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ABSTRACT

The document's research concerns are directed to the study of various dimensions of health care delivery systems and the dynamics of health manpower supply and requirements. It attempts to explore and determine the effectiveness of the economic system as a surrogate in health planning for the health care delivery system, and to estimate the interrelationships of the health manpower education systems with the economic system and the health care delivery system. The overall objectives of the project were to determine the applicability of regional economic theory in this framework, thus lending further insights into the process of locational decision-making, and developing a useful tool and perspective for the health planner. The document represents a summary of the major activities, findings, and conclusions identified in the final report of the research. It describes the major hypotheses and findings, and policy implications of the study. A 12-page bibliography is given under the topics of economics and health. (Author/EC)

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THE DELINEATION OF ECONOMIC AND HEALTH SERVICE AREAS
AND THE LOCATION OF HEALTH MANPOWER EDUCATION PROGRAMS

--A SUMMARY--

Summary from Final Report of Contract No. NIH 72-4083

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
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FORWARD

In recent years, economists and operation researchers have devoted considerable effort to the study of various dimensions of the health care delivery system and of the dynamics of health manpower supply and requirements. As such, a number of key aspects of economic theory--including the use of econometric models and concepts such as economies of scale, internal rate of return, and income and price elasticities--have become more prevalent in the health literature.

Concurrent with this development, and proceeding somewhat independently, has been a marked expansion in studies and articles concerned with specialty and geographic imbalances of health services and manpower. These developments apparently reflect a recognition that aggregate, national profiles of health dynamics provide only partial insights into understanding and groping with problems of equity and distribution.

Since its inception in 1970, the Division of Manpower Intelligence (DMI) of the Bureau of Health Resources Development has been vitally interested and actively engaged in analysis of both of these areas. As part of its extramural program, consequently, a number of major analytical efforts have been undertaken that attempt to examine empirically current and future dimensions of the health care delivery system and health manpower.

In line with these program objectives, in 1972 DMI commissioned the Division of Business and Economic Research, College of Commerce and Industry, The University of Wyoming, to undertake a research effort concerning the use of economic theory in health locational decision-making. Specifically, the first part of this effort was to explore and determine whether the economic system could effectively be used as a surrogate in health planning for the health-care delivery system. The

second aspect of this research endeavor was to estimate the interrelationships of the health manpower education system with the economic system and the health-care delivery system. The overall objectives of the project were to determine the applicability of regional economic theory in this framework, hopefully to lend further insights into the process of locational decision making, and to develop a useful tool and perspective for the health planner.

From the viewpoint of social science research, the results of this study effort represent important, initial steps in the empirical process. In this regard, a number of research areas are proposed within the study to further validate hypotheses presented and to test the transferability of the study results to other settings. From the viewpoint of practitioners of health manpower planning, at the same time, the study provides useful insights and perspectives. Challenge is given in the study, for example, to the traditional usage of practitioner/population ratios, while a rationale is provided for concentrating on communities and economic trade areas for planning purposes rather than using political-geographic jurisdictions.

This publication represents a summary of the major activities, findings, and conclusions identified in the final report of the contracted research. The abstract, largely excerpted from the final report, was prepared to permit a wider distribution of the results obtained. The bibliography presented in the final report--both economic and health--has also been included in this summary presentation.

John M. Leyes, Ph.D., currently with the Virginia State Council of Higher Education, was the primary author and project director for this research effort. During the course of the actual research work and the preparation of the final report, Dr. Leyes was Assistant Professor of Economics at the University of Wyoming. Other authors on the staff of Dr. Leyes included J. Stuart Miller, Joyce Lofgren, Jeffrey White, and Sara Goetz. Paul M. Schwab, of the Division of Manpower Intelligence, BHRD, HRA, was project officer for this extramural activity.

Copies of the final report of this study, entitled The Delineation of Economic and Health Service Areas and the Location of Health Manpower Education Programs, can be obtained by directing requests to the Information Office, Bureau of Health Resources Development, Health Resources Administration, National Institutes of Health, Bethesda, Maryland.

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The Delineation of Economic and Health Service Areas and the Location
of Health Manpower Education Programs--A Summary

Traditionally, research efforts concerned with examining the dynamics of the health-care delivery system have focused on this system as a separate entity independent of the economic system. In fact, however, the provision of sets of health-care services to various population segments is quite similar to the provision of respective sets of economic services to consumers. It would seem reasonable, therefore, to expect that detailed information about the economic system in a particular geographic area would be most helpful in studying the health-care delivery system for that area.

In addition, data on the characteristics and interactions within the health system, particular on an area basis, are often not collected regularly and uniformly, with the result that each study of the health system requires some survey activities. If the economic and the health systems are closely related, however, and given the generally more complete data on the former, then greater is the probability that the economic system can be used as a surrogate for the health-care delivery system.

In the University of Wyoming study, entitled The Delineation of Economic and Health Service Areas and the Location of Health Manpower Education Programs, preliminary attempts were undertaken to demonstrate this identity relationship, namely to use the regional economist's central place theory to compare the economic system and the health care system within a specific geographic setting.^{1/} Coincident with this effort were additional research activities designed to estimate the interrelationships of the health manpower education system with the respective economic and

^{1/} The State of Wyoming was initially chosen as the study area. Because the subject to be studied was economic and health services purchases of Wyoming residents, those counties immediately adjacent to Wyoming were included plus those additional counties in the surrounding States that contain major central places (i.e. Denver, Colorado; Billings, Montana; Salt Lake City, Utah; Provo, Utah; Idaho Falls, Idaho; and Rapid City, South Dakota).

health-care delivery systems. The following summary highlights the methodology applied by the authors to accomplish this undertaking, the major hypotheses tested and subsequent findings, as well as key conclusions and policy implications uncovered by the effort.

Methodology and Rationale

In brief, central place theory relates the spatial results of supply and demand decisions.^{2/} That is, when a commodity or service is presented for sale, a consumer's buying decision involves his consideration of the price, quality, and related transportation costs. The formal concept of central place theory has been attributed to two German scholars--Christaller, a geographer, and Losch, an economist--whose original works were published in 1933 and 1941, respectively.^{3/} The rigorous assumptions postulated in the formal theory, however, result in an economic model considerably removed from reality. As such, numerous investigators have added modifications to the theory which attempt to give the theory and resulting models greater applicability to "real world" conditions and greater ease of being determined and tested empirically.

The specific part of central place theory applied in the Wyoming study was that of hierarchical demand structures. The latter is based on the notion that the amount and frequency of goods and services purchased by consumers, including health services in this instance, varies according to the type of goods and services. Groceries are purchased with more frequency and regularity than clothing, which

^{2/} Chapter II of the Wyoming study, entitled "Literature Review," provides a detailed description of central place theory, as well as a review of the methodologies traditionally employed in empirical studies applying central place theory.

^{3/} Generalized descriptions of the Christaller-Losch model can be found in many works. As referenced in the economic bibliography appended to this summary, see, for example, Richardson, 1969, pages 105-8 and 156-65; Berry, 1967c, Chapter 2; Nourse, 1968, Chapter 3; and Marshall, 1969, Chapter 2.

is purchased more frequently than hospital services, which, in turn, are purchased more frequently than nursing home services. On an area basis, furthermore, the purchase of these commodities will tend to vary from one community to another. Consumers will be willing to travel greater distances for automobiles than for groceries, and greater distances for hospital services than for the services of primary care physicians. Because the range of commodities sold will vary from community to community, it is possible to infer, from the hierarchical structure of the commodities, a corresponding hierarchical structure of communities, trade services, and health service areas.

Seventy-four economic variables were identified in the study and used subsequently to delineate a hierarchical economic system for a part of the intermountain region characterized by rural conditions and low population density. The same geographical region was also used to delineate the health-care delivery system with twenty-four variables.^{4/} The two systems, economic and health-care delivery, were delineated with a computer programming methodology that permitted the grouping of 538 communities into seven different groups, each composed of the most similar communities.^{5/}

The methodology above was developed on the basis of individual communities rather than individual counties, which are often used in this type of analysis. The emphasis on communities seemed well-founded for a study of the intermountain region because counties in such areas tend to be large and distances between

4/ For example, some of the 74 economic variables used in the study were newspaper publishing, petroleum refining, and meat-packing establishments, as well as a large number of different wholesale and retail trade businesses. The 24 health variables largely consisted of counts of various health disciplines, as well as varied characteristics of health institutions and hospital facilities.

5/ The hierarchical structure of central places in the study region, in terms of the economic system, consisted of the following seven groups: (a) Regional trade centers (Denver); (b) Sub-regional trade centers (Salt Lake City); (c) Wholesale-retail centers (3 cities); (d) Primary shopping centers (8 cities); (e) Secondary shopping centers (21 cities); (f) Convenience centers (59 cities); and (g) Minimum convenience centers and hamlets (445 cities). Similar groupings, also in a hierarchical framework, were developed for the health system.

individual communities are often correspondingly large. However, given the low population density of the region under analysis, countless problems were uncovered by the Wyoming study in finding data for both the economic and health systems at the sub-county level. Nevertheless, the data used are similar to the data used for studies in other regions (e.g. Minnesota and Saskatchewan) and yielded results (see below) that were consistent with the expectations of observers familiar with the intermountain region.

Major Hypotheses and Findings

In the Wyoming study, it was found analytically feasible to identify a very close relationship between the economic and health-care systems within the intermountain region. Despite the success of this part of the study, however, the authors were not able to test the hypothesis that the health manpower education system is functionally dependent on or related to either the health-care delivery system or the economic system. The major conclusions of the study can be summarized by discussing the major hypotheses tested.

(A) There are statistically significant similarities between the hierarchical structures of the economic and health-care delivery systems. To test this hypothesis, a methodology was developed as indicated above, which was comprised of a "centrality index" as the measure of the economic importance of a central place, and of a heuristic programming algorithm which served the purpose of efficiently forming hierarchical groups of central places based upon their centrality index scores.^{6/} Two hierarchies were formed in the study area--one based on economic characteristics and the other based on health delivery characteristics.

^{6/} The centrality index, as an indicator for the economic system, measures the intensity of economic activity from one community to another, as well as the extent to which more specialized economic activities fall within communities. The same index would be transferable to characterizing the health-care delivery system--for example, the extent to which secondary and tertiary medical specialty services are available.

Statistical tests comparing the two hierarchies were performed by comparing the rankings of central places in the health and economic hierarchies. Spearman's rank correlation coefficient and Kendall's rank correlation coefficient indicated highly significant similarities between the two rankings. Parametric tests were also performed by assuming that the health index values for communities were a function of the economic index values. A regression equation was estimated and the parametric values were shown to be highly significant.

It was suggested in the study, however, that the statistical tests undertaken may have masked some important additional comparisons between the economic and health systems. The observation was made, for example, that the health-care delivery system seems to be less developed than the economic system. There were fewer communities in the top five hierarchical groups of the health system as compared to the economic system. This meant that there was a tendency for communities to fall into a lower health group than economic group.

(B) Hierarchical service areas are preferable to political units (e.g. counties) and other popular area designations as units for health planning. A review of the methodologies employed in the formation of Rand McNally trade areas, Bureau of Economic Analysis Economic Areas, and Functional Economic Areas was included in the Wyoming study, as well as a summary of other methods which have appeared in the literature. It was pointed out in the study that these methodologies generally have distinct weaknesses for planning purposes--that the hierarchical notion has often been omitted from the methods employed; that inappropriate data have been employed to reflect rural economic activity; and that political boundaries have often been assumed to equal economic boundaries with no justifying arguments presented.

The authors indicated two particular advantages to the methodology of formulating service areas used in this study. First, the methodology was found

to be specifically relevant for studying rural regions since it accounts for quite small communities (e.g. less than 4,000 population in the Wyoming study). Second, given the incorporation of the concept of hierarchies, the authors found it possible to utilize service areas in the planning of a wide range of health activities--from the very basic services requiring small service areas, to the sophisticated facilities and manpower serving very large areas.

(C) It is possible to make inferences about health services which a community and its market area population can support by noting the number and types of business establishments located in the area. This hypothesis was not fully validated, but further procedures which might be followed in proving the hypothesis were suggested by the authors. Characteristics of communities in each group were described for both the economic and the health service hierarchies. Propositions from central place theory were derived and applied to the hierarchies to define intergroup marginal economic activities (IMEA's) and intergroup marginal health activities (IMHA's).^{7/}

The propositions developed were then used to derive specific empirical rules which were operational in determining IMEA's and IMHA's for the study region. However, since no attempt was undertaken in the Wyoming study to relate the IMEA's and IMHA's, the study did not specifically indicate how knowledge about health services can be gained by counting business establishments.

^{7/} The economic or health activities added or subtracted due to inter-group movement of cities are defined by the authors as inter-group marginal activities. For example, given the occurrence of new industrial plants or new hospital facilities, if a central place should move upward from its original group to another, then it would be expected that one or more highly-order (i.e. more specialized) activities would be added to the original intra-group nucleus, and that there would be an increase in the number of activities in the original set of intra-group activities.

While specific rules of thumb were not provided for equating economic activities and health activities, there were broad planning implications identified in the study arising from the relationship of the two hierarchies. If changes in the economic hierarchy could be anticipated or forecasted by planners, then knowledge of the previous health system would give indications of what health activities could be supported by specific communities after the economic change occurred.

(D) The hierarchical nature of the economic system can serve as an efficient base for locating health manpower education programs. Largely based on limited availability of data, the research efforts designed to estimate the interrelationships of the health manpower education system with the economic and health-care delivery systems were inconclusive. Part of the difficulty in identifying the health manpower education system, as presented in the study, is the fact that schools of health manpower education tend to be located on the basis of political considerations rather than upon pure allocative considerations.

Apart from this consideration, however, the authors highlighted constraints upon empirical analysis posed by gaps in key data elements. First, the authors found a dearth of information on the students in the study region and the places of employment after graduation. The data problems were further compounded by the fact that there exists virtually no meaningful information on the optimal size range of individual health manpower education programs. As such, the authors report, in view of the lack of fundamental information on the nature of health manpower education programs, the research must necessarily be relatively speculative and subjective in this area.

The University of Wyoming study, in conclusion, strongly recommended that additional research be conducted in three areas before it would be possible to relate the economic and health-care delivery systems to the health manpower education

system: (1) determination of the distances that students will travel for attending individual health manpower education programs; (2) determination of the distance that students will consider in accepting employment after graduation; and (3) the determination of the optimal size range for individual health manpower education programs.

Policy Implications of Wyoming Study

The conclusions of this study of the economic system, the health-care delivery system, and the health manpower education system may potentially alter present research approaches to health manpower education and present health manpower education policy. In this chapter, possible implications for both research and policy are offered.

A. Health-Care in Some Community

To conduct consumer surveys to determine the range of economic and health-care activities used by residents in a community is feasible. However, a reasonable expectation is that a survey of the range of the activities offered in the community would yield similar information. Therefore, if all residents purchase refrigerators and dental services, the inference is that (a) if refrigerators and dental services are available in some community then some people may buy in the community, and some may buy elsewhere; and (b) if neither refrigerators nor dental services are available in the community, then the residents must buy elsewhere. Conducting a survey of consumer purchase patterns for refrigerators and dental services produces more information; however, the added information may not compensate for the extra cost.

The determination that (a) communities can be ordered, and (b) activities (both economic and health-care) can be ordered in a system consistent with central place theory has been established in this study. Inter-group marginal activities for a rural, low population density region have been identified.

The empirical results have indicated that the presence of some activity within the community is not totally related to the demand for that activity within the community--that communities can support a greater range and magnitude of activities when the notion of population is broadened to include the hinterland population as well as the indigenous community population. The concept of a Standard Metropolitan Statistical Area incorporates a similar notion by inferring that the population of some city exceeds the physical boundaries of that city and includes the peripheral population in the suburbs. In this study, the inference is that residents outside the corporate limits of some community may be as much an integral part of the community as those within the community even though the rural residents are not part of any incorporated place, per se. Identification of the exact size of the population that might be added to the indigenous population of the community is not feasible. However, a reasonable expectation is that if the indigenous populations of Communities A and B are, respectively, 4,000 and 10,000; and if the level of economic activity and the level of health-care activity are the same for both of these communities; then the total population served by these communities must be approximately the same.

Furthermore, if some order of physician services is available in a community, then the demand for that service is high enough (from both residents and non-residents) to warrant the provision of that order of physician services. Therefore, the presence or absence of some economic or health activity in a community provides indirect evidence about demand; if demand is high enough, the activity is present. Thus, the presence or absence of activities is a surrogate for household surveys of demand whether the survey is for the economic system or for the health-care delivery system.

For the smallest communities, where there are no hospital and no physician, health-care might be viewed in the context of need rather than in the context of

demand. To determine health-care needs in the smallest communities, the authors suggest that formal surveys of consumers appear to be necessary.^{8/} Since no survey work was conducted in the Wyoming study, as stated in the contract specifications, no information is available in quantifiable form. Nevertheless, the research effort did involve the assistance of many different individuals in the seven States. These individuals represent, in varying ways, resource persons providing qualitative information about the rural health-care system.

Smaller communities have various kinds of health manpower assisting in the treatment of illnesses and injuries. Some communities have chiropractors and some veterinarians. Others may have an RN or LPN living in the community. These kinds of manpower are utilized by rural residents to provide a variety of diagnostic treatment for illnesses and injuries. These qualitative data suggest that a referral system operates from small communities to larger communities via this informal health-care delivery system.

Research into the specific nature of the health-care delivery system should have potential value for planning. If, for example, allied health manpower and self-diagnosis are widely used in small communities, then non-physician manpower may be widely acceptable there. Research of this nature requires a survey to determine where rural residents enter the health-care system for diagnosis and treatment, since secondary data do not permit a definitive method for identifying the methods of diagnosis and treatment in rural areas.

B. Dynamic Models or Static Models

The empirical models of the economic and health-care delivery systems in the Wyoming report were derived from cross-sectional data. Thus, these models are static in nature. To have made the models dynamic across time periods, it would

^{8/} The delineations of both the economic and health-care delivery systems, as developed in the study, were based on demand rather than upon need. No attempt was made, consequently, to determine the level of services needed by rural residents.

have been necessary to develop time-series data.

In a more narrow sense, however, these models do have dynamic implications. For example, if rural development should occur, then at least one community will grow in size as a result of the development. If that community acquires higher-order economic activities, higher-order health facilities, and higher-order health manpower, then movement might occur between groups in the hierarchical system. The total number and types of activities will change for the region, thus changing the relative influence of each community in the region. To simply compare the change in one community with the rest of the system without re-submitting the whole region to the hierarchical methodology would not be consistent.

If, however, it is known that economic development will occur in some rural area, and if information is available on the size of the development, then inferences can be made about the configuration of the economic and health-care systems that will evolve. Such inferences about the future configuration of communities following development would have good potential for both health and health manpower planners. On the basis of the estimates of the future health-care delivery system, inferences could be made concerning the hospital facilities required, and the quantity and kinds of health manpower needed for employment in the community. Further, planners should be able to estimate changes in the health manpower education system required to alter the supply of health manpower for the given rural development. In this sense, the empirical models provide information about inter-group movement and have some dynamic implications for health and health manpower planning.

C. Transferability to other Regions

The economic and health-care delivery system models developed in this study were based on data collected in a region of mountains, high plains, and low population density. Are these models transferable to other regions with different characteristics--non-mountainous or high population density regions?

A definitive answer to this question is difficult. Nevertheless, there are several important considerations in answering it. First, the consumption pattern of the residents of the intermountain region is expected by the authors to parallel the consumption patterns of residents in other parts of the United States due to the influence of the communications system and the advertising system. The stimuli for consumption spending in the urban Northeast are similar to those in the rural intermountain region. Thus, the number and range of businesses in the economic system required to support some population size (both indigenous and hinterlands) are similar for a low density area and a high density area. More specifically, if Community A in southern Montana has some given range of businesses and serves a total population of X; then some Community B in New York, serving a population of size X, would have almost the same number and range of businesses.

Second, the question might be posed: "Given the low population density of the intermountain region, will the larger distances between communities in the intermountain region restrict the transferability of these results?" The answer to this question is subjective and must be so qualified. Nevertheless, if a household is located 50 miles from the nearest community in the intermountain region as compared to a household located 10 miles away in some other region, each householder travels a minimum distance of 50 and 10 miles respectively to the nearest trade center. If members of these two households require highly specialized medical services, and the householder in the study region would travel 400 miles and the one in the high density population region would travel 20 miles, then the travel distance becomes relative. It seems untenable to maintain, for example, that if residents of urban regions refuse to travel more than 25 miles for some services (assuming the service is available within a 25-mile radius), then a rural resident in a low population density region is unwilling to travel more than 25 miles for the same service. The minimum distance travelled for any commodity would then be determined by the nearest location where that commodity is available. Thus,

although the distance scale may be different in urban regions than in rural regions, the empirical models developed in this study are believed to be transferable from the low population density, intermountain region to high population density, urban areas of the United States.

The authors would expect the results to be transferable to other rural areas. Certainly, the eastern part of the study region (eastern Colorado, western Nebraska, and western South Dakota) is similar to many rural parts of the United States (many small rural communities that are spaced at regular intervals). Since these rural areas fit the general pattern observed in the more mountainous areas, it would seem reasonable to expect that the results of this study region would be transferable to the rural areas.

Two conclusions have been reached: (a) the methodology is transferable to other regions, and (b) the information learned about inter-group marginal economic activities and inter-group marginal health-care activities is transferable to other non-rural areas of the United States. Since the second conclusion requires empirical demonstration for support, there remains the possibility that it could be refuted empirically. Therefore, the authors propose that a similar study be conducted in an urban region of the United States for the purpose of identifying inter-group marginal economic and health activities, and for the purpose of further testing the hypothesis that the economic system can be used as a surrogate for the health-care delivery system. Further evidence confirming the interrelationship of these systems would justify the development of operational models using economic data as a tool for both health planning and health manpower planning.

D. Health Planning and the Economic System

Changes in economic activity result from exogenous changes in the system of production, distribution, and consumption. If exogenous changes can be identified in the system of production, distribution, and consumption, then, inferences can be

made in the economic system and the health-care delivery system. For example, if a mine, factory, or similar facility is planned for a rural area, and an estimate can be made of the potential employment impact in the community, then, inferences can be made about the change in the order and magnitude of the economic system and the health system and the configuration of the new health-care delivery system can be estimated by applying the IMEA and IMFA analyses.^{9/} Thus, health planners can utilize the information on exogenous change in a regional economic system to estimate the change in the health system.

Planners may have to consider alterations in the existing programs of health manpower education if an increase in the number and order of health manpower in the community is needed. Further, health planners would be able to estimate the configuration of health facilities required in the community and to propose methods of developing the health facilities and health manpower in advance of the change.

If it appears necessary to increase the range and magnitude of present health manpower education programs, then the economic system, as defined by the authors, is useful for identifying some alternatives. The evidence reported in the study indicates that graduates of health manpower education programs locate in the State in which they have received their education. To attract needed manpower, a State experiencing or expecting changes in production, distribution, and consumption might initiate changes in its education programs.

^{9/} Some efforts were undertaken in the Wyoming study to develop an operational method for utilizing the economic system as a surrogate for the health care delivery system. The results, as reported by the authors, were encouraging, but time and available manpower did not allow an adequate investigation. As such, the preliminary results were considered too tentative to merit inclusion in the final report of the study.

Further, the study continues, if the emphasis for the development of new or larger health manpower education programs could be influenced by federal decision-makers, then interstate program choices might be more efficient. For example, to serve the health-care needs of the assumed population increase for northeast Wyoming, development of new or larger health manpower education programs in communities such as Rapid City, South Dakota; Billings, Montana; Casper, Wyoming; or Sheridan, Wyoming; could be appropriate. That is, the number of alternatives can be increased and greater attention devoted to efficiency in this way, rather than if decisions to develop health manpower education programs are narrowly restricted to intrastate considerations only.

In sum, the potential for using the economic system as a method for improving the quality of health planning, health manpower planning, and health manpower program and facility planning is suggested by this study. Strong indications are that further research into the operational interrelationships of the economic and health-care systems could prove to be of significant value to planners.

E. Data Needs

Numerous references are made in the Wyoming study to the difficulties encountered in finding the appropriate data. Given this problem, it would seem necessary to identify the essential data needed to permit the update (possibly every 10 years) of the economic system and health-care delivery system for the intermountain region.

The essential information needed for delineating the economic system would include data on the number of businesses and dollar value of retail sales volume by four-digit SIC codes. Since this would pose nondisclosure problems in small communities, it is probable that similar work could be restricted to "number of establishments." In this respect, it would be much easier to conduct such a study if the several censuses of retail trade, wholesale trade, and selected services

would include information on all communities. If rural areas continue to experience a shortage or absence of health services, data on these communities should be made available, permitting a more analytical and meaningful analysis of the specific health needs of these areas.

The essential data needs for identifying the health-care delivery system could be met with the compilation of more detailed data on health occupations, and more extensive data on hospitals, including types of hospital employees, costs, and patient characteristics. Also, survey information would be beneficial on the travel patterns of consumers utilizing the health-care delivery system.

Two data requirements for identifying the health manpower education system are the place of residence of students prior to enrollment and residence and employment status of graduates. Additional information would be useful regarding the optimal program size and the cost structure of various sizes and types of programs.

And, finally, to test the hypothesis that consumers follow similar travel patterns to purchase health and non-health services would require a detailed investigation of the trips taken by consumers. A Wyoming transportation study was being conducted at the same time as this study. Unfortunately, the transportation study did not meet the needs of this analysis since the former sought information on transportation patterns within Wyoming and excluded information on origins and destinations outside Wyoming. Nevertheless, these kinds of data would seem important and useful for delineating the service areas for both the health system and the economic system.

F. Conclusion

Although this study did not involve the estimating of health needs and the use of time-series data, the empirical results indicated (a) that the methodology provided meaningful models of the economic and health systems in the intermountain region; (b) that the economic system data are easier to obtain than the health-care

system data; and (c) that given the close relationship of the two systems, the economic system has the potential of being a surrogate for the health-care delivery system.

In view of the limited nature of the study, namely a low population density study region, it may be advisable to apply the methodology in a more densely populated region. Offered in this study are several approaches to the problems of cross-sectional data and transferability that may make further research effort less important and unnecessary.

A well-organized and informal health-care delivery system (not physician and hospital oriented) may exist in many small and rural places in the intermountain region. If such is the case, then rural and small community residents (1,000 persons and below) may be more receptive to primary health care by allied health manpower.

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