Health service planning regions for Louisiana

Carl F. Baty

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Health Service Planning Regions For Louisiana

Carl F. Baty
Alvin L. Bertrand
Virginia P. Steelman
Evans W. Curry
Foreword

This monograph represents the second of three publications being developed by Dr. Alvin L. Bertrand, Dr. Carl F. Baty, Mrs. Virginia P. Steelman, and Mr. Evans W. Curry as part of a project related to the “Delineation of Health Care Regions Within the State of Louisiana.” This study was funded through the Louisiana Regional Medical Program as part of its thrust to aid health planning at subregional and community levels.

The distribution of health care resources throughout the state has many implications in planning for the delivery of health services. The first monograph entitled, “The Availability and Distribution of Health Personnel in Louisiana,” increased the data base for health planning. Additional variables that influence health care capability are evaluated in this monograph. A formula was developed to delineate medical service regions in the state around nodal urban centers of medical influence. This strategy also revealed certain gray areas in the state where such influence was not clear-cut.

The planning staff of the Louisiana Regional Medical Program has reviewed this monograph. We trust its findings will aid those individuals and agencies doing grassroots health care planning to coordinate their activities and health care resources to greater advantage.

J. A. Sabatier Jr., M.D.
Director, Louisiana Regional Medical Program
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Health Service Planning Regions  
For Louisiana*

CARL F. BATY, ALVIN L. BERTRAND, VIRGINIA P. STEELMAN  
AND EVANS W. CURRY**

Introduction

The populace of a state or nation has an implicit right to expect the optimum health care that can be delivered by its health agencies and personnel. However, this goal can only be achieved through enlightened planning, which in turn depends upon the availability of basic information. The research reported here represents an attempt to enlarge the scope of information available to health planners in Louisiana and the United States. The inspiration for the research came from a growing appreciation of the vital role which meaningful administrative districts or subregions play in service and planning.

Agencies such as the Louisiana Regional Medical Program, the Louisiana Interdepartmental Health Policy Commission, the Louisiana State Department of Hospitals, and the Louisiana Heart Association operate on a statewide basis. All of these agencies, and many others, function administratively in terms of regional subdivisions of the state. Yet, the individual regionalizations used are not based on a wide range of health and medical care information and in no case are they identical. Such arbitrariness and diversity obviously make the coordination of effort difficult—if not impossible—and reduce the efficiency of health care delivery in the state.

The regional idea is not new in health and medical care circles. Hospital service regions were inaugurated in the U. S. in 1931, and the idea has been widely used since that time. The President’s Commission on the Health Needs of the Nation, appointed under President Truman’s administration, highlighted the major advantage of regionalizing health care in these words:

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*This investigation was supported by the Louisiana Regional Medical Program (LRMP) with funds provided by the U.S. Public Health Service. The findings in this report are not to be construed as an official LRMP or USPHS position unless so designated by other authorized documents.

**Former Graduate Research Assistant, Departments of Sociology and Rural Sociology, LSU, now Assistant Professor, University of Missouri, Kansas City, and Research Associate, Institute for Community Studies, Kansas City, Mo.; Professor and Graduate Research Assistants, respectively, Departments of Sociology and Rural Sociology, LSU.
One of the best ways of taking care of medical emergencies as well as the routines of daily medical care, is to get all local health agencies to work more smoothly together. Regionalization calls for the mobilization and development of all health resources and services in a particular region. Regionalization is the organization and coordination of all health resources and services within a defined area, for the purposes of maintaining the highest possible level of medical care, and of adopting a comprehensive health program to the characteristics and needs of the area. This way of being efficient and at the same time preserving local autonomy, customs, and characteristics, fits the American scene.¹

The above quotation makes it clear that health problems tend to be regional in nature. This is true because the causal factors that give a locality an over-all regional identity are the same ones that create particular health problems. The relationship between health factors and economic activity illustrates this point. It is precisely because ways of living and making a living follow regional bounds that there is a coincidence of economic and health variables.

The basic philosophy of regional planning is that efficiencies can be achieved through the decentralization and redistribution of health care services in terms of meaningful aggregates of people. Basic to this philosophy is the assumption that regions should be determined through use of empirical techniques. Areas worked out arbitrarily by non-specialists in regional planning obviously invite questions of validity.

Although the utility of meaningful regions for planning and administrative purposes represents the major advantage of such delineations, there are at least two other justifications for defining such areas. One is that regional entities provide ideal units for data collection and reporting. Properly selected regions are homogeneous, a characteristic that obviates much of the necessity for detailed analysis of quantitative information. In the second place, regions provide advantages for research and evaluation. Sampling can be done more readily on a regional basis, as can evaluation of programs and assessment of change. All in all, there is much logic to support regionalization.

**Theoretical and Conceptual Frame of Reference**

The procedure developed for delineation of health service and planning regions for Louisiana was somewhat complex. (A bibliography of the methodology references is presented in Appendix A.) By way of introduction to the conceptual approach followed, it may be noted that within the discipline of sociology composite regions have been primarily delimited in terms of the presence of uniform or homogeneous

¹The President's Commission on Health Needs of the Nation, Building America's Health, Vol. 2, 1951.
characteristics.\textsuperscript{2} Rationalization for this type of approach was founded on the basic assumption that social and economic characteristics were closely correlated within a given population aggregate.\textsuperscript{3}

Traditionally, the procedure for regional delineation based on a homogeneity of characteristics involved correlation analysis or more complex factor analytic techniques. The major advantage of this type of procedure was that it allowed the inclusion of a large number of variables in the delineation. The generalized procedure followed in this type of regional delineation can be summarized in the following manner. Data representing the phenomenon under consideration are collected and indices summarizing these data developed. Redundant and unreliable indices are rejected prior to analysis. If simple correlation analysis is to be used, variables showing high intercorrelations with other characteristics and low intercorrelation among themselves are selected for use in the regional delineation.

When the more complex factor analytic techniques are followed, the variables used in the regional delineation are selected because they display high intercorrelations among themselves. Additionally, these variables are weighed on the basis of their correlations with a more inclusive factor. (This process will be described at more length in the following section.) Both correlation analysis and factor analysis procedures represent efficient means of selecting variables which are relevant to the delineation at hand.

The next step in the traditional delineation procedure is to obtain a distribution of values based on the original data for the selected variables. Cutoff points are established which group areal units with similar (homogeneous) values into subregions.

There are both advantages and disadvantages involved in the above procedure. The major advantage, cited previously, is that this type of analysis employs a large number of variables that are selected on the basis of relevance. The disadvantages of this procedure are inherent in the assumption that homogeneity is the major consideration in the delineation of composite regions. Such an assumption overlooks certain problems. For one thing, the regions resulting from this type of analysis are not inherently contiguous. Administratively, noncontiguous regions can be unwieldly and within-region cooperation becomes difficult due to the physical separation of theoretically-alike spatial units. A second disadvantage of regional delineations based on homogeneity is related to urban places. Urban centers and the peripheral or surrounding area attached to them typically form a region that is based more on interdependence than on homogeneity.

In considering the above limitations of the traditional approach to regionalization, it became evident that a more appropriate approach

\textsuperscript{2}Single factor regions do not present the problem of determining homogeneity among a set of variables, but rather variations along a continuum.

\textsuperscript{3}Margaret J. Hagood, Nadia Danilevsky and Corlin O. Beum, "An Examination of the Use of Factor Analysis in the Problem of Subregional Delineation," \textit{Rural Sociology} 6, No. 3. (September, 1941), p. 219.
would have to be utilized for delimiting health and medical care regions. Such a conclusion was implicit in the knowledge that urban centers are a dominant force in medical and health care services. This realization led to the consideration of the second basic model for regional delineation, known as the gravitational model. This model is based on the known influence of urban places or nodes on their surrounding area. Its theoretical base rests squarely on the assumption of an interchange between these centers and their peripheral areas. The intervening areas between nodes are conceived as divisible into regions. Isard explains this view as follows:

The mass is structured according to certain principles. These principles govern in an over-all fashion the range of behavior of the individual particles, both constraining and initiating their actions.\(^4\)

G.A.P. Carrothers presents the reasoning behind the gravity model in more specific terms:\(^5\)

1. To produce interaction, individuals must be in communication, directly or indirectly, with one another.

2. An individual, as a unit of a large group, may be considered to generate the same influence of interaction as any other individual.

3. The probable frequency of interaction generated by an individual at a given location is inversely proportional to the difficulty of reaching, or communicating with, that location.

4. The friction against this transportation or communication is directly proportional to the intervening physical distance between the individual and the given location.

This relationship may be expressed in the following manner:

\[
I_{ij} = \frac{f(P_i, P_j)}{f(D_{ij})}
\]

where:

- \(I_{ij}\) = interaction between center \(i\) and center \(j\)
- \(P_i, P_j\) = population of areas \(i\) and \(j\)
- \(D_{ij}\) = distance between center \(i\) and center \(j\).


Despite serious attempts to correct it, one weakness has persisted in gravitational models. This is the inability to incorporate a large number of variables as a measure of mass. It has been possible to weigh a primary factor such as population with measures such as income or school enrollment. However, the inclusion of a large number of variables has not been possible.

The limitations of the two models described were such as to raise a question regarding their use in delineating health service and planning regions. At the same time, the peculiar advantages of both the “homogeneity” and “gravitational” models could not be overlooked. Thus, an attempt was made to develop an approach that would incorporate the strengths of the two models and, at the same time, overcome their limitations. In this effort, it was reasoned that factor analysis could logically be used as a synthesizing device for data that could then be incorporated in a gravitational formula. In this way a synthesis of the homogeneity and gravity models is achieved.

The problem of additivity across factors necessitated the structuring of variables in such a way that a pure, unambiguous factor could be developed. A single score (factor score) could then be used as the mass component in the gravitational model. Single purpose nodal regions could subsequently be delineated using a multiplicity of variables instead of a single indicator. How this was done is explained in the following discussion. From a conceptual standpoint, the procedure developed assumes there are certain societal characteristics centered in urban places, and that urban places in turn are the core areas of health services and programs in the state.

**Delineation of Health Service and Planning Regions**

The first step in the procedure followed for delineating health service and planning regions in Louisiana was collection of information related to medical personnel and facilities. An extensive search was made in order not to overlook data appropriate to the study. In this regard, the lack of potentially useful data by city and parish breakdown was a handicap. In some cases, data were available but not current enough to justify use, and in other instances current data were available but were not felt to be valid or significant.

Twelve arrays of data (variables) were ultimately selected for use in establishing what was termed a medical adequacy index. It should be recognized that the medical adequacy index is not an attempt to assess the quality of services or the extent to which health needs are actually met; however, the index gives an indication of the potential for the delivery of medical services within an area. The 12 arrays were the numbers of (1) physicians, (2) medical specialists, (3) surgical specialists, (4) dentists, (5) registered nurses, (6) licensed practical

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nurses, (7) medical technologists, (8) radiologic technologists, (9) physical therapists, (10) dietitians, (11) optometrists, and (12) general hospital beds. The values for these variables for cities with populations of 10,000 or more are shown in Table 1.

Each of the above variables was related to the appropriate population base (city or parish) and expressed in ratio form (number per 1,000, etc.). Parish population projections for Louisiana were used in the calculation of ratios. These projections were taken from quarterly publications of the Louisiana Department of Public Welfare. (See Louisiana Department of Public Welfare Statistics, April, May, and June 1968.) The figures used were obtained by applying the reported natural increase to census data and increasing or decreasing estimates for migration.

Population totals for urban places with populations between 2,500 and 10,000 were not projected because of the high probability of error. Data for such places were placed in ratio form using 1960 population counts.

**Computation of a Medical Adequacy Index**

The second step in the procedure was computation of the medical adequacy index. This was accomplished by applying principal component factor analysis to the 12 medical variables for the areal units. In this step the relationships among these variables were reduced to a single factor and expressed in terms of a factor loading for each variable by parishes and cities. (See Table 2.) These factor loadings can be thought of as correlations of a variable with a factor.

The factor loadings of the variables were employed as weights in establishing the index of medical adequacy. This was done through utilization of factor scores. Factor scores were obtained by multiplying the individual loading of each variable on the factor times the original data and summing this product for all variables. This process yielded scores for each individual parish or city which were collectively designated as an index of medical adequacy. This index was then standardized for comparative purposes. (The derivation of this transformation is shown in Appendix B.) Such a transformation made it possible to define the absence of medical personnel or facilities as having a value of zero and to assign the indices a mean of 100. The resulting indices were such that they might be utilized for comparisons across time. Thus, a study of medical adequacy performed a decade from the time of this study could legitimately describe percentage changes in medical adequacy. The obtained values of medical adequacy for Louisiana cities of 10,000 and over are presented in Table 3.

The third step in the delineation of regions was construction of a medical influence index. To construct this index, it was necessary to allow population to have an effect on the index of medical adequacy.
<table>
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<th>City</th>
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<th>No. of Medical Specialists</th>
<th>No. of Surgical Specialists</th>
<th>No. of Dentists</th>
<th>No. of Registered Nurses</th>
<th>No. of Licensed Practical Nurses</th>
<th>No. of Medical Technologists</th>
<th>No. of Radiologic Technologists</th>
<th>No. of Physical Therapists</th>
<th>No. of Dietitians1</th>
<th>No. of Optometrists2</th>
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1Louisiana State Board of Medical Examiners Official List (1967).
2American Medical Association Directory (1967).
4Official List of the Louisiana State Board of Nurse Examiners (1967).
5Official Roster of the Louisiana State Board of Practical Nurse Examiners (1967).
6Board of Registry, American Society of Clinical Pathologists (1967).
7The American Registry of Radiologic Technologists (1968).
8Roster, Louisiana Chapter, American Physical Therapy Association (1968).
9Roster, Louisiana Dietetic Association (1968).
10Provides a wide range of data for the medical community in Louisiana.
TABLE 2.—First Factor Loadings of Medical Variables for Louisiana Cities of 10,000 or More Population Using Principal Component Analysis

<table>
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<th>Variables</th>
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<td>.3262</td>
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<tr>
<td>Hospital Beds</td>
<td>.5575</td>
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Thus the medical influence index was based on both population and medical adequacy. This was not a simple process. Giving equal weighting to population and medical adequacy would have yielded an index that overwhelmingly reflected population and diminished the relative effect of medical adequacy. The effect of the range of population, as opposed to the range of the medical adequacy index, would have biased the index in favor of population. These difficulties were surmounted by obtaining the product of the square root of the population and the medical adequacy index value. In order to facilitate handling of the index, this product was divided by 10. The resulting index is presented in Table 4. These medical influence index values were employed as the measure of mass in the gravitational model explained previously.

11
Actual Delineational Procedure

The medical influence index just described was constructed to determine the medical drawing power of an urban place. It was translated into a measure of spatial influence through use of the gravitational model. Essentially, this meant the larger the value of medical influence for a city, the greater its influence over the surrounding area. An illustration of this is found in the relative medical influence values for Baton Rouge (3,997) and New Orleans (8,336). In this instance, the medical influence value for Baton Rouge is a little less than half the value for New Orleans. Translated into spatial terms, the regional boundary between Baton Rouge and New Orleans could be drawn at a point approximately one-third of the distance from Baton Rouge to New Orleans. If the medical influence values for the two cities were identical, the boundary would be drawn exactly halfway between the cities.

The delineation procedure was first applied to the seven most populous urban areas in Louisiana. The results are shown in Figure 1. The areas surrounding urban centers can be looked upon as repre-

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The basic conceptions involved in the form of gravitational model employed here are found in William J. Reilly, The Law of Retail Gravitation, New York: Knickerbocker Press, 1931. The specific formula for the regional delineation was taken from R. M. Northam, James A. Barnes and James E. Lewis, Functional Regions of Georgia: Their Delimitation and Nature, Athens, Georgia: University of Georgia, Institute of Community and Area Development and Department of Geography, 1963. It represents a circle having a radius of $D \sqrt{I_1/I_2}$ beyond $I_2$ when measured in a straight line where: $D$ represents the distance between two cities and $I_1$ and $I_2$ represent the relative influence (along any selected dimension) of the two cities, with $I_1$ being greater in influence than $I_2$. 

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The table below shows the medical influence index values for Louisiana cities of 10,000 or more population:

<table>
<thead>
<tr>
<th>City</th>
<th>Index value</th>
<th>City</th>
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<tbody>
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<td>Minden</td>
<td>558</td>
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<td>886</td>
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<td>New Orleans</td>
<td>8,336</td>
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<td>966</td>
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<td>836</td>
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<td>Sulphur</td>
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senting unaltered spheres of medical influence; i.e., not adjusted to natural or political boundaries.

Practical considerations dictated the necessity of delineations coinciding with political boundaries. This requirement involved a further procedural step to assign parishes bisected by medical influence boundary lines to one region or another. In doing this, it was felt wise to consider three factors influencing the behavior of individuals. First, the influence of smaller cities had to be taken into account. In other words, these smaller centers were thought to be critical in pulling people into one region or another. Second, the existence of natural barriers limiting access to a regional center was considered. The presence of a river or lack of roads obviously might direct the flow of patients or clients in one direction or another. Finally, what might be termed social or cultural factors (such as a pattern of patronizing a hospital or specialist) were deemed important for a group of people, even though they lived outside a region.

In order to account for the influences listed above, two strategies were employed. The first was determination of the medical influence of urban places with populations of 10,000 or more, as shown in
Earlier investigation indicated that urban places with populations between 2,500 and 10,000 did not uniformly contain sufficient medical personnel and facilities to act as centers of medical influence. It can be noted in Figure 2 that overlapping spheres of medical influence exist. This overlapping was an aid in adjusting the delineation in Figure 1 to parish boundaries. For instance, in the case of Natchitoches the medical sphere of influence of this city is primarily within the major region centered on Shreveport. There is, thus, an indication that Natchitoches Parish would appropriately be assigned to the Shreveport region.

The strategy of delineating the influence areas of smaller urban centers was followed by personal interviews with leading and knowledgeable persons, such as hospital administrators and physicians, in each of the critical areas. As a result of this field work, parishes for which there was some question could be assigned to one of the seven basic nodal regions. The nine most questionable parishes were Allen, Assumption, Catahoula, Concordia, Lincoln, Natchitoches, Tangipahoa, Vernon, and Winn.
Allen Parish required field work to determine its placement in a planning district. Statistics indicated a relatively greater dependency on Alexandria than Lake Charles. In 1968, dependency for obstetric services in both private and charity cases showed a definite balance toward Alexandria. In addition, professionals there identified Oberlin as a dividing point from which residents north of that point go to Alexandria and those south of that point go to Lake Charles. The relative population concentration of Allen Parish indicates a slight majority in the north of the parish. All of these considerations lead the researchers to conclude that Allen Parish should be aligned with the Alexandria district, although it would obviously be more appropriate to divide the parish so that its southern part would be in the Lake Charles region.

The gravitational model placed more of Assumption Parish in the Baton Rouge region than in the New Orleans region, although interviews in the parish revealed that most referrals are made to New Orleans. In 1968, New Orleans handled 143 charity births and no private births from Assumption Parish. However, no births from Assumption Parish occurred in any other regional center. In this regard, one physician did indicate that Baton Rouge would probably receive more referrals as its medical services increased, due to its geographic proximity.

Interviews verified that most referrals from Catahoula and Concordia parishes are made to Natchez, Mississippi. The persons interviewed in Catahoula Parish noted that referrals to Alexandria were slightly more common than referrals to Monroe; however, they emphasized that the physicians located in Catahoula Parish were members with those of Concordia and Tensas parishes in the Tri-Parish Medical Society, which favored alignment with the Monroe planning district. Recently, at the request of this society, these parishes were placed in the Monroe region by the Louisiana Interdepartmental Health Policy Commission.

Interviewees in Lincoln Parish expressed a preference for the Monroe region rather than the Shreveport region, even though the bulk of the charity births from Lincoln Parish occur in Shreveport. This position appears in keeping with the fact that twice as many private births from Lincoln Parish occur in Monroe as in Shreveport.

Interviews with health professionals in Natchitoches Parish confirmed that this parish is logically aligned with the Shreveport region. A large majority of the private referrals were reported as made to Shreveport. The charity and private births that occur outside the parish also tend

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8Baird, Beverly, "Staff Study on Medical Subregions," New Orleans, Louisiana: Louisiana Regional Medical Program, Inc. (p. 34).
9Ibid. (p. 14).
10Ibid. (p. 41 & 47).
to be in Shreveport, but are not as strong an indicator of regional patterns as the total referrals reported by interviewees.\textsuperscript{11}

Tangipahoa Parish provides for most of its own health needs, including charity patients who are treated almost exclusively within the parish at the Lallie Kemp Charity Hospital. Professionals in the northern part of the parish reported they refer more patients to Baton Rouge than New Orleans, but physicians in the southern portion said a large majority of their referrals are to New Orleans, and there was a consensus among those interviewed that the parish should be aligned with New Orleans.

The delineational procedure followed divided Vernon Parish among three regions. However, persons interviewed in this area were in complete agreement that the parish should be aligned with the Alexandria planning region. There seems to be little reason to question this position, as Alexandria was the only regional center that handled either charity or private births from this parish in 1968.\textsuperscript{12}

Winn Parish was also divided among three regions—Shreveport, Monroe, and Alexandria—by the delineation formulas used. Interviews with professionals did, in fact, reveal that referrals reflected such a coincidence of influence. However, interviewees were in complete agreement that Winn Parish should be placed within the Alexandria region. In support of this view, it may be noted that a few Winn Parish births occurred in Shreveport in 1968, but the large majority of births from parish residents that occurred outside the parish were deliveries in Alexandria.\textsuperscript{13} This choice reflects the greater accessibility of Alexandria to Winn Parish.

The ultimate regional division worked out is shown in Figure 3. This delineation of health regions represents what might be termed a primary delineation.

There are possible alternatives that could be worked out on the basis of the influence factors previously mentioned. For example, field work in the northwestern section of the state indicated medical practitioners in the Ruston area were interested in an eighth medical region, centered in Ruston and including the parishes of Union, Lincoln, Bienville, and Jackson. This alternative delineation is shown in Figure 4. However, the indicators of medical influence worked out for Ruston did not warrant a separate medical region. Nevertheless, it is recognized that local cultural factors are, in some instances, more important for regional delineation than objective criteria. Individual planners will have to decide if these factors are important enough in the Ruston area to warrant separate consideration.

\textsuperscript{11}\textit{Ibid.} (p. 34 & 41).
\textsuperscript{12}\textit{Ibid.} (p. 34).
\textsuperscript{13}\textit{Ibid.} (p. 34).
FIGURE 3. — Potential medical planning districts based on relative spheres of medical influence of seven major urban areas of Louisiana, 1969.

FIGURE 4. — Alternate potential medical planning districts based on relative spheres of medical influence and field interviews in Louisiana, 1969.
Comparison of Regions Delineated With Other Regional Schemes

The investigation made in connection with the delineation of health service and planning regions for Louisiana disclosed numerous regional subdivisions of the state. As was pointed out in the introduction, essentially every agency functioning in Louisiana utilizes an implicit or explicit subdivision of the state for planning and administrative purposes. On the basis of the work done, it was estimated that well over a hundred such delineations are in use in the state. Some of these areal divisions were obviously drawn on the basis of intuition, while others were based on one level or another of empirical data. The one generalization that can be made about all these delineations is that they are not identical. Six of them are depicted for illustrative and comparative purposes in Figures 5 through 10. It can be seen that they represent a wide latitude of approaches, ranging from delineations based on health to those based on economic and demographic factors, and still others based on sociocultural factors.

Study of Figures 5 through 10 readily indicates agreement on what might be termed the core areas of regions in the state. This is simply a manifestation of the known influence of these central places on their surrounding areas. However, it is also obvious that little agreement exists regarding the outer boundaries of regions. This phenomenon highlights the problem which prompted this study.

Figure 5 represents the health planning subdivisions of the state which come closest to the delineation presented in this report. This particular regional delineation was worked out according to a rather sophisticated methodology, but its data base was limited to the population of urban centers. That is, a single indicator was employed in the delineation procedure. Since the present delineation was accomplished through a statistical synthesis of population data and medical personnel and facilities data into a single index, it is felt that it is more appropriate and valid for health regions. Nevertheless, comparison of the two delineations demonstrates the close relationship between the population base and health factors in given areas. In a general sense, this inter-relatedness is carried over to economic variations in the state, which assume a nodal perspective. The regions shown in Figures 9 and 10 are based on economic variables and with minor exceptions coincide with the delineation presented in this report. The relative coincidence of medical, population, and economic subregions is not surprising in view of a preliminary study that showed economic variables and population density to be very closely related to medical adequacy. This finding and the fact that almost all other regional delineations have identical core areas have implications for regional planning. There is an obvious indication that all types of regional programs—economic, educational, health, control, etc.—can be integrated into one set of regional divisions. Potential savings in time and resources would seem to justify planning in this direction.
FIGURE 5.—Recommended health planning regions for Louisiana. Source: Louisiana Health Policy Planning Commission.

FIGURE 7.—Rural social areas of Louisiana.
Source: The Many Louisianas, by Alvin L. Bertrand.

FIGURE 8.—State economic areas of Louisiana.
FIGURE 9.—Recommended economic development districts.
Source: Gulf South Research Institute.

FIGURE 10.—Louisiana planning districts.
Source: Louisiana State Planning Commission.
Conclusions and Implications

This study leads to several conclusions that seem worthy of serious consideration because of the implications they have for health and medical care programs in the state. These conclusions may be stated briefly as follows:

1. The need for and utility of regional divisions within the state are widely recognized and are evidenced by the large number of regional schemes now in use.

2. It is apparent that with a few exceptions very little has been done to coordinate and validate the regions used by various agencies and departments.

3. Until the present study, no delineation effort in the state has been primarily based on medical adequacy criteria.

4. There is a statistically demonstrable interrelationship between economic and demographic variables and the level at which health and medical care services are available.

5. The 64 parishes of the state are divided into seven composite regions when a measure of medical adequacy is used as a delineational tool.

6. Certain mitigating factors serve to complicate administration and planning for health and medical care programs, including the proximity of large urban centers in neighboring states and the patterns of use of hospitals and other facilities established over time.

Several implications related to the delivery of health and medical services are inherent in the above conclusions. First, it is clearly implied that efficiencies in planning, programming, and administering such services can be effected through the use of carefully delineated sub-areas or regions. The notion which pervades here is that operations of various types could be centralized and integrated through utilization of common territorial units. It is realized, of course, that some adjustments would be necessary, but these could readily be rationalized in terms of the advantages to be gained.

The second implication is related to the first, but has a special significance. This is the obvious finding that various regions within the state have unique needs in terms of health care. For one reason or another—the economic base, the cultural base, the demographic equation or the epidemiology of disease—there is need for specialized facilities and care. Regional centers are the most appealing solution to problems of this type.

A third implication is derived from the present lack of universally accepted base units for the collection and summation of health and medical care data. With meaningful and empirically sound regional units available, data could be collected, systematized, and analyzed in terms of one set of regional delineations. This practice would make comparisons possible that now are out of the question because each agency summarizes its data according to its own regional plan. In
addition, longitudinal and experimental studies could readily and easily be inaugurated, as could evaluative studies of one type or another.

A fourth implication of the study is the potential the procedure worked out and used has for application in other states and territories. There is a strong indication, backed by a validation check in another state, that the delineational procedure followed can be performed and have useful application elsewhere. This is not to imply that adjustments and refinements in procedure may not be made, but that the conceptual framework and general analytical approach are sound.

There are other implications that relate to the strategies that will have to be employed to implement the use of the regional entities delineated, both in terms of convincing administrators of various agencies of the utility of the regions worked out and in terms of the specific adjustments each agency will have to make. However, these matters are in the realm of long range planning and are more properly the concern of interagency councils of one type or another.

Appendix A
Methodology Bibliography


Appendix B

MEDICAL ADEQUACY INDEX DERIVATION

An index with a true 0 and mean of 100 is defined:

\[ I' = \alpha + \beta I \]  

(1)

where:

- \( I' \) = index having true 0 and mean of 100
- \( \alpha \) = 100—value of \( I' \) when \( I = 0 \)
- \( \beta \) = unit change in \( I' \) for one unit change in \( I \)

and:

\[ I = \sum_{j=1}^{q} \left[ f_j \left( \frac{x_{ij} - \bar{x}_j}{s_j} \right) \right] \]  

(2)

where:

- \( f_j \) = factor loading value for the \( j \)th class of medical personnel and facilities, e.g. physicians = \( j = 3 \), \( j = 3,4,--14 \)
- \( x_{ij} \) = number of medical personnel and facilities of the \( j \)th class residing in the \( i \)th city or county of the state. \( i = 1,2,-- \)
- \( \bar{x}_j \) = mean value for the \( j \)th class of medical personnel or facilities
- \( s_j \) = standard deviation of the distribution of the \( j \)th class of medical personnel and facilities.

(Continued)
Appendix B (Continued)

Therefore:
\[ I' = \alpha + \beta \left\{ \sum_{j=1}^{q} f_j \left( \frac{x_{ij} - \bar{x}_j}{s_j} \right) \right\} \]  
(3)

\[ = \alpha + \beta \left[ \left\{ \sum_{j=1}^{q} f_j \left( \frac{x_{ij}}{s_j} \right) \right\} - \left\{ \sum_{j=1}^{q} \bar{x}_j \right\} \right] \]  
(4)

and we define:
\[ I' = 100 \]

When:
\[ I = 0 \]

[Note: \( I=0 \) when \( x_{ij} = \bar{x}_j \) for all \( j \) classes of \( i \)]

Therefore:
\[ 100 = \alpha + \beta \]  
(0)

(5)

and:
\[ \alpha = 100 \]  
(5.2)

When \( x_{ij} = 0 \) for \( j \) classes, \( I' = 0 \);

Therefore:
\[ I' = 100 + \beta \left[ - \sum_{j=1}^{q} f_j \left( \frac{x_{ij}}{s_j} \right) \right] \]  
(6)

\[ 0 = 100 - \beta \left[ \sum_{j=1}^{q} f_j \left( \frac{x_{ij}}{s_j} \right) \right] \]

Therefore:
\[ 100 = \beta \left[ \sum_{j=1}^{q} f_j \left( \frac{x_{ij}}{s_j} \right) \right] = \alpha \]  
(6.a)
Appendix B (Continued)

and:

$$\beta = 100 \left[ \frac{1}{q} \sum_{j=1}^{q} \left( f_j \frac{x_i}{s_j} \right) \right]$$  \hspace{1cm} (6.b)

from (4), we obtain:

$$I' = \alpha + \beta \left[ \sum_{j=1}^{q} \left( f_j \frac{x_i}{s_j} \right) \right] - \beta \left[ \sum_{j=1}^{q} \left( f_j \frac{-x_j}{s_j} \right) \right]$$

since from (6.a):

$$\alpha = \beta \left[ \sum_{j=1}^{q} \left( f_j \frac{-x_j}{s_j} \right) \right]$$

$$I' = \beta \left[ \sum_{j=1}^{q} \left( f_j \frac{x_i}{s_j} \right) \right]$$  \hspace{1cm} (7)

since:

$$\beta \left[ \sum_{j=1}^{q} \left( f_j \frac{x_i}{s_j} \right) \right] = \beta \left[ \left( f_1 \frac{x_{i1}}{s_1} \right) + \left( f_2 \frac{x_{i2}}{s_2} \right) \right. -$$

$$+ \left( f_q \frac{x_{iq}}{s_q} \right) \right]$$  \hspace{1cm} (7.a)

$$= \beta \left( f_1 \frac{x_{11}}{s_1} \right) + \beta \left( f_2 \frac{x_{12}}{s_2} \right)$$

$$+ \beta \left( f_q \frac{x_{1q}}{s_q} \right)$$  \hspace{1cm} (7.b)

since for each $j$ class:

$$\beta' f_j$$, and $s_j$ are constants;

(Continued)
Appendix B (Continued)

we define:

\[ C_j = \beta \frac{f_j}{s_j} \]

therefore from (7.b)

\[ I' = C_1x_{11} + C_2x_{12} + \ldots + C_qx_{1q} \tag{8} \]

\[ = \sum_{j=1}^{q} C_jx_{ij} \tag{8.a} \]

Formula (8.a) thus derived may be applied to the development of a medical adequacy index having a true 0 point and mean of 100.
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