physician due to the use of a physician assistant (from 5,400 visits per doctor per year to 7,020 visits per doctor per year) would produce a 23-percent decrease in primary care physician requirements (from 2,369 to 1,822 physicians). However, it must be kept in mind that each physician now employs a physician assistant. Thus, region I would require 1,822 physician assistants in addition to 1,822 physicians.

Table 3. Requirements for Physicians and Physician Assistants

Region	1980 population (1)	Service norm (visits per capita) (2)	Productivity of physician services (visits per doctor/yr.) (3)		Primary care physician and P.A. requirements (1) x (2) ÷ (3)			
			Staffing pattern without P.A.	Staffing pattern with one P.A.	Without P.A.		With one P.A.	
					M.D.	P.A.	M.D.	P.A.
I	2,508,000	5.1	5,400	7,020	2,369	0	1,822	1,822
II	332,000	4.8	5,400	7,020	295	0	227	227
III	1,400,000	5.5	4,500	5,850	1,711	0	1,316	1,316
IV	145,000	3.9	8,000	10,400	71	0	54	54

Note: Assuming that with one P.A. per physician productivity would increase 30 percent.

Strengths and Weaknesses of the Method

The strength of the service targets approach to estimating requirements is its focus on the central issue of providing services, and therefore on the importance of the efficient and effective organization of the delivery of care. Attention is directed to manpower utilization and its impact on productivity. The implications of the health team can be studied, allowing the planner to theoretically test the effect of alternative manpower mixes on manpower requirements.

The planner is directed by this method to do an indepth analysis of each service component of health care and of the staff to provide the service. This disaggregation enables the planner to tailor his methodology according to the unique characteristics of the particular service sector.

In the area of manpower requirements for pharmaceutical services, for example, one must estimate the impact of the expanded use of drugs in medical practice; the shifting role of pharmacists away from drug compounding and dispensing and toward advising and maintaining drug profiles; the relative importance of different employment settings — pharmaceutical houses, drugstores, hospitals, HMO's; and the potential use of auxiliary personnel. A completely different set of considerations must be quantified in determining manpower requirements for radiologic technologists. First, the radiologist determines the diagnostic and curative use of X-ray and other radiation techniques. The use of radiologic services and of radiologic technologists depends upon the doctors' orders. New technology — B-scan, holography, xerography — expands the horizon, but the concern about health hazards will surely limit the use of radiologic services.

The search for understanding of the underlying factors and relationships that is required in the service targets approach is one of its greatest strengths. The planner is faced with the Achilles' heel of this method when he attempts to quantify the variables dealing with service targets, manpower staffing and productivity. He will almost

certainly find important data gaps. Should he decide to collect primary data, he must be prepared for a long-term effort, considerable expense and the need for expert technical assistance.

The planner should be wary of the temptation to elaborate the study to such an extent that the detailed findings are only of academic interest and of no practical value in the light of his policy options.

By far the greatest danger of this method is the use of improper criteria for setting the service standards — in terms of the demand for services and the productivity of labor. If the standards used are not valid, the estimates may be grossly unrealistic. In this, as in every other methodological approach, the final outcome is only as good as the judgment and statistical data that are used.

Reference

Maryland Council for Higher Education, *A Projection of Maryland's Health Manpower Needs Through the 1980's.* Baltimore, Md.: Maryland Council for Higher Education, January 1969.

Health Needs Approach

One sophisticated methodological approach to health manpower requirements employs the biologic needs of the community as the fundamental determinant of manpower requirements. The starting point is to identify and quantify the community's health care needs, using a normative judgment of good health care. Reflecting its basic orientation, the health needs approach has been labeled the "biologic care" and "professional standards" method.

Problem Addressed

When asked, "How much and what types of health manpower do you need to provide optimal health care for your community?" the planner turns to the health needs approach. His concern is with what "ought to be" and what "might be," not with "what is" or "what is likely to be." As a planner, he is thinking in terms of the ultimate goal and highest target of health care — planning to assure that level of preventive, diagnostic or

therapeutic care which will obtain the optimal health status for the community.

Alternatively, the planner may be faced with the question of the requirements for minimal health care, that is, the amount of manpower necessary to maintain the health of the community at the lowest level that is considered acceptable. In this case, too, the health needs approach is used.

The health needs approach may be viewed as a particular application of the service targets method, in which the standard for consumer demand for services is set by professional judgment of the care needed. These standards can be set at any level: optimal, minimal or acceptable care.

Data Requirements

The data requirements are extensive: the extent of health needs must be identified; agreement on the proper modes of care and type of treatment for each health need must be reached; the appropriate treatment must be defined in terms of the personnel to deliver the service and the time needed for the treatment; and the amount of service that the individual health worker can be expected to provide must be set.

In other words, the first step determines the health status of the community; that is, the number and characteristics of people with specific incidences or prevalences of illness or disease — or other requirements for health care services — are quantified. In the second, the appropriate treatment of each disease and illness is specified in quantitative terms. The third specifies the amount of time it takes for the typical practitioner to provide each service and the fourth calculates the number of hours in a year that the practitioner works.

While National Health Survey data on morbidity and census population figures are at hand, the bulk of the essential data at this time is based on the judgment of professionals.

General Description

The basic logic of the health needs approach is akin to the reasoning behind the service targets

method; the number of personnel needed is determined by dividing the total amount of services needed by the average service provided by a health worker. The unit of measurement is usually time, so that total amount of service time needed and the amount of service time provided by the practitioner is calculated.

Underlying Assumptions

When the planner goes the route of the health needs approach, he is making two major assumptions: (1) data on health needs, appropriate treatment and manpower productivity are available or can be obtained; (2) the community's needs are the relevant criteria for determining manpower requirements. The validity of the assumptions depends upon, on the one hand, the resources available to the planner, and on the other, the purposes for which he is preparing his estimate.

In other words, manpower requirements, now or in the future, are calculated "by multiplying the population and the number of conditions per person, the number of service units each person needs and the time required for each service unit; then, dividing all this by the average workload (or desirable workload) of the practitioner."

The mechanics may be easier to see using a formula.

$$M_{rt} = \frac{P \times C \times V \times T}{W},$$

where:

- M_{rt} = manpower requirement in year t;
- P = the population that needs a given type of care for a specific health problem in year t (current or projected);
- C = the average number of "conditions" per person per year;
- V = the average number of a given kind of service per person per condition per year, based on need;
- T = average time required per service;

W = average workload of the individual practitioner — total amount of service time provided by the average practitioner per year for a given kind of service.

Step-by-Step Description [9]

The objective of the study is to estimate the number of physicians needed to provide "good" primary care.

1. First, we must delineate the scope of the study. Primary care physicians shall be defined for purposes of this analysis as internists and pediatricians, providing "all personal health needs except those relating to dental, mental and obstetrical problems and routine physicals for adults." [10]

2. Data on the incidence of disease and the prevalence of conditions requiring medical care must be obtained. We refer to such sources as U.S. Department of Health, Education, and Welfare, Public Health Service, *NCHS Series 10,* No. 37, "Current Estimates for the Health Interview Survey, U.S.," July 1965-June 1966, pp. 20, 33; and NCHS, *Vital and Health Statistics,* "Chronic Conditions and Limitations of Activity and Mobility, U.S.," July 1965-June 1967, PHS-1000-161, pp. 19, 59.

3. The appropriate treatment for a variety of diseases and health conditions afflicting children

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9. The case study used in this section was adapted from Schonfeld, Hyman K., Heston, Jean F. and Falk, Isidore S., "Numbers of physicians required for primary medical care." *The New England Journal of Medicine.* Pp. 571-576. March 16, 1972. A four-volume monograph by the same authors entitled, "Standards for Good Medical Care" has been published by the Social Security Administration (DHEW Pub. No. [SSA] 75-11926) and will be available from the National Technical Information Service, Springfield, Virginia. These volumes describe the methodology in detail, contain information on appropriate numbers of attendances, and discuss applications of the data.

10. Schonfeld, Hyman K., Heston, Jean F. and Falk, Isidore S., "Number of physicians required for primary medical care." *The New England Journal of Medicine,* March 16, 1972.

and adults must be established. An opinion survey of physicians is undertaken for this purpose.

4. Information about the amount of service time required to treat the health problems and the amount of hours that pediatricians and internists spend delivering patient care to each particular group is obtained. The treatment of acute and chronic conditions and well-baby care are reviewed separately and then combined for a measure of the total service required in each age group.

The study of Schonfeld, Heston and Falk published in the *New England Journal of Medicine* grouped acute conditions into the following categories in order to match data on incidence of illness and prevalence of conditions reported by the National Center for Health Statistics: infective and parasitic; respiratory; digestive; injuries; and others. Chronic conditions were classified as: neoplasms; allergic and respiratory; circulatory; digestive; genitourinary; muscles, bones, joints; paralysis, impairments, fractures, injuries; and others.[11]

5. Data analysis is next. For purposes of illustration, let us consider the special case of children under 17 years of age with acute conditions, and let us use the following set of hypothetical data to estimate the number of pediatricians needed to provide for their care.

a. Suppose a community exists with 10,000 children under 17 in year *t*.

b. Imagine that, on the average, each child visits a pediatrician for two acute conditions per year.

c. Suppose professional judgment is that the average amount of service required for diagnosis and treatment of each acute condition is two visits *(V)*.

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11. *Ibid.*

d. Furthermore, based on professional opinion, the average amount of time (in minutes) for each unit of service is set as 20 minutes *(T)*.

e. Let us suppose further that on the average a pediatrician in the community devotes 48 hours per week to primary care of acute conditions and practices 48 weeks per year. The average workload, therefore, of a pediatrician is 2,304 (48 x 48) hours per year, or 138,240 (2,304 x 60) minutes per year *(W)*.

f. We then calculate the answer to our question, "How many pediatricians are required in our community to treat the acute conditions of persons under 17 years of age?"

where:

- P = 10,000 (persons under 17 years of age seeking primary care for their acute condition);
- C = two (acute conditions per person per year, on the average);
- V = two (visits required, on the average, to treat each acute condition);
- T = 20 (minutes per visit, on the average);
- W = 138,240 (minutes per year that a pediatrician devotes to care of acute conditions).

By substituting all these numbers in the formula for M_t, the number of pediatricians required in year t to treat 10,000 persons under 17 years of age, each having two acute conditions per year, is

$$\frac{10{,}000 \times 2 \times 2 \times 20}{138{,}240} = 5.8 \text{ pediatricians}$$

6. The number of physicians needed to provide "good" primary care — the objective of the overall study — is obtained by summing the estimates of internists and pediatricians required to provide well-baby care and to treat the acute and chronic

conditions of all age groups in the population during the target year.

Strengths and Weaknesses of the Method

The logical coherences of the health needs method — that manpower needs are determined by health care required — are very satisfying for health resources planners. One can easily conceptualize the analytical framework: types of health conditions, such as acute, chronic, preventive; required types of care, such as ambulatory, hospital based, long term; health occupations providing the care, such as physicians, nurses, therapists. When the community's needs are the proper criteria, and data on health status and appropriate treatment are obtainable, this approach is excellent.

The planner should be aware that the technical difficulties in defining and quantifying health needs, "acceptable" modes of care, and manpower's output are formidable. Professionals do not agree; the health status of a population changes over time; medical practice advances; assignments of responsibility and functions of health occupations shift; and last, but not least, published statistics are out of date, inapplicable or incomplete.

Most serious of all, criticism is directed at the method's failure to take into account the patient's willingness to seek care and the community's ability to pay for health services. The assumption is that there are no financial, psychological or social constraints to seeking care. The concept of "demand as need" has the inherent danger of overestimating manpower requirements, as we pointed out in Chapter II of Volume I.

Economic (Effective) Demand Approach: Budgeted Vacancies Method

The economic demand approach brings into consideration the financial resources available to pay for the services of health personnel. For employed health workers, these financial resources pay wages and salaries; for the self-employed, they pay fees and charges. Payment may come from patients' pocketbooks, Blue Cross-Blue

Shield, commercial insurance companies, or government agencies. Purchasers of medical care and of the services of health manpower are sensitive to the level of medical prices and labor costs and react by varying the quantities they buy. The element of "effective" demand is introduced in several methods described here: (1) the survey of budgeted vacancies, (2) economic analyses deriving manpower requirements from utilization or expenditure data, and (3) an input-output model based on occupational and industry matrixes.

One of the most popular methods for determining current and future requirements is the budgeted vacancies or job vacancy method. In another guise, it is known as an area skill survey or employer survey. It gathers information from the best-informed respondents—employers—in recognition of the fact they know better than anyone else how many workers they will hire now and in the future and the considerations that go into these decisions. This method answers the basic questions: How many job openings are there today, and for what occupations? How many are filled? How many are part time; how many full time? What are your plans for expansion and new services? How many jobs will be available in the future? In addition, this method can collect a vast array of additional pertinent data, e.g., statistics on facility size and occupancy and on institutional training programs and educational activities.

Data Requirements

Essential data requirements are:

1. Current employment and budgeted vacancies for each of the selected occupations;
2. Projected employment or anticipated additional personnel to be employed in the target year;
3. Hours worked, full time or part time.

In addition, information may be gathered related to job descriptions, new occupational cate-

gories, wages, characteristics of the staff,[12] turnover, length of time jobs are vacant, and so on. This type of information is important for an understanding of the functioning of the labor market.

With regard to the characteristics of the facility, information on number of beds, staffed and not staffed, number of inpatient days, and plans for expansion may be collected.

General Description

In brief, data are obtained from an employer survey concerning the number of current employees, budgeted open positions, and anticipated personnel needed in the target year. Present manpower requirements are the sum of filled and unfilled budgeted positions; future manpower requirements are the sum of the additional personnel needed in the target year and present requirements.

If

M_{rp} = Present manpower requirements and

M_{rt} = Future manpower requirements

then,

$$M_{rp} = E_{by} + V_{by} \text{ and}$$

$$M_{rt} = E_{by} + V_{by} + A_{rt}.$$

where:

E_{by} = Present or base-year employment;

V_{by} = Present or base-year vacancies;

A_{rt} = Additional personnel needed in target year;

$V_{by} + A_{rt}$ = Workers needed due to vacancies and expansion.

Underlying Assumptions

Assumptions are made regarding the present and future. It is assumed that budgeted vacancies represent "live" job openings for which funds are

12. Such information — age, sex, race, educational attainment — is more easily and reliably obtained from the individual or professional association than from the institution.

available and for which qualified applicants would be hired. Excluded are the "fictitious" budgeted vacancies for which no recruitment will take place because the budget is out of line with the institution's current financial position. It is further assumed that the estimate of additional personnel needed in the future is made in the light of realistic expansion plans. To guide its respondents, one study listed the following assumptions as a basis for the estimate of additional personnel needed in the next two and five years:

1. That qualified workers will be available to meet any anticipated employment needs;

2. That the present long-term trend of economic growth of the United States will continue with no major setbacks for the next few years;

3. That scientific and technological advances will continue, affecting work methods, manpower requirements, and consumption patterns, for both goods and services;

4. That the present-day normal workweek of the establishment will continue through the forecast period;

5. That the current plans for plant and facilities expansion and modernization will materialize according to schedule. [13]

Step-by-Step Description: Case Study [14]

1. The critical first step is to define the scope of the survey: what population or geographic area is to be studied and what occupational categories

13. South Carolina Hospital Association and South Carolina Employment Security Commission, *Manpower Requirements for Health Facilities in South Carolina*, 1966. Quoted in Berkowitz, Monroe et al., *Medical Care Prices and Health Manpower in New Jersey: An Exploratory Study*. Prepared for the New Jersey Comprehensive Health Planning Agency. New Brunswick, N.J.: Rutgers University, 1970.

14. The case study is adapted from the State of Wisconsin, Department of Health and Social Services, *Hospital Manpower Survey*. Wisconsin: Division of Health, 1969.

and health facilities will be included. The decision on the survey scope is based on the objectives of the study, taking into account political, social and other nontechnical considerations. In our case study, an inventory of short-term general hospitals was conducted. Another study surveyed all private and public hospitals, all nursing homes, the State Board of Health and those medical laboratories covered by the State Unemployment Compensation Board. In contrast, another study collected data from hospitals, convalescent homes, physicians' offices, dentists' offices, dental laboratories, health clinics and public health agencies.[15] Among the studies that have limited themselves to hospitals alone, the scope has been defined in various combinations to include long-term and short-term, general and special, governmental and nongovernmental, profit and nonprofit hospitals.

The selection of occupations may be comprehensive or selective. In any case, a job description for each job title used is typically included in the questionnaire. Information on occupational titles and examples of job descriptions are given in a companion volume in this series, entitled *Data and Information Needs for Health Manpower Planning*.

2. The sampling frame must be prepared by listing the name and mailing address of all employers in the area defined for study. Typically, lists from several sources are combined to create the sampling frame. Ingenuity is needed to gather together a complete coverage of all facilities and employing institutions from various sources — for example, licensing agencies, professional associations and the yellow pages.

3. The sampling design must be prepared. Taking into account the desired precision, cost and time requirements, decide on the sample size and sampling plan. A stratified random sampling technique is often used.

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15. Connecticut Board of Education, Division of Vocational Education, *untitled memo*, September 1, 1967.

A bias in favor of conducting a census of employers is common among health planners who suspect that valid results can be obtained only from a complete enumeration and fear that sampling produces unreliable results in a totally unpredictable fashion. In fact, a true census count is a fantasy; a census rarely, if ever, achieves 100 percent complete coverage. Well-designed samples that can provide accurate data, within specified limits as to the deviation from true values, at lower cost and in less time, must be constructed.

4. The survey collection instrument must be constructed with careful attention given to definitions and instructions to the respondents. The goal is a questionnaire format that conveys the same idea to all respondents and facilitates their recording an answer. It should gather all necessary information for the subsequent analysis. At this point, thought should be given to the format of the work tables, which will transform the information from the respondents to statistical data to be analyzed by the planner. A study of the effectiveness of collecting occupational employment data from hospitals by mail, using a structured and nonstructured questionnaire, reached the following conclusions on data collection methods:[16]

   a. The nonstructured questionnaire is impractical and costly for the collection of occupational employment data from an industry group which is dominated by very large establishments with almost limitless occupational possibilities.

   b. The response to the structured questionnaire was better than the response to the nonstructured schedule.

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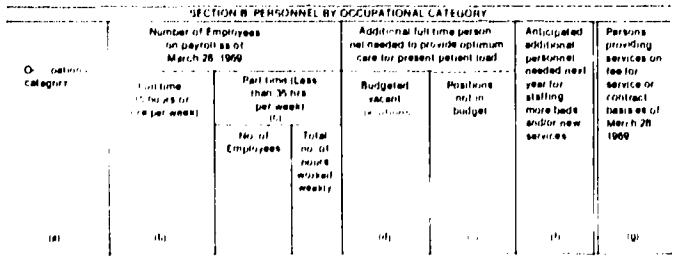
16. State of Massachusetts, Division of Employment Security, *A Comparative Study of the Collection of Occupational Employment Data in Hospitals in Massachusetts by Means of Structured and Nonstructured Questionnaires, June-September 1971.* Boston, Mass.: Occupational Research Department, Division of Employment Security, 1972.

c. In terms of response quality both questionnaires appear capable of yielding comprehensive staffing information.
d. The cost of developing the structured schedule is substantially greater than for the nonstructured document.
e. The cost of editing and coding the nonstructured schedule is many times that of the structured questionnaire.
f. The aggregate costs of developing the structured schedules, editing and coding them, are considerably less than the aggregate costs of developing the nonstructured schedules and editing, classifying and coding the occupations listed.

Fig. 4. An Example Of One Questionnaire[17]



SECTION B PERSONNEL BY OCCUPATIONAL CATEGORY

Occupational category	Number of Employees on payroll as of March 28, 1969			Additional full time person not needed to provide optimum care for present patient load		Anticipated additional personnel needed next year for staffing more beds and/or new services	Persons providing services on fee for service or contract basis as of March 28, 1969
	Full time (35 hours or more per week)	Part time (Less than 35 hrs per week) (c)		Budgeted vacant positions	Positions not in budget		
		No. of Employees	Total no. of hours worked weekly				
(a)	(b)			(d)	(e)	(f)	(g)

Note that column c in the preceding questionnaire, which deals with part time employees, asks not only for the number of persons

17. State of Wisconsin, Department of Health and Social Services, *Hospital Manpower Survey*. Wisconsin: Division of Health, 1969.

but also the number of hours worked per week. Conversion of part-time to full-time equivalents is tricky. Full-time equivalent employees can be calculated on a reliable basis only if the actual number of hours is known. Columns d and e refer to personnel needed to provide optimum care. Such terminology may present no difficulty to the respondent who clearly has in mind what he considers "optimum"; the problem arises for the researcher who is interpreting the collective views of employers. A distinction between additional personnel needed for whom budgeted vacancies exist and those for whom no financial support is available helps the planner to differentiate requirements based on "effective demand" from those based on "need."

5. The data must be collected by mail or personal interviews. Follow-up of nonrespondents is usually necessary to identify or limit the bias inherent in underreporting. In our case study, 19 hospitals, 12 percent of the sample, did not respond. An analysis of the location,and size of the nonrespondents was made in order to understand the direction of bias due to nonreporting and to determine what, if any, corrections should be made to adjust for it.

6. The data must be processed. Each returned questionnaire is edited for inadequate or inconsistent responses. Respondents are contacted, if necessary, for the correct information. Cards should be punched, 100 percent verified, and converted to magnetic tape. The first computer run should identify reported figures exceeding expected limits so that questionnaires can be examined to locate the error, and, if necessary, those respondents can be queried for accurate information.

7. The work tables must be prepared, followed by analysis and estimation. The Chi-square test may be used in deciding the grouping of employers (e.g., by size of hospital) by judging whether the statistics confirm or disprove the hypothesis that the institutions are in fact alike or different. Decide on the appropriate measure of

central tendency and compute the standard error of estimate to understand the degree of accuracy of the measure.

When a sample survey is conducted, the data in all sample strata are weighted by the reciprocals of the probability of sample selection (e.g., for 25-percent probability of sample selection, multiply by four, and then adjust for nonresponse). The weighting inflates the sample to the size of the population.

Strengths and Weaknesses of the Method

The strong point of the employer survey approach is that the source of information is the best-informed respondent, especially for the short term. In addition, relative to other methods, data collection is simple and inexpensive.

However, there are inherent weaknesses, both operational and conceptual. It is often difficult to identify every employer in the population to be surveyed. The sampling frame, therefore, may not cover the universe.

The number of respondents is critical but unpredictable, since respondents may elect not to respond for a wide variety of reasons. Consequently, there may be unmeasurable sampling errors. Adjustments for nonrespondents may require information on the characteristics of nonrespondents that is not available or is costly to obtain.

Response error is difficult to avoid: the particular respondent who is filling out the questionnaire — someone like an administrative assistant in the personnel department — may not know some of the answers; the data requested may be too difficult to obtain from the records; the respondent may not be motivated to respond but may view the survey as an unproductive, irrelevant activity; and the data collection instrument may be so long and so complex that the willing respondent inadvertently errs.

Moreover, problems arise in the wording of questions. The use of "budgeted" openings is questionable, since budgets frequently deviate from the real financial situation. Department

heads budget for positions at salary levels that are unrealistic or use the budgeted personnel funds for other uses. In addition, the use of "optimum care" as a standard introduces unstated and varying assumptions made by respondents about the criteria of desirable care and the situation in the future, and ignores the important element of the level of funds available to pay for that "optimum." Respondents are asked to report the additional personnel they will need at some future time, such as next year or five years from the present. What is not evident in their response is the line of reasoning that each employer follows with regard to future conditions — his budget, his institution's growth, the organization and state of the art of medical care, the general economy and many other influences.

References

State of Wisconsin, Department of Health and Social Services, *Hospital Manpower Survey.* Wisconsin: Division of Health, 1969.

U.S. Department of Health, Education, and Welfare, National Institutes of Health, *Health Manpower in Hospitals.* Prepared by Losee, Garrie J. and Altenderfer, Marion E. Washington, D.C.: U.S. Government Printing Office, 1971.

The Ohio Valley Health Services Foundation, *Health Services Manpower Survey.* Ohio: Ernst and Ernst, 1970.

Office of Comprehensive Health Planning, *Allied Health Manpower in Texas.* 1970.

Economic (Effective) Demand Approach: Constant Utilization Rate with Changing Population Method

Another methodology can be employed to link effective demand to manpower requirements. It derives manpower projections from a study of the changes in health services used (or purchased) that occur as a result of demographic shifts. This dynamic approach reasons that the composition as well as the size of the population is the major determinant of the types and quantity of services used. In turn, it is the population's demand for particular services that creates the demand for special types of manpower.

Problem Addressed

Illustrative of the kinds of issues that may be addressed by the service utilization approach is the planner's responsibility to review and comment on "certificate of need" applications. The planner must consider how much services of what type will be demanded in the future and how much and what type of manpower will be needed and will be available to staff these services. Only with this information can he assess the request for new or additional facilities. His concern for the financial viability of the community's health institutions focuses his attention on the effective demand for services.

General Description

In applying this method, the planner derives the estimate of manpower requirements from the estimate of the demand for services. The demand for services is in turn based upon the pattern of service utilization of each group in the population and the number and characteristics of persons in that group. The future demand for medical care is converted into projected manpower demand by applying the proportionate change in services used to the present manpower requirements. The method disaggregates the population and the services used and permits estimation of manpower requirements for aggregates of health personnel or particular, discrete occupations.

The underlying logic may be described in the following formula:

$$M_{it} = M_{ib} \times \left(\frac{\Sigma V_{ip} \times N_{pt}}{\Sigma V_{ip} \times N_{bp}} \right)$$

where:

- Σ = the sum;
- i = type of care, such as physician visits, laboratory tests;
- p = population group, such as males under 17 or females over 60;
- b = base year;
- t = target year;

M_{it} = manpower required to produce a particular type of care (e.g., ambulatory care) in the target year;

M_{ib} = manpower required to produce the particular type of care in the base year;

V_{ip} = the utilization rate of the particular type of care, i (for example, physician visits) by the population group, p (males under 17);

N_{pt} = number of persons in the population group, p (males under 17), in the target year;

N_{pb} = number of persons in the population group, p, in the base year.

The product of $V_{ip}\ N_{pt}$ divided by the product of $V_{ip}\ N_{pb}$

$$\frac{\Sigma V_{ip}\ N_{pt}}{\Sigma V_{ip}\ N_{pb}}$$

represents the proportionate change in the utilization of services due to the change in population from the base year to the target year.

Data Requirements [18]

Population, manpower and service utilization data are required.

First, base-year and projected population for the area, by demographic characteristics such as sex and age, must be obtained. Figure 5 illustrates a simple population matrix table.

Second, statistics on base-year manpower requirements by type of care are needed: doctor's office; hospitals; other institutional use; laboratory, pharmacy and other types of services.

Third, information on the utilization of services is necessary.

An example of a care matrix indicates the extent of disaggregation that can be built into this method. (See Fig. 6.)

18. Data on health care expenditures, disaggregated by type of care and population group, can be used instead of utilization data

Age	Base Year		Target Year	
	Male	Female	Male	Female
Under 17				
17-24				
25-44				
45-64				
65 and over				

Fig. 5. A Simple Population Matrix Table

Underlying Assumptions

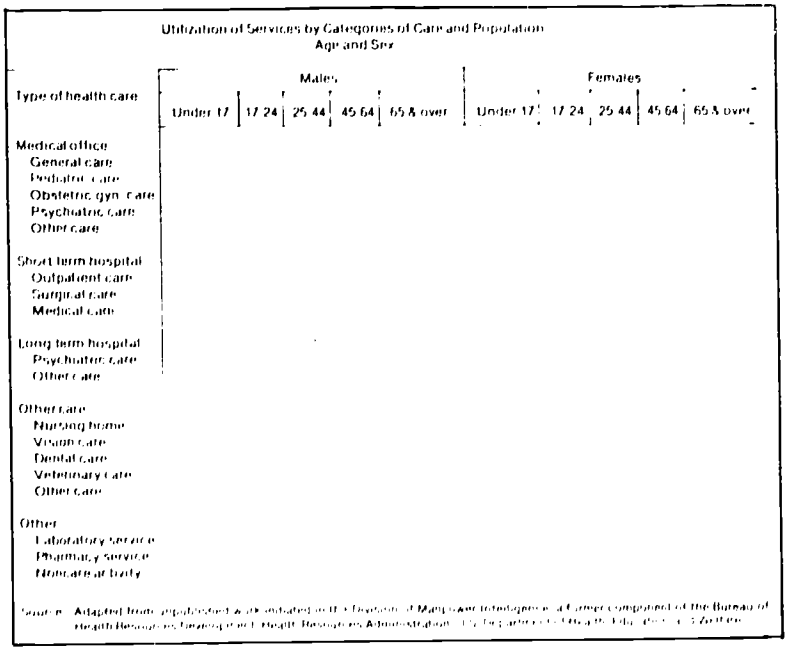
Fundamental to this method is the assumption that health manpower requirements are derived from the demand for health services. The demand for health services is, in turn, determined by the demographic characteristics of the area's population and the pattern of service utilization of each group.

While we recognize that children and the aged make different demands on the health care system, we assume that like groups will continue to use services in the same way so that the utilization pattern of the base year is equally applicable in the target year. Moreover, it is assumed that the elasticity of demand with regard to population is such that an equally proportionate change in service demand occurs from a change in the population size and composition. The same relationship exists between manpower requirement and service demand: a percentage change in services demanded results in an equal percentage change in the manpower required.

Other variables affecting the utilization rate — such as the price of medical services, personal income and the financing arrangements — can be ignored or are reasonably assumed to remain unchanged during the projection period.

The assumption of *ceteris paribus* — all other things being equal or constant — blankets many important variables influencing manpower requirements: labor productivity, technological change, and relative factor prices.

Fig. 6. Example of a Care Matrix



Utilization of Services by Categories of Care and Population Age and Sex

Type of health care	Males					Females				
	Under 17	17-24	25-44	45-64	65 & over	Under 17	17-24	25-44	45-64	65 & over
Medical office										
General care										
Pediatric care										
Obstetric-gyn. care										
Psychiatric care										
Other care										
Short-term hospital										
Outpatient care										
Surgical care										
Medical care										
Long-term hospital										
Psychiatric care										
Other care										
Other care										
Nursing home										
Vision care										
Dental care										
Veterinary care										
Other care										
Other										
Laboratory service										
Pharmacy service										
Aftercare at body										

Source: Adapted from [illegible]

Step-by-Step Description: Case Study [19]

Projections may be made for numerous occupational categories, e.g., physicians, dentists, vision care and hospital manpower. We will illustrate the use of one health service's utilization method for estimating the statewide demand in 1980 for physicians providing ambulatory care.

1. Data must be gathered from many sources.[20] Ideally, current information would be available; in practice, the latest available statistic for each variable is used. The planner is properly concerned that the base year be as recent and as uniform among the variables as possible. The data that are necessary are:

   a. Base-year resident population by age and sex, by state and by county (U.S. Bureau of the Census, *General Population Characteristics*, Series PC(1)B, tables 16 and 35, would have the 1970 data);

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19. The case study has been adapted from Berkowitz, Monroe et al., *Medical Care Prices and Health Manpower in New Jersey: An Exploratory Study*. Prepared for the New Jersey Comprehensive Health Planning Agency. New Brunswick, N.J.: Rutgers University, 1970.

20. Various publications from the U.S. Department of Health, Education, and Welfare, Public Health Service, *NCHS Series 10* and *NCHS Series 13* contain data on the utilization of health services. The most current are: *"Physician Visits, Volume and Interval Since Last Visit, U.S., 1969."* HSM 72-1066, *NCHS Series 10*, No. 73, July 1972. On the utilization of short-term hospitals, the major sources are: *"Utilization of Short-Stay Hospitals: Summary of Nonmedical Statistics, U.S., 1967."* HSM 72-1058, *NCHS Series, 13*, No. 9, May 1972; *"Utilization of Short-Stay Hospitals, U.S., 1968." NCHS Series 13*, vol. 21, no. 6, September 19, 1972; and *"Utilization of Short-Stay Hospitals: Summary of Nonmedical Statistics, U.S., 1970." NCHS Series 13*, vol. 21, no. 9, December 6, 1972. Other sources such as *Current Estimate from the Health Interview Survey, United States, 1970*, HSM 72-1054, *NCHS Series 10*, No. 72, May 1972, provide selected general information on utilization of health services. Data from the Health Interview Survey are also available on micro-data tapes from the National Center for Health Statistics. For detailed information about coverage, general description, cost, delivery time and data years available, see *Standardized Micro-Data Tape Transcripts*, U.S. Department of Health, Education, and Welfare, Public Health Service, NCHS, DHEW Pub. No. (HRA) 74-1213, rev. June 1974, pp. 16-18.

b. Projected population by age and sex, by state and by county (each state may make its own projection; however, one may obtain the data from the Bureau of the Census, *Current Population Reports*, Series 375);

c. Base-year estimated health manpower requirements by type of care and type of occupation for the area under study. In some studies present manpower requirements are estimated by use of one of the alternative methodologies, such as budgeted vacancies; in others, the latest supply figures are used as a proxy; [21]

d. The utilization rate of health service by demographic characteristics of population and by type of care for the area under study. If such statistics are not available for the state (or local area), the national data from the National Health Survey can be used as a proxy measure.

2. Computation is relatively simple. We have already designed the formula that described the relationships among the variables. We have collected the data and manipulated them into the form we need. The computation step plugs the statistics into the formula:

$$M_{it} = M_{ib} \times \left(\frac{\Sigma V_{ip} \times N_{pt}}{V_{ip} \times N_{pb}} \right)$$

We have said that future requirements are present requirements, adjusted for changes in service utilization as a result of population changes.

In the case of the state's requirements for physicians to provide ambulatory care, the computations are:

a. Requirement for physicians in 1970 (M_{ib}) = 8,256.

b. Base year and projected number of residents by age and sex for the area under

21. Supply estimates are appropriately used as proxy measure for requirements for time periods when the two are in equilibrium. The use of proxy measures was discussed previously in this chapter.

study (N_{pb} *and* N_{pt}). In Table 4 we show the distribution for the state of New Jersey.

c. Percentage change in the demand for services due to the effect of population is calculated in Table 5.

d. 1970 total demand for physician service in New Jersey equaled 30,830,000 visits ($\Sigma V_{ip} \times N_{pb}$). Projected 1980 total demand for physician services in New Jersey is 34,857,000, taking into account population changes only ($\Sigma V_{ip} N_{pt}$).

e. The proportional change in total demand for physician service for all types of care in New Jersey between 1970 and 1980 due solely to population change equals 13.06 percent (34,857,000 ÷ 30,830,000 = 1.1306).

f. Therefore, the total number of physicians for all types of care required for New Jersey in 1980 is 9,334 (8,256 x 1.1306 = 9,334).

Strengths and Weaknesses of the Method

The strong suits of this method are its reliance on measures of effective demand — the utilization rate — and its detailed study of the behavior of groups of people seeking health care. The degree of disaggregation inherent in this method permits the planner to base his manpower estimate on the health care demands of each segment of the population, reflecting the cultural and physical characteristics of each group of people. This estimate represents the change likely to occur as a result of one important dynamic factor, namely, the change in population over time.

However, the assumption that other important economic factors, such as income, price, and third-party financing, remain unchanged is very limiting and unlikely to represent reality. The assumption that population and the demand for services are so related that a change in population brings a proportionate response in the demand for services is very restrictive and needs to be validated. Furthermore, the assumption that present utilization patterns are the proper standard for the future is questionable, since we realize that there are many unmet health needs in our country.

Table 4. Adjusted Population Distribution for New Jersey by Age and Sex
(in thousands)

Sex and age	N_{pb} 1970	N_{pt} 1980
Male		
Under 17	1,151	1,141
17 - 24	424	534
25 - 44	842	1,077
45 - 64	777	810
65 plus	288	340
Female		
Under 17	1,108	1,101
17 - 24	446	567
25 - 44	906	1,141
45 - 64	842	890
65 plus	410	486
TOTALS	7,194	8,087

The method has operational as well as conceptual weaknesses. These relate to the vast amount of data and the expertise needed to do the analysis. The analytical potential of the method is enormous; the computer makes it possible to study innumerable combinations of population groups and types of care. The planner must exercise control to disaggregate in a meaningful fashion and only to a logical degree. Without control, the compilation of statistics can be overwhelming.

References

State of New Jersey, Department of Health, *Health Manpower in New Jersey*. Report of the Health Manpower Data Project. Trenton, N.J.: Department of Health, 1972.

Table 5. Population and Physician Visits for State of New Jersey, 1970 and 1980[22]

Sex and age	Constant utilization rates V_{ip} (Average no. of physician visits per person per year, U.S., 1969 [a]) (1)	Base-year (1970) population[b], V_{pb} (2)	Base-year (1970) total demand for physician visits $V_{ip} V_{pb}$ (1) x (2) = (3)	Projected-year (1980) population N_{pt} (4)	Projected-year (1980) total demand for physician visits $V_{ip} N_{pt}$ (1) x (4) = (5)
		..... thousands			
Male					
Under 17	3.7	1,151	4,259	1,141	4,222
17 - 24	3.0	424	1,272	534	1,602
25 - 44	3.2	842	2,694	1,077	3,446
45 - 64	4.1	777	3,186	810	3,321
65 and over	5.5	288	1,584	340	1,870
Female					
Under 17	3.4	1,108	3,767	1,101	3,743
17 - 24	4.8	446	2,141	567	2,722
25 - 44	5.3	906	4,802	1,141	6,047
45 - 64	5.2	842	4,378	890	4,628
65 and over	6.7	410	2,747	486	3,256
Total ( )		$E V_{ip} N_{pb}$ = 30,830		$E V_{ip} N_{pt}$ = 34,857	

a See Fig. 8.
b See table 4.

22. State of New Jersey, Department of Health, *Health Manpower in New Jersey*. Report of the Health Manpower Data Project. Trenton, N.J.: Department of Health, 1972. p 286.

Berkowitz, Monroe et al., *Medical Care Prices and Health Manpower in New Jersey*. Prepared for the New Jersey Comprehensive Health Planning Agency. New Brunswick, N.J.: Rutgers University, 1970.

U.S. Department of Health, Education, and Welfare, Health Resources Administration, *DMI Modeling Program for Health Manpower Analysis: Overview, Rationale and Status*. Report No. 74-163. Washington, D.C.: U.S. Government Printing Office, 1974.

Economic (Effective) Demand Approach: Constant Utilization Rate with Changing Population and Changing Income Method

This method improves on the previous methodology — constant utilization rate with changing population — by removing one of the restrictive assumptions that held that income would not change during the projection period. With this refined model, health manpower requirements are again derived from health care demand as determined by the utilization of services by population groups whose numbers and income are changing over time.

General Description

The logic underlying this method is, as has been stated, that the manpower requirements are derived from effective demand. To accurately project health service demand, people's income, as well as their age, sex, and other characteristics, must be considered. Therefore, one should apply the base year's service utilization rate to a like group in the target year — a group whose characteristics are defined by demography, income and the type of care used. In general terms, the projection would alter present requirements by taking into account the population effect, income effect and the effect of the interaction of population and income. Thus, the formula describing the underlying logic may be written as before:

$$M_{it} = M_{ib} \times \left(\frac{\Sigma V_{ip} \times N_{pt}}{\Sigma V_{ip} \times N_{pb}} \right),$$

where:

M_{it} = manpower required to produce a particular type of care in the target year;

M_{ib} = manpower required to produce the particular type of care in the base year;

V_{ip} = the utilization rate of the particular i type of care, by the population group;

N_{pt} = number of persons in the population group, p, in the target year;

N_{pb} = number of persons in the population group, p, in the base year;

p = the population group, by age, sex and income, such as males 15-24 years of age with less than $3,000 income, females over 60 with $3,000-$4,999 income.

In fact, however, utilization and manpower data may not be available in sufficient detail to permit classification by age, sex and income. [23] Therefore, an alternative estimating procedure has been developed that uses aggregate data and separately measures income effect, population effect and the interaction effect of changes in population and income on the demand for services, then calculates the combined effect on demand that results from these separate effects. The resulting percentage change in the demand for services is applied to the base-year manpower requirements to project manpower requirements in the target year.

The method of estimating the income, population and the interaction effect separately requires an explicit estimate of income elasticity and population elasticity, showing the sensitivity of service utilization (or expenditures) to changing income and changing population.

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23. National utilization data for physicians, dentists and inpatient hospital care is available by sex, age and family income from U.S. Department of Health, Education, and Welfare, National Center for Health Statistics. Additional national baseline data, from U.S. Department of Health, Education, and Welfare, Division of Manpower Intelligence, is given in Appendix B.

Income elasticity is measured thus:

$$n_i = \frac{\Delta e/e_b}{\Delta Y/Y_b} = \text{the estimated income elasticity for utilization of health service or expenditure.}$$

where:

Δ = difference between target year and base year;

$\Delta e/e_b$ = percentage change in the utilization of health services (or percentage changes in health services expenditures) from the base year to the target year;

$\Delta Y/Y$ = percentage change in income level from the base year to the target year.

Population elasticity is measured in this manner:

$$n_p = \frac{\Delta e/e_b}{\Delta P/P_b} = \text{the population elasticity for the utilization of health service expenditures.}$$

where:

$\Delta P/P_b$ = percentage change in population.

The projection of manpower requirements, combining the separate effects, can be represented in the following formula:

$$M_{rt} = M_{rb} \times \left(1 + \frac{\Delta E}{E_b}\right)$$

where:

$$\frac{\Delta E}{E_b} = \underbrace{\left(n_i \times \frac{\Delta Y}{Y_b}\right)}_{\text{income effect}} + \underbrace{\left(n_p \times \frac{\Delta P}{P_b}\right)}_{\text{population effect}} + \left(n_i \times \frac{\Delta Y}{Y_b}\right) \times \left(n_p \times \frac{\Delta P}{P_b}\right)$$

interaction effect

where:

M_{rt} = estimated number of health manpower requirements in target year t;

M_{rb} = number of health manpower requirements in base year b;

$\Delta E/E_b$ = percentage changes in demand for health service that is measured by percentage changes in utilization of health services (or by percentage changes in health services expenditures) as a result of changes in income level, population composition, and their interaction.

The interaction term — the product of the income effect and the population effect — takes into account that the demand for health care is changed not only by the separate shifts of income and population but also by the impact that these moves have on each other. The impact of income on health demand is due not only to income elasticity but also to the number of people at each income level; the impact of population on health demand is due not only to population elasticity but also to the average income of each population subgroup.

Data Requirements

As in the earlier constant utilization rate method, data requirements are extensive:

1. Base-year and projected population by subgroups for the area under study.
2. Base-year manpower requirements by type of care.
3. Base-year utilization of health services by population groups and by type of care,[24] and additionally,
4. Base-year and projected personal income for the area under study.

This case study projects the number of dentists in the state in 1975, 1980 and 1985.

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24. If available, expenditure data may be used in place of utilization data.

25. The case study was adapted from the State of New Jersey, Department of Health, *Health Manpower in New Jersey*, a Report of the Health Manpower Data Project (Trenton, N.J.: Department of Health, 1972).

1. Essential data are collected:
   a. Base-year and projected population for the area by sex and age.
   b. Base-year manpower requirements. The American Dental Association membership directory showed 4,503 dentists in the state.
   c. Base-year utilization data (or expenditure data). Since area data may be difficult to obtain, national data may be used if the national [26] demographic and income population is comparable to that of the area under study. The national data may be adapted by applying national utilization rates to the comparable local population groups.
   d. Base-year and projected personal income for the state. [27]
2. Computations are made.

To estimate the percentage change in the demand for dental services, $\Delta E/E_b$, the three major factors that induce change — the income effect, the population effect, and the interaction effect — must be calculated.

The *income effect* is measured by

$$\frac{e/e_b}{Y/Y_b} \times \frac{\Delta Y}{Y_b}$$

(income elasticity X (percentage change in income)

26. Sources for utilization data have been given previously. For health services expenditures, the major source is the U.S. Department of Health, Education, and Welfare, Social Security Administration, Office of Research and Statistics. For example, *Personal Health Care Expenditures by State and Statistics*, Social Security Administration, DHEW Pub. No. (SSA) 73011906 contains useful information.

27. Historical data on total personal income by states may be obtained from U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business*, or may be available from the state economic planning agency. Income and population projections by states and regions for 1980 and 1990 are now available from the U.S. Department of Commerce, Bureau of Economic Analysis. If projected population and income data are not available for the area, a simple linear model can be employed by running a regression on historical data and assuming the past trend will continue throughout the projection period.

The income elasticity for dental services, according to the study of the Commission on the Cost of Medic Care, is 1.17, which means that on the average, a 1-percent rise in income will induce a 1.17 percent rise in the number of dental visits or in money spent for dental services.[28]

The percentage change in income for the state was calculated by dividing target year income by base year income.

Period	Total personal income (Y) in $ million	Projection period	Percentage change in income $\frac{\Delta Y}{Y_b}$
1970 . . .	33.674		
1975 . . .	37.485	1970-75	11.3
1980 . . .	42.477	1975-80	13.3
1985 . . .	47.506	1980-85	11.8

Putting together income elasticity and income percentage change data produces an estimate of the income effect.

Period	$\frac{\Delta e/e_b}{\Delta Y/Y_b}$ (1)	$\frac{\Delta Y}{Y_b}$ (%) (2)	Income effect (%) (1) x (2)
1970-75 . . .	1.17	11.3	13.2
1975-80 . . .	1.17	13.3	15.6
1980-85 . . .	1.17	11.8	13.8

28. Income elasticity for dental expenditures was estimated in part by the 1964 American Medical Association Survey. *The Cost of Medical Care: A Survey.* Chicago: American Medical Association, 1964. However, one can always estimate the value of income elasticity for the area under study by running a simple regression analysis base on the model, log E = log a + b log y, where log E = percentage change in health services expenditures (or services), log a = constant term, b = income elasticity, and log y = percentage change in income level, if area data are available. For further information, see Feldstein, Paul J., *The Demand for Medical Care,* General Report, vol., 1. Chicago: American Medical Association, 1964. pp. 57-76.

Thus, it is estimated that the percentage change in the demand for total number of dental visits would increase 13.2 percent, 15.6 percent and 13.8 percent in the respective projection periods due to income effect alone.

The *population effect* is measured by

$$\frac{\Delta e/e_b}{\Delta P/P_b} \times \frac{\Delta P}{P_b}$$

(elasticity of population) X (percentage change in population)

The elasticity of population is usually assumed to be 1. In other words, the change in population induces a proportional change in utilization or expenditures.

The percentage change in population is calculated by dividing projected population size by base-year population.

Period	Total population *(P)* in thousands	Projection period	Percentage change in population $\frac{\Delta P}{P_b}$
1970	7.194		
1975	7.645	1970-75	6.3
1980	8.087	1975-80	5.8
1985	8.606	1980-85	6.4

Combining population elasticity and population percentage change yields the population effect:

Period	$\frac{\Delta e/e_b}{\Delta P/P_b}$ (1)	$\frac{\Delta P}{P_b}$ (%) (2)	Population effect (%) (1) x (2)
1970-75 ...	1	6.3	6.3
1975-80 ...	1	5.8	5.8
1980-85 ...	1	6.4	6.4

Thus, it is estimated that the percentage change in the demand for total number of dental visits would increase 6.3 percent, 5.8 percent and 6.4 percent in the respective projection periods due to the population effect alone.

The *interaction effect* is measured by multiplying the income effect and population effect, since it represents the reaction that results from the combination of these changes.

Period	Income effect (%) (1)	Population effect (%) (2)	Interaction effect (%) (3) = (1) x (2)
1970-75 ...	13.2	6.3	0.8
1975-80 ...	15.6	5.8	0.9
1980-85 ...	13.8	6.4	0.9

We are now in a position to estimate the percentage change in the demand for dental care services, $\Delta E/E_b$, by summing the three separate effects for each projection period.

Period	Income effect (%) (1)	Population effect (%) (2)	Interaction effect (%) (3)	$\frac{\Delta E}{E_b}$ Change in demand (%) (1) + (2) + (3)
1970-75 ...	13.2	6.3	0.8	20.3
1975-80 ...	15.6	5.8	0.9	22.3
1980-85 ...	13.8	6.4	0 9	21.1

Finally, the number of dentists required in the state in 1975, 1980 and 1985 may be estimated.

Period	Base-year dentists (1)	Percentage change (2)	Requirements for additional dentists (1) x (2)	Target-year dentist requirement (1) + [(1) x (2)]
1970 . . .	4,503	20.3	914	5,417
1975 . . .	5,417	22.3	1,208	6,625
1980 . . .	6,625	21.1	1,398	8,023
1985 . . .	8,023	. .	. .	. .

Strengths and Weaknesses of the Methods

As with the earlier utilization method, the strength of this method lies in its reliance on effective demand, as determined by the income, age and sex of the area's population, as the basis for estimating manpower requirements. The introduction of the dynamic element of change in income over the projection period tends to make the estimates more realistic.

Several weaknesses are especially significant. The assumption that factors other than demography and income will not change during the projection period is unwarranted except for the very short run. The planner should be aware that the use of utilization or expenditure data hides from view the unmet needs for services from the people who do not have access to medical care, for reasons of geography, ignorance or poverty. The planner should also recognize that this method can entail, as our case study demonstrated, a very complex statistical analysis requiring considerable time, money and expertise.

References

Berkowitz, Monroe et al., *Medical Care Prices and Health Manpower in New Jersey: An Exploratory Study*. Prepared for the New Jersey Comprehensive Health Planning Agency. New Brunswick, N.J.: Rutgers University, 1970.

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Economic (Effective) Demand Approach: The Industry-Occupational Matrix Method

If we view the health service industry in the context of the total economy and health manpower in the context of the manpower stock required to produce all the goods and services demanded by the community, we are led to the industry-occupational matrix method developed by the U.S. Bureau of Labor Statistics.

This method estimates future manpower requirements on the basis of an industry-occupational employment matrix that shows the percent distribution of an industry's employment by occupation and the percent distribution of an occupation's employment by industry. Given the total labor force, one can derive the employment in each industry and each occupational category in the matrix.

The Bureau of Labor Statistics developed the national industry-occupational employment matrix over a number of years of intensive study and projected the matrix to 1980 on the basis of historical trend, multiple regression analyses, input-output analyses and special industry studies. A number of states have also prepared industry-occupational matrices. It is possible for an area to create its own base-line matrix based on statistics available in the 1970 census. (Table 6.)

The Problem Addressed

Let us assume that the planner has to justify the health sector plan to the governor's planning board. The health planner wants to present an overview of the direction in which his community is headed and the part that the health sector is likely to play. He recognizes that the resources available to support health manpower and health facilities depend on the total resources of the community and the priority given to health care in the allocation of these limited resources. His focus, then, is not on manpower requirements based on population size or services or needs, but based on the relationship of employment in the health industry to that in other industries.

One of the concerns of the general planning board may be educational planning and the ade-

quacy of existing educational programs for the future. The value of the input-output approach is that it facilitates the allocation of funds to health educational programs, consistent with overall manpower needs for skilled workers.

The planner may use this method to address another problem. He may already have an estimate of manpower requirements and wish to substantiate it by the findings of another method. Or, recognizing the weakness of a one-point measure of requirements, he may wish to use the input-output method to develop, in conjunction with his other estimate, a range of possible future outcomes that, considering the future's uncertainties, might be a better guide for policy decisions.

General Description

The national BLS matrix includes 160 two-digit and three-digit standard industrial classification industries and 13 health occupation categories. Matrix ratios have been prepared for the years 1970 and 1980. A sample of the nationwide BLS matrix for medical and other health services follows.[29]

To apply the industry-occupational matrix method, we select the occupations and industries to be covered in the local matrix. One possible criterion for selection is the proportion of the total industry employment accounted for by each health occupation. Second, we project future area employment in the selected industries, and third, multiply the projected industry employment by the matrix ratio for each occupation to obtain the estimate of future employment.

Data Requirements

The data required are:

1. Industry-occupational matrix, for the planning area. The national industry-occupational

29. U.S. Department of Labor, Bureau of Labor Statistics, *Tomorrow's Manpower Needs*, vol. IV, *The National Industry-Occupational Matrix and Other Manpower Data*, BLS Bulletin 1737, pp. 108-111, 135-139. Washington, D.C.: U.S. Government Printing Office, 1972.

Table 6. National Industry-Occupational Employment Matrix, 1970 and Projected 1980 (Percent Distribution of Industry Employment by Occupation)

Occupation	Medical and Other Health Services		Hospitals		Other Medical and Health Services	
	70 Ratio	80 Ratio	70 Ratio	80 Ratio	70 Ratio	80 Ratio
Medical, Other Health Workers	34.63	34.26	30.76	32.51	40.96	36.96
Dentists	2.15	1.94	.06	.05	5.58	4.84
Dietitians, Nutritionists	.44	.34	.54	.39	.28	.28
Nurses, Professional	14.74	14.45	16.65	18.33	11.63	8.48
Optometrists	.34	.33	.02	.03	.86	.78
Osteopaths	.31	.30	.04	.04	.75	.69
Pharmacists	.33	.30	.45	.42	.13	.11
Physicians and Surgeons	5.79	5.91	1.84	1.87	12.25	12.14
Psychologists	.16	.17	.12	.13	.22	.23
Technicians, Medical, Dental	5.71	7.20	5.69	8.12	5.73	5.78
Veterinarians	.01	.01	.00	.00	.02	.02
Other Medical, Health Workers	4.65	3.32	5.35	3.14	3.50	3.61
Other Service Workers	20.64	21.69	4.39	4.27	2.26	2.24
Nurses, Practical	7.13	10.13	6.38	8.23	8.35	13.06

matrix prepared by BLS may be adapted for local or state use.

2. Estimates of total area employment for the health industry in the base period.

3. Projections of total area employment for the health industry in the target year.

Underlying Assumptions

If the national BLS matrix is used, it is assumed that BLS assumptions about the economy, technological change and other future conditions are well founded and apply to the local area as well as to the nation as a whole.

One of the most important assumptions underlying manpower projections describes the labor force in the target year. The size, sex, and age composition of the labor force are expected to change by 1980 as indicated by the latest labor force projections prepared by the Bureau. [30] (1) The labor force, 100.7 million; (2) Armed Forces, 2.7 million; and (3) civilian labor force, 98.0 million.

The assumed size of the Armed Forces in 1980 (2.7 million) is generally consistent with peace-time conditions in the late 1950's and early 1960's. The validity of this assumption depends greatly upon developments in foreign affairs in the 1970's.

Another important assumption is full employment in the target year, 1980. Based on a three-percent unemployment rate to represent full employment, [31] civilian employment in 1980 was computed as follows: (1) Civilian labor force, 98.0 million; (2) unemployment (3 percent) 2.9 million; and (3) civilian employment, 95.1 million.

Other major assumptions underlying the national manpower projections are: (1) *The*

30. U.S. Department of Labor, Bureau of Labor Statistics, *The U.S. Labor Force to 1985*, BLS Report 119. Washington, D.C.: U.S. Government Printing Office.

31. Although projections in this volume are based on a three-percent model, alternate projections based on a four-percent unemployment rate are published in U.S. Department of Labor, Bureau of Labor Statistics, *U.S. Economy in 19870.* BLS Bulletin 1673. Washington, D.C.: U.S. Government Printing Office, 1970.

international climate will improve. The United States will no longer be fighting a war, but, on the other hand, a still guarded relationship between the major powers will permit no major reductions in armaments. This would still permit some reduction from the peak levels of defense expenditures during the Vietnam conflict; (2) *The institutional framework of the American economy* will not change radically; (3) *Economic, social, technological, and scientific trends* will continue, including values placed on work, education, income, and leisure; (4) *Fiscal and monetary policies* will achieve a satisfactory balance between low unemployment rates and relative price stability without reducing the long-term economic growth rate; (5) *All levels of government* will join efforts to meet a wide variety of domestic requirements, but Congress will channel more funds to State and local governments; (6) *Problems posed by air and water pollution and solid waste disposal may* require an increasing amount of the Nation's productive resources, but will not dampen significantly our long-run potential rate of growth.[32]

If the national BLS matrix is used, in addition to accepting the assumptions underlying the projections, the planner assumes that the local area occupational distributions are consistent with national patterns.

The use of fixed coefficients to describe the proportion of industry employment attributable to an occupation contains certain inherent assumptions. First, the relationship of earnings among the various occupations and the cost of labor relative to other inputs into health care will remain constant during the projection period. In other words, employers have no incentive to change the amount of labor they use relative to other inputs or substitute one type of worker for another. Second, the supply of labor will be sufficient to

32. U.S. Department of Labor, Bureau of Labor Statistics, *Tomorrow's Manpower Needs*, vol. IV, *The National Industry-Occupational Matrix and Other Manpower Data*. BLS Bulletin 1737. Washington, D.C.: U.S. Government Printing Office, 1972.

meet employment requirements during the projection period; therefore, changes in the use of manpower will not be introduced due to labor shortages.

Step-by-Step Description

Two techniques have been prepared by BLS for the development of state and area occupational projections based on the national industry-occupational matrix: the first depends upon the national matrix for the base period and the target period; the second requires the use of an area matrix for the base period. [33]

BLS Area Projection: Method A

To illustrate this method, we use the case study of one state's requirements for professional nurses in 1980. [34]

1. As in all other methods, data acquisition is the starting point. Essential data are the 1980 national industry-occupational matrices and the 1970 and 1980 area industry employment estimates. [35]

2. From these sources, identify the industries in which RN's are employed. In addition to medical and other health services, we find mining, construction, manufacturing, transportation, communication and public utilities, wholesale trade, retail trade, finance, insurance and so on. The medical and other health service industry is

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33. U.S. Department of Labor, Bureau of Labor Statistics, *Tomorrow's Manpower Needs*, vol. I, *Developing Area Manpower Projections*. pp. 10-13. BLS Bulletin 1606. Washington, D.C.: U.S. Government Printing Office, 1969.

34. The case study was adopted from Chirikos, Thomas N., *Allied Health Manpower in Ohio: Employment Trends and Prospects*. Ohio: The Ohio State University, Center for Human Resource Research: 1972.

35. U.S. Department of Labor, Bureau of Labor Statistics, *Tomorrow's Manpower Needs*, vol. IV, *The National Industry-Occupational Matrix and Other Manpower Data*. Appendices F and G.

dominant, as one would expect, with 94.26 percent of RN employment in 1970 and a projected 93.36 percent in 1980. We are, therefore, introducing a shortcut for purposes of this case study, and will use only the health service industry, recognizing that the final estimate is a slight understatement since the distribution in all other industries, which is relatively small, has been neglected.

3. Determine the extent to which RN employment accounts for total employment in the hospital industry: 16.65 percent in 1970 and 18.33 percent in 1980; in other medical and health service industries, 11.63 percent in 1970 and 8.48 percent in 1980.

4. Obtain the area employment, 1970 and 1980, for the industries we are studying.

Industry	Total area employment	
	1970 estimated	1980 projected
Hospital	140,000	196,000
Other medical and health services	74,700	122,000

5. The 1970 national industry-occupational patterns are applied to their respective 1970 area industry employment estimate. The resulting occupational employment is then summed to area totals. This same procedure is followed using the 1980 national industry-occupational patterns and the projected area industry employment estimates (see Table 7).

6. The 1970-80 change factor for the occupations must then be computed by dividing the 1980 area employment aggregate (46,272.40) by the 1970 area employment aggregate (32,130.81) developed in step 5. The computed 1970-80 change factor for professional nurses is 46,272.40/32,130.81, or 1.440.

Table 7. Method for Computing Area Industry Employment Estimates

Industry	Estimated 1970 area total employment (1)	1970 national industry-occupational pattern[a] (percent) (2)	Col. (1) X col. (2) = col. (3)	Projected 1980 area total employment (4)	1980 national industry-occupational pattern (percent) (5)	Col. (4) X col. (5) = col. (6)
Hospital	140,800	16.65	23,443.20	196,000	18.33	35,926.80
Other medical and health services ...	74,700	11.63	8,687.61	122,000	8.48	10,345.60
All other industries[b].	..	..	..	..	..	..
Total			32,130.81			46,272.40

a. See U.S. Department of Labor, Bureau of Labor Statistics, *Tomorrow's Manpower Needs*, vol. IV, *The National Industry-Occupational Matrix and Other Manpower Data*. BLS Bulletin 1737. Washington, D.C.: U.S. Government Printing Office, 1972.

b. Excluded from the illustrative case study.

7. Base-period (1970) area employment estimates must be made for each occupation for which projections are desired. The 1970 census can supply the basic data needed for these estimates. Suppose, for purposes of the estimate, the number of professional nurses in 1970 was reported to be 41,000 nurses.

8. The 1980 employment estimates for each occupation may be computed by applying the change factor (step 6) to the base-period area employment (step 7).

The 1970-80 change of professional nurses (1.440) x base-period professional nurse employment (41,000) = 1980 employment of professional nurses in the community (5,904).

BLS Area Projection:
Method B

This second method will be outlined, but a case study will not be presented.

1. The area base-period industry-occupational matrix must be developed. Such profiles are available from the 1970 census.

2. The 1970-80 occupation change factors must be computed for each cell in the national matrices, thus (1980 national matrix cell) / (1970 national matrix cell).

3. The 1980 matrix is computed by applying the derived national occupation change factors (step 2) to the corresponding cell in the area base-period matrix (step 1). This procedure is repeated for all occupations in an industry and the resulting occupational ratios summed to industry totals and forced to 100 percent.

4. To forecast the area's total requirements for an occupation, steps 2 and 3 must be completed for each industry. The resulting occupational ratios for the projected year for each industry must be applied to the separately projected area industry employment estimates.

5. The resulting occupational estimate for each industry is then aggregated to obtain the area's

total employment requirements for the occupation in the target year.

Strengths and Weaknesses of the Method

The great advantage of this method is that it builds upon the solid base of Census and BLS data. Two methodologies have been designed by BLS that permit area planners to adapt national data for purposes of area projections. (In practical terms the BLS method A is relatively simple to use, in contrast to method B.) One can elect to alter the occupational structures and industry growth if alternative assumptions are more likely to be realized.

The overriding weakness of the use of the national matrices is that state and local area staffing patterns may not fit the national pattern. In addition, the assumptions underlying the national matrix may be unrealistic for the local community.

Disaggregated estimates are not possible using this method. The BLS national input-output matrix contains only a dozen health occupational categories, some of which cover a combination of occupations, such as, for example, the category of "technicians-medical and dental."

Serious criticism can be directed at the use of fixed coefficients, since it fails to take account of the flexibility in the use of manpower that is possible in response to changing circumstances. The use of fixed ratios is as objectionable in the input-output method as in the manpower/population ratio method. The substitution possibilities that make it possible to vary the manpower mix are assumed to be nil. This assumption flies in the face of our experience in the past decade.

References

Chirikos, Thomas N., *Allied Health Manpower in Ohio: Employment Trends and Prospects.* Columbus, Ohio: Center for Human Resource Research, The Ohio State University, 1972.

State of Illinois Office of Planning and Analysis, *Occupational Manpower Projections, 1975-1980.* February 1972

U.S. Department of Labor, Bureau of Labor Statistics, *Tomorrow's Manpower Needs*, vol. 4, *The National Industry — Occupational Matrix and Other Manpower Data*. BLS Bulletin 1737. Washington, D.C.: U.S. Government Printing Office, 1972.

IV. Detailed Description of Alternative Supply Methodologies

Current Supply

Employer Survey: Method of Estimating

Since active supply consists largely of employed personnel, primary data on the active supply are obtained from an employer survey. The methodology is sometimes called an area skill survey and is identical to the job vacancy or budgeted vacancies approach used in estimating requirements. The use of the same methodology indicates the compatibility of the concept of active supply and with that of "effective demand" requirements.

Problem Addressed

The central problems that the planner faces with current supply are the imbalance with current requirements — shortage or surplus — and geographic and specialty maldistribution. To properly address these problems and to select effective policies to correct for inadequacies, the planner must pinpoint the particular characteristics of supply that may be the roots of the difficulty or the keys to the solution. For example, if hospitals report an excessively large number of vacancies in the nursing services, can inactive nurses be attracted back into the labor force? Can LPN's be substituted for RN's? Can the nursing schools respond? Are there unfilled slots in nursing

classes? Are there excessive dropouts — before or after graduation? Are the vacancies concentrated in a particular geographic location?

General Description

A survey of employers is undertaken, using the same methodology as described in the budgeted vacancies approach to measuring requirements in Chapter III. The inventory is typically undertaken along with a study of job vacancies and future staff plans. The survey may be a census or a sample and produces an occupational profile of the employment setting — hospital, nursing home, clinic, private office and so on.

Underlying Assumptions

There are two underlying assumptions: first, the unemployed are an insignificant proportion of the "active" supply and therefore can be ignored; second, much pertinent and relatively accurate information can be amassed at relatively low cost by means of a survey of employers.

Data Requirements

Essential data requirements are:

1. Current employment for each of the selected occupations;
2. Projected employment or anticipated additional personnel to be employed in the target year;
3. Hours worked — full time, part time; number of hours worked in past 7 days.

In addition, information may be gathered related to job descriptions, new occupational categories, wages, the personnel characteristics of the staff,[1] turnover, length of time jobs are vacant, the nature and size of the institution, and its future plans. This type of information is important for an understanding of the future supply as well as the current supply.

1. This type of information is best obtained from the individual or the professional association, not the employing institution.

Step-by-Step Description

Survey methodology was described in Chapter II, and a case study of a survey of employers was presented in Chapter III in the description of the budgeted vacancies approach. At this point, we will list the steps that are undertaken without further amplification.

1. Define the scope of the survey; choose the area and occupations to be covered in the study;
2. Prepare the sampling frame (the master list of employers by name and mailing address);
3. Design and select the sample;
4. Design the questionnaire, including the rationale for each question asked;
5. Plan the analysis, including the preparation of dummy tables;
6. Conduct a dry run;
7. Collect the data;
8. Process the data;
9. Prepare the estimates.

Strengths and Weaknesses of the Method

The great strength of this approach to estimating current active supply is that the employers are a reliable central source of information on the supply structure and the institution's characteristics. Much pertinent and reasonably accurate information can be amassed at relatively low cost.

The weaknesses, however, are very real. It is difficult to develop a sampling frame that represents the universe, covering every employer in the sector under study. Sampling and response error are inevitable and may be difficult or impossible to correct.

The questionnaire asks for a great deal of data. The description of the occupations, for example, takes several pages, and it is doubtful if any respondent will take the time to study it carefully. Many surveys ask for the number of full-time and the number of part-time workers, but do not obtain the information on number of hours worked. This information is needed to calculate full-time equivalent employees; untenable assumptions such as "two part-time workers equal one full-time"

are sometimes used to convert to full-time equivalents.

Employers are not necessarily the best sources of information for some aspects of active supply, and they provide no data on the unemployed.[2] The characteristics of individual active practitioners (age, sex, race, educational attainment) and of the labor market (wages in this occupation relative to other occupations) are needed to understand the problems in the current situation and to plan properly for the future.

References

Ohio Valley Health Services Foundation, *Health Service Manpower Survey*. Ohio: Ernst and Ernst, 1970.

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Licensure Survey: Method of Estimating

The concept of potential supply encompasses all qualified workers, whether they are active or inactive. A licensure survey covers both the actively employed and the inactive, and is a method of measuring current potential supply. The National Center for Health Statistics is encouraging state licensing boards to develop a supply data

2. One source of area unemployment statistics is the State Employment Security Agency, which collects data on applicants to the U.S. Employment Service and on claimants for unemployment insurance. The Employment Service Automated Reporting System (ESARS) provides quarterly data on job applicants by selected occupational categories for 125 Standard Metropolitan Statistical Areas. Unfortunately, some unemployed workers, especially in the health field, do not apply to state employment agencies and therefore are not counted in the ESARS. Reliable unemployment data for individual occupations and areas are not readily available.

base by attaching a questionnaire to their license application forms.

Problem Addressed

The health planner seeks information to help him properly address health manpower problems. Although today's problems may appear on the surface to be a "shortage" or "surplus," closer inspection, made possible by information obtained in a licensure survey, may disclose that the issue in fact is not numbers, but maldistribution, malutilization or artificial constraints to entry. The planner must study the options that the characteristics of current potential supply offer him before he can decide on the programs of actions he would recommend. Changes in supply in the short run, for example, may be accomplished by tapping the pool of qualified inactives or removing barriers to the qualified ineligibles. On the other hand, services may be improved by altering the manpower mixes, substituting new professions, such as physician extenders, physical therapy assistants and pharmacy assistants. One long-range option is to increase the production of health workers through expanded or redirected educational programs. A licensure survey will provide information that will help the planner to assess the alternatives.

General Description

There are two forms of licensure surveys in use: the first is a one-time census survey; the second is a licensure attachment survey of a sample of individuals applying for a license or its renewal. The data obtained provide information on the number of qualified persons in each licensed occupation, on the types of employers, on educational preparation, and on labor force participation and geographic mobility. If the state does not require annual license renewal, a number of years may elapse before the attachment survey provides representative or complete data on the supply of licensed practitioners.

Underlying Assumptions

The use of a licensure survey alone to estimate supply assumes that the relevant health workers

belong to licensed occupations. Nonlicensed occupations or unlicensed workers are excluded from the count of current supply. Furthermore, it is implicitly assumed that only licensed personnel are performing the functions designated by law in the profession's scope of practice. Persons without licenses or differently titled professionals are excluded, although they may be assigned equivalent duties on the job. Finally, it is assumed that the head count of discrete occupations may be used as the proper measure of potential supply.

Data Requirements

The essential data cover several broad categories: demographic characteristics; education and training background; current employment experience and work history; geographic location and mobility; occupational specialty. One must balance the benefits of additional data against the risk of nonresponse. Specifically, the information required is:

1. Demography — age, sex, marital status, race;
2. Education — school location, year of graduation, educational attainment;
3. Employment — years of experience, activity status, locations of present and past employment, type of employer;
4. Occupational specialty — primary, secondary, tertiary.

Additional information would be very helpful for more intensive analysis and further research. It would be desirable but not essential to have the respondent's name and mailing address. Probe questions in every category would add dimension to the analysis; for example, in the area of education, the name of school and length of program; in the area of employment, the reason for inactive status or earning level at present or most recent job.

Step-by-Step Description

The first step in a licensure survey is to obtain the cooperation of the licensing boards for the

occupations under study. The boards will provide the sampling frame for the survey or attach the questionnaire to the license application forms. The number of licensed occupations and licensing boards may vary from state to state.

The succeeding steps are identical to those followed in any survey, and are described in detail in Chapter I. Briefly, they are:

1. Define the scope of the survey; choose the occupations to be included in the study;
2. Prepare the sampling frame (the master list of licentiates by name and mailing address);
3. Design and select the sample;
4. Design the questionnaire, including the rationale for each question asked;
5. Plan the analysis, including the preparation of dummy tables;
6. Conduct a dry run;
7. Collect the data;
8. Process the data;
9. Prepare the estimates.

An example of a licensure survey questionnaire is shown in Fig. 7. The questionnaire is a card, tailored to fit into license renewal envelopes, with questions on both sides. Instructions are given on a separate card. This design had two major drawbacks:

> The difficulty in consulting a separate card for codes caused many respondents not to use them, and some respondents answered only through question 18, not realizing there were additional questions on side 2.[3]

Identifying information, such as name, address, license number and social security had to be blocked out. This proved necessary when respondents objected to public disclosure of confidential information. The unfortunate consequence is that follow-up mailings are impossible; one

3. Lewis Dare and Jon Tomson, *Development of a Uniform Data Base for State and Local Health Manpower Planning*, Health Manpower Planning Series, Monograph 2. Trenton, N.J.: New Jersey Department of Higher Education, 1974, p. 7.

cannot check incomplete or suspect responses or conduct special sample studies.

The licensure attachment survey is a continuous process, and complete coverage of the potential supply requires a block of time, varying with the renewal interval (annual, biennial or longer periods) and the timing of the renewal data (fixed uniform date, birth date, original date of licensure). The conduct of an attachment survey is operationally different from the one-time census survey. The analytical scheme must include a plan for assembling the periodic survey responses to be equivalent to the universe and for eliminating duplication.

Strengths and Weaknesses of the Method

The licensure survey has a number of operational advantages: the choice of occupations is prescribed, and the problem of organizing the sampling frame is eliminated. Some socioeconomic data may be obtained as a by-product of the licensure process. When the questionnaire is enclosed with the licensure application, mailing costs are substantially reduced, and the proportion of returns is probably higher.

Fig. 7. Uniform Survey Questionnaire[4]

UNIFORM COOPERATIVE HEALTH INFORMATION SURVEY   N.J. STATE DEPARTMENTS OF HEALTH - HIGHER EDUCATION - LAW AND PUBLIC SAFETY

PLEASE COMPLETE BOTH SIDES OF THIS FORM AND RETURN IT WITH YOUR 1974 APPLICATION. When completing coded responses (those marked with an * accompanying the phrase "SEE CODE") please refer to the card marked "CODES" which is included in this package. NOTE: Any question not pertaining to your profession should be left blank. In completing a response which requests a set of numbers, the last number should appear in the last box on the right. IF YOU HAVE ANY QUESTIONS, PLEASE CONTACT 609-292-8052.

This is a statistical survey which will be used to assist the State of New Jersey in educational and health manpower planning; all information collected will be regarded as CONFIDENTIAL. The answers to ALL questions will be protected by the fact that data will be reported only in AGGREGATE FORM WITHOUT THE IDENTIFICATION OF ANY INDIVIDUAL SET (S) OF CHARACTERISTICS. THE COMPLETION OF THIS FORM IS NOT A PRECONDITION TO LICENSURE.

*1 OCCUPATION (SEE CODE A)

2. NAME (FILL-IN) LAST FIRST INIT

3. MARITAL STATUS (✓ ONE) MAR UNMAR

4. DATE OF BIRTH (FILL IN) MO DAY YR

*5 STATE OR COUNTRY OF BIRTH (SEE CODE B OR C)

6. RESIDENCE ADDRESS # AND ST (FILL IN) CITY / TWP (FILL IN) # STATE (CODE B) # COUNTY (CODE D) ZIP CODE

7 DO NOT WRITE IN THIS SPACE

8. N.J. OCCUPATION LICENSE # (FILL IN)

*9 PROF DEGREE(S) HELD (SEE CODE F)

*10 STATE OR COUNTRY WHERE HIGHEST DEGREE TAKEN (SEE CODE B OR C)

*11. STATE OR COUNTRY IN WHICH YOU TOOK AN INTERNSHIP OR RESIDENCY (SEE CODE B OR C) INTERN RES

12. # OF CLOCK HOURS OF CONTINUING ED TAKEN IN PAST 2 YEARS (FILL IN)

13. # OF YEARS PRACTICING IN NJ (FILL IN)

14. DO YOU PRESENTLY PRACTICE / WORK IN N.J. (✓ ONE) YES NO

15. CURRENT EMPLOYMENT STATUS (✓ ONE) FULL PART TIME INAC RET

16. # OF YEARS IN PRESENT MAJOR PLACE OF EMPLOYMENT (FILL IN)

17. WHERE ARE YOU PRESENTLY EMPLOYED (✓ ALL THAT APPLY)

- HOSPITAL, NURSING HOME OR OTHER INST
- SCHOOL (NON-TEACHING POSITION)
- SCHOOL (TEACHING POSITION)
- BUSINESS OR INDUSTRY
- PRIVATE PRACTITIONERS OFFICE
- ARMED SERVICES
- COMMUNITY (PUBLIC HEALTH)
- OTHER

18. IF YOU WORK OR ARE SELF-EMPLOYED IN ONE OR MORE PRIVATE OR GROUP PRACTICE SETTINGS PLEASE GIVE LOCATION (S)

CITY / TWP (FILL IN) # STATE (CODE B) # COUNTY (CODE D) PVT OR GRP (✓ ONE)

OVER ↓

4 Dars, Lewis and Tomson, Jon, Development of a Uniform Data Base for State and Local Health Manpower Planning. Health Manpower Planning Series, Monograph 2. Trenton, N.J.: New Jersey Department of Higher Education, 1974

18. NAME TWO INSTITUTIONS (HOSP, SCHOOL, ETC) OR AGENCIES AT WHICH YOU SPEND THE MOST TIME. (DO NOT INCLUDE PRIVATE SOLO/GROUP PRACTICE) (A) (B) NAME (FILL IN) *COUNTY (CODE B)

19. TOTAL # OF INSTITUTIONS AT WHICH YOU PRACTICE (FILL-IN) (DO NOT INCLUDE PRIVATE SOLO/GROUP PRACTICE).

*21. IF IN SPECIALTY PRACTICE - LIST MAJOR AREA (SEE CODE E)

NURSE ONLY: IF NURSE PRACTITIONER (eg PNP) IN SPECIALTY (✓)

22. SPECIALTY CREDENTIAL STATUS WITH PROFESSIONAL ASSOCIATION (✓ ONE)

BOARD OR ASS'N:
ELIGIBLE
CERTIFIED
ASSOCIATION:
REGISTERED

23. # OF HOURS PER WEEK YOU SPEND IN THE FOLLOWING (FILL IN ALL THAT APPLY):

DIRECT PATIENT CARE
INDIRECT PATIENT CARE (LAB, DIET, ETC)
ADMINISTRATION
RESEARCH
TEACHING
OTHER

24. # IF PATIENTS / PATRONS YOU SEE WEEKLY IN DIRECT PATIENT CARE (IF IN LAB, # OF TESTS) (FILL-IN)

25 AVERAGE AGE OF PATIENTS YOU SERVICE IN DIRECT PATIENT CARE (FILL-IN)

26. IF SELF-EMPLOYED, WHAT TYPES OF PERSONNEL DO YOU EMPLOY AND WHAT IS THEIR STATUS

	* OCCUPATIONS YOU EMPLOY - BY CODE (SEE CODE A)	NUMBER IN EACH CATEGORY THAT YOU EMPLOY (FILL-IN)	WHAT IS THEIR STATUS (THE NUMBER OF EACH WHO ARE FULL-TIME, 1/2-TIME, LESS THAN 1/2-TIME AS IN ABOVE HEADING) (FILL IN)		
			FULL	1/2	LESS 1/2
(A)					
(B)					
(C)					

27. WHAT CHANGES IN YOUR PROFESSIONAL PRACTICE DO YOU ANTICIPATE DURING THE NEXT 2 YRS. (✓ ALL THAT APPLY)

NO CHANGE
RETIRING
BECOMING INACTIVE
ENTERING / TEACHING
PRACTICE
RESEARCH
ADMINIS.
MOVING / TO N.J. — WHERE * (CODE B)
OUT OF N.J. — WHERE *(CODE B OR C)
WITHIN N.J. — WHERE * (CODE B)

NOTE: Question #'s 28 and 29 included only to determine if efforts to widen educational opportunities in health professions have been successful.

28. SEX (✓ ONE) M F

29. RACE / ETHNIC GROUP (✓ ONE)
BLACK
HISPANIC
OTHER
ORIENTAL
WHITE

JTC 4181

Fig. 7 (continued)

Fig. 7 (continued)

INSTRUCTIONS: Several times during your completion of the accompanying questionnaire you will be asked to insert a code in a set of response boxes. These questions are marked with an (*) and have instructions which will direct you to the proper code. EXAMPLE OF CODE USE: You will be asked to identify a state or country by code. When this is encountered, a notation appear which will direct you to CODES "B" (STATE) or "C" (COUNTRY) you will look at these codes you will see that CODE "B" lists all of the 50 states and CODE "C" lists approximately 15 countries and a listing for "other" countries. In completing a response, you would merely select the code of the appropriate state or country and insert it in the response boxes on the questionnaire. If you needed to select a response from the country code (CODE "C") but could not find the appropriate country listed, you would instead select the response 999- denoting a country "other" than those listed.

A. OCCUPATIONAL CODES

SELECT THE OCCUPATION WITHIN EACH CATEGORY THAT APPLIES TO YOU (e.g., YOU ARE A DENTAL HYGIENIST; LOOK UNDER DENTAL SERVICES AND SELECT OCCUPATION #0802-DENTAL HYGIENIST)

CHIROPRACTIC
- 0201 CHIROPRACTOR

CLINICAL LAB SERVICES
- 0401 CLINICAL LAB DIRECTOR (ALSO - BIOANALYTIC LAB DIRECTOR)
- 0402 CLINICAL LAB TECHNOLOGIST (ALSO - MED LAB, MED, CYTO TECHNOLOGISTS)
- 0403 CLINICAL LAB TECHNICIANS (ALSO - MED LAB, MED, CYTO TECHNICIANS)
- 0404 CLINICAL LAB AIDE (ALSO - LAB, CERTIFIED LAB ASSISTANT)

DENTAL SERVICES
- 0801 DENTIST (GENERAL AND ALL SPEC.)
- 0802 DENTAL HYGIENIST
- 0803 DENTAL ASSISTANT
- 0804 DENTAL LAB TECHNOLOGIST - TECHNICIAN
- 0805 DENTAL SECRETARY
- 0899 OTHER DENTAL

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CODES (CARD #2)

MEDICINE AND OSTEOPATHY
- 1401 M.D. (GENERAL AND ALL SPEC.)
- 1402 D.O. (GENERAL AND ALL SPEC.)
- 1403 MEDICAL ASSISTANT (ALSO - PHYSICIAN'S ASS'T.)
- 1404 MEDICAL SECRETARY
- 1499 OTHER MEDICINE AND OSTEOPATHY

MIDWIFERY
- 1501 MIDWIFE (EXCEPT NURSES)

NURSING SERVICES
- 1701 PROFESSIONAL REGISTERED NURSE
- 1702 LICENSED PRACTICAL NURSE (ALSO VOCATIONAL NURSE, LVN)
- 1703 NURSES AIDE
- 1799 OTHER NURSING

PHARMACY SERVICES
- 2001 PHARMACIST
- 2002 PHARMACY ASSISTANT
- 2003 PHARMACY AIDE
- 2099 OTHER PHARMACY

PHYSICAL THERAPY
- 2101 PHYSICAL THERAPIST
- 2102 PHYSICAL THERAPY ASSISTANT
- 2103 PHYSICAL THERAPY AIDE

PODIATRIC SERVICES
- 2201 PODIATRIST (GENERAL AND ALL SPEC.)

RADIOLOGIC TECHNOLOGY
- 2301 RADIOLOGIC TECHNOLOGIST (X-RAY TECH.)
- 2302 RADIOLOGIC TECHNICIAN (X-RAY TECH.)

VETERINARY SERVICES
- 2901 VETERINARIAN (GENERAL AND ALL SPEC.)
- 2902 VETERINARY ASSISTANT
- 2903 VETERINARY AIDE
- 2999 OTHER VETERINARY

VISION SERVICES
- 3001 OPTOMETRIST
- 3002 VISION CARE TECHNICIAN
- 3003 ORTHOPTIC TECHNICIAN
- 3004 OPTICIAN
- 3005 OPHTHALMIC/OPTOMETRIC TECHNICIAN
- 3099 OTHER VISION CARE

ALL OTHER SERVICES

IF YOUR OCCUPATION DOES NOT FALL INTO ANY OF THE ABOVE CATEGORIES - ANSWER 9999.

B. STATE CODES

- 001 ALABAMA
- 002 ALASKA
- 003 ARIZONA
- 004 ARKANSAS
- 005 CALIFORNIA
- 006 COLORADO
- 007 CONNECTICUT
- 008 DELAWARE
- 009 FLORIDA
- 010 GEORGIA
- 011 HAWAII
- 012 IDAHO
- 013 ILLINOIS
- 014 INDIANA
- 015 IOWA
- 016 KANSAS
- 017 KENTUCKY
- 018 LOUISIANA
- 019 MAINE
- 020 MARYLAND
- 021 MASSACHUSETTS
- 022 MICHIGAN
- 023 MINNESOTA
- 024 MISSISSIPPI
- 025 MISSOURI
- 026 MONTANA
- 027 NEBRASKA
- 028 NEVADA
- 029 NEW HAMPSHIRE
- 030 NEW JERSEY
- 031 NEW MEXICO
- 032 NEW YORK
- 033 N. CAROLINA
- 034 N. DAKOTA
- 035 OHIO
- 036 OKLAHOMA
- 037 OREGON
- 038 PENNSYLVANIA
- 039 RHODE ISLAND
- 040 S. CAROLINA
- 041 S. DAKOTA
- 042 TENNESSEE
- 043 TEXAS
- 044 UTAH
- 045 VERMONT
- 046 VIRGINIA
- 047 WASHINGTON
- 048 W. VIRGINIA
- 049 WISCONSIN
- 050 WYOMING

- 051 DIST. OF COL.
- 052 PUERTO RICO
- 053 GUAM
- 054 VIRGIN IS.

OVER ↓

C. COUNTRY CODES

- 060 CANADA
- 202 CHINA
- 250 CUBA
- 388 DOMINICAN REP
- 332 ENGLAND
- 396 FRANCE
- 487 GERMANY
- 440 HAITI
- 495 INDIA
- 509 IRELAND
- 861 ITALY
- 872 JAPAN
- 888 KOREA
- 649 MEXICO
- 740 PHILIPPINES
- 888 SCOTLAND
- 847 SPAIN
- 999 OTHER

D. COUNTY CODES

NEW JERSEY

A00 ATLANTIC
B00 BERGEN
C00 BURLINGTON
D00 CAMDEN
E00 CAPE MAY
F00 CUMBERLAND
G00 ESSEX
H00 GLOUCESTER
J00 HUDSON
K00 HUNTERDON
L00 MERCER
M00 MIDDLESEX
N00 MONMOUTH
P00 MORRIS
Q00 OCEAN
R00 PASSAIC
S00 SALEM
T00 SOMERSET
U00 SUSSEX
V00 UNION
W00 WARREN

PENNSYLVANIA

201 BUCKS
202 DELAWARE
203 MONROE
204 N HAMPTON
206 PIKE
207 OTHER PENN

DELAWARE

301 KENT
302 NEW CASTLE
303 SUSSEX

NEW YORK

101 NEW YORK CITY (5 BOROUGHS)
102 NASSAU/SUFFOLK
103 ORANGE
104 ROCKLAND
105 WESTCHESTER
106 OTHER NEW YORK

JTC 401810

E. SPECIALTY CODES

MEDICAL-OSTEOPATHIC

001 AEROSPACE MEDICINE
002 ALLERGY
003 ANESTHESIOLOGY
004 BRONCHO-ESOPHAGOLOGY
005 CARDIVASCULAR DISEASES
006 DERMATOLOGY
007 DIABETES
008 ENDOCRINOLOGY
009 FAMILY PRACTICE
010 GASTROENTEROLOGY
011 GENERAL PREVENTIVE MED
012 GERIATRICS
013 GYNECOLOGY
014 HEMATOLOGY
015 HYPNOSIS
016 INFECTIOUS DISEASES
017 INTERNAL MEDICINE
018 LARYNGOLOGY
019 NEOPLASTIC DISEASES
020 NEPHROLOGY
021 NEUROLOGY
022 NEUROLOGY, CHILD
023 NUCLEAR MEDICINE
024 NUTRITION
025 OBSTETRICS
026 OBSTETRICS-GYNECOLOGY
027 OCCUPATIONAL MEDICINE
028 OPHTHAMOLOGY
029 OTOLOGY
030 OTORHINOLARYNGOLOGY
031 PATHOLOGY
032 PATHOLOGY, CLINICAL
033 PATHOLOGY, FORENSIC
034 PEDIATRICS
035 PEDIATRICS, ALLERGY
036 PEDIATRICS, CARDIOLOGY
037 PHYSICAL MEDICINE-REHAB.
038 PSYCHIATRY
039 PSYCHIATRY, CHILD
040 PSYCHOANALYSIS
041 PSYCHOSOMATIC MEDICINE
042 PUBLIC HEALTH
043 PULMONARY DISEASES
044 RADIOLOGY
045 RADIOLOGY, PEDIATRIC
046 RADIOLOGY, THERAPEUTIC
047 RHEUMATOLOGY
048 RHINOLOGY
049 ROENTGENOLOGY, DIAGNOSTIC
050 SURGERY, ABDOMINAL
051 SURGERY, CARIOVASCULAR
052 SURGERY, COLON-RECTAL
053 SURGERY, GENERAL
054 SURGERY, HAND
055 SURGERY, HEAD-NECK
056 SURGERY, NEUROLOGICAL
057 SURGERY, ORTHOPEDIC
058 SURGERY, PEDIATRIC
059 SURGERY, PLASTIC
060 SURGERY, THORACIC
061 SURGERY, UROLOGICAL

DENTISTRY

101 GENERAL DENTISTRY
102 ENDODONTICS
103 ORTHODONTICS
104 PERODONTICS
105 PERIODONTICS
106 PROSTHODONTICS
107 PUBLIC HEALTH
108 SURGERY, OMAL

NURSING

201 EMERGENCY SERVICE
202 FAMILY HEALTH
203 GERIATRIC
204 MATERNAL-CHILD HEALTH
205 MATERNITY
206 MEDICAL-SURGICAL
207 PEDIATRIC
208 PSYCHIATRIC/MENTAL HEALTH
299 OTHER SPECIALTY

IF YOU HAVE BEEN TRAINED AS A NURSE PRACTITIONER (e.g. PNP) IN ANY OF THE SPECIALTIES LISTED PLEASE CHECK (✓) THE RESPONSE FOX IN QUESTION # 21.

OPTOMETRIC

301 CONTACT LENSES
302 DEVELOPMENTAL VISION
303 GENERAL OPTOMETRY
304 SUBNORMAL VISION
305 VISUAL TRAINING

F. DEGREE CODES

01 CERTIFICATE
02 DIPLOMA
03 ASSOCIATE DEGREE
04 BACHELORS DEGREE
05 MASTERS DEGREE
06 DOCTORATE (PROFESSIONAL-MD, ETC)
07 DOCTORATE (ACADEMIC-PhD)
09 OTHER

NURSING ONLY
10 ASSOCIATE DEGREE IN NURSING
11 BACHELORS DEGREE IN NURSING
12 MASTERS DEGREE IN NURSING

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Fig. 7 (continued)

The weaknesses are largely conceptual. Licensure surveys focus on discrete occupations, assuming an equality between the number of persons and the amount of services that we know is unrealistic. We know that the setting in which health personnel work affects their productivity and that many work part time. Moreover, not all qualified workers are licensed, and some functions legally limited to licensed personnel are in fact performed by others.

The licensure survey does not necessarily produce a total count of potential supply. Not all inactive workers retain their licenses; some drop their licenses and re-register when they return to the labor force.

References

Dars, Lewis and Tomson, Jon, *Development of a Uniform Data Base for State and Local Health Manpower Planning.* Health Manpower Planning Series, Monograph 2. Trenton, N.J.: New Jersey Department of Higher Education, 1974.

U.S. Department of Health, Education, and Welfare, Public Health Service, National Center for Health Statistics, *State Licensing of Health Occupations.* PHS Pub. No. 1758. Washington, D.C.: U.S. Government Printing Office, 1967.

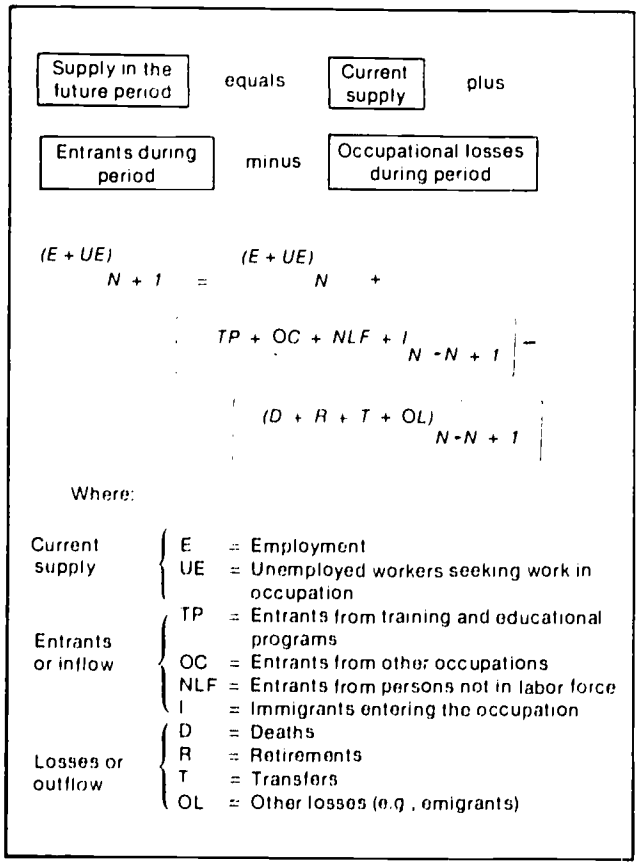
Future Supply Projections

To estimate the supply of health personnel at some future time, one measures the inflows and outflows from the current supply. Fig. 8 outlines the essential data.

The essential data are:

1. Baseline data on the supply of health personnel, defined as the employed and the unemployed seeking work;
2. Data on entrants as a result of the addition of new graduates, occupational and geographic mobility and re-entry into the labor force of inactive professionals;
3. Data on occupational losses reflecting deaths, retirement, occupational and geographic transfers.

Supply Projection Methodology [5]



5. Adapted from Glasgow, John M., *Health Manpower Supply and Requirements Projection Techniques*, a paper presented at the University Consortium Conference for Comprehensive Health Planning, Arlington, Virginia, May 29-30, 1974, mimeo.

Ideally, each element of future supply is estimated separately. These estimates are aggregated to obtain the supply projection. However, in practice, statistical data for some elements of future supply, such as occupational and geographic mobility, are not available. One has a choice: employ an assumption, based on the information available; or adopt a methodology, such as trend analysis, which enables one to take into account the inflows and outflows to the stock of supply without requiring that each element be measurable.

Assumptions must be made regarding the conditions which are likely to occur during the projection period and which will affect each element of inflow and outflow. For example, in preparing the estimates of the number of graduates from educational programs, one must assume that the level of government-financed support for training, the number of schools, size of class, etc., will stay the same, increase or decline. If it is reasonable to believe that the trend will continue, the rate of change in the past can be used in the projection period. Changes in the rate of growth should be based on statistical evidence or sound logic.

Inventory of Educational Institutions: A Method of Estimating Inflows of New Graduates

Problem Addressed

Graduates of health education programs are the major source of additions to the supply stock. Health planners and education planners join in their efforts to keep supply and requirements in balance by adjusting the output of educational programs. Excessive numbers of graduates have unfortunate consequences: qualified young people are unable to find jobs, and public and private funds devoted to education are misapplied. Insufficient numbers of graduates are equally undesirable, since employers cannot fill openings, and needed services cannot be delivered. The

problem is to fine-tune the system of health personnel production to blend into the system of health delivery.

The planner may be fortunate in having available secondary sources of information on health education programs in the area. The U.S. Department of Health, Education, and Welfare, *Allied Health Education Programs in Junior Colleges/ 1970* (DHEW Pub. No. [NIH] 72-163) and *Allied Health Education Programs in Senior Colleges/ 1971* (DHEW Pub. No. [NIH] 73-241) offer local information on individual allied health programs. Professional associations, such as the AMA and ANA, also have data for individual occupations. However, secondary sources may not be up to date or may not provide sufficiently detailed information. In that event, primary data may be required.

General Description

A census or inventory of educational programs in the planning area is conducted by mail or personal interview.

Underlying Assumptions

First, it is assumed that the output of institutions located in the area represents the total addition of new graduates to the supply in the area; that there is no attrition and that the inflows of new graduates trained elsewhere balance the outflows of local graduates. Second, it is assumed that no new institutions will come into existence.

Data Requirements

To estimate and project the number of additions to the stock of supply that comes from graduates of educational and training programs, the following information is essential:

1. Number of educational and training institutions;
2. Number of programs;
3. Enrollment in each class;
4. Number of graduates;
5. Capacity of programs;

6. Plans for changes in the number of programs and in their graduate capacity.

Additional information could be helpful in projecting future supply. Probe questions on number of applicants, acceptances, and unfilled student spaces in each class, the locale of employed graduates, and the dropout rates of students would provide valuable insights. One survey of allied health personnel solicited opinions concerning:

> (1) the identification of problems related to future demands for the allied health personnel being trained by their institutions in terms of numbers, changes in skills needed and education required; (2) the plans of their institutions for the addition of new allied health specialities to their present curricular offerings; (3) the factors that are inhibiting the expansion of present programs or the introduction of new programs at their institutions; and (4) the process used by each of their institutions for determining need and for implementing expanded or additional allied health occupational programs.[6]

An open-ended question asking for comments on any issue the respondent wishes to discuss may reveal previously unidentified problems and constraints.

Step-by-Step Description

The conduct of a census has been described in Chapter I. The specific application in the case of an inventory of educational institutions involves the following steps:

1. Define the scope of the survey. Decisions must be made concerning occupations to be studied, curriculums to be covered (baccalaureate, associate degree, technical/vocational), and types of institutions to be included (universities,

6. State of Pennsylvania, Department of Education, *A Description of the Demand and Supply of Allied Health Personnel Trained by Institutions of Higher Education in the Commonwealth of Pennsylvania.* Harrisburg, Pa.: Pennsylvania Department of Education, Bureau of Planning, 1971.

colleges, commercial schools, teaching hospitals).

2. Identify all relevant schools and all programs, accredited and nonaccredited, within the area. The AMA *Allied Medical Education Directory* lists accredited programs in selected allied health fields. Nonaccredited training programs in institutions, high schools, Voc-Tech schools, etc., should be included if they are within the scope of the survey.

3. Identify the contact person in each institution who would be a reliable informant on each program.

4. Structure the questionnaire. Determine the questions to be asked relating to the institution, program and student body. (For examples of survey questionnaires see Appendix A.)

5. Conduct the interviews or mail questionnaires.

6. Compile the data on the number of potential graduates by years and by occupational categories.

Strengths and Weaknesses of the Method

Educational institutions have the central role in the production of newly qualified health personnel. Therefore, an inventory of educational institutions produces the most accurate information on current and past classes and the most reliable projections of future programs.

However, the perspective of educators, sensitive to the commitment to faculty and the investment in buildings and equipment, may not be clearly focused on the future demands for qualified personnel. This is a basic weakness of this methodological approach to estimating future inflow. The impetus for new occupations and the initial assignments of new professional responsibilities are found not in educational institutions but on the job. The state-of-the-art, the organization of the delivery system and the demands of consumers specify the skills health personnel must have. Core practitioners and employing institutions respond to new technology and other

biomedical advances by restructuring personnel tasks. Educators respond more or less rapidly to the demands of employers for graduates who have been trained to deliver the needed services.

Another weakness may occur if assumptions about the future, especially government programs, are not well founded. The response of educators is conditioned by the funds available to underwrite new programs. Consequently, the assumption about the future level of Federal support must be made explicit, since it is crucial for projecting the numbers of new graduates. We have seen how Federal funding support, as in the case of physician assistant programs, will stimulate institutions to undertake development they are not likely to have foreseen. It would appear at this time that a major change in governmental policy regarding health manpower training is taking place with inevitable repercussions on the enrollment and capacity of educational institutions.

While educational institutions are the largest producers of health personnel, alternative routes to formal education are being recognized and may become increasingly important, e.g., in the development of proficiency examinations. This group of health professionals whose skills were acquired in nontraditional ways are overlooked in the inventory.

The inventory obtains the views of administrators of existing programs about the future status of their programs and of any new ones that they believe will be inaugurated. The last decade has seen a burgeoning of medical and allied health programs in new institutions, particularly community colleges. New institutions are by definition excluded from an inventory.

Another weakness of the new graduates approach is that it fails to take into account the extent to which new graduates of educational programs are retained in the community in which they are trained. Newly graduated practical nurses are more likely to work in the same area where

they studied than are newly graduated doctors, who will move on to internships and residencies in other areas. To estimate the additions to the supply stock, the planner must adjust the total number of graduates by the retention rate. The professional societies and licensing boards may have information that can be useful for this purpose.

References

Reibling, Louis A., *National Conference of Health Manpower Programs*. St. Louis, Missouri, January 14-16, 1973.

Pennsylvania Department of Education, *A Description of the Demand and Supply of Allied Health Personnel Trained by Institutions of Higher Education in the Commonwealth of Pennsylvania*. Harrisburg, Pa.: Pennsylvania Department of Education, 1971.

Butter, Irene and Feldstein, Paul J., *Increasing the Supply of Physicians — Alternative Sources for a State*. Health Manpower Policy Discussion Paper Series, No. A.4. Ann Arbor, Mich.: University of Michigan, School of Public Health, 1973.

Method of Estimating Inflows of New Licentiates: Net Additions to the Stock of Supply

Problem Addressed

An alternative method of estimating additions to the stock of supply uses the number of licenses issued in a year. This approach produces a net figure of additions, since the adjustments for geographic and occupational mobility have already been made by the person applying for the license.[7] Projections of future inflows may be made by trend analysis of the historical data on new licentiates.

7. The adjustment for mobility is approximate since some professionals maintain licenses in several states.

General Description

The licensing boards are asked to provide the number of new licenses, covering initial state licensure, based on examinations, endorsement and reciprocity, but excluding renewals and "grandfather clause" waivers, for as many years as the data are available. Two alternative methods of analysis may be used: the first based on trend analysis, the second using the average of the annual rate of change. Both methods produce an estimate of net inflows to the stock of supply.

Underlying Assumptions

The underlying assumptions are that the historical trend is a reliable basis for estimating the inflows into stock of supply during the projection period and that no new element will enter the picture which will significantly alter the situation.

Moreover, it is assumed that new licentiates are a measure of the additions to the stock of supply, that nonlicensed personnel are nonexistent or inconsequential. Furthermore, it is assumed that the analysis of a head count of discrete occupations is meaningful.

Data Requirements

The essential data requirements are the historical trends of new licentiates by year. However, additional background information on new licentiates would be useful for validating the results of this method. Data on the percentage who pass (or fail) the licensure exam and information on the location of the required education and experience could be used to adjust the number of new graduates. The area graduates estimate, corrected for geographic retention and occupational mobility, plus the out-of-area inflows, should equal the estimate of new licentiates.

Information on the age of new licentiates can be used to update the age distribution of the professionals, an important datum for estimating the separations due to deaths and retirements.

Step-by-Step Description: Method A — Trend Analysis

The application of trend analysis in the method of estimating new licentiates would proceed with the following five steps.

1. Obtain historical information on annual new licentiates for the occupation.
2. Plot the trend series of the number of new licentiates on graph paper.
3. Examine the graph to determine whether a constant or changing rate of increase (decrease) is a reasonable assumption.
4. Compute the annual average rate of increase (decrease) in the occupations. A constant rate of change can be derived by using the linear model $Y = a + bt$ where b is the annual average rate of change. However, if the rate is increasing, decreasing, or differs from one time period to another, one can use an exponential trend model, $Y = ab^t$ or $\log Y = \log a + (\log b)\, t$, or other curve-fitting equations.
5. Apply the annual average rate to the current supply to compute the number of net additions to the stock of supply. (Correct for losses due to separations to project next year's supply. Repeat this process for each year in the projection period.)

Step-by-Step Description: Method B — Annual Rate of Change

As an alternative to the trend analysis used in method A, the planner may use the average of the annual rate of change. The planner would proceed with the following four steps:

1. Compute the percent change for each year. This is done by calculating the difference between two years and dividing the difference by the base year.
2. Sum all of the percentages.
3. Compute the average annual change by dividing the sum (step 2) by the number of years for which the percent change has been calculated. For example:

8. For a more detailed description of trend analysis, see Chapter I.

Percent Net Increase in New Physician Licentiates

Year	Number of physicians	Annual difference	Annual change (percent)
1965	7,410		
1966	7,565	155	2.1
1967	7,737	172	2.3
1968	7,900	163	2.2
1965 to 1968			6.6
Annual average			2.2

4. Apply the annual average rate to the current supply to compute the number of net additions to the stock of supply. (Deduct for losses due to separations to project next year's supply. Repeat this process for each year in the projection period.)

An alternative procedure under method B multiplies the average annual increase by the number of years in the projection period to obtain estimated inflows, as in the following sample.

Net Additions to Supply of Physicians, 1970-75

1970 supply	8,256
Average rate of increase	2.2
Number of years in projection period	5
Estimated inflows to supply, 1970-75	908

Add the estimated inflows to the current supply. Deduct the estimated outflows due to separations during the projection period to determine future supply in the target year.

Strengths and Weaknesses of the Method

The method of estimating net inflows to the supply stock by means of a trend analysis of historical data on new licentiates overcomes the difficulty of separately measuring geographic and occupational mobility. Alternative methods, such as the new graduates approach, are handicapped

by insufficient data on the location and field of employment that graduates follow. As a result, reliable adjustments for graduates retained in the area and in the health field are difficult to make. However, when one uses data on new licentiates, one may assume that the reason a person is applying for a license is his desire to work in the state and at that occupation. Place of residence, given in the application form, is an indicator of the geographic area of employment.

The limiting factor, of course, is that licenses are held by inactive as well as active workers. Individuals seek a license who may have no present intention of working in the state. Professionals with multiple licenses — license collectors — are not uncommon; the additional licenses may be sought to safeguard one's future options.

On the one hand, new licentiates overstate the inflows; on the other, they may understate the number. Despite the legal definitions of the scope of practice, delegation of new tasks and reassignments of duties are continuing processes that produce new occupations and redefine the functions of existing professions. Because nonlicensed personnel are performing some of the responsibilities limited by law to licensed professionals, a head count of new licensees does not give a complete picture.

Another limitation of the new licentiate method — as in any approach that relies on licensure data — is the fact that licensure applies to a limited number of professions, albeit important ones. Certified and noncertified occupations, representing the majority of the long list of allied health programs, are not covered in any licensure study.

References

Maryland Council for Higher Education, *A Projection of Maryland's Health Manpower Needs Through the 1980's.* pp. 3-31 and 3-32. Baltimore: Maryland Council for Higher Education, 1969.

State of New Jersey, Department of Health, *Health Manpower in New Jersey.* pp. 100-101. Trenton, N.J.: New Jersey Department of Health, 1972.

Life Tables: A Method of Estimating Outflows Due to Mortality

Problem Addressed

To project future supply, one must take into account the outflows from the stock of active supply. These losses stem from occupational and geographic transference, withdrawal from the labor force, and death. Data gaps or unavailability create difficulties in measuring losses caused by transference and labor force withdrawals. However, a method is available for estimating the loss due to death. It employs life tables prepared by the National Center for Health Statistics that are based on Bureau of the Census population data and death statistics.

General Description

The National Center for Health Statistics publishes three series of life tables — complete, provisional abridged and final abridged. The complete life table contains values for single years of age and represents an analysis of decennial census data and a complete count of deaths over a three year period; the abridged tables provide mortality rates by age groups, relying on postcensal population estimates and deaths in a calendar year. Appendix B contains a sample page of the abridged life table for the United States, 1972.

The method of estimating outflows due to mortality applies the mortality rate for each age group to the number of health personnel in that age group to compute the loss to supply caused by death.

Underlying Assumptions

It is assumed that the mortality rates given in the life tables are appropriate for the projection period and for the health personnel included in the estimate. This means that no drastic change in the way of life that would affect the number of deaths — no wars or life-extending medical advances — is likely to occur. It also implies that the life span of the cohort groups in the general population is similar to that of health personnel.

Data Requirements

Essential data needed tc estimate losses due to death are:

1. Age distribution of the health manpower under study for the base year
2. Life tables found in U.S. Department of Health, Education, and Welfare, National Center for Health Statistics, *Monthly Vital Statistics Report*, Summary, *Final Mortality Statistics, 1972*. DHEW Pub. No. (HRA) 75-1120, vol. 23, no. 7, Supplement, October 3, 1974. Washington, D.C.: U.S. Government Printing Office, 1974.

Step-by-Step Description

1. Obtain the age distribution of the supply of health professionals. For purposes of illustration, let us use physicians. The professional society or licensing bureau may be the source for the baseline data. Suppose the baseline data of the supply of health professionals (i.e., physician) by age group in the year 1970 is as follows:

Age group	1970 physician supply
25-29	11
30-34	337
35-39	957
40-44	1,142
45-49	1,165
50-54	826
55-59	888
60-64	937
65-69	496
70 +	480
All ages	7,239

2. Obtain the mortality rate for each age group from the life tables. The tables show the proportion of persons alive at the beginning of the age interval who die during the five-year interval. For example, the mortality rate for U.S. males, ages 25-30, was 1.0 percent in 1970. Suppose it is found that the mortality rates for each age group is as follows:

Age group	Male mortality rate [a] (%)
25-29	1.0
30-34	1.1
35-39	1.6
40-44	2.4
45-49	3.8
50-54	6.0
55-59	9.2
60-64	13.7
65-69	19.3
70 +	74.9

[a] Male mortality rate was selected since the majority of physicians are male.

3. Apply the appropriate mortality rate to the number in the corresponding age group. For example, in the group 25-29 years of age in 1970, there are 11 doctors, with a mortality rate of one percent. Thus, none would die, and there would be 11 survivors for the age group 30-34 in 1975. If we do the same calculation for each age group, the attrition due to death for each age group in 1975 is as follows:

1970 age	1970 physician supply	Male mortality rate (%)	1975 attrition
25-29	11	1.0	0
30-34	337	1.1	4
35-39	957	1.6	15
40-44	1,142	2.4	27
45-49	1,165	3.8	44
50-54	826	6.0	50
55-59	888	9.2	82
60-64	937	13.7	128
65-69	496	19.3	96
70 +	480	74.9	360
All ages.	7,239		806

Strengths and Weaknesses of the Method

The availability of national life tables that are updated annually by the National Center for Health Statistics and are based on census data and death statistics is an overwhelming advantage.

Data problems do exist, nonetheless. Age distributions for the occupations under study are an essential input to this method, but may not be available. National age distributions are published for some professions, such as doctors and nurses. State professional societies may be able to approximate the distribution from other information they have. National or state age distributions may or may not be suitable as proxy measures for the area.

The applicability of national vital statistics to the workers in any health occupation in a particular area must be questioned. Are these workers likely to live longer, shorter, or on the average almost the same span of years as other males and females of their race in the general population? One should not blindly adopt the mortality rates given in the life tables for any specific group in any particular area, but should adjust them to provide a better fit, if possible.

Moreover, in adopting the mortality rate of 1972 or later published figures, one must consider the prospect for change in the projection period that will alter longevity. While it is true that such drastic events are atypical, wars do occur and life expectancy does change over time.

Reference

State of New Jersey, Department of Health, *Health Manpower in New Jersey*. Report of the Health Manpower Data Project. Trenton, N.J.: New Jersey Department of Health, 1972.

Labor Force Separation Rates: A Method of Estimating Outflows Due to Deaths and Retirements

Problem Addressed

Supply projections are made by adding inflows from various sources to the stock of current supply and by subtracting outflows. These outflows are the result of geographic and occupational transfers and deaths and retirement. The Bureau of Labor Statistics has prepared labor

force separation tables for each state that enable the planner to estimate the loss to current and future supply that is attributable to deaths and retirements. The tables provide data for selected health occupations by state for the years 1970 and 1985.

The number of separations is a vital datum to education and manpower planners because it represents the level of production of health workers that is necessary to replenish current supply, assuming no growth in requirements or worker mobility. This is the number of health workers that must be replaced if the supply status quo is to be maintained.

General Description

Two alternative methods may be used to estimate the outflows due to death and retirement for specific occupations in each state. Method A is based on calculations of separations year by year; method B uses an average annual separation rate for the entire projection period. In both methods, one applies the separation rate to the number that represents the sum of the stock of current supply in the base year and the additions to the stock.

Method A — Separations Year by Year. Method A calculates, consecutively, the losses for each year in the projection period. The total supply and additions is estimated for each year seriatim before annual separations are computed.

The following formula describes method A in mathematical terms:

$$P_b = (S_b + A_b) \times R_b$$

$$S_{b+1} = (S_b + A_b) - P_b$$

$$P_{b+1} = (S_{b+1} + A_{b+1}) \times R_{b+1}$$

$$S_{b+2} = (S_{b+1} + A_{b+1}) - P_{b+1}$$

$$P_{b+n} = [(S_{b+(n-1)} + A_{b+(n-1)}] \times R_{b+(n-1)}$$

$$S_{b+n} = (S_{b+n} + A_{B+n}) - P_{b+n}$$

where:

P_b = Annual separations in the base year;
S_b = Supply in the base year;
A_b = Annual additions to supply in the base year;
R_b = Annual rate of separations in the base year.

Method B — Average Annual Separation Rate. Method B uses an estimate of the supply in the base year plus additions to the mid-year of the projection period. The average annual separation rate multiplied by the number of years in the projection period gives us the total separation in the time span from the base year to the target year.

The formula for method B is:

$$P = S_b + (A_t/2) \times (R \times Y),$$

where:

P = Total number of separations;
S_b = Supply in the base year;
A_t = Total additions to base-year supply during the projection period;
$A_t/2$ = Total additions to supply by the mid-year of the projection period;
R = Average annual rate of separation;
Y = Number of years in the projection period.

Underlying Assumptions

The use of the labor force separation tables incorporates into the supply projections whatever assumptions underlie the statistics in the

published tables. Computation of the rates of retirement and deaths by age, sex, and specific occupation group is based on working life tables that assume, for example, that separations for men under 35 are solely due to death, not retirement. This is a reasonable assumption since few retirements occur at that age. An assumption that may not be equally acceptable is the use of 1960 working life patterns for women to develop the separation rates for women in 1970 and 1985. It can be argued that while the pattern for female labor force participation in 1960 may still be valid in 1970, it is of doubtful validity for 1985.

The separation tables provide state data. Their use for local area studies assumes that the area pattern of working life and age distribution is comparable to that found in the state as a whole.

Data Requirements

Essential data include:

1. The total active supply in the base year.
2. The publication of the U.S. Department of Labor, Bureau of Labor Statistics, *Tomorrow's Manpower Needs: Estimating Occupational Separations From the Labor Force for States.* Supplement No. 4, prepared by McElroy, Michael P. and Cangialosi, Joseph S. Washington, D.C.: U.S. Government Printing Office, 1974. This volume contains annual labor force separation rates in 1970 and 1985 by state for more than 400 occupations.

If data are available for the proportion of males and females in the base-year supply, a more refined estimate may be prepared. A breakdown by sex for each occupation in every state is available upon request from BLS regional offices.

Step-by-Step Description: Method A — Separations Year by Year

1. Add the annual inflows representing all new additions to the base-year supply. For purposes of illustration, let us assume that the new additions each year remain constant at 5,000 and that base-year supply is 100,000 . . . . . 105,000.
2. Obtain the separate rates (for the occupation and state) for 1970 and 1985 from U.S. Department of Labor, Bureau of Labor Statistics,

Tomorrow's Manpower Needs: Estimating Occupational Separations From the Labor Force for States, Supplement No. 4. For this example, let us use the rate for dental laboratory technicians in Alabama:

Year	*Separation Rate*
1970	0.01900
1985	0.01860

3. Interpolate the rates for years between 1970 and 1985. [9]

To interpolate the 1980 rate, the number of years from the base year to the interim year (10) is divided by the number of years in the projection period (15) and then multiplied by the change in the rate from the base year to the projected year.

$$\frac{10}{15} \times 0.00040 = 0.00027$$

Since the rate is decreasing from the base year to the projected year, the change is added to the base year to obtain the interim-year rate.

Base-year rate - change = interim-year rate
0.01900 - 0.00027 = 0.01873

9. For an explanation of the method of interpolation, see U.S. Department of Labor, Bureau of Labor Statistics, *Tomorrow's Manpower Needs: Estimating Occupational Separations From the Labor Force From States*. Supplement No. 4, p. 9.

4. Apply the separation rate to the sum of supply and annual inflow (step 2) to calculate the number of separations.

Year	Supply	Annual [a] inflows	Supply plus annual inflows	Separation rate [b] (R)	Number of separations
1970 . .	100,000	5,000	105,000	0.01900	1,995
1971 . .	103,005	5,000	108,005	0.01897	2,049
1972 . .	105,956	5,000	110,956	0.01895	2,103
1973 . .	108,853	5,000	113,853	0.01892	2,154
.	.	.	.	.	.
.	.	.	.	.	.
.	.	.	.	.	.
1980 . .	127,748	5,000	132,748	0.01873	2,486
.	.	.	.	.	.
.	.	.	.	.	.
.	.	.	.	.	.
1985 . .	139,891	5,000	144,891	0.01860	2,695

a. It is assumed that number of new additions per year will remain constant throughout the period.

b. Separation rates for those years between the base year 1970 and projected year 1985 are based on straight-line interpolation. The rate selected applies to dental laboratory technicians in Alabama.

Step-by-Step Description: Method B — Annual Separations Rate

1. Determine the supply in the base year (1970 supply = 100,000).

2. Add the inflows to base-year supply of 5,000 per year (inflows from 1970 to 1985 = 75,000).

3. Sum supply plus cumulative additions up to the middle year of the projection period (1977.5) to calculate middle-year projection of supply and inflows: 100,000 + [75,000 X (7.5/15)] = 137,500.

4. To calculate the average annual rate of separation to interpolate the 1977.5 rate, the number of years from the base year to the target year (7.5) is divided by the number of years in the BLS data (15) and then multiplied by the change in the rate from 1970 to 1985: (7.5/15) X (0.0190 - 0.0186) = 0.0002. Since the rate is decreasing over

time, the change is deducted from the base year to obtain the target year (1977.5) rate: 0.0190 — 0.0002 = 0.0188.

5. The middle-year projection of supply and additions multiplied by 1977.5 rate equals average annual separations (step 3 total X step 4 total = 137,500 X 0.0188 = 2,585).

6. Average annual separations multiplied by number of years in the projection period (15) equals the losses due to deaths and retirements during the projection period (2,585 X 15 = 38,775).

Strengths and Weaknesses of the Method

Again, the availability of published material on separations, by state and occupation, for the 1970 base year and the 1985 projection year is a great advantage. Data limitations are one of the biggest hindrances to the study of labor force separations. However, the 1985 separation rates in this volume (U.S. Bureau of Labor Statistics, *Tomorrow's Manpower Needs*, Supplement 4) are based upon 1985 age-specific rates and 1970 census occupational age distributions. One limitation of using the 1970 age distribution is the assumption that the age and sex distribution of the occupation will remain the same. The 1970 age distribution is used because the 1970 census is the latest source of age distribution for occupations, and there is no reliable method to project occupational age distributions. Projections of the labor force age distributions can be made, but insufficient data on occupational mobility preclude the projection of occupational age distributions.

Another limitation is the lack of working life tables by occupation. The same age-specific separation rates apply to age distributions as if mortality and retirement do not differ by occupation. The nature and environment of work, coverage and provisions of pension plans, opportunities for employment, and other factors influence retirement patterns and mortality trends among occupations. We know, however, that doctors are less likely to retire, at any age, than people in other occupations.

The marital status and number of children are assumed to have the same effect on all women regardless of occupation. The more education women have, the higher are their labor participation rates and their concentration in certain occupations. Data are not available to account for these differences.

Trend Analysis of Annual Supply: A Method of Estimating Net Changes to the Stock of Supply

Problem Addressed

The local planner has to cope with the lack of data regarding specific inflows and outflows in this area. A method is available for estimating net changes in the supply stock based on the historical record. This approach circumvents the need to measure the component elements that make up additions and losses to supply.

General Description

Differences between one year's supply and the next represent the effect of all of the forces operating to increase and to reduce the supply stock. The net change in supply may be determined by a trend analysis of total supply over a period of time. The method of trend analysis is described in Chapter I and in estimating the net additions to the stock of supply based on new licentiates.

Underlying Assumptions

In adopting this method, the planner assumes that the difference between inflows and outflows

in the future will follow the pattern of change in the past. In other words, the relationship between inflows from new graduates, in-migration, occupational transfers and outflows from deaths, retirements and emigration will continue to follow the historical pattern.

Data Requirements

The historical record of active supply for the health occupations in the area under study is required. In general, the longer the period for which data is available, the better.

Step-by-Step Description

For purposes of illustration, let us project the supply of doctors of osteopathy, by specialty, for the state in 1980, using the method of net changes, using the following case study. [10]

1. Obtain historical information on the total number of doctors of osteopathy from the American Osteopathic Association directories for the years 1960-72. Since an historical series showing osteopaths by specialty is not available, the methodology adopted is to project the total supply to 1980 and then estimate the number in each specialty, such as general practice, internal, pediatric medicine and general surgery based on the proportion of such physicians found in the 1971 Directory of Osteopathic Physicians. [11]

The historical data for total number of doctors of osteopathy for years 1960-72 is illustrated in the table that appears on the next page.

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10. This case study was adapted from George E. Brehman, Jr., *A Study of Physician Manpower Demand and Supply in Pennsylvania: Methodology and Findings.* Harrisburg, Pa.: Pennsylvania Department of Education, 1973.

11. *1971 Yearbook and Directory of Osteopathic Physicians*, 63rd ed. Chicago: American Osteopathic Association, 1971.

Year	Total number of doctors of osteopathy
1960	1,357
1961	1,364
1962	1,393
1963	1,442
1964	1,449
1965	1,461
1966	1,487
1967	1,526
1968	1,550
1969	1,573
1970	1,601
1971	1,667
1972	1,666

In 1971, 1,667 osteopathic physicians were practicing in the state. Of that number 1,213, or 72.8 percent, were providing direct care to patients.

The 1971 distribution of direct-care osteopathic physicians, by type of activity, is as follows:

Specialty	1971 number of doctors of osteopathy	Percent distribution
Total direct care	1,213	100.0
General practice	781	64.4
Internal medicine	58	4.8
Pediatrics	32	2.6
General surgery	64	5.3
Other care or specialties	278	22.9

2. Plot the trend series of the total number of osteopathic physicians on graph paper.

3. Examine the scatter diagram and determine whether a constant rate of increase is a reasonable assumption.

4. Compute the annual average growth in the number of osteopathic physicians by using a linear model, $Y = a + bX$.

Year	X	Y	X^2	XY
1960....	−6	1,357	36	−8,142
1961....	−5	1,364	25	−6,820
1962....	−4	1,393	16	−5,572
1963....	−3	1,442	9	−4,326
1964....	−2	1,449	4	−2,898
1965....	−1	1,461	1	−1,461
1966....	0	1,487	0	0
1967....	1	1,526	1	1,526
1968....	2	1,550	4	3,100
1969....	3	1,573	9	4,719
1970....	4	1,601	16	6,404
1971....	5	1,667	25	8,335
1972....	6	1,666	36	9,996
N=13	Σ X=0	Σ Y=19,536	Σ X^2=182	Σ XY=4,861

Substituting the relevant figures into the following formulae:

$$a = \frac{\Sigma Y}{N} = \frac{19,536}{13} = 1,502.8$$

$$b = \frac{\Sigma xy}{\Sigma X^2} = \frac{4,861}{182} = 26.7$$

the trend equation with 1966 as the year of origin is:

$$Y_e = 1,502.8 + 26.7X \quad (1)$$

For convenience, we shift the year of origin to 1960. The trend equation equals:

$$Y = 1,502.8 + 26.7(X-6)$$
$$Y = 1,342.6 + 26.7X \quad (2)$$

With these trend equations, one is able to project the total number of osteopathic physicians to any year beyond 1972. Suppose a projection for the year 1980 is needed. With 1960 as the year of origin, the value of x in our estimating equation (2) equals 20, the difference between 1960 and 1980. By substituting in equation (2):

$$Y = 1,342.6 + 26.7X$$
$$Y = 1,342.6 + 26.7(20)$$
$$Y = 1,876.6 = 1,877$$

Thus the total supply of doctors of osteopathy in 1980 is projected to be 1,877.

From 1971 information we know that direct-care physicians make up 72.8 percent of the supply of osteopathic physicians. Applying that percentage to the projected supply, we calculate that 1,366 osteopathic physicians will be providing direct care in 1980. It is assumed also that the distribution of direct-care osteopathic physicians among various specialties in 1980 would follow the pattern prevailing in 1971. The number of direct-care doctors of osteopathy in 1980, by type of care, is projected as follows:

Type of care	1980 projection, osteopathic physicians	Percent distribution
Total direct care	1,366	100.0
Internal medicine	880	64.4
Pediatricians	65	4.8
General surgery	36	2.6
Other care or specialties	313	22.9

Strengths and Weaknesses of the Method

The use of historical supply data and trend analysis to project future supply overcomes the difficulty of collecting data and estimating separately the components of inflows and outflows. It permits the planner to measure the net change to the stock of supply during he projection period caused by all additions and all separations.

However, it should be recognized that the past is not always a good indicator of the future. Discontinuities do occur, so that historical experience in certain periods may provide a poor basis for projection.

Reference

Brehman, George E., Jr., *A Study of Physician Manpower Demand and Supply in Pennsylvania* p. 87. (Harrisburg, Pa.: Pennsylvania Department of Education, 1973).

APPENDIX A. QUESTIONNAIRE SAMPLES

HRA - T 1
10-73

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
HEALTH RESOURCES ADMINISTRATION
BUREAU OF HEALTH RESOURCES DEVELOPMENT
DIVISION OF MANPOWER INTELLIGENCE
IN COLLABORATION WITH THE

O M B NO. 068-673131
Approval Expires JUNE 30, 1974

ASSOCIATION OF SCHOOLS OF ALLIED HEALTH PROFESSIONS

1973 INVENTORY OF HEALTH OCCUPATIONS EDUCATION PROGRAMS IN TWO-YEAR AND FOUR-YEAR COLLEGES AND UNIVERSITIES

INSTRUCTIONS FOR QUESTIONNAIRE II

FORM HRA-T 1 (10 73)

RETURN OF THE QUESTIONNAIRE Please complete this questionnaire and return to the Association in the enclosed envelope no later than November 30, 1973. Questions about the survey should be directed to Ms. Marlene Leonard at the Association headquarters, One Dupont Circle, N.W., Washington, D.C. 20036. Area Code 202. Phone 202-293-3422

Before attempting to complete the questionnaire, please take a few minutes to read the following

DEFINITIONS AND CRITERIA FOR REPORTING PROGRAMS

PROGRAM - A health occupation education program, for purposes of the Inventory, includes formal classroom instruction, laboratory instruction, clinical training, and/or supervised field experience, leading to competency in a specific health occupation or profession, and resulting in a degree, certificate, or diploma. PROGRAMS OFFERED AT DIFFERENT AWARD LEVELS AND HAVING DIFFERENT PRE-REQUISITES ARE CONSIDERED TO BE SEPARATE PROGRAMS. A SEPARATE QUESTIONNAIRE MUST BE COMPLETED FOR EACH PROGRAM

The following requirements must be met for the inclusion of a program in the inventory

- A diploma, certificate, or degree must be granted by the reporting institution. This award must be granted AFTER the professional component of the program has been completed.
- The program must have matriculated its first class of students on or before October 15, 1973
- The program must be at least 16 clock hours in duration.

INCLUSIONS - The enclosed *Glossary of Occupational Titles* represents examples of health occupations whose education programs will be included in the Inventory. This list is not intended to be all inclusive. Programs for occupations not specifically listed should be reported if you consider them to be within the framework of the Glossary

AWARD LEVEL - Degree, diploma, and certificate programs should be reported in this survey and are defined as follows

- Degree Program - Any program which results in the awarding of an associate, bachelor's, master's, or doctoral degree
- Diploma Program - Any program which results in a diploma granted for at least 1 but less than 2 years of training after 12th grade
- Certificate Program - All of the following certificates should be reported
  - Occupational/Vocational Certificate - Certificate awarded for training of at least 16 clock hours duration but not more than 36 months duration after matriculation in the program
  - Collegiate Certificate - Certificate awarded for training (other than continuing education) of more than 36 months beyond the 12th grade or post baccalaureate training for which NO additional degree is granted
  - Certificate for Advanced Standing - Certificate awarded for training which is beyond the Master's, but NOT at the Doctoral, degree level
  - Continuing Education Certificate - Certificate awarded for training to maintain a health worker's proficiency, which signifies evaluation of the worker's participation in the program

PROGRAMS OFFERED AT DIFFERENT AWARD LEVELS ARE CONSIDERED DIFFERENT PROGRAMS AND SHOULD BE REPORTED SEPARATELY

EXCLUSIONS - The Inventory is limited by the exclusion of various types of programs

DO NOT report

Programs which award only a "Certificate of Attendance"

Programs leading to the M.D. or D.O. degree, graduate and continuing education of physicians, and premedical courses.

Programs for dentists, optometrists, podiatrists, pharmacists, and veterinarians.

Programs leading to licensure as R.N., L.V.N., L.P.N., and programs of continuing education for such persons, but programs for nursing-related occupations are included

Programs for engineers at all levels with the exception of those programs which you judge to have a significant biomedical/environmental health content or emphasis.

Programs for natural scientists such as biologic and microbiologic scientists

Programs for social scientists, including psychologists.

Programs for social workers at all levels with the exception of those programs which you judge to have a significant medical or psychiatric content or emphasis

Programs for mathematicians and statisticians at all levels with the exception of those programs which you judge to have a significant health statistics content and emphasis

PLEASE PRINT USING BLUE OR BLACK INK WHEN COMPLETING THIS FORM

HRA 11
(10 71)

U S DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

O.M.B. NO. 58-5731
Approval Expires: JUNE 30, 19

PUBLIC HEALTH SERVICE
HEALTH RESOURCES ADMINISTRATION
BUREAU OF HEALTH RESOURCES DEVELOPMENT
DIVISION OF MANPOWER INTELLIGENCE
IN COLLABORATION WITH THE

ASSOCIATION OF SCHOOLS OF ALLIED HEALTH PROFESSIONS

1973 INVENTORY OF HEALTH OCCUPATIONS EDUCATION PROGRAMS IN TWO-YEAR AND FOUR-YEAR COLLEGES AND UNIVERSITIES

QUESTIONNAIRE II

SECTION A - INSTITUTION IDENTIFICATION

1 Responding Institution

INSTITUTION NAME

CITY | STATE | ZIP

OFFICIAL USE ONLY

2 What type of institution is represented by this response? *(Check the ONE which best describes the location of your program)*

CAHO 01

(14 1) [ ] MAIN CAMPUS OF A MULTI CAMPUS INSTITUTION
(14 2) [ ] BRANCH CAMPUS OF A MULTI CAMPUS INSTITUTION
(14 3) [ ] PEER CAMPUS OF A MULTI CAMPUS INSTITUTION *(equal status campuses with central administration but no defined "Main Campus")*
(14 4) [ ] COLLEGE OR UNIVERSITY WITH NO BRANCH CAMPUSES
(14 5) [ ] MEDICAL CENTER/HOSPITAL ADMINISTRATIVELY LOCATED WITHIN COLLEGE/UNIVERSITY
(14 6) [ ] MEDICAL CENTER/HOSPITAL ADMINISTRATIVELY UNRELATED TO COLLEGE/UNIVERSITY

SECTION B - PROGRAM IDENTIFICATION

3 From the enclosed GLOSSARY OF OCCUPATIONAL TITLES indicate in the boxes below the TWO DIGIT number of the major category into which your program falls.

(15 16) [ ] MAJOR CATEGORY

4 From the enclosed GLOSSARY, select and copy exactly the GLOSSARY title in the boxes below the TWO DIGIT code number of the occupation which most accurately describes the job for which your students are prepared.

(17 20) [ ] OCCUPATIONAL TITLE

If nothing in the GLOSSARY approximates the occupational title for which your students are being prepared, indicate the occupational title which does describe their training efforts.

If you have selected the occupational title in the GLOSSARY which approximates that for which your students are being prepared, provide a clear picture of the duties commonly associated with this occupational title.

If you [illegible] in the GLOSSARY please send any materials you have [illegible] when returning the questionnaire.

5 [illegible]

(21 72) OFFICE USE ONLY

I. Complete all lines necessary to identify the specific academic organizational unit in which this program is located

		UNIVERSITY ______
CARD 02		COLLEGE ______
	(14-43)	SCHOOL ______
CARD 03	(44-73)	DIVISION ______
	(14-43)	DEPARTMENT ______
	(44-73)	______

SECTION C – PROGRAM CHARACTERISTICS

I. Indicate the type of program you are reporting. CHECK ONLY ONE.

CARD 04 (14-1) ☐ BASIC OCCUPATIONAL PREPARATION: Program design to provide students with the knowledge and skills needed to work in a specific occupation at the entry level of that occupation. Admission to program does not require previous formal training in the occupation but may build on previous informal training or practical experience. Typically, this type of program grants the "first professional" degree, leads to certification or licensure, or prepares the student for an entry-level job. The program may be academic at the undergraduate level or may be non-academic.

(14-2) ☐ ADVANCED EDUCATION OR TRAINING. Program designed to provide health workers with formal education or training beyond that which is offered as "Basic Occupational Preparation," AND which confers additional academic credit or professional recognition in a specific discipline or occupation. This type of program includes SPECIALTY TRAINING which qualifies the individual in a recognized specialty of his discipline, for which there are specific educational requirements beyond "Basic Occupational Preparation."

(14-3) ☐ CONTINUING EDUCATION. Program of educational activities designed to maintain a health worker's proficiency in his occupation. Continuing education up-dates "Basic Occupational Preparation," or "Advanced Education."

(14-4) ☐ TEACHER TRAINING. Program which provides individuals ALREADY TRAINED in a health profession with competency as teachers or as educational program managers. Teacher training may include some elements which are advanced education or training, but it is never limited to this.

I. Within this program may a student elect a specialization?

Specialization is an area of concentration within a program that develops a particular expertise and distinguishes one group of workers from others trained in the same program, e.g., some institutions offer degree programs in radiologic technology with specializations in medical radiography, nuclear medicine, or radiation therapy.

NOTE: If you consider a specialization to be a separate program (see definition of "program" found in the Instructions), report it on a separate questionnaire.

(15-1) ☐ NO SPECIALIZATION OFFERED ☐ SPECIALIZATION IS OFFERED, *(Specify below)*

	OFFICIAL USE ONLY	
(16-30)		______
(31-45)		______
(46-60)		______
(61-75)		______

I. Indicate the MINIMUM PREVIOUS education REQUIRED for entry into this program

NOTE. If it seems appropriate for you to check more than one, you may be reporting more than one program on this form. Please re-examine the definition of "program" found in the INSTRUCTIONS.)

CARD 05 (14-21)

(01) ☐	NONE	(07) ☐	ASSOCIATE DEGREE
(02) ☐	SOME HIGH SCHOOL *(Specify Minimum Grade)*	(08) ☐	3 YEARS COLLEGE
(03) ☐	HIGH SCHOOL DIPLOMA OR CERTIFICATE OF HIGH SCHOOL EQUIVALENCY	(09) ☐	4 YEARS COLLEGE *(without Degree)*
(04) ☐	LESS THAN 2 YEARS COLLEGE	(10) ☐	BACHELOR'S DEGREE
(05) ☐	2 YEARS COLLEGE *(without Degree)*	(11) ☐	MASTER'S DEGREE
(06) ☐	REGISTERED NURSE PREPARATION	(12) ☐	DOCTORAL DEGREE
		☐	OTHER *(Please Specify)*

OFFICIAL USE ONLY ☐☐

(22-23)

HRA 11 Page
10 7.0

10. Check the specific academic background(s) REQUIRED for entry into this program — CHECK AS MANY AS APPLY.

(24-53)

- (01) ☐ NONE
- (02) ☐ BIOLOGICAL SCIENCES
- (03) ☐ CHEMICAL SCIENCES
- (04) ☐ CLERICAL SKILLS
- (05) ☐ FINE ARTS
- (06) ☐ GENERAL SCIENCES
- (07) ☐ INDUSTRIAL ARTS
- (08) ☐ MATHEMATICS
- (09) ☐ PHYSICAL EDUCATION
- (10) ☐ PHYSICAL SCIENCES
- (11) ☐ SOCIAL/BEHAVIORAL SCIENCES

SPECIFIC HEALTH TRAINING:

- (12) ☐ BASIC PREPARATION IN OCCUPATION OR DISCIPLINE FOR WHICH THIS IS AN ADVANCED COURSE
- (13) ☐ NURSING, R.N.
- (14) ☐ OTHER SPECIFIC HEALTH TRAINING
- (15) ☐ REQUIRED BACKGROUND NOT ELSEWHERE CLASSIFIED.

(Specify) _____

11 Indicate the level at which this program is offered and the specific award granted upon completion of the program (i.e., BS, BA, MPH, etc.)
Check ONLY ONE. *(NOTE. If it seems appropriate for you to check more than one, you may be reporting more than one program on this form. Please re-examine the definition of "program" found in the INSTRUCTIONS.)*

(54-55)	LEVEL OF OFFERING	SPECIFIC AWARD CONFERRED
(01) ☐	OCC/VOC CERTIFICATE I *(Less than 6 months)*	
(02) ☐	OCC/VOC CERTIFICATE II *(6 but less than 12 months)*	
(03) ☐	OCC/VOC CERTIFICATE III *(12 but less than 24 months)*	
(04) ☐	OCC/VOC CERTIFICATE IV *(24-36 months)*	
(05) ☐	DIPLOMA	
(06) ☐	ASSOCIATE DEGREE	
(07) ☐	ASSOCIATE DEGREE + CERTIFICATE	
(08) ☐	BACHELOR'S DEGREE	
(09) ☐	BACHELOR'S DEGREE + CERTIFICATE	
(10) ☐	COLLEGIATE CERTIFICATE ONLY *(Training at or beyond baccalaureate level)*	
(11) ☐	MASTER'S DEGREE	
(12) ☐	MASTER'S DEGREE + CERTIFICATE	
(13) ☐	CERTIFICATE OF ADVANCED STANDING *(Training beyond master's degree level but not at doctoral degree level)*	
(14) ☐	DOCTORAL DEGREE	
(15) ☐	CONTINUING EDUCATION CERTIFICATE	

FOR OFFICIAL USE ONLY

56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71

12 For UNDERGRADUATE PROGRAMS ONLY. In what collegiate year(s) do students without advanced standing GENERALLY enter this program? Check ALL level(s) which are appropriate.

CARD 06
14 19

- (01) ☐ NOT APPLICABLE (GRADUATE PROGRAM)
- (02) ☐ STUDENTS NOT CONSIDERED TO BE ENROLLED IN COLLEGIATE PROGRAM
- (03) ☐ 1ST (OR FRESHMAN)
- (04) ☐ 2ND (OR SOPHOMORE)
- (05) ☐ 3RD (OR JUNIOR)
- (06) ☐ 4TH (OR SENIOR)
- (07) ☐ 5TH (PRE BACCALAUREATE CLINICAL YEAR)

13 Indicate the MINIMUM number of month(s) typically necessary for a full-time student entering without advanced standing in the program to complete all prescribed courses following TIME OF ENTRY shown in Item 12 (above) for undergraduate programs or following matriculation for graduate programs. *(EXCLUDE summer vacation unless summer school is REQUIRED to complete this program in the average amount of time.)*

MONTHS

(20 21) ☐☐

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(10 73)

Check the credit hour system at your institution

(22 1) ☐ SEMESTER

(22 2) ☐ QUARTER

(22 3) ☐ TRIMESTER

☐ OTHER *(Please specify and explain if necessary.)*

_____ _____

List the CREDIT HOUR distribution for the following departmental *(program)* and institutional requirements

For programs which do NOT offer academic credit, please indicate the CLOCK hours required.

For programs which offer a range of possible credit hours combinations and tracks, please indicate either the number of credit OR the clock hours which represents a TYPICAL program

		Credit Hours (23 1)	Clock Hours (23 2)	*Complete only if this program offers NO academic credit.*
(24 27)	A	☐	☐	Of the total credit *(or clock)* hours required for completion of this program *(including university requirements, electives, departmental requirements, etc.)* how many hours are needed to fulfill departmental requirements STRUCTURED SOLELY FOR STUDENTS IN THIS PROGRAM?
				Of the departmental requirements indicated in Line "A" above, how many hours are needed in the following areas
(28 31)			____	1) Classroom study *(NOT associated with clinical training or field experience.)*
(32 35)			____	2) Class laboratory study *(NOT associated with clinical training or field experience.)*
(36 39)			____	3) Clinical training and/or supervised field experience, including student teaching experience, if applicable *(FOR THE PURPOSES OF THIS INVENTORY, THIS TRAINING CONSISTS OF ACTUAL OR SIMULATED WORK EXPERIENCES, WHICH MAY OR MAY NOT BE ACCOMPANIED BY SPECIALLY STRUCTURED LABORATORY OR DIDACTIC SESSIONS.)*
(40 43)			____	4) Special project hours.
(44 47)			____	5) Thesis or dissertation hours *(If your program offers a thesis and non thesis option, please enter the hours as though the thesis option only were being reported and then check "Thesis or dissertation is optional.")*
				☐ Thesis or dissertation is optional.
				The total of 1), 2), 3), 4), and 5) should equal Section "A". If not, please explain
(48 51)	B	☐	☐	Of the total credit *(or clock)* hours required for completion of this program, how many hours are needed for departmental electives *(or departmental requirements NOT structured solely for health students.)*? Do NOT duplicate credit or clock hours reported in Section C, below.
(52 55)	C	☐	☐	Of the total credit *(or clock)* hours required for completion of this program, how many hours are needed to complete courses required of all students in the institution whether or not they are enrolled in this program *(sometimes called General Education Requirements)*? Do NOT duplicate credit or clock hours reported in Section B, above
(56 59)	D	☐	☐	In order for a student to complete this program and receive the award specified in Item 11, Page 3, of this form, how many hours must be earned from all sources? *(Total of A + B + C)*

Is your program affiliated with one or more schools, agencies, hospitals, etc., for the purpose of providing some portion of the clinical training and/or supervised field experience required by your institution?

(61 1) ☐ YES ANSWER ITEMS 17 - 19

(61 2) ☐ NO PROCEED TO ITEM 20

17. If your answer to Item 16 was "Yes", please complete the following chart regarding your affiliated institution.

		INSTITUTION TYPE	NUMBER OF AFFILIATED INSTITUTIONS: No. Located Within Your School's Administrative Structure (1)	No. Located Outside Your School's Administrative Structure (2)	No. Having Written Affiliation Agreements With Your Institution (3)	NUMBER OF SPACES FOR YOUR STUDENTS: No. of Guaranteed Spaces Reserved for Your Students (4)	No. of Spac Usually Available f Your Stude but not Guarantee (5)
CARDS 07-10	(01)	HOSPITAL *(Private, Gov't Supported, etc.)*					
	(02)	FACILITY FOR MENTALLY RETARDED, PHYSICALLY HANDICAPPED, EMOTIONALLY DISTURBED					
	(03)	OUT-PATIENT CLINIC					
	(04)	NURSING HOME/EXTENDED CARE FACILITY					
	(05)	SOCIAL SERVICE AGENCY					
	(06)	MEDICAL CENTER *(University)*					
	(07)	LABORATORY					
	(08)	PRACTITIONER'S OFFICE					
	(09)	STATE/LOCAL HEALTH DEPARTMENT					
	(10)	VOLUNTARY AGENCY *(i.e., Heart Fund, Cancer Society)*					
	(11)	CORRECTIONS INSTITUTION					
	(12)	COMPREHENSIVE HEALTH PLANNING AGENCY					
	(13)	DAY CARE CENTER					
	(14)	ELEMENTARY/SECONDARY SCHOOL					
	(15)	INSURANCE OFFICE					
	(16)	OTHERS *(Please Specify)*					

18 Who arranges for a student to attend an affiliated institution? CHECK ONLY ONE

CARD 11

(14-1) ☐ FACILITY MEMBER FROM YOUR INSTITUTION

(14-2) ☐ STUDENT HIMSELF

(14-3) ☐ BOTH OF THE ABOVE SITUATIONS EXIST WITHIN THIS PROGRAM

(14-4) ☐ COOPERATIVE ARRANGEMENT AMONG FACULTY MEMBER, STUDENT, AND AFFILIATE

(14-5) ☐ OTHER. *(Please Specify)*

19. Does any member of an affiliate institution OUTSIDE your school's administrative structure *(as reported in Column (2), Item 17)*, who is concerned with the instruction or supervision of your students, have an appointment on your faculty?

(15-1) ☐ YES (15-2) ☐ NO

If "Yes," how many of those institutions listed in Column (2), Item 17, have a member of their staff on your faculty?

(16-17) ☐

20. For the credit or clock hours of courses listed in Section A of Item 15, please indicate the number of faculty by the approximate percentage of their time spent teaching and/or supervising students in this program. Include those who teach and or supervise students in the clinical or the didactic portions of the program, or in both, regardless of the faculty member's full-time departmental appointment. Do NOT include time spent by faculty members' supervision of special projects, theses, or dissertations.

NUMBER OF FACULTY WITHIN PERCENTAGE OF TEACHING AND/OR SUPERVISING TIME

100% (18)	80% but less than 100% (20)	60% but less than 80% (22)	40% but less than 60% (24)	20% but less than 40% (26)	less than 20% (28)

(30-32) ☐ Of the total faculty above, how many Full Time Equivalent faculty teach in this program?

Is this Program accredited or approved by a national agency or national health professional association? *(Exclude general accreditation of institution as a whole or budgetary approvals by funding agencies.)*

Accreditation/Approval - The process by which an agency or organization evaluates and recognizes a program of study as meeting certain predetermined qualifications or standards. For this survey, only national agencies or organizations will be reported.

(33.1) ☐ PROGRAM IS ACCREDITED/APPROVED — PROCEED TO ITEM 22

(33.2) ☐ PROGRAM ACCREDITATION/APPROVAL IS IN PROCESS — PROCEED TO ITEM 22

(33.3) ☐ CLINICAL PORTION OF PROGRAM IS ACCREDITED/APPROVED OR APPROVAL IS IN PROCESS. ACADEMIC PORTION IS NOT APPROVED — PROCEED TO ITEM 22

(33.4) ☐ PROGRAM ACCREDITATION/APPROVAL PROCESS EXISTS FOR THIS TYPE PROGRAM BUT IS NOT BEING SOUGHT. — PROCEED TO ITEM 23

(33.5) ☐ PROGRAM TOO NEW TO SEEK ACCREDITATION/APPROVAL. — PROCEED TO ITEM 23

(33.6) ☐ NO ACCREDITATION/APPROVAL PROCESS EXISTS FOR THIS TYPE PROGRAM. — PROCEED TO ITEM 23

If this program or its principal clinical affiliate is accredited/approved, please check at the left the agency(ies) by which the program is accredited/approved, and supply the information in the columns to the right of the respective agency(ies), using the codes indicated in Columns (B) and (C).

		ACCREDITING/APPROVING AGENCIES	Year Program Last Accredited (A)	Status of Accreditation/Approval 1 = Full 2 = Conditional/ Provisional 3 = In Process (B)	Portion of Program Accredited/Approved 1 = Academic Only 2 = Clinical Only 3 = Total Program (C)
	(01) ☐	Accrediting Commission of Graduate Education for Hospital Administration			
	(02) ☐	American Academy of Pediatrics			
	(03) ☐	American Association of Clinical Pastoral Education			
	(04) ☐	American Association of Medical Assistants			
	(05) ☐	American Association of Nurse Anesthetists			
	(06) ☐	American Association of Pastoral Counselors			
	(07) ☐	American College of Nurse Midwives			
	(08) ☐	American Corrective Therapy Association			
	(09) ☐	American Council on Pharmaceutical Education			
	(10) ☐	American Dental Association, Council on Dental Education			
	(11) ☐	American Dietetic Association			
	☐	American Medical Association, Council on Medical Education, in collaboration with _____ *(Write in Collaborating Organization)*			
	(13) ☐	American Medical Technologists			
	(14) ☐	American Optometric Association			
	(15)	American Public Health Association			
	(16) ☐	Association for the Education of the Visually Handicapped			
	(17) ☐	Association of Medical Illustrators			
	(18) ☐	Association of Medical Rehabilitation Directors and Coordinators, Inc.			
	(19) ☐	Conference of Executives of American Schools of the Deaf			
	(20) ☐	Engineers Council for Professional Development			
	(21) ☐	International Society of Clinical Laboratory Technologists			
	(22) ☐	Medical Library Association			
	(23) ☐	National Association for Music Therapy			
	(24) ☐	National Council for the Accreditation of Teacher Education			
	(25) ☐	National Environmental Health Association			
	☐	Other *(Please specify)*			

SECTION D – PROGRAM ENROLLMENT AND CAPACITY

23. How many students were enrolled in this program as of October 15, 1973? Exclude students in correspondence courses, auditors, or students at branch campuses in foreign countries.

	STUDENT YEAR	FULL-TIME Total	FULL-TIME Male	FULL-TIME Female	PART-TIME Total	PART-TIME Male	PART-TIME Female
CARD 12	1st (or Freshman)						
	2nd (or Sophomore)						
	3rd (or Junior)						
CARD 13	4th (or Senior)						
	5th (Pre-baccalaureate, post-baccalaureate, or 1st Master's year)						
	6th						
CARD 14	7th						
	8th						
	Total						

If this does not reflect normal program enrollment, please explain. _____

24. Indicate the racial/ethnic distribution of all students, full-time and part-time, enrolled in this program as of October 15, 1973. Report each student in the racial/ethnic group with which the student most closely identifies. Each student should be reported in only ONE group.

	RACIAL/ETHNIC GROUP	TOTAL	MALE	FEMALE
CARD 15	BLACK/AFRO AMERICAN			
	WHITE			
	ORIENTAL/ASIAN			
	AMERICAN INDIAN			
	SPANISH SURNAME OR SPANISH SPEAKING (Puerto Rican, Latin American, Cuban, Mexican American, Chicano)			
	OTHER, i.e., Filipino, Aleut, Eskimo, etc. (Specify) _____			
CARD 16	TOTAL			

How many of the above students are foreign students (not U.S. citizens)? [ ]

25. For any given entering class in this program, estimate the percentage of students who will complete the program requirements and receive the award conferred.

(54-56) [ ] %

26. How many students could complete this program in the 1973-74 school year with present curriculum and standards, using presently available facilities and resources, IF FULL ENROLLMENT WERE ATTAINED? *(If clinical training or supervised field experience is required, do not include more students than can be accommodated for this training within one year.)*

(57-59) [ ] MAXIMUM GRADUATES

27. In what calendar year did this program first accept students?

(60-61)

(01) ☐ Prior to 1940	(04) ☐ 1951-55	(07) ☐ 1962	(10) ☐ 1965	(13) ☐ 1968	(16) ☐ 1971	
(02) ☐ 1940-45	(05) ☐ 1956-60	(08) ☐ 1963	(11) ☐ 1966	(14) ☐ 1969	(17) ☐ 1972	
(03) ☐ 1946-50	(06) ☐ 1961	(09) ☐ 1964	(12) ☐ 1967	(15) ☐ 1970	(18) ☐ 1973	

28. Is this program offered on a regular basis? *(A program offered on a regular basis has a definite and periodic schedule for matriculation of students.)*

(62-1) ☐ YES (62-2) ☐ NO

If "Yes," how many entering classes are accepted each year? ▶ (63-64)

(01) ☐ ONE	(04) ☐ FOUR	(07) ☐ SEVEN	(10) ☐ TEN	
(02) ☐ TWO	(05) ☐ FIVE	(08) ☐ EIGHT	(11) ☐ More than ten (specify no. _____)	
(03) ☐ THREE	(06) ☐ SIX	(09) ☐ NINE		

How many students graduated or otherwise successfully completed this Program in each school year, 1965-73? *(If more than one class per year completed the program, please combine the number of graduates for each year.)*

3 17

(14-17) ☐ 1965-66

(18-21) ☐ 1966-67

(22-25) ☐ 1967-68

(26-29) ☐ 1968-69

(30-33) ☐ 1969-70

(34-37) ☐ 1970-71

(38-41) ☐ 1971-72

(42-45) ☐ 1972-73

Estimate the number of students who are expected to complete this program successfully in the next three school years (if more than one class per year is expected to complete the program, please combine the number of graduates for each year.)

(46-49) ☐ 1973-74

(50-53) ☐ 1974-75

(54-57) ☐ 1975-76

Are you now implementing or planning to implement within the next 2 years a significant change in this program's enrollment?

(58-1) ☐ NO CHANGE IS PLANNED **PROCEED TO ITEM 32**

(58-2) ☐ YES, PROGRAM IS BEING EXPANDED **PROCEED TO ITEM 33**

(58-3) ☐ YES, PROGRAM IS BEING CURTAILED **PROCEED TO ITEM 32**

(58-4) ☐ YES, PROGRAM IS BEING PHASED OUT DATE OF FINAL ENTERING CLASS_____ **PROCEED TO ITEM 32**

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(59-60) ☐

If this program is not expanding, what reasons prevent or make unwise the expansion of this Program? Please indicate the degree of constraint beside each reason

3 18

(14-1) ☐ Program's present enrollment is satisfactory. **PROCEED TO ITEM 33**

	REASON FOR CONSTRAINT	NO CONSTRAINTS	MODERATE CONSTRAINTS	SEVERE CONSTRAINTS
(15-17)	Limited employment opportunities for graduates in this specialty	☐	☐	☐
	Insufficient applications from interested students difficult to recruit additional students	☐	☐	☐
	Limited operating funds *(insufficient funds for additional faculty, other staff, equipment, etc.)*	☐	☐	☐
	Unable to recruit qualified faculty to fill vacancies, when funds are available	☐	☐	☐
	Insufficient or unsuitable physical facilities for didactic instruction.	☐	☐	☐
	Inadequate or insufficient clinical training facilities	☐	☐	☐
	Insufficient financial aid for students	☐	☐	☐
	Limited by accrediting association	☐	☐	☐
(39-41)	Other *(Specify)* _____	☐	☐	☐

SECTION E – GUIDANCE INFORMATION

33. Please check the entrance requirements for your institution or your program. *(Do NOT include tests advised or required for guidance or placement purposes.)*

(42-1) ☐ INSTITUTION HAS OPEN ADMISSIONS POLICY.

(43-1) ☐ PROGRAM HAS OPEN ADMISSIONS POLICY.

ENTRANCE REQUIREMENTS	REQUIRED BY INSTITUTION	REQUIRED BY PROGRAM
(44-45) Scholastic Aptitude Test (CEEB Series)		
[illegible] Sample (CEEB Series)		
[illegible] Tests (CEEB Series)		
[illegible] Testing Program Examination (ACT)		
[illegible] Examination - Aptitude Test		
[illegible] Record Examination - Advanced Test		
(Please specify) _____		
Miller Analogy		
Standardized National Examination - Not Elsewhere Classified		
(Please specify) _____		
Institution - designed Examination		
Personal Interview		
Grade Point Average on a local system *(Specify* _____*)*		
Biographical Material		
Audition		
Portfolio		
Preference/Interest Tests		
(74-75) Other *(Please specify)* _____		

(76-78) OFFICIAL USE ONLY ☐

34. For four-year colleges and universities only, does your institution accept credits earned by students in a two-year college?

CARO19 (14-1) ☐ YES (14-2) ☐ NO COMMENT? _____

35. How many completed applications were received for this program's most recent entering class?

(15-18) ☐ NUMBER OF APPLICANTS

36. For your program, do you maintain a waiting list of qualified students who were not admitted at their first application?

(19-1) ☐ YES (19-2) ☐ NO

If "Yes," how long is a student's name maintained on the list

_____ MONTHS

(20-23) OFFICIAL USE ONLY ☐

What is the cost to students to complete the entire program, excluding room and board? *(From time of matriculation for GRADUATE programs. OR time of entry shown in Item 12, Page 3 of form, for UNDERGRADUATE programs.)*

		RESIDENT	NON RESIDENT	
TUITION *(or similar fee)*	(24-28)	_____	_____	(29-33)
BOOKS	(34-37)	_____	_____	(38-41)
LAB FEES	(42-44)	_____	_____	(45-47)
UNIFORMS	(48-50)	_____	_____	(51-53)
OTHERS	(54-57)	_____	_____	(58-61)
TOTAL	(62-66)	_____	_____	(67-71)

Check the types of financial aid available to students in your program

) 20
)-43)

(01) ☐ GENERAL INSTITUTIONAL SCHOLARSHIPS
(02) ☐ SPECIFIC PROGRAM SCHOLARSHIPS
(03) ☐ FEDERALLY INSURED LOANS
(04) ☐ FEDERAL GOVERNMENT SCHOLARSHIPS
(05) ☐ FEDERAL GOVERNMENT LOANS
(06) ☐ STATE GOVERNMENT SCHOLARSHIPS
(07) ☐ STATE GOVERNMENT LOANS
(08) ☐ WORK/STUDY PROGRAMS
(09) ☐ TRAINEESHIPS
(10) ☐ SALARIES PAID BY INSTITUTION OR CLINICAL AFFILIATE
(11) ☐ STIPENDS
(12) ☐ G. I. BILL
(13) ☐ FELLOWSHIPS
(14) ☐ ASSISTANTSHIPS
(15) ☐ OTHERS. *(Specify)*

_____
_____
_____

Please estimate the percentage of your program's students who work at the same time as they are enrolled in the program, in order to provide at least part of their support.

(44-46) ☐ %

Do you assist your students in finding employment upon completion of this program?

(47-1) ☐ YES (47-2) ☐ NO

If "Yes", check below the type(s) of assistance given

		BEFORE GRADUATION	AFTER GRADUATION
Formal *(Placement office, etc.)*	(48-49)	☐	☐
Informal *(Faculty Contacts, etc.)*	(50-51)	☐	☐

Please list the name and title of the Program Director or other person who can be contacted for further information about this Program.

NAME _____ TELEPHONE *(Area Code, Number, Ext.)*
TITLE _____

Respondent to this survey form, if different than Program Director named above, should be entered below.

NAME _____ TELEPHONE *(Area Code, Number, ext.)*
TITLE _____

T1 (Page 10)
)

Thank you for completing this survey. The information that you so kindly provided will be of great use to both guidance counselors and health planners. T
space below has been set aside for any comments you might have concerning this survey.

PLEASE RETURN THIS COMPLETED QUESTIONNAIRE TO:
ASSOCIATION OF SCHOOLS OF ALLIED HEALTH PROFESSIONS
ONE DUPONT CIRCLE, N.W.
SUITE 300
WASHINGTON, D.C. 20036

HRA - T1 (Page 11)
(10-73)

A - T3
- 73

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
HEALTH RESOURCES ADMINISTRATION
BUREAU OF HEALTH RESOURCES DEVELOPMENT
DIVISION OF MANPOWER INTELLIGENCE
IN COLLABORATION WITH THE

O.M.B. NO. 68-S73131
Approval Expires: JUNE 30, 1974

ASSOCIATION OF SCHOOLS OF ALLIED HEALTH PROFESSIONS
1973 INVENTORY OF HEALTH OCCUPATIONS EDUCATION PROGRAMS IN TWO-YEAR AND FOUR-YEAR COLLEGES AND UNIVERSITIES

INSTRUCTIONS FOR QUESTIONNAIRE III

FORM HRA - T3 (10-73)

TURN OF THE QUESTIONNAIRE: Please complete this questionnaire and return it to the Association in the enclosed relope no later than _____. Questions should be directed to Ms. Marlene Leonard at the Association Headarters in Washington, D.C., Area Code 202, Phone. 293-3422.

ie questionnaire should be completed for each health occupational program being planned at your institution.

fore attempting to complete the questionnaire, please take a few minutes to read the following definitions and criteria for porting future programs.

DEFINITIONS AND CRITERIA FOR REPORTING PROGRAMS

OGRAM - A health occupations education program, for purposes of the Inventory, includes formal classroom instruction, oratory instruction, clinical training, and/or supervised field experience, leading to competency in a specific health occupation profession, and resulting in a degree, certificate, or diploma. PROGRAMS OFFERED AT DIFFERENT AWARD LEVELS ND HAVING DIFFERENT PRE-REQUISITES ARE CONSIDERED TO BE SEPARATE PROGRAMS. A SEPARATE UESTIONNAIRE MUST BE COMPLETED FOR EACH PROGRAM.

ie following requirements must be met for the inclusion of a future program in the Inventory:

- The planned program will become active with an established matriculation date between October 15, 1973 and October 17, 1975.
- A diploma, certificate, or degree will be granted by the reporting institution after the professional component of the program has been completed. *(Note: do not report programs which will award only a "Certificate of Attendance.")*
- The planned program will be at least 36 clock hours in duration.

CLUSIONS: The enclosed *Glossary of Occupational Titles* present examples of health occupations whose education proams will be included in the Inventory. This list is not intend- to be all inclusive. Programs for occupations not specifically ted should be reported if you consider them to be within the imework of the Glossary.

WARD LEVEL - Degree, diploma, and certificate programs ould be reported in this survey and are defined as follows

- Degree Program. Any program which results in the awarding of an associate, bachelor's, master's or doctoral degree.
- Diploma Program. Any program which results in a diploma granted for at least 3 but less than 4 years of training after the 12th grade.
- Certificate Program. All of the following certificates should be reported:
  - Occupational/Vocational Certificate: Certificate awarded for training of at least 36 clock hours duration but not more than 36 months duration after matriculation in the program.
  - Collegiate Certificate: Certificate awarded for training (other than continuing education) of more than 36 months beyond the 12th grade, or post-baccalaureate training for which NO additional degree is granted.
  - Certificate of Advanced Standing: Certificate awarded for training which is beyond the Master's, but NOT at the Doctoral, degree level.
  - Continuing Education Certificate: Certificate awarded for training to maintain a health worker's proficiency, which signifies evaluation of the worker's participation in the program.

PROGRAMS OFFERED AT DIFFERENT AWARD LEVELS ARE CONSIDERED DIFFERENT PROGRAMS AND SHOULD BE REPORTED SEPARATELY.

EXCLUSIONS: The Inventory is limited by the exclusion of various types of programs.

DO NOT report:

- Programs which award only a "Certificate of Attendance.
- Programs leading to the M.D. or D.D. degree, graduate and continuing education of physicians and premedical courses.
- Programs for dentists, optometrists, podiatrists, pharmacists, and veterinarians.
- Programs leading to licensure as R.N., L.V.N., L.P.N., and programs of continuing education for such persons, but programs for nursing-related occupations are included.
- Programs for engineers at all levels with the exception of those programs which you judge to have a significant biomedical/environmental health content or emphasis.
- Programs for natural scientists such as biologic and microbiologic scientists.
- Programs for social scientists, including psychologists.
- Programs for social workers at all levels with the exception of those programs which you judge to have a significant medical or psychiatric content or emphasis.
- Programs for mathematicians and statisticians at all levels with the exception of those programs which you judge to have a significant health statistics content and emphasis.

PLEASE PRINT USING BLUE OR BLACK INK WHEN COMPLETING THIS FORM

HRA - T3
10-73

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

O.M.B. Approval No. 68-R73131
Approval Expires: JUNE 30, 1974

PUBLIC HEALTH SERVICE
HEALTH RESOURCES ADMINISTRATION
BUREAU OF HEALTH RESOURCES DEVELOPMENT
DIVISION OF MANPOWER INTELLIGENCE
IN COLLABORATION WITH THE

ASSOCIATION OF SCHOOLS OF ALLIED HEALTH PROFESSIONS

1973 INVENTORY OF HEALTH OCCUPATIONS EDUCATION PROGRAMS IN TWO-YEAR AND FOUR-YEAR COLLEGES AND UNIVERSITIES

QUESTIONNAIRE III - FUTURE PROGRAMS

FORM HRA - T3 (10-73)

SECTION A - INSTITUTIONAL DATA

1 Responding Institution

NAME

CITY STATE , ZIP CODE

OFFICIAL USE ONLY

2. Respondent NAME

TITLE

TELEPHONE DATA

AREA CODE NUMBER EXT.

DATE

SECTION B - PROGRAM IDENTIFICATION

1. From the enclosed *Glossary of Occupational Titles*, indicate in the boxes below the TWO-DIGIT number of the major category into which your program falls.

CARD 01 (15-16) ☐☐ MAJOR CATEGORY

2. From the occupational titles listed under the major categories of the *Glossary*, indicate in the boxes below the TWO-DIGIT code number of the occupation which most closely resembles that for which your students will be prepared.

(19 20) ☐☐ OCCUPATIONAL TITLE

If nothing in the *Glossary* approximates the occupational title for which your students will be prepared, indicate the occupational title which will describe your training efforts.

If you have indicated that no occupational title in the *Glossary* approximates that for which your students will be prepared, a description of the duties commonly associated with the occupational title.

If your program's occupational title was not listed in the *Glossary*, please send any materials you have to further describe your program, i.e., catalog, brochure, etc., when returning the questionnaire.

3. By what title is this program known at your institution?

(23 72) OFFICIAL USE ONLY

Indicate the MINIMUM previous education to be REQUIRED for entry in this program.
(Note: If it seems appropriate for you to check more than one, you may be reporting more than one program on this form. Please re-examine the definition of "program" found in the INSTRUCTIONS.)

ARD 02
(14-21)

(01) ☐ NONE
(02) ☐ SOME HIGH SCHOOL *(Specify Minimum Grade _____)*
(03) ☐ HIGH SCHOOL DIPLOMA OR CERTIFICATE OF HIGH SCHOOL EQUIVALENCY
(04) ☐ LESS THAN 2 YEARS COLLEGE
(05) ☐ 2 YEARS COLLEGE *(without Degree)*
(06) ☐ REGISTERED NURSE PREPARATION
(07) ☐ ASSOCIATE DEGREE
(08) ☐ 3 YEARS COLLEGE
(09) ☐ 4 YEARS COLLEGE *(without Degree)*
(10) ☐ BACHELOR'S DEGREE
(11) ☐ MASTER'S DEGREE
(12) ☐ DOCTORAL DEGREE
☐ OTHER *(Please specify)* _____

FOR OFFICIAL USE ONLY (22-23) ☐☐

Check the specific academic background(s) to be REQUIRED for entry into this program. CHECK AS MANY AS APPLY

(24-83)

(01) ☐ NONE
(02) ☐ BIOLOGICAL SCIENCES
(03) ☐ CHEMICAL SCIENCES
(04) ☐ CLERICAL SKILLS
(05) ☐ FINE ARTS
(06) ☐ GENERAL SCIENCES
(07) ☐ INDUSTRIAL ARTS
(08) ☐ MATHEMATICS
(09) ☐ PHYSICAL EDUCATION
(10) ☐ PHYSICAL SCIENCES
(11) ☐ SOCIAL/BEHAVIOR SCIENCES

SPECIFIC HEALTH TRAINING

(12) ☐ Basic Preparation in Occupation or Discipline for which this is an advanced course
(13) ☐ Nursing, R.N.
(14) ☐ Other Specific Health Training

(15) ☐ REQUIRED BACKGROUND NOT ELSEWHERE CLASSIFIED.
(specify) _____

Indicate the type of program you are reporting. CHECK ONLY ONE

(54-1) ☐ BASIC OCCUPATIONAL PREPARATION: Program designed to provide students with the knowledge and skills needed to work in a specific occupation at the entry level of that occupation. Admission to program does not require previous formal training in the occupation but may build on previous informal training or practical experience. Typically, this type of program grants the "first professional degree," leads to certification or licensure, or prepares the student for an entry-level job. The program may be academic at the undergraduate level or may be non-academic.

(54-2) ☐ ADVANCED EDUCATION OR TRAINING: Program designed to provide health workers with formal education or training beyond that which is offered as "Basic Occupational Preparation," AND which confers additional academic credit or professional recognition in a specific discipline or occupation. This type of program includes SPECIALTY TRAINING which qualifies the individual in a recognized specialty of his discipline, for which there are specific educational requirements beyond "Basic Occupational Preparation."

(54-3) ☐ CONTINUING EDUCATION: Program of educational activities designed to maintain a health worker's proficiency in his occupation. Continuing education up-dates "Basic Occupational Preparation," or "Advanced Education."

(54-4) ☐ TEACHER TRAINING: Program which provides individuals ALREADY TRAINED in a health profession with competency as teachers or as educational program managers. Teacher training may include some elements which are advanced education or training, but it is never limited to this.

7. How many calendar months, exclusive of vacation time, will be required for a student to complete this program?

(55-57) [ ] MONTHS

8. Indicate the level at which this program will be offered and the SPECIFIC award to be granted upon completion of the program *(i.e., BS, BA, MPH, etc.)*

CHECK ONLY ONE

(Note: If it seems appropriate for you to check more than one, you may be reporting more than one program on this form. Please re-examine the definition of "program" found in the INSTRUCTIONS.)

(58-59)		LEVEL OF OFFERING	SPECIFIC AWARD CONFERRED
	(01) [ ]	OCC/VOC CERTIFICATE I *(Less than 6 months)*	
	(02) [ ]	OCC/VOC CERTIFICATE II *(6 But less than 12 months)*	
	(03) [ ]	OCC/VOC CERTIFICATE III *(12 But less than 24 months)*	
	(04) [ ]	OCC/VOC CERTIFICATE IV *(24 - 36 months)*	
	(05) [ ]	DIPLOMA	
	(06) [ ]	ASSOCIATE DEGREE	
	(07) [ ]	ASSOCIATE DEGREE + CERTIFICATE	
	(08) [ ]	BACHELOR'S DEGREE	
	(09) [ ]	BACHELOR'S DEGREE + CERTIFICATE	
	(10) [ ]	COLLEGIATE CERTIFICATE ONLY *(Training at or beyond baccalaureate level)*	
	(11) [ ]	MASTER'S DEGREE	
	(12) [ ]	MASTER'S DEGREE + CERTIFICATE	
	(13) [ ]	CERTIFICATE OF ADVANCED STANDING *(Training beyond Master's Degree level but not at Doctoral Degree level)*	
	(14) [ ]	DOCTORAL DEGREE	
	(15) [ ]	CONTINUING EDUCATION CERTIFICATE	

OFFICIAL USE ONLY [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]

60 61 62 63 64 65 66 67 68 69 70 73 74 75

9. In what month and year is matriculation of the first class planned?

CARD 03 OFFICIAL USE ONLY (14-17) [ ] [ ] MONTH YEAR

10. What is the anticipated capacity of the program's entering class?

(18-20) [ ] CAPACITY

PLEASE RETURN THIS COMPLETED QUESTIONNAIRE TO:
ASSOCIATION OF SCHOOLS OF ALLIED HEALTH PROFESSIONS
ONE DUPONT CIRCLE, N.W.
SUITE 300
WASHINGTON, D.C. 20036

APPENDIX B. SELECTED TABLES USEFUL FOR ESTIMATING HEALTH MANPOWER REQUIREMENTS AND SUPPLY

List of Tables
Health Manpower Requirements

Health Manpower Requirements
Utilization of Health Services

Table B-1. Number of Physician Visits per Person per Year by Family Income, Sex and Age: United States, 1969

Sex and age	Family income						
	All incomes[1]	Less than $3,000	$3,000-$4,999	$5,000-$6,999	$7,000-$9,999	$10,000-$14,999	$15,000 or more
	Number of visits per person per year						
Both sexes							
All ages	4.3	4.8	4.5	3.9	4.1	4.2	4.5
Under 5 years	5.7	4.2	4.6	5.2	6.1	6.7	7.1
5–14 years	2.8	2.0	2.0	2.2	2.7	3.4	3.7
15–24 years	3.7	3.7	3.9	3.7	3.8	3.5	3.7
25–34 years	4.4	4.6	5.0	4.0	4.2	4.5	5.1
35–44 years	4.1	5.8	4.9	3.8	3.8	4.2	4.2
45–54 years	4.3	5.4	5.6	3.7	4.2	4.0	4.4
55–64 years	5.1	5.5	5.4	5.4	5.4	4.6	4.8
65–74 years	6.1	6.2	6.2	5.4	6.3	6.3	9.2
75 years and over	6.2	5.7	6.9	6.2	5.6	6.7	8.5
Male							
All ages	3.7	3.9	4.0	3.3	3.6	3.9	4.0
Under 5 years	6.0	4.2	4.6	5.3	6.8	7.0	7.0
5–14 years	2.9	2.1	2.2	2.3	2.9	3.7	3.6
15–24 years	2.9	2.8	2.5	2.8	3.0	2.9	3.8
25–34 years	3.0	3.7	3.6	2.8	2.9	3.1	2.5
35–44 years	3.3	4.1	4.8	3.2	2.9	3.5	3.4
45–54 years	3.5	3.9	5.0	2.7	3.3	3.6	3.7
55–64 years	4.8	4.9	5.7	4.7	5.1	4.6	4.7
65–74 years	5.5	5.6	5.7	4.6	5.7	5.1	8.1
75 years and over	5.5	4.7	6.3	4.8	4.9	7.5	8.3
Female							
All ages	4.7	5.4	4.9	4.5	4.5	4.5	5.1
Under 5 years	5.5	4.2	4.6	5.2	5.5	6.3	7.2
5–14 years	2.6	1.9	1.7	2.2	2.5	3.0	3.9
15–24 years	4.3	4.7	5.0	4.5	4.4	4.0	3.7
25–34 years	5.7	5.2	6.0	5.2	5.4	5.9	7.3
35–44 years	4.8	6.7	5.0	4.3	4.6	4.9	5.0
45–54 years	5.1	6.3	6.1	4.6	5.1	4.5	5.0
55–64 years	5.4	5.8	5.2	6.1	5.7	4.6	4.9
65–74 years	6.6	6.6	6.7	6.2	6.7	7.6	10.4
75 years and over	6.7	6.3	7.6	7.2	6.1	6.2	8.6

[1] Includes unknown income.

Table B-2. Number of Physician Visits per Person per Year by Race, Sex, and Age: United States, 1969

Sex and age	Total	White	All other
	Number of visits per person per year		
Both sexes			
All ages	4.3	4.4	3.5
Under 5 years	5.7	6.1	4.0
5–14 years	2.8	2.9	1.8
15–24 years	3.7	3.7	3.3
25–34 years	4.4	4.5	4.1
35–44 years	4.1	4.0	4.7
45–54 years	4.3	4.3	4.4
55–64 years	5.1	5.2	4.5
65–74 years	6.1	6.2	4.9
75 years and over	6.2	6.3	5.4
Male			
All ages	3.7	3.9	2.8
Under 5 years	6.0	6.4	3.8
5–14 years	2.9	3.1	1.8
15–24 years	2.9	3.0	2.1
25–34 years	3.0	3.1	2.3
35–44 years	3.3	3.3	3.5
45–54 years	3.5	3.6	3.0
55–64 years	4.8	4.9	3.9
65–74 years	5.5	5.6	4.4
75 years and over	5.5	5.5	5.3
Female			
All ages	4.7	4.8	4.2
Under 5 years	5.5	5.8	4.2
5–14 years	2.6	2.8	1.8
15–24 years	4.3	4.3	4.4
25–34 years	5.7	5.7	5.5
35–44 years	4.8	4.7	5.6
45–54 years	5.1	5.0	5.6
55–64 years	5.4	5.4	5.0
65–74 years	6.6	6.7	5.4
75 years and over	6.7	6.8	5.5

Table B-3. Number of Physician Visits per Person per Year by Race, Family Income and Age: United States, 1969

Family income and age	Total	White	All other
All incomes[1]	Number of visits per person per year		
All ages	4.3	4.4	3.5
Under 15 years	3.7	3.9	2.5
15–44 years	4.0	4.0	3.9
45–64 years	4.7	4.7	4.4
65 years and over	6.1	6.2	5.1
Less than $5,000			
All ages	4.6	5.0	3.5
Under 15 years	2.8	3.3	2.1
15–44 years	4.3	4.4	4.1
45–64 years	5.5	5.8	4.4
65 years and over	6.1	6.2	5.5
$5,000 or more			
All ages	4.2	4.2	3.6
Under 15 years	3.9	4.0	2.9
15–44 years	4.0	4.0	3.9
45–64 years	4.5	4.5	4.6
65 years and over	6.4	6.6	3.4

[1] Includes unknown income.

Table B-4. Number of Dental Visits per Person per Year, by Family Income, Sex, and Age: United States, 1969

Sex and age	All incomes[1]	Family income					
		Less than $3,000	$3,000-$4,999	$5,000-$6,999	$7,000-$9,999	$10,000-$14,999	$15,000 or more
		Number of visits per person per year					
Both sexes							
All ages	1.5	0.8	1.0	1.1	1.4	1.9	2.5
Under 5 years	0.3	*	*	*	0.3	0.4	*
5–14 years	1.8	0.8	1.0	1.2	1.7	2.2	3.2
15–24 years	1.7	1.4	1.2	1.4	1.9	2.0	2.5
25–44 years	1.6	1.0	1.1	1.0	1.4	2.0	2.4
45–64 years	1.6	0.8	1.2	1.2	1.4	1.8	2.5
65 years and over	1.0	0.6	1.0	1.3	1.7	1.3	2.6
Male							
All ages	1.4	0.7	0.8	0.9	1.3	1.7	2.3
Under 5 years	0.3	*	*	*	*	*	*
5–14 years	1.7	0.8	1.0	1.1	1.6	2.2	2.8
15–24 years	1.6	1.4	0.9	1.4	1.8	1.6	2.4
25–44 years	1.4	*	0.7	0.8	1.3	1.8	2.3
45–64 years	1.4	*	0.9	1.0	1.2	1.6	2.2
65 years and over	1.0	0.6	0.9	1.0	1.5	*	*
Female							
All ages	1.6	0.8	1.2	1.2	1.5	2.0	2.7
Under 5 years	0.3	*	*	*	*	*	*
5–14 years	1.9	*	1.1	1.3	1.8	2.1	3.6
15–24 years	1.9	1.4	1.4	1.3	1.9	2.4	2.6
25–44 years	1.8	1.1	1.4	1.2	1.5	2.2	2.6
45–64 years	1.7	0.9	1.5	1.3	1.7	2.1	2.7
65 years and over	1.1	0.6	1.1	1.5	1.8	*	3.3

[1] Includes unknown income.

Table B-5. Number of Dental Visits per Person per Year, by Race, Sex and Age: United States, 1969

Sex and age	Total	White	All other
	Number of visits per person per year		
Both sexes			
All ages	1.5	1.6	0.7
Under 5 years	0.3	0.3	*
5–14 years	1.8	2.0	0.8
15–24 years	1.7	1.9	0.8
25–44 years	1.6	1.7	1.0
45–64 years	1.6	1.6	0.8
65 years and over	1.0	1.1	*
Male			
All ages	1.4	1.5	0.7
Under 5 years	0.3	0.4	*
5–14 years	1.7	1.9	0.8
15–24 years	1.6	1.7	0.7
25–44 years	1.4	1.5	0.8
45–64 years	1.4	1.5	0.7
65 years and over	1.0	1.0	*
Female			
All ages	1.6	1.7	0.8
Under 5 years	0.3	0.3	*
5–14 years	1.9	2.1	0.8
15–24 years	1.9	2.0	1.0
25–44 years	1.8	1.9	1.1
45–64 years	1.7	1.8	0.8
65 years and over	1.1	1.1	*

Table B-6. Number of Dental Visits per Person per Year, by Race, Family Income and Age: United States, 1969

Family income and age	Total	White	All other
	Number of visits per person per year		
All incomes[1]			
All ages	1.5	1.6	0.7
Under 5 years	0.3	0.3	•
5–14 years	1.8	2.0	0.8
15–24 years	1.7	1.9	0.8
25–44 years	1.6	1.7	1.0
45–64 years	1.6	1.6	0.8
65 years and over	1.0	1.1	•
than 000			
All ages	0.9	1.0	0.6
Under 5 years	•	•	•
5–14 years	0.9	1.2	0.6
15–24 years	1.3	1.4	0.8
25–44 years	1.1	1.2	0.8
45–64 years	1.0	1.1	0.6
65 years and over	0.7	0.7	•
$5,000 or more			
All ages	1.7	1.7	0.8
Under 5 years	0.3	0.4	
5–14 years	2.0	2.1	
15–24 years	1.9	2.0	0.8
25–44 years	1.7	1.7	1.0
45–64 years	1.7	1.8	1.0
65 years and over	1.6	1.6	•

[1] Includes unknown income.

Table B-7. Number of Short-Stay Hospital Days During the Past Year per Person with 1 + Hospital Episodes, by Number of Episodes, Sex, and Age: United States, 1969

Sex and age	Number of hospital episodes: All episodes	1	2	3+
	Days per person with episodes			
Both sexes				
All ages	10.5	7.7	21.0	44.1
Under 17 years	6.8	5.3	13.8	34.3
17–24 years	6.7	5.6	14.7	27.4
25–34 years	7.1	5.4	14.9	37.4
35–44 years	9.8	7.2	20.0	42.0
45–64 years	13.6	10.1	23.5	50.0
65+ years	18.5	13.3	30.6	50.2
Male				
All ages	12.3	9.0	24.5	52.3
Under 17 years	6.8	5.5	14.5	34.0
17–24 years	11.2	9.6	21.4	39.1
25–34 years	9.9	7.5	23.1	72.9
35–44 years	11.5	8.6	21.3	63.0
45–64 years	16.0	10.8	26.5	64.0
65+ years	18.4	12.9	32.3	60.1
Female				
All ages	9.3	7.0	18.8	38.2
Under 17 years	6.3	5.1	13.1	34.8
17–24 years	5.4	4.3	12.7	22.8
25–34 years	6.3	4.7	13.0	30.2
35–44 years	8.0	6.6	19.2	34.3
45–64 years	12.4	9.6	20.6	40.2
65+ years	18.6	13.6	29.2	50.4

Table B-8. Number of Discharges from Short-Stay Hospitals per 100 Persons per Year, by Sex and Age: United States, 1969

Age	Both sexes	Male	Female
	Number of discharges per 100 persons per year		
All ages	12.9	10.6	15.1
Under 17 years	8.5	6.9	6.0
17–24 years	15.5	8.2	21.8
25–34 years	16.4	7.6	24.4
35–44 years	12.9	10.7	15.0
45–64 years	14.8	14.2	15.4
65 years and over	24.1	25.1	23.3

Table B-9. Estimated Total Resident Population by Age, Sex, and Family Income Level: United States, 1970 (In thousands)

Sex and age	All incomes	Under $5,000	$5,000-$9,999	$10,000-$14,999	$15,000 & over
All persons	202,466	40,342	62,097	53,541	46,486
Under 14 years	54,273	8,869	18,660	15,976	10,768
14–24 years	39,389	6,948	11,648	10,152	10,641
25–44 years	47,870	5,547	15,488	15,143	11,692
45–64 years	41,696	7,796	11,793	10,420	11,687
65 years and over	19,238	11,182	4,508	1,850	1,698
Male	98,161	16,982	30,430	26,955	23,794
Under 14 years	27,611	4,532	9,480	8,126	5,473
14–24 years	19,172	3,173	5,473	4,990	5,536
25–44 years	23,303	2,218	7,759	7,628	5,788
45–64 years	10,832	2,698	5,531	5,386	6,217
65 years and over	8,153	4,361	2,187	825	780
Female	104,305	23,360	31,667	26,586	22,692
Under 14 years	26,662	4,337	9,180	7,850	5,295
14–24 years	20,217	3,775	6,175	5,162	5,106
25–44 years	24,477	3,329	7,729	7,515	5,904
45–64 years	21,864	5,098	6,262	5,034	5,470
65 years and over	11,086	6,821	2,321	1,025	918

Table B-10. Estimated Total Resident Population by Age, Sex, and Family Income Level: United States, 1980 (In thousands)

Sex and age	All incomes	Under $5,000	$5,000-$9,999	$10,000-$14,999	$15,000 & over
All persons	227,765	25,954	46,431	55,952	99,428
Under 14 years	53,400	4,367	12,667	14,550	21,816
14–24 years	44,793	4,275	8,747	10,775	20,996
25–44 years	62,357	3,546	13,425	17,527	27,859
45–64 years	43,513	4,515	7,991	10,149	20,858
65 years and over	23,702	9,251	3,601	2,951	7,899
Male	111,241	10,776	22,528	27,707	50,230
Under 14 years	27,244	2,423	6,330	7,266	11,225
14–24 years	22,739	2,076	4,190	5,421	11,052
25–44 years	31,008	1,390	6,727	8,786	14,105
45–64 years	20,568	1,346	3,621	5,070	10,531
65 years and over	9,682	3,541	1,660	1,164	3,317
Female	116,524	15,178	23,903	28,245	49,198
Under 14 years	26,156	1,944	6,337	7,284	10,591
14–24 years	22,054	2,199	4,557	5,354	9,944
25–44 years	31,349	2,156	6,698	8,741	13,754
45–64 years	22,945	3,169	4,370	5,079	10,327
65 years and over	14,020	5,710	1,941	1,787	4,582

Table B-11. Estimated Total Resident Population by Age, Sex, and Family Income Level: United States, 1985 (In thousands)

Sex and age	All incomes	Under $5,000	$5,000-$9,999	$10,000-$14,999	$15,000 & over
All persons	240,154	23,182	41,127	51,422	124,423
Under 14 years	57,505	3,922	11,535	13,668	28,380
14–24 years	41,626	3,236	6,763	8,694	22,933
25–44 years	71,983	3,567	13,001	17,507	37,908
45–64 years	43,523	3,779	6,621	8,809	24,314
65 years and over	25,517	8,678	3,207	2,744	10,888
Male	117,336	9,569	19,858	25,343	62,566
Under 14 years	29,359	2,190	5,739	6,796	14,634
14–24 years	21,129	1,603	3,182	4,334	12,010
25–44 years	35,946	1,401	6,508	8,771	19,266
45–64 years	20,575	1,065	2,966	4,394	12,150
65 years and over	10,327	3,310	1,463	1,048	4,506
Female	122,818	13,613	21,269	26,079	61,857
Under 14 years	28,146	1,732	5,796	6,872	13,746
14–24 years	20,497	1,633	3,581	4,360	10,923
25–44 years	36,037	2,166	6,493	8,736	18,642
45–64 years	22,948	2,714	3,655	4,416	12,164
65 years and over	15,190	5,368	1,744	1,696	6,382

Table B-12. Estimated Total Resident Population by Age, Sex, and Family Income Level: United States, 1990 (In thousands)

Sex and age	All Incomes	Under $5,000	$5,000-$9,999	$10,000-$14,999	$15,000 & over
All persons	251,431	20,914	37,140	47,444	145,933
Under 14 years	59,161	3,366	10,349	12,456	32,990
14–24 years	41,095	2,671	5,722	7,544	25,158
25–44 years	78,493	3,297	12,237	16,810	46,149
45–64 years	45,171	3,352	5,878	8,037	27,904
65 years and over	27,511	8,228	2,954	2,597	13,732
Male	122,934	8,602	17,873	23,307	73,152
Under 14 years	30,205	1,918	5,126	6,161	17,000
14–24 years	20,883	1,346	2,661	3,740	13,136
25–44 years	39,323	1,291	6,122	8,417	23,493
45–64 years	21,441	915	2,625	4,017	13,884
65 years and over	11,082	3,132	1,339	972	5,639
Female	128,497	12,312	19,267	24,137	72,781
Under 14 years	28,956	1,448	5,223	6,295	15,990
14–24 years	20,212	1,325	3,061	3,804	12,022
25–44 years	39,170	2,006	6,115	8,393	22,656
45–64 years	23,730	2,437	3,253	4,020	14,020
65 years and over	16,429	5,096	[illegible]	1,625	8,093

Table B-13. Care Utilization Rates by Population Category and by Type of Care (Visits/Year), 1990

Population Age, Sex, and Family Income	Medical Office					Short-Term Hosp.			Long-Term Hosp.	Other Care			Other
	General Care	Pediatric Care	Ob-Gyn. Care	Psych. Care	Other Care	Outp. Care	Surg. Care	Medical Care	Psych. Care	Nursing Home	Vision Care	Dental Care	Pharmacy Services
Income under $5,000													
Male													
Under 14 years	1.9101	.4759	.0083	.0278	.3083	.8017	.0350	.057			.0206	.6785	2.9000
14-24 years	1.9810			.0288	.5757	.5268	.0443	.039			.0654	1.0894	1.7000
25-44 years	2.5110			.1328	1.4630	.7710	.0678	.236	.0034	.0003	.0147	.7083	2.7000
45-64 years	3.8051			.0764	1.1514	.5676	.0772	.157[illegible]	.0062	.0010	.0466	.6845	5.2000
65 years and over	4.3588			.0189	1.5462	.4035	.0819	.178	.0099	.0180	.1338	.6856	9.3000
Female													
Under 14 years	1.6149	.5040	.0079		.3238	.6485	.0884	.0450			.0211	.8253	2.7000
14-24 years	3.0951		.7004	.0327	.6393	.5788	.1750	.0585			.0373	1.4012	3.6000
25-44 years	4.0800	.0337	.4803	.0675	.9534	1.2643	.1704	.[illegible]012	.0019	.0002	.0997	1.3067	5.5000
45-64 years	4.3287		.1233	.0210	1.0413	.6918	.0645	.[illegible]80	.0052	.0010	.123	1.1898	7.9000
65 years and over	5.2872		.0324	.0070	.7607	.4608	.0761	.144[illegible]	.0116	.0311	.2286	.7379	13.1000
Income $5,000-9,999													
Male													
Under 14 years	1.9605	.9819	.0262	.0093	.3647	.5729	.0371	.0441			.0379	.9482	2.9000
14-24 years	2.1048	.0284	.0154	.0168	.5657	.3312	.0455	.0410			.0488	1.6871	1.7000
25-44 years	2.0832	.0158	.0034	.0227	.7421	.3925	.0455	.0507	.0034	.[illegible]03	.0661	1.0910	2.7000
45-64 years	2.9781			.0153	.8466	.3427	.0578	.008[illegible]	.009[illegible]	.0010	.0480	1.1181	5.2000
65 years and over	3.9456				.9793	.3025	.0822	.14[illegible]	.0099	.0180	.2822	1.2111	9.3000
Female													
Under 14 years	1.7020	.8193	.0100		.3215	.3664	.0794	.0301			.0297	1.0483	2.7000
14-24 years	2.3565	.0389	1.1104	.0615	.4422	.2661	.1741	.0419			.0344	1.7310	3.6000
25-44 years	3.0390	.0225	.8115	.0724	.7090	.4237	.1688	.0656	.0[illegible]4	.0002	.0485	1.3730	5.5000
45-64 years	3.7715		.1484	.0269	1.0420	.3819	.0016	.0981	.0052	.0010	.0787	1.4782	7.9000
65 years and over	5.0973		.0368	.0212	.9233	.2391	.0791	.1690	.0116	.0311	.2677	1.5914	13.1000

Table B-13 (continued)

Population Age, Sex, and Family Income	Medical Office					Short-Term Hosp.			Long-Term Hosp.	Other Care			Other
	General Care	Pediatric Care	Ob-Gyn. Care	Psych. Care	Other Care	Outp. Care	Surg. Care	Medical Care	Psych. Care	Nursing Home	Vision Care	Dental Care	Pharmacy Services
Income $10,000-14,999													
Male													
Under 14 years	1.8612	1.2823	.0133		.5028	.3411	.0417	.0346			.0606	1.6579	2.9000
14–24 years	2.0770	.1006		.0943	.7210	.3628	.0378	.0301			.1355	1.7246	1.7000
25–44 years	2.0125	.0294	.0116	.0771	.9665	.5189	.0469	.0409	.0034	.0003	.0699	1.7765	2.7000
45–64 years	2.8090		.0077	.0408	.9670	.2885	.0620	.0679	.0062	.0010	.1096	1.5964	5.2000
65 years and over	3.7257			.1241	2.5119	.7304	.0853	.1485	.0099	.0180	.2248	1.4303	9.3000
Female													
Under 14 years	1.3043	1.3417			.16[illegible]	.3217	.0839	.0236			.0877	1.5860	2.7000
14–24 years	2.1283	.0744	.8006		.5074	.2032	.0944	.0356			.1138	2.4815	3.6000
25–44 years	2.9968	.0246	1.1140	.0960	.5856	.3962	.1592	.0575	.0019	.0002	.0296	2.2023	5.5000
45–64 years	3.0742	.0092	.2437	.0649	.3066	.3728	.1017	.0739	.0052	.0010	.0468	2.0915	7.9000
65 years and over	5.3353		.1115		.6059	.2992	.1131	.1840	.0116	.0311	.2868	1.2436	13.1000
Income $15,000 and over													
Male													
Under 14 years	1.5224	1.2681	.0324		.5133	.3249	.0386	.0186			.0813	2.2241	2.9000
14–24 years	2.4331	.1514		.0757	.9855	.5122	.0534	.0387			.0658	2.5837	1.7000
25–44 years	1.8650		.0375		.9664	.3311	.0435	.0449	.0034	.0003	.0358	2.2908	2.7000
45–64 years	2.7049	.0103	.0109	.0325	1.1408	.3177	.0525	.0718	.0062	.0010	.0758	2.2246	5.2000
65 years and over	5.4928				4.1243	.0903	.1201	.1755	.0099	.0180	.3492	1.9639	9.3000
Female													
Under 14 years	1.4958	1.6521		.0260	.5577	.3377	.0892	.0233			.0660	2.4913	2.7000
14–24 years	2.0529	.1718	.3899	.0439	.7391	.2463	.0602	.0349			.0406	3.1359	3.6000
25–44 years	2.8028	.0103	1.2643	.1021	1.0640	.4305	.1260	.0425	.0019	.0002	.0991	2.5305	5.5000
45–64 years	3.1888	.0123	.3153	.0619	1.0311	.3992	.0868	.0650	.0052	.0010	.1305	2.7212	7.9000
65 years and over	6.6989		.1585	.0981	.5839	.5716	.1425	.1852	.0116	.0311	.1744	3.2823	13.1000

Table B-14. Estimated Health Manpower by Type of Care and Type of Occupation: United States, 1970, 1960

	LONG-TERM HOSP.		OTHER CARE					OTHER		
	Psych. Care	Other Care	Nursing Home	Vision Care	Dental Care	Veterinary Care	Other Care	Lab. Services	Pharmacy Services	Noncare Activity
All Manpower Types	431,116	307,032	473,633	107,691	311,264	28,525	236,278	86,139	121,371	154,492
Physicians (MD)	13,992	2,133	1,287	9,383			6,230	3,472		38,812
General *	7,845	1,909	1,287				617			7,932
Pediatric		224					112			2,482
Obstetrics-Gyn.							56			1,309
Ophthalmology				9,383						551
Psychiatry *	6,147						168			4,274
Surgery *							224			4,274
Secondary Specialist *							449			11,444
Noncare Specialist *							4,604	3,472		7,446
Physicians (DO)	117	56					224			413
Dentists	936	3,144			112,192					15,443
Optometrists				21,955						413
Podiatrists			122				7,805			68
Pharmacists	595	224							121,258	14,892
Veterinarians						22,910				7,170
Registered Nurses	25,759	14,599	30,050				95,458			28,957
Physician Extender										
Allied Health Manpower	389,727	286,876	442,174	76,353	199,072	5,615	126,561	82,667	133	48,324
Administration	31,380	30,097	19,625	30,664	18,457	5,615	11,791			137
Medical Librarian	702	673					3,930			68
Medical Record	7,493	2,807	5,028				1,459			1,378
Clinical Lab.	5,678	6,794						39,967		
Dietary	4,976	2,302	11,407				8,085			6,342
Radiologic	2,751	2,751					31,669	34,160		2,757
Therapy	29,740	8,310	5,642				32,736			2,619
General Medical *	7,845	12,802					14,543	8,540		27,647
Nursing Care	192,027	68,505	400,472				22,348			5,929
Vision Care				45,689						
Pharmacy	1,053	898							113	
Dental Care	3,512	3,369			180,615					1,447
Hospital Support	102,570	147,568								

Table B-14 (continued)

	TOTAL	MEDICAL OFFICE					SHORT-		
		General Care	Pediatric Care	Ob-Gyn Care	Psych. Care	Other Care	Outp. Care	[illegible]	Medical Care
All Manpower Types	5,822,676	345,520	88,205	100,845	65,655	587,827	385,544	1,049,114	942,425
Physicians (MD)	361,950	61,080	32,765	19,113	18,08[illegible]	25,757	6,689	100,120	23,036
General*	128,121	61,080	20,861	1,861	3,865		4,214	8,594	8,956
Pediatric	20,488		11,904				316	1,674	3,776
Obstetrics-Gyn.	23,081			17,252				4,464	
Ophthalmology	11,998							2,064	
Psychiatry*	28,326				14,216		1,633		1,888
Surgery*	76,828							72,330	
Secondary Specialist*	51,310					25,757	526	5,581	7,553
Noncare Specialist*	21,793							5,413	863
Physicians (DO)	13,738	9,917	113	248		1,778	105	390	377
Dentists	134,282							2,567	
Optometrists	22,368								
Podiatrists	7,995								
Pharmacists	149,189								
Veterinarians	30,080						6,322	2,455	3,453
Registered Nurses	815,337	41,133	13,605	12,412	1,870	90,152	88,[illegible]1	178,593	194,238
Physician Extender	226	56	170						
Allied Health Manpower	4,287,511	233,334	41,552	69,072	45,704	470,140	283,917	764,989	721,321
Administration	697,360	85,648	17,006	26,065	18,706	164,359	45,941	97,556	94,313
Medical Librarian	10,544						1,001	2,120	2,050
Medical Record	59,215						7,902	16,854	16,294
Clinical Lab.	155,329	15,777					16,754	35,774	34,585
Dietary	63,481						2,160	14,343	13,866
Radiologic	126,569						8,113	17,133	16,564
Therapy	126,124					10,671	9,061	18,082	17,481
General Medical*	469,731	88,184	16,383	28,734	18,020	2,453	7,165	31,700	12,409
Nursing Care	1,523,656	43,725	8,163	14,273	8,978	195,759	129,975	270,681	261,682
Vision Care	45,689					96,898			
Pharmacy	11,046						1,738	3,683	3,561
Dental Care	190,193						263	502	485
Hospital Support	808,574						53,844	256,561	248,031

Table B-14 (continued)

	TOTAL	MEDICAL OFFICE					SHORT-TERM HOSP.		
		General Care	Pediatric Care	Ob-Gyn Care	Psych. Care	Other Care	Outp. Care	Surg. Care	Medical Care
All Manpower Types	5,058,350	306,600	77,800	81,250	52,650	479,250	365,900	939,900	873,350
Physicians (MD)	310,700	54,200	28,900	15,400	14,500	21,000	6,350	89,700	21,350
General*	112,300	54,200	18,400	1,500	3,100		4,000	7,700	8,300
Pediatric	17,900		10,500				300	1,500	3,500
Obstetrics-Gyn.	18,900			13,900				4,000	
Ophthalmology	9,900							1,850	
Psychiatry*	23,200				11,400		1,550		1,750
Surgery*	68,100							64,800	
Secondary Specialist*	42,200					21,000	500	5,000	7,000
Noncare Specialist*	18,200							4,850	800
Physicians (DO)	12,000	8,800	100	200		1,450	100	350	350
Dentists	102,200							2,300	
Optometrists	18,200								
Podiatrists	7,100								
Pharmacists	129,300						6,000	2,200	3,200
Veterinarians	25,600								
Registered Nurses	723,000	365,000	12,000	10,000	1,500	73,500	84,000	160,000	180,000
Physician Extender	200	50	150						
Allied Health Manpower	3,730,050	207,050	36,650	55,650	36,650	383,300	269,450	685,350	668,450
Administration	603,600	76,000	15,000	21,000	15,000	134,000	43,600	87,400	87,400
Medical Librarian	9,500						950	1,900	1,900
Medical Record	53,000						7,500	15,100	15,100
Clinical Lab	140,000	14,000					15,900	32,050	32,050
Dietary	55,150						2,050	12,850	12,850
Radiologic	112,100					8,700	7,700	15,350	15,350
Therapy	111,450					2,000	8,600	16,200	16,200
General Medical*	395,200	78,250	14,450	23,150	14,450	159,600	6,800	28,400	11,500
Nursing Care	1,327,750	38,800	7,200	11,500	7,200	79,000	123,350	242,500	242,500
Vision Care	37,250								
Pharmacy	10,050						1,650	3,300	3,300
Dental Care	145,200						250	450	450
Hospital Support	729,800						51,100	229,850	229,850

Table B-14 (continued)

	LONG-TERM HOSP.		OTHER CARE					OTHER		
	Psych. Care	Other Care	Nursing Home	Vision Care	Dental Care	Veterinary Care	Other Care	Lab. Services	Pharmacy Services	Noncare Activity
All Manpower Types	368,200	273,400	386,150	87,800	236,100	25,400	210,400	75,650	106,500	112,050
Physicians (MD)	11,950	1,900	1,050	7,650			5,550	3,050		28,150
General *	6,700	1,700	1,050				550			5,100
Pediatric		200					100			1,800
Obstetrics–Gyn.							50			950
Ophthalmology				7,650						400
Psychiatry *	5,250						150			3,100
Surgery *							200			3,100
Secondary Specialist *							400			8,300
Noncare Specialist *							4,100	3,050		5,400
Physicians (DO)	100	50					200			300
Dentists	800	2,800			85,100					11,200
Optometrists				17,900						300
Podiatrists			100				6,950			50
Pharmacists	500	200							106,400	10,800
Veterinarians						20,400				5,200
Registered Nurses	22,000	13,000	24,500				[illegible]			21,000
Physician Extender										
Allied Health Manpower	332,850	255,450	360,500	62,250	151,000	5,000	[illegible]	72,600	100	35,050
Administration	26,800	26,800	16,000	25,000	14,000	5,000	[illegible]			100
Medical Librarian	600	600					3,500			50
Medical Record	6,400	2,500	4,100				1,300			1,000
Clinical Lab.	4,850	6,050						35,100		
Dietary	4,250	2,050	9,300				7,200			4,600
Radiologic	2,350	2,450					28,200	30,000		2,000
Therapy	25,400	7,400	4,600				29,150			1,900
General Medical *	6,700	11,400					12,950	7,500		20,050
Nursing Care	164,000	61,000	326,500				19,900			4,300
Vision Care				37,250						
Pharmacy	900	800							100	
Dental Care	3,000	8,000			137,000					1,050
Hospital Support	87,600	131,400								

Table B-15. National Health Care Expenditures by Type of Expenditure, Fiscal Years 1968 to 1972

(In Millions)

Type of Expense	Fiscal Year				
	1968	1969	1970	1971	1972
Total	$53,563	$59,975	$68,058	$75,624	$83,417
Health services and supplies	49,599	55,686	63,044	70,182	77,291
Hospital care	19,384	22,356	25,929	29,357	32,460
Physicians' services	10,734	11,842	13,447	15,038	16,150
Dentists' services	3,498	3,821	4,233	4,637	5,025
Other professional services	1,210	1,292	1,386	1,542	1,655
Drugs and drug sundries	5,864	6,480	7,057	7,506	7,909
Eyeglasses and appliances	1,665	1,743	1,814	1,922	2,037
Nursing-home care	2,070	2,465	2,860	3,282	3,500
Expenses for prepayment and administration	1,935	2,058	2,105	2,383	2,868
Government public health activities	1,001	1,105	1,437	1,698	2,100
Other health services	1,238	2,434	2,776	2,817	3,587
Research and medical facilities construction	3,964	4,290	5,015	5,443	6,127

Table B-16. Per Capita Expenditures on Major Health Care Items, Fiscal Years 1968 to 1972

Fiscal Year	Hospital Care	Physicians' Care	Dentists' Care	Drugs & Sundries
1968	$ 95.36	$52.80	$17.21	$28.85
1969	108.92	57.69	18.62	31.57
1970	125.03	64.84	20.41	34.03
1971	140.10	71.76	22.13	35.82
1972	153.38	76.31	23.74	37.37

Physicians' Workload

Table B-17. Average Number of Weeks Practiced per Year by Specialty and Location, 1968

Specialty	Total	Location	
		Non-Metropolitan	Metropolitan
All specialties	47.9[a]	48.1	47.8
General practice	48.3	48.4	48.2
Surgery	47.8	48.1	47.7
Internal medicine	47.9	47.8	47.9
Obstetrics and gynecology	48.4	48.4	48.4
Pediatrics	48.1	48.6	48.0
Psychiatry	47.3	49.1	47.2
Radiology	48.3	47.6	48.4
Anesthesiology	46.7	45.5	46.8
Other	47.2	46.4	47.3

Table B-18. Average Number of Weeks Practiced per Year by Specialty and Location, 1970

Specialty	Total	Location	
		Non-Metropolitan	Metropolitan
Total	47.5 (4,226)	47.7	47.5
General practice	48.1 (876)	48.0	48.1
Internal medicine	47.2 (795)	46.7	47.3
Surgery	47.4 (1,319)	47.3	47.4
Obstetrics and gynecology	48.0 (314)	48.1	48.0
Pediatrics	48.1 (282)	49.5	48.0
Psychiatry	46.2 (139)	47.7*	46.1
Radiology	49.0 (165)	49.1*	48.9
Anesthesiology	46.1 (161)	47.8*	45.8
Other	46.9 (175)	45.0*	47.2

( ) = Number of observations.
*Based on fewer than 30 observations.

Table B-19. Average Number of Hours Practiced per Week by Specialty and Location, 1969

Specialty	Total	Location	
		Non-Metropolitan	Matropolitan
All specialties	51.3[a]	53.9	50.7
General practice	52.0	53.9	51.0
Surgery	51.5	55.3	50.8
Internal medicine	52.8	58.6	52.2
Obstetrics and gynecology	54.3	57.6	53.8
Padiatrics	52.9	54.7	52.8
Psychiatry	47.3	47.8	47.3
Radiology	47.7	48.6	47.6
Anesthesiology	52.4	49.0	52.7
Other	47.5	49.4	47.2

[a]Based on 3,837 observations.

Table B-20. Average Number of Hours Practiced per Week by Specialty and Location, 1971

Specialty	Total	Location	
		Non-Metropolitan	Metropolitan
Total	53.6 (4,064)	56.0	53.2
General practice	54.1 (847)	57.8	52.5
Internal medicine	55.2 (771)	54.9	55.3
Surgery	54.6 (1,257)	55.2	54.4
Obstetrics and gynecology	59.1 (296)	61.4	58.8
Pediatrics	54.2 (271)	52.2	54.3
Psychiatry	45.1 (137)	49.5*	45.0
Radiology	48.7 (160)	44.4*	49.8
Anesthesiology	54.4 (153)	44.6*	55.5
Other	41.8 (172)	47.7*	41.1

( ) = Number of observations.
*Based on fewer than 30 observations.

Table B-21. Average Number of Hours per Week of Direct Patient Care by Specialty, 1966-71

Specialty	Hours of Direct Care Per Week[a]						
	PSP 1 2/1966	PSP 2 10/1967	PSP 3 5/1968	PSP 4 10/1968	PSP 5 10/1969	PSP 6 10/1970	PSP 7[b] 10/1971
All specialties	45.3	46.2	45.0	44.6	44.7	44.7	46.3
General practice	49.2	49.1	47.7	47.0	47.8	47.7	49.6
Surgery	45.6	46.7	46.2	45.4	45.6	47.2	44.3
Internal medicine	45.8	47.8	46.8	46.2	47.7	45.5	49.7
Obstetrics and gynecology	47.4	47.8	47.1	46.1	48.8	49.9	46.6
Pediatrics	46.4	48.7	45.9	45.5	46.9	45.9	48.5
Psychiatry	38.1	38.1	37.6	37.7	39.2	37.3	38.6
Radiology	30.3	35.6	32.6	34.0	32.8	34.5	40.1
Anesthesiology	43.0	44.2	44.7	44.7	47.0	46.8	43.8
Other specialties	36.6	40.8	33.5	39.6	35.5	35.6	36.0

a--Direct care means seeing patients, however, it also includes patient services by such physicians as pathologists and radiologists

b--Preliminary data

Note: The above data are based on the Period Survey of Physicians (PSP) which was initiated in 1966 by AMA's Dept. of Survey Research and sent out periodically to samples of approximately 5,000 physicians. These surveys gather information on utilization of physicians' services, the characteristics and changing patterns of medical care under various forms of organization.

Sources: 43 and 44

Table B-22. Average Number of Hours per Week of Direct Patient Care by Specialty and Location, 1971

Specialty	Total	Location	
		Non-Metropolitan	Metropolitan
Total	46.3 (3,478)	50.5	45.5
General practice	49.6 (752)	53.4	48.0
Internal medicine	49.7 (680)	48.9	49.7
Surgery	44.3 (1,084)	48.6	43.6
Obstetrics and gynecology	46.6 (252)	49.5	46.3
Pediatrics	48.5 (223)	44.1	48.8
Psychiatry	38.6 (129)	44.6*	38.5
Radiology	40.1 (110)	39.6*	40.2
Anesthesiology	43.9 (124)	36.4*	44.7
Other	36.0 (124)	42.7*	35.2

( ) = Number of observations.
*Based on fewer than 30 observations.

Table B-23. Average Number of Weeks Practiced per Year by Census Division and Specialty, 1970

Census Division	Total**	Specialty					
		General Practice	Internal Medicine	Surgery	Obstetrics Gynecology	Pediatrics	Psychiatry
Total	47.5	48.1[a]	47.2[b]	47.4[c]	48.0[d]	48.1[e]	46.2[f]
New England	46.9	47.5	46.9	47.8	45.4*	47.8*	44.4*
Middle Atlantic	47.0	47.3	46.8	46.9	48.8	47.6	46.3
East North Central	47.8	48.6	48.4	47.5	47.5	47.5	46.4*
West North Central	48.1	48.5	48.1	47.0	48.9*	50.1*	47.8*
South Atlantic	48.1	48.9	47.8	47.6	48.7	48.5	46.0*
East South Central	48.1	48.4	47.6	48.6	48.6*	49.6*	48.0*
West South Central	48.2	47.6	48.1	48.8	49.0*	45.9*	47.4*
Mountain	46.9	46.3	46.9	47.4	48.0*	49.4*	37.6*
Pacific	47.3	48.4	46.4	46.4	48.5	49.1	47.7

a–Based on 876 observations.

b–Based on 795 observations.

c–Based on 1,318 observations.

d–Based on 314 observations.

e–Based on 282 observations.

f–Based on 139 observations.

*Based on fewer than 30 observations.

**Physicians reporting Radiology, Anesthesiology and Other Specialties are included in this *Total* column.

Table B-24. Average Number of Hours Practiced per Week by Census Division and Specialty, 1971

Census Division	Total**	Specialty					
		General Practice	Internal Medicine	Surgery	Obstetrics-Gynecology	Pediat.	Psychiatry
Total	53.6	54.1[a]	55.2[b]	54.6[c]	59.1[d]	54.2[e]	45.1[f]
New England	56.6	51.7	59.0	57.1	61.2*	63.5*	34.2*
Middle Atlantic	51.7	51.8	55.0	52.[illegible]	53.7	49.[illegible]	46.2
East North Central	54.0	53.0	55.4	54.[illegible]	59.9	54.1	[illegible]*
West North Central	54.7	55.9	54.7	55.[illegible]	57.1*	57.8*	[illegible]
South Atlantic	55.0	51.3	60.7	54.9	64.1	57.3	[illegible]*
East South Central	57.3	60.6	46.3	62.1	58.7*	52.5*	[illegible]*
West South Central	53.0	56.3	53.4	53.3	52.6*	66.4*	39.[illegible]
Mountain	57.2	57.1	62.4	60.1	61.7*	47.2*	57.6*
Pacific	52.1	52.1	51.4	52.4	61.6	54.4	45.1

a–Based on 847 observations.
b–Based on 771 observations.
c–Based on 1,257 observations.
d–Based on [illegible] observations.
e–Based on 271 observations.
f–Based on 137 observations.
*Based on fewer than 30 observations.
**Physicians reporting Radiology, Anesthesiology and Other Specialties are included in this *Total* column

United States, 1972

Age Interval	Proportion Dying	Of 100,000 Born Alive		Stationary Population		Average Remaining Lifetime
Period of life between two exact ages stated in years	Proportion of persons alive at beginning of age interval dying during interval	Number living at beginning of age interval	Number dying during age interval	In the age interval	In this and all subsequent age intervals	Average number of years of life remaining at beginning of age interval
(1)	(2)	(3)	(4)	(5)	(6)	(7)
x to $x+n$	$_nq_x$	l_x	$_nd_x$	$_nL_x$	T_x	$\mathring{e}_x$
Total						
0-1	0.0183	100,000	1,831	98,375	7,113,638	71.1
1-5	.0032	98,169	317	391,917	7,015,263	71.5
5-10	.0021	97,852	201	488,717	6,623,246	67.7
10-15	.0020	97,651	198	487,808	6,134,629	62.8
15-20	.0055	97,453	539	486,028	5,646,821	57.9
20-25	.0073	96,914	709	482,830	5,160,793	53.3
25-30	.0071	96,205	679	479,352	4,677,963	48.6
30-35	.0084	95,526	804	475,713	4,198,611	44.0
35-40	.0118	94,722	1,115	471,007	3,722,898	39.3
40-45	.0181	93,607	1,691	464,110	3,251,891	34.7
45-50	.0284	91,918	2,606	453,540	2,787,781	30.3
50-55	.0417	89,310	3,726	437,785	2,334,241	26.1
55-60	.0644	85,584	5,511	414,902	1,896,456	22.2
60-65	.0942	80,073	7,543	382,415	1,481,554	18.5
65-70	.1346	72,530	9,752	339,170	1,099,139	15.2
70-75	.1987	62,760	12,472	283,560	759,969	12.1
75-80	.2895	50,296	14,559	215,701	476,409	9.5
80-85	.3955	35,737	14,135	142,631	260,708	7.3
85 and over	1.0000	21,602	21,602	118,077	118,077	5.5
Male						
0-1	0.0206	100,000	2,060	98,168	6,737,509	67.4
1-5	.0036	97,940	352	390,921	6,639,341	67.8
5-10	.0023	97,588	229	487,328	6,248,420	64.0
10-15	.0025	97,359	246	486,256	5,761,091	59.2
15-20	.0079	97,113	774	483,813	5,274,835	54.3
20-25	.0110	96,341	1,061	479,086	4,791,022	49.7
25-30	.0100	95,280	955	474,007	4,311,936	45.3
30-35	.0112	94,325	1,051	469,[illegible]	3,837,929	40.7
35-40	.0151	93,271	1,411	463,064	3,368,832	36.1

Table B-25 (continued)

Age Interval	Proportion Dying	Of 100,000 Born Alive		Stationary Population		Average Remaining Lifetime
Period of life between two exact ages stated in years	Proportion of persons alive at beginning of age interval dying during interval	Number living at beginning of age interval	Number dying during age interval	In the age interval	In this and all subsequent age intervals	Average number of years of life remaining at beginning of age interval
(1)	(2)	(3)	(4)	(5)	(6)	(7)
x to $x+n$	${}_nq_x$	l_x	${}_nd_x$	${}_nL_x$	T_x	$\overset{o}{e}_x$
Male						
40-45	.0230	91,860	2,111	454,413	2,905,768	31.6
45-50	.0368	89,749	3,306	441,110	2,451,355	27.3
50-55	.0554	86,443	4,789	420,962	2,010,245	23.3
55-60	.0868	81,654	7,085	391,476	1,589,283	19.5
60-65	.1290	74,569	9,617	349,802	1,197,807	16.1
65-70	.1821	64,952	11,828	295,925	848,005	13.1
70-75	.2605	53,124	13,836	231,413	552,080	10.4
75-80	.3618	39,288	14,216	160,813	320,667	8.2
80-85	.4673	25,072	11,715	94,940	159,854	6.4
85 and over	1.0000	13,357	13,357	64,914	64,914	4.9
Female						
0-1	0.0159	100,000	1,591	98,593	7,807,966	75.1
1-5	.0029	98,409	281	392,956	7,409,373	75.3
5-10	.0017	98,128	171	490,171	7,016,417	71.5
10-15	.0015	97,957	147	489,437	6,526,246	66.6
15-20	.0031	97,810	299	488,350	6,036,809	61.7
20-25	.0037	97,511	359	486,688	5,548,459	56.9
25-30	.0041	97,152	402	484,799	5,061,771	52.1
30-35	.0058	96,750	557	482,435	4,576,972	47.3
35-40	.0086	96,193	824	479,039	4,094,537	42.6
40-45	.0134	95,369	1,275	473,868	3,615,498	37.9
45-50	.0204	94,904	1,916	466,992	3,141,630	33.4
50-55	.0288	92,178	2,658	454,613	2,675,638	29.0
55-60	.0435	89,520	3,893	438,457	2,221,025	24.8
60-65	.0628	85,627	5,377	415,470	1,782,568	20.8
65-70	.0944	80,260	7,579	383,348	1,367,098	17.0
70-75	.1505	72,671	10,937	337,387	983,750	13.5
75-80	.2370	61,734	14,629	273,480	646,363	10.5
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	7.9

Age Interval	Proportion Dying	Of 100,000 Born Alive		Stationary Population		Average Remaining Lifetime
Period of life between two exact ages stated in years	Proportion of persons alive at beginning of age interval dying during interval	Number living at beginning of age interval	Number dying during age interval	In the age interval	In this and all subsequent age intervals	Average number of years of life remaining at beginning of age interval
(1)	(2)	(3)	(4)	(5)	(6)	(7)
x to $x+n$	${}_nq_x$	l_x	${}_nd_x$	${}_nL_x$	T_x	$\overset{o}{e}_x$
White						
0-1	0.0160	100,000	1,603	98,564	7,198,312	72.0
1-5	.0029	98,397	288	392,907	7,099,748	72.2
5-10	.0020	98,109	193	490,026	6,706,841	68.4
10-15	.0019	97,916	191	489,150	6,216,815	63.5
15-20	.0053	97,725	514	487,440	5,727,665	58.6
20-25	.0064	97,211	621	484,517	5,240,225	53.9
25-30	.0059	96,590	570	481,534	4,755,708	49.2
30-35	.0068	96,020	653	478,544	4,274,174	44.5
35-40	.0096	95,367	920	474,698	3,795,630	39.8
40-45	.0155	94,447	1,468	468,851	3,320,932	35.2
45-50	.0253	92,979	2,357	459,454	2,852,081	30.7
50-55	.0384	90,622	3,484	444,932	2,392,627	26.4
55-60	.0608	87,138	5,298	423,220	1,947,695	22.4
60-65	.0903	81,840	7,394	391,680	1,524,475	18.6
65-70	.1308	74,446	9,736	348,904	1,132,795	15.2
70-75	.1937	64,710	12,537	293,229	783,891	12.1
75-80	.2889	52,173	15,073	223,888	490,662	9.4
80-85	.4006	37,100	14,863	147,586	266,774	7.2
85 and over	1.0000	22,237	22,237	119,188	119,188	5.4
White, Male						
0-1	0.0182	100,000	1,824	98,362	6,826,243	68.3
1-5	.0033	98,176	323	391,949	6,727,881	68.5
5-10	.0023	97,853	220	488,679	6,335,932	64.7
10-15	.0024	97,633	238	487,646	5,847,253	59.9
15-20	.0075	97,395	735	485,302	5,359,607	55.0
20-25	.0096	96,660	927	480,994	4,874,305	50.4
25-30	.0083	95,733	799	476,647	4,393,311	45.9
30-35	.0089	94,934	845	472,645	3,916,664	41.3
35-40	.0123	94,089	1,154	467,767	3,444,019	36.6
40-45	.0198	92,935	1,840	460,444	2,976,252	32.0
45-50	.0331	91,095	3,013	448,548	2,515,808	27.6
50-55	.0516	88,082	4,542	429,763	2,067,260	23.5

Table B-25 (continued)

Age Interval	Proportion Dying	Of 100,000 Born Alive		Stationary Population		Average Remaining Lifetime
Period of life between two exact ages stated in years	Proportion of persons alive at beginning of age interval dying during interval	Number living at beginning of age interval	Number dying during age interval	In the age interval	In this and all subsequent age intervals	Average number of years of life remaining at beginning of age interval
(1)	(2)	(3)	(4)	(5)	(6)	(7)
x to $x+n$	${}_nq_x$	l_x	${}_nd_x$	${}_nL_x$	T_x	$\mathring{e}_x$
White, Male						
55-60	.0827	83,540	6,913	401,365	1,637,497	19.6
60-65	.1255	76,627	9,618	360,144	1,236,132	16.1
65-70	.1793	67,009	12,014	305,829	875,988	13.1
70-75	.2575	54,995	14,160	240,078	570,159	10.4
75-80	.3624	40,835	14,798	167,128	330,081	8.1
80-85	.4745	26,037	12,354	98,082	162,953	6.3
85 and over	1.0000	13,683	13,683	64,871	64,871	4.7
White, Female						
0-1	0.0137	100,000	1,370	98,777	7,587,872	75.9
1-5	.0025	98,630	252	393,917	7,489,095	75.9
5-10	.0017	98,378	164	491,443	7,095,178	72.1
10-15	.0014	98,214	141	490,735	6,603,735	67.2
15-20	.0029	98,073	285	489,691	6,113,000	62.3
20-25	.0032	97,788	314	488,173	5,623,309	57.5
25-30	.0035	97,474	339	486,555	5,135,136	52.7
30-35	.0047	97,135	461	484,588	4,648,581	47.9
35-40	.0071	96,674	687	481,771	4,163,993	43.1
40-45	.0114	95,987	1,093	477,400	3,682,222	38.4
45-50	.0180	94,894	1,710	470,486	3,204,822	33.8
50-55	.0260	93,184	2,425	460,199	2,734,336	29.3
55-60	.0402	90,759	3,649	445,269	2,274,137	25.1
60-65	.0585	87,110	5,096	423,644	1,828,868	21.0
65-70	.0899	82,014	7,370	392,773	1,405,224	17.1
70-75	.1445	74,844	10,784	347,747	1,012,451	13.6
75-80	.2361	63,860	15,078	283,120	664,704	10.4
80-85	.3534	48,782	17,237	200,664	381,584	7.8
85 and over	1.0000	31,545	31,545	180,920	180,920	5.7
All Other						
0-1	0.0291	100,000	2,907	97,485	6,560,530	65.6
1-5	.0048	97,093	465	387,213	6,463,045	66.6
5-10	.0025	96,629	243	482,475	6,075,832	62.9

Table 5-25 (Continued)

Age Interval	Proportion Dying	Of 100,000 Born Alive		Stationary Population		Average Remaining Lifetime
Period of life between two exact ages stated in years	Proportion of persons alive at beginning of age interval dying during interval	Number living at beginning of age interval	Number dying during age interval	In the age interval	In this and all subsequent age intervals	Average number of years of life remaining at beginning of age interval
(1)	(2)	(3)	(4)	(5)	(6)	(7)
x to $x+n$	${}_nq_x$	l_x	${}_nd_x$	${}_nL_x$	T_x	$\overset{c}{e}_x$
All Other						
15-20	.0072	96,147	688	479,192	5,111,973	53.2
20-25	.0133	95,459	1,270	474,288	4,632,781	48.5
25-30	.0155	94,189	1,464	467,438	4,158,493	44.2
30-35	.0194	92,725	1,795	459,358	3,691,055	39.8
35-40	.0265	90,930	2,407	448,978	3,231,697	35.5
40-45	.0369	88,523	3,266	434,840	2,782,719	31.4
45-50	.0529	85,257	4,508	415,651	2,347,879	27.5
50-55	.0703	80,749	5,680	390,262	1,932,228	23.9
55-60	.0989	75,069	7,421	357,453	1,541,966	20.5
60-65	.1294	67,648	8,755	316,815	1,184,513	17.5
65-70	.1691	58,893	9,961	269,802	867,698	14.7
70-75	.2496	48,932	12,215	213,862	597,896	12.2
75-80	.2959	36,717	10,863	156,144	384,034	10.5
80-85	.3308	25,854	8,551	107,391	227,890	8.8
85 and over	1.0000	17,303	17,303	120,499	120,499	7.0
All Other, Male						
0-1	0.0319	100,000	3,186	97,240	6,145,462	61.5
1-5	.0052	96,814	501	386,002	6,048,222	62.5
5-10	.0029	96,313	276	480,822	5,662,220	58.8
10-15	.0031	96,037	294	479,529	5,181,398	54.0
15-20	.0104	95,743	995	476,497	4,701,869	49.1
20-25	.0207	94,748	1,957	469,088	4,225,372	44.6
25-30	.0234	92,791	2,168	458,692	3,756,284	40.5
30-35	.0278	90,623	2,516	447,078	3,297,592	36.4
35-40	.0367	88,107	3,237	432,883	2,850,514	32.4
40-45	.0484	84,870	4,109	414,563	2,417,631	28.5
45-50	.0688	80,761	5,557	390,667	2,003,068	24.8
50-55	.0899	75,204	6,761	359,912	1,612,401	21.4
55-60	.1264	68,443	8,654	321,261	1,252,489	18.3
60-65	.1607	59,789	9,607	275,507	931,228	15.6
65-70	.2091	50,182	10,444	224,930	655,721	13.1

Table B-25 (continued)

Age Interval	Proportion Dying	Of 100,000 Born Alive		Stationary Population		Average Remaining Lifetime
Period of life between two exact ages stated in years	Proportion of persons alive at beginning of age interval dying during interval	Number living at beginning of age interval	Number dying during age interval	In the age interval	In this and all subsequent age intervals	Average number of years of life remaining at beginning of age interval
(1)		(3)	(4)	(5)	(6)	(7)
x to $x+n$	${}_nq_x$	l_x	${}_nd_x$	${}_nL_x$	T_x	$\mathring{e}_x$
All Other, Male						
70-75	.2890	39,738	11,486	169,351	430,791	10.8
75-80	.3531	28,252	9,975	115,813	261,440	9.3
80-85	.3821	18,277	6,984	73,362	145,627	8.0
85 and over	1.0000	11,293	11,293	72,265	72,265	6.4
All Other, Female						
0-1	0.0262	100,000	2,620	97,736	6,988,705	69.9
1-5	.0044	97,380	428	388,456	6,890,969	70.8
5-10	.0022	96,952	210	484,173	6,502,613	67.1
10-15	.0019	96,742	181	483,286	6,018,340	62.2
15-20	.0039	96,561	381	481,947	5,535,054	57.3
20-25	.0066	96,180	638	479,405	5,058,107	52.5
25-30	.0088	95,542	838	475,745	4,573,702	47.9
30-35	.0122	94,704	1,153	470,809	4,097,957	43.3
35-40	.0179	93,551	1,678	463,812	3,627,148	38.8
40-45	.0272	91,873	2,497	453,419	3,163,836	34.4
45-50	.0388	89,376	3,472	438,699	2,709,917	30.3
50-55	.0528	85,904	4,536	418,792	2,271,218	26.4
55-60	.0744	81,368	6,054		1,852,426	22.8
60-65	.1016	75,314	7,651		1,460,113	19.4
65-70	.1365	67,663	9,234		1,102,339	16.3
70-75	.2156	58,429	12,598		786,780	13.5
75-80	.2486	45,831	11,395	200,672	525,976	11.5
80-85	.2956	34,436	10,178	146,356	325,304	9.4
85 and over	1.0000	24,258	24,258	178,948	178,948	7.4

Source: Reprinted from U.S. Department of Health, Education, and Welfare, National Center for Health Statistics, *Monthly Vital Statistics Report*, Summary, Final Mortality Statistics, 1972, DHEW Pub. No. (HRA) 75-1120, vol. 23, no. 7, supplement (October 3, 1974) (Washington, D.C.: U.S. Government Printing Office, 1974).

Labor Force Separation Rates

Table B-26. Annual Labor Force Separation Rates by State and by Selected Health Care Occupation, 1970 and 1985[a]

STATE	DENTISTS		PHARMACISTS		PHYSICIANS, MD OSTEOPATHS		REGISTERED NURSES	
	1970	1985	1970	1985	1970	1985	1970	1985
ALABAMA	.0245	.0729	.0293	.0273	.0298	.0279	.0571	.0580
ALASKA	.0177	0164	.0471	0447	.0106	.0090	.0529	.0547
ARIZONA	.0193	0178	.0441	.0413	.0297	0277	.0531	.0549
ARKANSAS	.0343	.0315	.0350	.0327	.0280	.0260	.0582	.0599
CALIFORNIA	.0300	.0278	.0345	.0326	.0294	.0275	.0534	.0551
COLORADO	.0322	.0302	.0426	.0404	.0251	.0234	.0569	.0580
CONNECTICUT	0288	.0264	.0391	.0367	0317	.0296	.0578	.0597
DELAWARE	.0320	.0300	.0384	.0362	.0319	0296	.0531	.0552
DISTRICT OF COLUMBIA	0541	.0504	0479	.0462	.0405	.0378	.0513	.0529
FLORIDA	.0261	.0242	.0380	0359	.0282	.0263	.0575	.0591
GEORGIA	0316	.0296	.0290	0281	.0253	0234	.0587	.0604
HAWAII	0339	0312	.0410	0390	.0350	.0333	.0465	.0483
IDAHO	0274	0255	0254	0238	0364	.0338	.0539	.0550
ILLINOIS	0491	0457	.0371	0351	0351	0329	0569	0588
INDIANA	0380	0362	0354	.0335	0319	.0298	0578	0597
IOWA	0379	0351	0405	.0381	0364	0340	.0602	0618
KANSAS	0436	0406	0447	.0410	0317	0295	0584	.0601
KENTUCKY	0324	0299	0350	0337	.0325	0303	0598	0616
LOUISIANA	0310	0295	0408	0384	0264	0245	0555	0573
MAINE	0332	0308	0508	0477	0411	0386	0596	0614
MARYLAND	0289	0267	.0327	0307	0275	0257	0542	0562
MASSACHUSETTS	0379	0351	0373	0351	0378	0356	0621	0630
MICHIGAN	0320	0297	.0373	0353	0308	0287	0557	0576
MINNESOTA	0483	0450	0389	.0367	0290	0280	0625	0644
MISSISSIPPI	0332	0309	0350	0330	0339	0317	0560	0584
MISSOURI	0538	0503	0470	0453	0342	.0319	0621	0639
MONTANA	0344	0321	0299	0280	0367	0341	0537	0553
NEBRASKA	0642	0600	0450	0436	0367	0343	0636	0653
NEVADA	0105	0093	0377	0350	0268	0240	0533	0548
NEW HAMPSHIRE	0363	0334	0369	0347	0437	0407	0596	0610
NEW JERSEY	0373	0346	0354	0332	0342	0320	0575	0594
NEW MEXICO	0221	0201	0292	0273	0301	0279	0521	0541
NEW YORK	0431	0401	0450	0433	0393	0360	0582	0599
NORTH CAROLINA	0294	0270	0323	0305	0342	0319	.0547	0565
NORTH DAKOTA	0611	0560	0294	0279	0330	0305	0636	0656
OHIO	0429	0390	0353	0334	0343	.0321	.0588	0608
OKLAHOMA	0367	0338	0374	0353	0335	0311	.0550	0575
OREGON	0282	0261	0330	0319	0303	0282	0552	0560
PENNSYLVANIA	0497	0462	0441	0416	0364	.0342	0595	0615
RHODE ISLAND	0347	0321	0482	0458	0410	.038	0615	0636
SOUTH CAROLINA	0331	0307	0305	0287	0330	0	0583	0601
SOUTH DAKOTA	0311	0286	0295	027	0331	03	.0519	.0535
TENNESSEE	0262	0242	0323	03	0259	0230	0582	0598
TEXAS	0298	0275	0398	0	0300	0280	0556	0573
UTAH	0223	0203	0241	0225	0258	0239	0565	0586
VERMONT	0308	.0296	0437	0411	0349	.0325	0578	0598
VIRGINIA	0309	0287	0291	0275	0289	.0269	0569	0589
WASHINGTON	0313	0289	.350	0335	0266	.0247	.0554	.0574
WEST VIRGINIA	0460	.0426	0328	0308	.0415	.0387	0566	.0584
WISCONSIN	0503	0468	0434	0409	0349	032	.585	.0604
WYOMING	0294	0271	0236	.0234	0270	0249	0497	.0516

STATE	THERAPISTS		CLINICAL LAB TECHNOL. TECH.		RADIOLOGIC TECHNOL. TECH.		PRACTICAL NURSES	
	1970	1985	1970	1985	1970	1985	1970	1985
ALABAMA	.0420	.0433	.0483	.0493	.0463	.0469	.0550	.0560
ALASKA	.0322	.0336	.0484	.0493	.0478	.0493	.0630	.0666
ARIZONA	.0398	.0402	.0483	.0494	.0438	.0451	.0618	.0640
ARKANSAS	.0466	.0465	.0476	.0489	.0530	.0548	.0618	.0640
CALIFORNIA	.0435	.0444	.0400	.0420	.0467	.0474	.0598	.0575
COLORADO	.0471	.0470	.0513	.0529	.0700	.0715	.0628	.0641
CONNECTICUT	.0464	.0472	.0580	.0596	.0754	.0772	.0710	.0736
DELAWARE	.0362	.0371	.0680	.0700	.0668	.0686	.0662	.0676
DISTRICT OF COLUMBIA	.0360	.0377	.0474	.0484	.0491	.0503	.0453	.0467
FLORIDA	.0448	.0453	.0467	.0476	.0575	.0587	.0605	.0619
GEORGIA	.0484	.0489	.0499	.0511	.0563	.0576	.0573	.0590
HAWAII	.0334	.0343	.0429	.0441	.0511	.0524	.0514	.0526
IDAHO	.0443	.0450	.0564	.0574	.0702	.0717	.0505	.0524
ILLINOIS	.0508	.0518	.0562	.0575	.0504	.0513	.0620	.0645
INDIANA	.0527	.0536	.0585	.0600	.0672	.0686	.0644	.0662
IOWA	.0449	.0459	.0573	.0587	.0678	.0689	.0727	.0741
KANSAS	.0491	.0490	.0517	.0533	.0586	.0598	.0701	.0714
KENTUCKY	.0424	.0430	.0464	.0476	.0593	.0603	.0617	.0638
LOUISIANA	.0465	.0478	.0461	.0471	.0350	.0364	.0552	.0566
MAINE	.0419	.0424	.0547	.0563	.0642	.0655	.0643	.0659
MARYLAND	.0472	.0483	.0459	.0470	.0657	.0671	.0542	.0557
MASSACHUSETTS	.0522	.0520	.0597	.0612	.0682	.0696	.0686	.0690
MICHIGAN	.0490	.0511	.0488	.0503	.0532	.0541	.0562	.0575
MINNESOTA	.0484	.0496	.0570	.0595	.0706	.0720	.0754	.0775
MISSISSIPPI	.0484	.0488	.0465	.0473	.0435	.0443	.0588	.0606
MISSOURI	.0595	.0607	.0507	.0520	.0490	.0502	.0632	.0646
MONTANA	.0593	.0605	.0475	.0491	.0632	.0647	.0640	.0664
NEBRASKA	.0444	.0453	.0653	.0564	.0600	.0621	.0790	.0803
NEVADA	.0260	.0268	.0506	.0518	.0427	.0435	.0599	.0610
NEW HAMPSHIRE	.0580	.0595	.0452	.0461	.0709	.0717	.0750	.0750
NEW JERSEY	.0486	.0492	.0582	.0575	.0600	.0623	.0673	.0687
NEW MEXICO	.0441	.0451	.0415	.0422	.0291	.0298	.0535	.0555
NEW YORK	.0479	.0486	.0483	.0495	.0428	.0432	.0654	.0668
NORTH CAROLINA	.0478	.0485	.0553	.0568	.0660	.0683	.0623	.0636
NORTH DAKOTA	.0491	.0497	.0585	.0603	.0523	.0533	.0908	.0932
OHIO	.0480	.0501	.0576	.0591	.0703	.0716	.0644	.0650
OKLAHOMA	.0438	.0446	.0433	.0444	.0416	.0423	.0575	.0592
OREGON	.0337	.0344	.0453	.0466	.0528	.0545	.0684	.0702
PENNSYLVANIA	.0444	.0451	.0638	.0654	.0667	.0681	.0665	.0681
RHODE ISLAND	.0550	.0574	.0573	.0586	.0739	.0752	.0651	.0667
SOUTH CAROLINA	.0491	.0493	.0575	.0587	.0682	.0690	.0592	.0613
SOUTH DAKOTA	.0531	.0539	.0486	.0497	.0730	.0747	.0782	.0794
TENNESSEE	.0375	.0382	.0516	.0529	.0450	.0458	.0566	.0585
TEXAS	.0492	.0502	.0444	.0454	.0484	.0494	.0619	.0634
UTAH	.0361	.0368	.0439	.0452	.0550	.0562	.0618	.0637
VERMONT	.0519	.0536	.0690	.0722	.0658	.0672	.0817	.0835
VIRGINIA	.0499	.0500	.0547	.0559	.0571	.0590	.0631	.0648
WASHINGTON	.0434	.0443	.0476	.0489	.0479	.0491	.0617	.0633
WEST VIRGINIA	.0405	.0400	.0651	.0667	.0675	.0686	.0616	.0626
WISCONSIN	.0500	.0519	.0579	.0598	.0619	.0634	.0736	.0757
WYOMING	.0268	.0275	.0357	.0384	.0486	.0482	.0701	.0723

aThe BLS separation rates for 1970 and 1975 by state covered over 400 occupations. There are many other health care related occupations, such as: dietitians; optometrists; podiatrists; other medical and health technologists; dental hygienists; health record technologists, technicians; therapy assistants; other health technologists, technicians; psychologists; health specialties teachers; health administrators; dental laboratory technicians; opticians; dental assistants; health aides, except nursing; health trainees; lay midwives; nurses aides, orderlies; etc. Each BLS regional office possesses two sets of unpublished computer printouts on labor force separation rates for men and women by occupation and by state, 1970 and 1985. For information and assistance regarding such data, write to Commissioner of Labor Statistics, U.S. Department of Labor, Bureau of Labor Statistics, 411 G Street, N.W., Washington, D.C. 20212.

Source: U.S. Department of Labor, Bureau of Labor Statistics, *Tomorrow's Manpower Needs*, Supplement No. 4, *Estimating Occupational Separations From the Labor Force for States*, prepared by Michael P. McElroy and Joseph S. Cangialosi (Washington, D.C.: U.S. Government Printing Office, 1974).

Table B-27. U.S. Labor Force Separation Rates for Men and Women by Selected Health Care Occupations, 1970 and 1985

Occupation	1970			1985		
	Men	Women	Total	Men	Women	Total
Dentists	0364	0686	.0375	0336	0690	.0348
Dietitians	0211	0595	0565	0192	0614	0570
Optometrists	0317	0622	0329	0291	0623	.0304
Pharmacists	0348	0622	0361	0322	0635	.0359
Physicians, M D Osteopaths	0309	0532	0329	0284	0542	0308
Registered nurses	0185	0584	0574	0168	0604	.0592
Therapists	0125	0674	0472	0111	0695	.0481
Clinical lab technol technician	0088	0679	0513	0076	0701	.0526
Dental hygienists	0259	0722	.0694	0237	.0747	0716
Radiologic technol technician	0103	0771	0561	0090	0790	0572
Dental laboratory technician	.0204	0646	0305	0185	0667	.0295
Practical nurses	.0211	0643	0628	0192	0660	.0644

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