THE LOCATION AND UTILIZATION OF PRIMARY HEALTH CARE SERVICES IN GUATEMALA CITY, CENTRAL AMERICA: A STUDY BASED ON A PUBLIC HEALTH USER POPULATION

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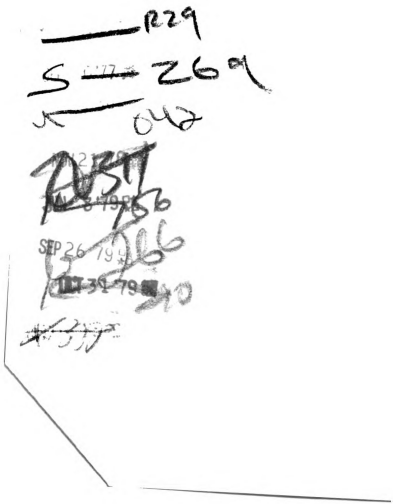

ABSTRACT

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By

James L. Mulvihill

The extensive system of public health dispensaries in Guatemala City presents important research opportunities. Although public health care has a long history within the city, little effort has been made to evaluate the variables associated with service use, or to justify the locational advantages of any specific site. The present study meets these two research needs by analyzing: the personal and family characteristics of public health users, and the locational characteristics of public dispensaries. Recommendations are made from these findings concerning changes needed to encourage service use and relocations of health facilities to conform closer to the spatial distribution of the user population.

The analyses are based on two population samples, one a 10 percent stratified random sample (410 respondents) of all public dispensary users during November, 1974. The

second sample was obtained from a general population, and contains 200 respondents. This second sample provides the opportunity to compare and contrast the characteristics of the more narrowly defined user sample. Principal components analysis reveals the basic relationships within the two data sets by identifying general associations among their socio-economic, demographic, transportation, and health attitude characteristics. Gamma coefficients identify the explanatory relationships between frequency of health care use, and the personal and family characteristics of the respondents.

The results of the principal components and Gamma coefficient analyses support one another regarding the variables most closely associated with frequency of health care use. Among the users of public dispensaries, health attitude variables are most closely associated with use, while certain socio-economic variables are of secondary importance. Surprisingly, the variables of travel distance and time are not significant. The general population revealed a wider range of variables associated with frequency of utilization, including: travel distance and time, sanitation and water facilities, as well as health attitude characteristics. Most striking is the complete lack of association with any of the socio-economic variables.

A recommendation is made for encouraging service use by establishing closer liaison between the public

health facility and the public through an "outreach" program of health education composed primarily of neighborhood health auxiliaries.

The second half of the study compares the present location of public health facilities vis-a-vis their user population, then recommends where location and capacity changes should be made to increase their accessibility. By centralizing these facilities not only are patient travel distances minimized, but also those of the visiting health auxiliaries. Finally, a central location should increase the potential awareness of the facility among the population.

The locations identified by location-allocation techniques are theoretic optimums, and additional factors must enter into final decision-making. Of these considerations, the specific site characteristics of each potential location are important. Is it available for public service use? Is it accessible to both patient and health personnel? Is it in a neighborhood perceived to be dangerous? Also important are the added costs of opening and staffing new centers. Cost considerations raise further questions, e.g. are expanded health services as effective in improving the health status of a population as alternative investments in education, sanitation, and housing?

Overriding these considerations is the need for a development strategy that integrates social with economic

progress. Previously, development planning has stressed economic objectives, and, though economic indicators show progress being made, the benefits of this success have not been widely distributed throughout the population. Health care is one facet of this broader social development problem, and to be effective health policy must be integrated into a general plan to improve the social conditions faced by the majority of Guatemala's population. Without a multi-faceted approach to social improvement, encompassing education, housing and sanitation, any improvements brought about simply through expanded health services will be short-lived.

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CHAPTER I

INTRODUCTION

In recent years there has been an intensified awareness among urban geographers of social issues.[1] One result of this has been an increased interest in the identification and functioning of the urban system. One such component is the health care delivery system. A basic concern of these researchers has been that health care is a fundamental right, and that high quality health care must be available to all at reasonable costs. Where constraints to use do exist, because of poverty or great distances between facilities and patients, public action has attempted to correct the worst deprivation.

Three topics have been of greatest interest in such health studies: 1) the locational characteristics of health facilities and patient travel patterns, 2) patient utilization characteristics, and 3) disease patterns and their relationships with other geographic variables. This

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[1] In fact one of the most recent texts on the subject (Herbert, 1972) is given entirely to the "social perspective." Gale and Moore (1975) provide a multidisciplinary look at urban social problems, while Harvey (1973) contains a more ideologically pointed discussion.

study focuses on the first two topics, location and utilization.

Berry and Horton (1970) review the basic research on intra-urban travel behavior. Earickson (1970) relates these principles to the subject of health care utilization. Earickson's study techniques concern:

1) The identification of socio-economic, demographic, and location characteristics of the user population.

2) The classification of health services, i.e. identification of facility types and their distribution.

3) The analysis of travel distances between users and health service locations.

4) The minimization of overall travel distances by freely shifting user and health service outlets through the use of mathematical models.

As this research evolved during the last decade, insights were gained into other complex problems associated with health service provision and utilization.

Urban Geographic Research in Latin America

Few topics evoke the continuing concern of social researchers and planners as the conditions that have accompanied urban growth in Latin America. Combining urban growth rates of 4.4 percent with low literacy rates and great disparities of national income, yields a potentially explosive social situation (Fox, 1975). Surprisingly, few geographic studies exist on the spatial structures and

processes of Latin American metropolitan areas,[2] which indicates that many of the research models and findings completed in North America have yet to be tested in the distinctive context provided by Latin American cities. If such cross-cultural testing were undertaken, the contrasts could provide further insights into urban social activities. It was in this light that the present study of health care delivery was undertaken in Guatemala City.

Compared with North America, Latin America provides radically different constraints on health service provision and utilization because of a much greater commitment to the public provision of low cost comprehensive health care (Roemer, 1964), yet much remains to be done. Although public care is available, the need for it usually far exceeds the amount provided.

Health Research in Latin America

To date, much of the health care research has been done by anthropologists and sociologists. Anthropological studies have emphasized traditional agricultural or Indian communities, and the inherent problems of cultural and social change in backward areas; while sociologists have

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[2]Wheeler and Thomas (1973) outline this research deficiency. Morris and Pyle (1971) provide an example of such needed research.

emphasized urban areas with their competing social groups within national contexts of modernization, urbanization and industrialization. Also, sociologists tend to rely more heavily on statistical data analyses, and, thereby, are more affected by the critical shortage of published statistics throughout Latin America.

A selection of exemplary research in these areas is presented here to show what has been done, and to better identify what needs to be done in Latin American health research. With this background, a clearer judgement can be made of how the present study fits into the health field.

Anthropological Research

A survey of medical beliefs in a series of traditional coastal communities in Chile and Peru shows the role of culture in communicating old medical beliefs and providing entry modes for new (Simmons, 1955). Culturally defined values become the filters through which new ideas are evaluated and screened for their usefulness.

In rural Peru and Chile, doctors become agents of change from the modern sector of the nation. Rather than being quickly accepted, modern medical practices become simply another alternative to traditional cures, and are used only when these traditional cures prove ineffective. When finally used, if the new medicine is successful, it becomes a cure for that specific illness--but no attitude

change takes place regarding other illnesses. Obviously these findings have negative implications for preventive health care programs that encourage treatment prior to disease occurrence. However, a recommendation is presented that modern medicine could be more rapidly introduced if physicians would be willing to change their attitudes towards the traditional culture. If they would accept the beliefs of the people as having value, they would be better able to couch their modern practices in culturally relevant forms.

Another study deals with underlying reasons why traditional folk react toward health services in seemingly inexplicable ways (Solien de Gonzalez, 1966). Physicians found that traditional groups were not interested in preventive health care, but only curative measures. In most instances people wait until the last stages of an illness before seeking care. They seldom follow medical advise, and fail to use prescriptions or return for check-ups. Yet they will rely heavily on the advice of pharmacists, neighbors, and other non-medical personnel. The explanation proposed is that health practices, as distinct from medicine per se, have little validity in the folk culture, where charms, incantations, and neighborly advice become good health practices, rather than frequent check-ups, preventive inoculations, rest, or fresh air.

Urban lower-class Latins have been found to possess a wider variety of medical beliefs and practices than their rural counterparts (Solien de Gonzalez, 1965). This is attributed to the immediate availability of a range of health services, from modern physicians and clinics, through pharmacists, to spiritualists and natural healers. Of interest is a hypothetical behavior sequence that an average mother will proceed through in time of family illness (Solien de Gonzalez, 1965, pp. 326-327):

> First, she will try all remedies she herself has found to be effective. These will most frequently be herbs, but will also include common patent medicines such as aspirin, zinc oxide, and cough syrup. If these are unsuccessful, she will ask her neighbors, especially older women, who are usually more than glad to give advice. After trying a number of similar recommended home remedies, she will finally consider seeking a specialist. At this point, she will either call in a local curandero (a spiritualist or medicine man), if one lives nearby, or she may consult a pharmacist in the neighborhood. Only after trying the cures suggested by these people is she likely to seek a doctor.

During a single illness as many as twenty-five remedies or treatments may be tried, with the only criterion for judging their quality being their immediate effectiveness. When the ill person becomes well, she will consider the last medicine or treatment to have been effective, and will heartily recommend it to others having similar symptoms.

The importance of anthropological research has been an increased understanding of how social and cultural factors can adversely influence the operation of health

programs.[3] This has given planners answers to why responses to specific health campaigns or public health services differed from expectations--and how modern medicine can be made compatible with the culture of a traditional population.

Sociological Studies

Roemer (1964 and 1965) describes the fragmented and class-oriented medical care systems common to many Latin American nations where:

1) The wealthy have always met their own needs through private physicians.

2) Public health services have been provided for the poor, originally through religious groups, and more recently by national governments.

3) Special health care components exist for members of the military.

4) Special health care components are present for specific segments of the labor force, e.g. government, railroad, or petroleum employees.

Roemer recommends greater coordination, if not integration, of these several agencies, thereby cutting expenditures and eliminating this class-oriented system.

Other research has found a correlation between urban social class and individual response to disease, the response of the health system to patient demands, and the impact of disease occurrence on specific social classes.

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[3] See Sepulveda (1966) for greater elaboration of these points.

Iutaka (1966) shows that lower classes miss more work days because of illness, and attributes this to a differential awareness of disease. When a disease seems severe, a higher status person will immediately spend some days at home, or in the hospital, thereby avoiding worse consequences. The lower social classes, who are not as likely to be aware of a symptom's importance, will delay seeking care until the disease is in a more advanced stage.

Health Planning in Latin America

Reviewers of health planning literature concerning Latin America tend to concentrate on broad methodological considerations rather than actual findings because of the lack of empirical studies on the topic. However, those few studies that do exist point out the direction future research should take. For example, Zschock (1970) reviews the composition and objectives of various national health planning efforts. He refers to the general problem of data shortages, and those attempts made to ease this shortage. However, in a Colombian example, an attempt to improve data collection and availability was of limited success due to shortages of skilled analysts and data processing technology.

Assuming that problems surrounding manpower and data will eventually be solved, Zschock makes an intriguing proposal for future research into the evaluation of health service effects. Given the scarcity of financial resources

for national development, are the returns from investment in expanded health care as effective in raising health standards as those made in education, housing, and sanitation? This is a challenging problem, and one that must be recognized in planning efforts. The present research will suggest how a start can be made.[4]

The Study Area

Guatemala City was selected for study because several Guatemalan acquaintances contacted me about the locational and service problems that exist in their public health system. Many of these problems have geographic implications, and, thus, the city provided the opportunity to test the urban health delivery models that had been developed in North America.

Guatemala City is located in a volcanic basin approximately 4900 feet above sea level. Due to its tropical highland location the area enjoys monthly average temperatures ranging between 61°F and 69°F. The most prominent seasonal variations are the dry season, November

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[4]A second study of health planning (PAHO, 1973) devotes a great amount of space to discussing economic development theory, and the role of health planning in the development process. The remainder deals with a lengthy description of the establishment and training programs of the Pan American Health Planning Center in Santiago, Chile.

through April, and the wet season during the remaining months. Residential growth is greatest along the major transportation routes leading out of the city (Figure 1). The most recent area of industrial location is along highway CA 9, south of the city. Most of these industries are of the "clean" type, located on spacious tracts of land and very similar to those in suburban North America.

Guatemala City exemplifies many of the characteristics of a city in the developing world. The annual urban growth rate is just under five percent, about half of which is due to rural to urban migration (Thomas, 1968). This rapid growth is partly responsible for the estimated shortage of 450,000 urban housing units throughout the nation (Consejo Nacional de Planificación Económica, 1975). A major share of this shortage lies in the capital. Consistent population figures are difficult to obtain; however, the 1973 census lists the capital's population as slightly over 700,000. Alternatively, the Public Health Ministry (MSPAS, 1972) gives a much higher figure of 1,141,000.

These figures do not convey the often pathetic living conditions of a large percentage of the population. This is especially true in the marginal slum areas where overcrowding, lack of adequate water, sewage, ventilation, and electricity are combined with infestation by rats and

Figure 1

Guatemala City

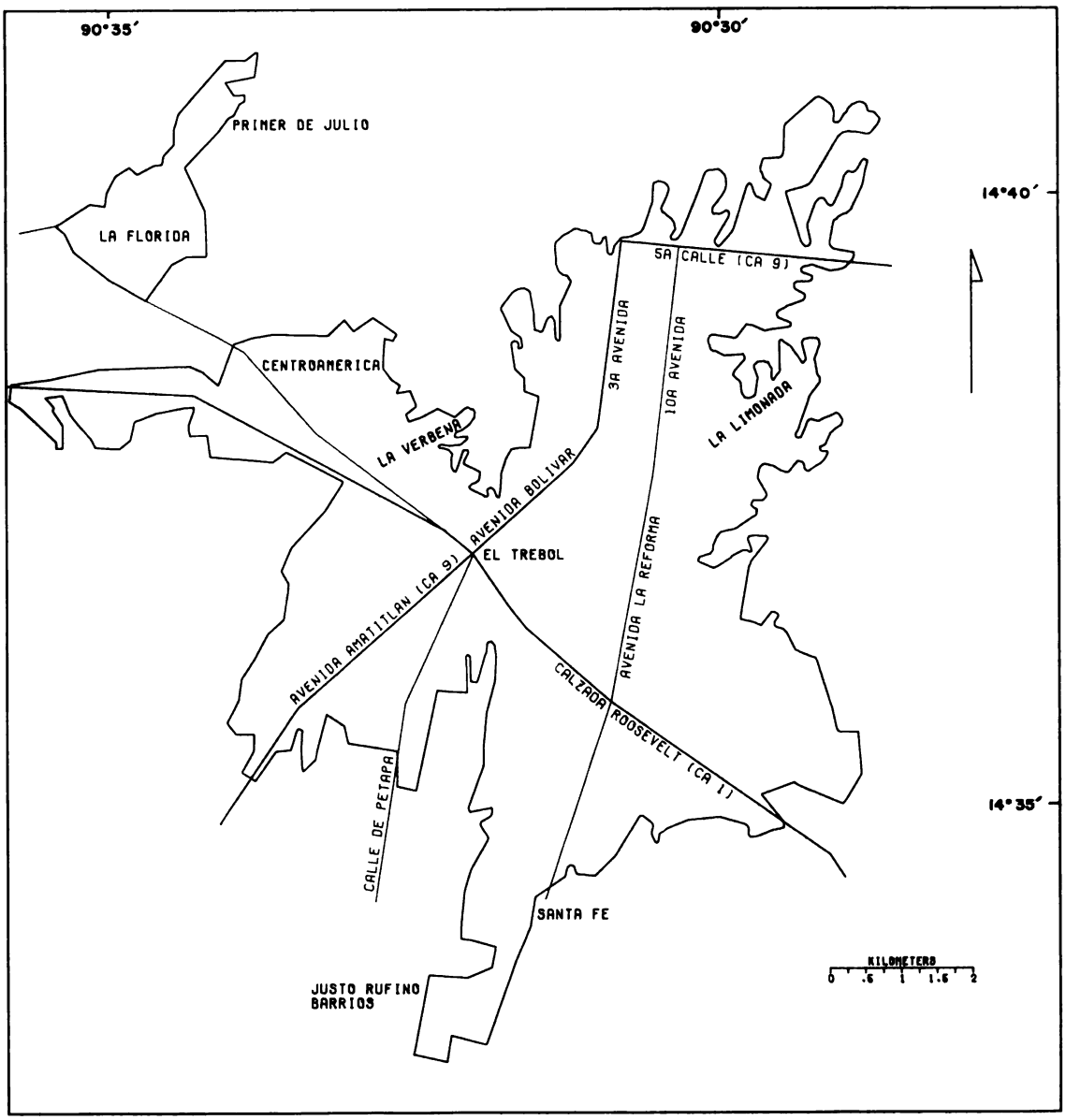
90°35'
90°30'
14°40'
14°35'
PRIMER DE JULIO
LA FLORIDA
CENTROAMERICA
LA VERBENA
5A CALLE (CA 9)
3A AVENIDA
1OA AVENIDA
LA LIMONADA
AVENIDA BOLIVAR
EL TREBOL
AVENIDA AMATITLAN (CA 9)
AVENIDA LA REFORMA
CALZADA ROOSEVELT (CA 1)
CALLE DE PETAPA
SANTA FE
JUSTO RUFINO BARRIOS
KILOMETERS
0 .5 1 1.5 2

Figure 1

other disease-carrying animals and insects.[5] Health and sanitary education is almost totally lacking as the incidence of the four leading causes of death indicate (MAPAS, 1973): gastrointestinal ailments, respiratory infections, heart disease, malnutrition. The situation is one where high mortality rates exist for some easily preventible diseases.

The newest national health plan (Consejo Nacional de Planificación Económica, 1975) emphasizes preventive health care, along with improvements in housing, sanitation and education, as having the greatest potential for improving health in Guatemala. Whatever the specific combination of these programs, some basis must be laid for health data gathering in order to assess what health improvements have been brought about, and to identify where subsequent policy changes could be made, if needed. A system of health data gathering units could be based on existing public dispensaries. Such a proposal calls for an expanded view of the role played by these facilities from one limited to health delivery, to that of a basic component of health planning. This idea will be elaborated in Chapter V.

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[5]Portes (1971) has classified urban slums in Chile, and sheds a great deal of light on their internal organization and external relations with the rest of the metropolitan area.

The System of Public Health Dispensaries in Guatemala City

Three components of the health sector operate public health centers within Guatemala City: the Ministry of Public Health and Social Assistance (MSPAS), the Department of Municipal Health of the Municipality of Guatemala, and the Guatemalan Institute for Social Security.[6] Figure 2 shows the health facilities encompassed by this study within the zonal districts of Guatemala City.[7,8] These centers were authorized by a series of legislative acts during the

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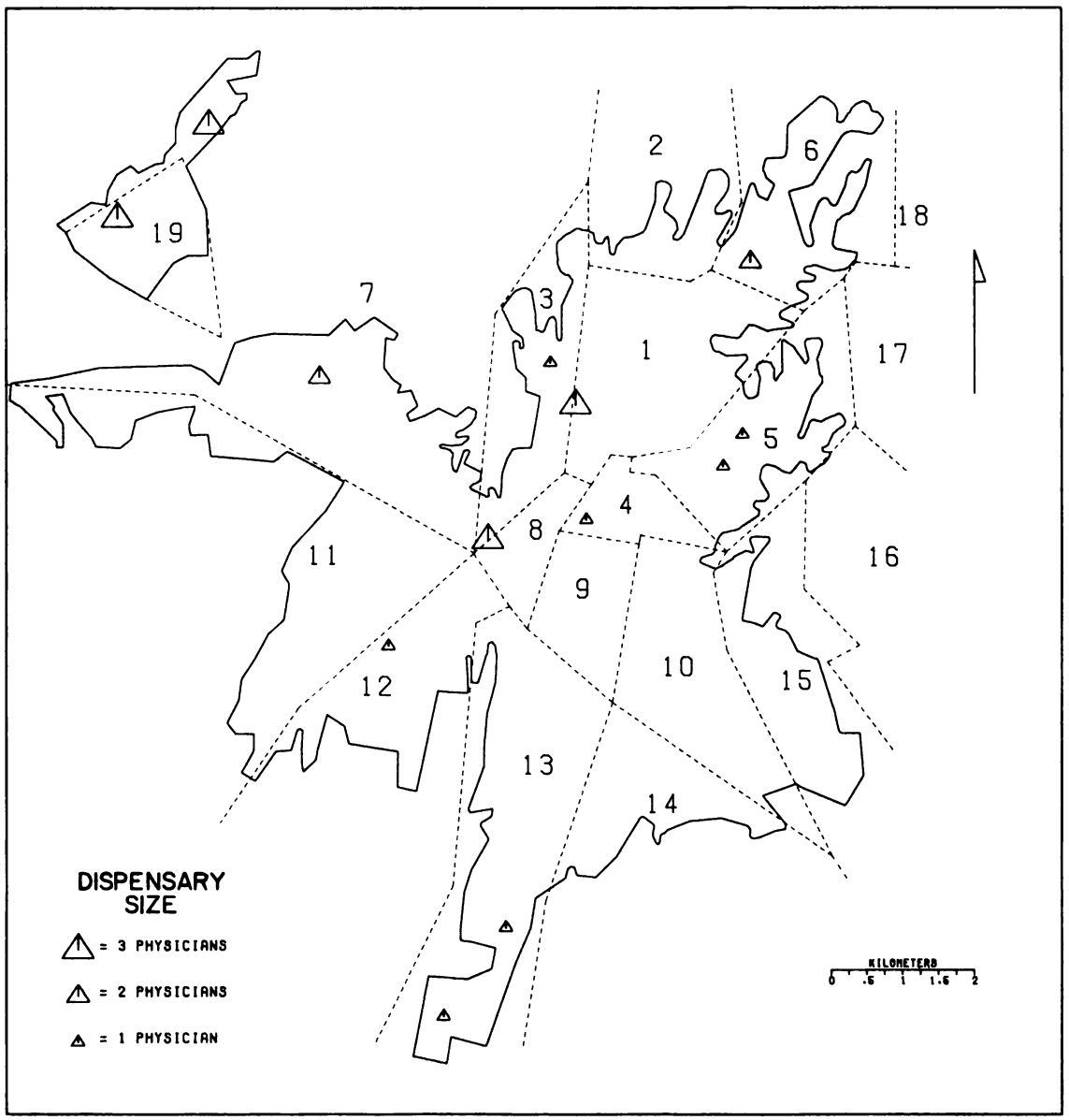
[6]Though contacts were made with the Guatemalan Institute for Social Security, support for this research was not obtained, and their facilities were eliminated from this study. Though important, the services of the Institute are limited to members, and only those persons employed by business concerns employing five or more persons can become members. Thus, most of the lower class are eliminated from health care. Because of its membership limitation the institute is not available to all persons, and, therefore, its exclusion from this study is justifiable.

[7]All facilities responded with the desired data except that in Zone 19. The personnel in that facility refused even the written request from the director of the Municipal Health Department to provide the requested information. However, because of its relatively isolated location, being separated from the city by a tract of non-urbanized land, its service area is geographically identifiable. In addition, the needed data were obtained from the Colonia Primer de Julio which contains similar social classes as Zone 19, so representation of at least some of this group is included in the analyses.

[8]The zonal districts in Guatemala City serve a critical need because street names are often repeated in different zones, i.e. the designations are independent between zones. Knowing that someone lives on 6th Avenue near 12 Calle means very little unless the zone is specified.

Figure 2

Dispensary Locations, by Zone


19
2
6
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12
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15
13
14
DISPENSARY SIZE
= 3 PHYSICIANS
= 2 PHYSICIANS
= 1 PHYSICIAN
KILOMETERS
0 .5 1 1.5 2

Figure 2

late-1940's, in a period of social responsiveness following the overthrow of the dictator Ubico in 1944.

The official responsibilities of these centers are to (MSPAS, 1973): 1) treat disease, 2) provide sources of preventive health care, 3) coordinate health campaigns, 4) act as sources of information on family health, nutrition, and environmental sanitation, 5) provide social services, and 6) provide pre- and post-natal care. With these responsibilities the health system is legally enabled to provide a wide range of services. Unfortunately, often neither the economic, nor the human resources, are sufficient to effectively carry them out.

Guide to Subsequent Chapters

Chapter II presents the theoretical basis for studying health services. Though demand for health services is unique in many ways, there are many similarities with the consumer travel studies that have attracted a great amount of interest from geographers. The objectives, hypotheses, and research procedures of this study are also identified. Chapter III reveals the associations between the socio-economic, demographic, and the health behavior characteristics of public health service users in Guatemala City. Principal components analysis and Gamma coefficients reveal these associations. Chapter IV presents a location-allocation study of health travel patterns for users of

public health dispensaries, and identifies where changes in service capacity are needed. Chapters III and IV examine complementary elements of the health delivery problem, those of supply and demand. The integration of these elements within one study allows a much more detailed analysis than has been previously attained. Chapter V evaluates these results and recommends health service and policy changes to correct shortcomings identified through the analyses and through personal observations in the field.

CHAPTER II

LITERATURE REVIEW AND PROBLEM STATEMENT

Before presenting the problem, hypotheses and analyses that constitute my research, it is important to provide a conceptual framework within which the implications of the hypotheses and the relevance of the analytic techniques become clearly identified. This is done by reviewing selected research demonstrating the important aspects of urban health care. The review is divided into three sections: the patterns of service availability, the influences over service demand, and examples of health care system modeling.

The Patterns of Health Care Service Availability

Morrill and Earickson (1968, p. 224) note that casual observers of the health care system view it as offering a homogeneous service to patients having common needs. Moreover, the health care problem is seen as one of adjusting capacities to meet these unspecified demands. But closer inspection reveals the complexity of the situation. To better understand the distribution of health care service outlets, three factors must be known (Pyle, 1971,

p. 136): the composition of the present health service hierarchy, the comparative costs of various-sized facilities and the limiting effects of past growth on present health planning alternatives.

The Health Service Hierarchy

Morrill, Earickson and Rees (1970, p. 161) observe a common phenomenon in the utilization of hospital facilities; that is, the number of patients who utilize a given outlet declines with distance and the frequency of intervening opportunities. Moreover, in many instances this distinct distance decay is not as strong as in others, and movement beyond intervening opportunities does take place. They cite differences in the range of services offered at each facility as explaining part of this variation.

To explain how health services are distributed, Earickson (1970, pp. 40-41) draws an analogy from Central Place Theory:

> . . . if the resident population in an area reaches some threshold quantity, there is a strong likelihood that a physician will appear. If the population grows, the number of consultations with this doctor will increase until he is unable to service the full demand. At this point, if patients are concentrated, a second doctor will be enticed to open a practice, but if the demand is diffuse, additional physician locations may become profitable. Under the right conditions, the doctors might coalesce into a group practice or establish a clinic. This action is designed to broaden the scope of care available to prospective patients while offering certain advantages to the doctors. With greater populations, a small hospital might be constructed.

Extending this, it becomes obvious that as population growth continues, further demand thresholds are reached. Eventually a complete health services hierarchy develops and supports the largest, most diversified hospital.

Morrill and Earickson (1968) devise a method for delineating Chicago's hospital hierarchy. First, a ninety-nine variable data set describing each hospital in the Chicago area is submitted to principle components analysis. By this method they isolate nine dimensions of correlated variables. In order of their importance, these dimensions concern: 1) the volume of service, 2) the character of the service area--whether it was localized or dispersed, 3) the length of stay and the quality of care, 4) the importance of obstetric and pediatric care, 5) the effects of recent changes in service capacities, 6) the presence of competition, 7) the admission of non-white patients, 8) the range of personnel, expenses per bed and proportion of patients on public aid, and 9) the importance of elderly patients.

Next, the factor scores from the first analysis were submitted to a grouping algorithm which classified the original set of hospitals into ten categories by similarities on the nine dimensions. Because the dimensions concern the characteristics of the hospitals as well as of their service areas, the groupings emphasize the composition and relative geographic locations of the hospitals.

These categories range from large centrally located "teaching" hospitals, through medium and small city hospitals that are more dispersed throughout the city, to suburban and satellite city facilities. Smaller groupings include veterans and childrens hospitals. The authors go on to show that larger hospitals attract patients from a wider area than do smaller hospitals, depending on the size of their staffs and the range of their services. The value of this analysis is the delineation of components within a large hospital system.

Scale Economies Associated with Health Service Facilities

Economies of scale refer to the reduction in average cost of output as production increases. Hefty (1969) has detailed several viewpoints on the interactions of hospital size, range of services and occupancy rates. The essential conclusion is ". . . average costs for short-term hospitals declines with increasing scale of output." Such economies increase with scale until an optimum is reached at hospital capacities of 200 or 300 beds. Above this point average costs gradually rise due principally to increased administrative complexity. Pyle (1974) correlates these rising costs with the hospital hierarchy defined by Morrill and Earickson (1968).

Long and Feldstein (1967) consider the economies possible by consolidating small, inefficient facilities. These economies must be considered against the increased distances some patients would have to travel because of a reduction in the number of outlets. Brown, et al. (1974, pp. 787-797) examine the opposite planning strategy; that is, the increased social benefits resulting from an increase in the number of health service outlets. They side-step the issue of the costs entailed for site selection, construction, or scale of operation, because of the difficulty in obtaining these figures.[1] Further, these difficulties in calculating costs versus benefits in providing health services pose a complex problem for planners throughout the health system.

The Inertia of Past Development

If the adjustment of hospital services responded quickly to the growth of population, the operation of the threshold mechanism would automatically bring about an efficient allocation of the hospital hierarchy, but the system usually lacks this flexibility. Earickson (1970,

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[1]These important cost questions are usually passed over quickly by academic researchers possibly because of the subjectivity involved in these decisions, particularly budget and political considerations. Hall (1973, pp. 15-22) gives a breakdown of site considerations in locating public services.

pp. 47-49) estimates a lag of several years between the need for additional facilities and subsequent expansion. The reasons for this lag include the attachment of physicians, patients and health service employees to existing facilities, and the time needed for fund raising.

Teitz (1968, pp. 48-50) elaborates on this when he views past investment in hospital facilities as constraining present and future attempts to efficiently redistribute these services. Most hospital locations result from a series of planning decisions that maximize objectives at a given time. Once the investment in a health facility is made, it is "fixed" at that location, and though improvements can be made, the basic investment is virtually immobile regardless of changing locational optimums due to demand shifts or changing technology. Allen (1970, pp. 101-104) addresses the problem of temporal instability in locational optimums, though his proposed solution appears to differ only slightly from the space partitioning problem. He ignores those dynamic elements on which the greatest degree of temporal instability exists, i.e. relocation costs, obsolescence rates and the dynamics of the decision process.

Regardless of the number and utility of locational strategies, Teitz points out the lack of consistent and rational policy-making for public facility planning due in part to the insecurity of budget allocations because of

preference vacillations in the public and private sector. Moreover, Pyle (1971, p. 136) points out that in addition to declining locational optimality because of population shifts, an equitable facility distribution never existed. He emphasizes that higher income neighborhoods have always received a greater proportion of public health care investment than those of lower income.

This section on health care availability shows the basis for a hierarchical distribution of health facilities. Theoretically, the growth of health demand should lead to the establishment of the number of facilities needed, and several studies have identified the spatial development of such a hierarchy. However, various factors restrict this process including scale economies which tend to discourage location of small, widely dispersed facilities. Also, the inertia of past development limits the adaptability of the health system to temporal demand changes.

The Influences Over the Utilization of Health Care Services

Earickson (1971, p. 8) lists six variables that affect the spatial patterns of health service use: 1) a patient's relative need for care, 2) the distance/costs of health travel, 3) the patient's ability to pay for care, 4) the attributes of the physician, clinic or hospital, 5) past patient experiences, and 6) the social milieu of

the patient.[2] These "use" criteria can be grouped into three categories: socio-economic, demographic and behavioral. In practice these categories are highly correlated which makes the explanation of their respective impacts extremely difficult.

Socio-Economic Influences on Health Service Use

Socio-economic variables include income, education, employment and residence. Pauly (1974, p. 225) cites four ways in which income can affect health and health service use. With more income greater amounts of health services can be purchased, and, assuming that health care is beneficial, general health is improved. Second, goods whose use increases with income, such as better housing and higher quality food, improve health. Third, other qualities that indirectly affect health, such as education, increase with income. Finally, certain goods whose use increases with income, such as rich foods and liquor, tend to reduce health levels.

Andersen and Anderson (1967) provide a basic analysis relating health care use and a series of population variables. The associations between family income and

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[2]Griffith (1972, p. 7) expands this demand typology to thirteen factors; however, he does not identify any components that are distinctive from Earickson's classification.

source of regular medical care gives an indication of the type and quality of care received by individual groups (Table 1). Families of highest income are the greatest users of specialists, being nine percentage points higher than the middle income group and almost double the use rate of low income families. General practitioners show high use throughout the income categories with the middle income level showing the greatest percentage use. Finally, low income families are most likely to have no regular source of care.

The relationship between family income and time since last physical examination indicates the desire for care as well as the family's ability to pay for it (Table 2). The higher the income, the more likely an individual will have had a physical examination within the preceding year, fifty-nine percent for the highest incomes and forty-five for the lowest. Also, the proportion never having had an exam in the low income category is triple that of the highest category and almost double that of the medium income level.

Weiss and Greenlick (1970) found disparities between individuals of high and low social status on the relative use of three health care modes: the office visit by appointment, the office visit without appointment (walk-in), and the use of the telephone. At distances less than ten miles from a health facility, persons of higher social status

Table 1. Source of Medical Care by Selected Patient Characteristics.

Characteristic	Source of Regular Care					
	Percent specialist	Percent general practitioner	Percent clinic	Percent osteopath, other	Percent no regular care	Sample size
Family Income:						
$0-3,999	20	43	17	4	16	1830
4,000-6,999	29	46	10	4	11	2318
7,000 and over	38	37	7	6	12	3406
Age:						
1-5	36	42	11	3	8	801
6-17	32	40	13	5	10	1941
18-34	27	42	10	4	17	1778
35-54	32	40	9	5	14	1720
55-64	31	44	9	4	12	603
65 and over	30	45	9	3	13	711
Race:						
White	32	42	9	5	12	6326
Non-white	24	38	20	3	15	1132

Source: Andersen and Anderson (1967, p. 14).

Table 2. Length of Time Since Last Physical Examination, by Selected Characteristics.

Characteristic	Time Since Last Examination				
	Percent 1 year or less	Percent between 1 and 5 years	Percent over 5 years	Percent never	Sample size
Family Income:					
$0-3,999	45	26	10	19	1807
4,000-6,999	51	32	7	10	2263
7,000 and over	59	29	6	6	3372
Age:					
1-5	65	20	--	15	788
6-17	49	27	6	18	1910
18-34	56	32	6	6	1747
35-54	50	33	11	6	1708
55-64	50	32	11	7	587
65 and over	53	28	11	8	702
Race:					
White	53	30	8	9	6254
Non-white	55	25	4	16	1094

Source: Andersen and Anderson (1967, p. 19).

tend to make scheduled appointments more often than individuals of lower status. Lower status individuals make use of "walk-in" office calls at this distance. Substitutions take place at distances over ten miles. For example, the higher status group substitutes telephone contact for direct office visits. The telephone is a viable substitute for these patients because of their ability to better articulate needs to medical personnel. Alternatively, those of lower status substituted scheduled appointments for "walk-ins."

The authors also found that lower status patients made greater use of emergency facilities. They speculate that this group takes a more stoic view of illness. If symptoms are not perceived as clear and compelling, such persons are likely to delay receiving care. The greater use of emergency facilities may indicate the delay period ends with an abrupt worsening of symptoms.[3]

Holtman (1972) gives an economic interpretation to the influence of time on medical care use. He theorizes that lower income individuals place a lower value on time than do those of higher income. Therefore, such individuals will choose a form of physician care that consumes more time but is less expensive, such as a public clinic. On

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[3]Iutaka (1966) shows these patterns of delayed use exist within other cultural contexts.

the other hand, persons of greater income will select contact modes consuming less time, but at greater expense, such as a scheduled appointment with a private physician. For higher income patients a public clinic entails an unfavorable mix of time and money compared to a private physician, so they are discouraged from using clinics.[4]

Tucker (1970) has examined the impact of major medical expenditures on the poor. Such conditions cause a financial strain in poor families because, as income falls, the proportion of it available for health expenditures declines more rapidly than do expenditures for food, shelter and other necessities. In a similar study, Iutaka (1966) found that large, unavoidable medical expenses actually reduced food purchases. Thus, one of the most basic items for maintaining health was cut in amount and quality, thereby encouraging further ill health.

In general, socio-economic characteristics influence the type and frequency of health service use, the type of scheduling mode selected, the response time of the individual to disease symptoms, in addition to the amount of health care that an individual can afford. Other

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[4]Grossman (1974) elaborates on the relationship between wages (as an indicator of socio-economic status), age, demand for health services, and the role of human capital (education, etc.) on the quantity, type and effectiveness of health services received. His discussion is non-empirical and based on the impact on production functions by varying the mix of these inputs.

characteristics are related with both socio-economic standards and health care; among these are age and race.

Demographic Influences of Health Service Use

Two demographic influences on health care use will be reviewed, age and race.

Effects of age

As persons advance through life, their health needs change due to aging, educational attainment and personal experiences. Data on the type of regular care received (Table 1) show the most elderly group has the highest percentage use of general practitioners. Conversely, the youngest age group is most likely to use specialists, and is least likely to have no regular care. The next youngest group, between ages six and seventeen, uses clinics more often than the others. Finally, young adults eighteen to thirty-four years show the greatest percentage of no regular care. It may be interpreted that parents are greatly concerned about the care of their children, while showing little interest toward their own.

Regarding time since last physical examination, the youngest age group is the one most likely to have had a physical exam in the last year (Table 2). Interestingly, the next highest age group is least likely to have received a recent physical and is the most likely to never have had

such an exam. One explanation for this is, ". . . that children simply have not lived as long and thus not been exposed to as many possibilities for having examinations" (Andersen and Anderson, 1967, p. 20). After children, ages one to five, young adults ages eighteen to thirty-four are most likely to have received examinations within the last year. This rise is influenced by the high rate of obstetrical care for women in the group, as well as physical exams for employment and insurance purposes. As people reach middle age a decreasing frequency of such exams is reflected in the high percentages of the group in the time periods greater than one year.

Marden (1966) examined the relationship of the metropolitan location of general practitioners with an index of technologic status (the availability of hospital beds) and three population characteristics: 1) age composition, specifically the number of persons under five and over sixty-five years; 2) educational levels, as indicating socio-economic status; and 3) the percent of Black population. Using regression analysis he found the location of general practitioners is neither influenced by medical environment nor education levels of the local population, but is positively associated with the age categories and negatively associated with the percent Black.

In general, health care demands can be described in a cyclical manner as Abler, Adams and Gould (1970, pp.

176-178) have done for housing demands. Young families make greater demands for pediatricians and obstetricians, while the elderly make demands for other types of health care. Pediatricians conform to these demand variations by locating close to areas populated by younger families, with a corresponding adjustment of medical specialists in areas inhabited by older families.

Thus age influences health care use through the changing sensitivity to disease and the attitudes of individuals toward care. It is common for parents to be concerned about the health of their children, and frequently use health services to maintain it, while at the same time, they are much less concerned about their own health. Finally, the average age of a neighborhood's population enters into the locational decisions of certain categories of medical specialists.

Effects of race

Non-whites show a lower percentage use of specialists and general practitioners (Table 1), and they also are most likely to use clinics or have no regular source of care. This reflects generally lower socio-economic conditions that restrict the amount of care that can be purchased and lower education levels that may restrict health attitudes and awareness. Similar explanations can be given for variations in time since the last physical examination (Table 2).

Although the likelihood of having a recent physical examination is almost the same for the two racial groups, the percentage of Non-whites never having received an exam is almost twice that for Whites.

Racial discrimination manifests itself in a variety of ways. Morrill, Earickson and Rees (1970, p. 165) report the use by several Chicago hospitals of ". . . various means to prevent black patients from being treated." Moreover, fewer physicians locate in black neighborhoods because of greater opportunities elsewhere. Because of these circumstances it is estimated that the average distance travelled by Blacks is double the general average of three miles. Though one might associate some of these disadvantages with the low socio-economic status of Blacks, de Vise (1969, pp. 17-22), after lengthy analysis and familiarity with health care problems in Chicago, concludes that these disparities are due specifically to racial contrasts. The presence of racial discrimination has led to the formation of a dual health care system--one component for Blacks, the other for Whites. It is the unequal service available within these two components that causes the service disparities for Blacks.

Race, through lower socio-economic factors, influences health care by restricting the care that can be bought, the care that is desired and discourages the location of physicians in Black neighborhoods. In addition,

research has identified racial discrimination as causing additional travel costs for Black patients.

Behavioral Influences on Health Service Use

Most writers agree that consumer travel behavior is learned through a series of trial and error responses (Marble, 1967; Golledge and Brown, 1976). Responses that bring satisfactory results are reinforced; those that bring negative results are eliminated. Earickson (1971, p. 10) states:

> A realistic theory of how patterns of spatial interaction arise is that individuals make more than one attempt to satisfy their desire for service. After each move, 'measures the error' in his behavior, makes the needed adjustment and tries again.

In theory, the responses bringing the most satisfying results are then repeated until they ultimately become habitual. Because such responses exhibit limited versatility, the behavior patterns they constitute are said to be in equilibrium or "steady state." Habitual activities have been of great interest to geographers because they indicate a stabilization of an individual's movement patterns over space, thereby making them predictable by applying concepts such as least effort and economic man (Golledge and Brown, 1967, p. 116). However, random samples are inevitably composed of diverse behavior patterns of people at various stages in the learning process. At any given time, part

of a population will exhibit habitual behavior explainable by least effort and economic man, while other population segments will exhibit random search behavior. The proportion of search to habitual behavior is related to the rate of change in the individual's environment that brings on disequilibrium conditions and begins new phases of problem solving (search) processes (Golledge, 1969). Environmental factors of importance to patient travel behavior include variations in socio-economic and demographic variables outlined above.

Rosenblatt and Suchman (1969) illustrate applied research on this subject. They studied the outward cues by which persons of diverse social groups evaluate the status and quality of a physician. It is shown that the lower class is most likely to use outward symbols in its evaluation. Since these same individuals are also the most probable users of public clinics, they recommend that municipalities endeavor to properly "package" services in order to make better impressions on a user group that is unsure of their quality.

Though it is generally assumed that patients have little basis for judging the quality of a physician's care, Kisch and Reeder (1969, p. 57) sampled a number of supposedly "ignorant" clients and found their ability to rank their physicians overwhelmingly agreed with assessments made by other physicians. It is clear that patients learn

to distinguish subtle variations in quality of health care and react accordingly.

A Proposed Synthesis

It is appropriate at this point to organize the ideas on the complex interactions between the socio-economic, demographic and behavioral variables that affect health service utilization. One such conceptualization is presented by Gross (1972, pp. 74-76), where he states that utilization is a function of five composite variables:

$$U = f(E;P;A;H;X) + e$$

where,

U = Utilization of various services reported by the patient.

E = Enabling factors, e.g. income "Y"; health insurance status "I"; family size "S"; occupation, sex and education of the family head.

P = Predisposing (behavioral) factors, e.g. attitude of individual toward health care, services and physicians; health values; health behavior when symptoms of health disorder are recognized; use of a regular source of care; knowledge of existence of various services.

A = Accessibility factors, e.g. distance and/or time of individual from facility; appointment delay time; waiting times; availability of hospital, physician and dental services at varying distances from household; availability of a regular source of care.

H = Perceived health level of individual and/or his family as assessed from health interview survey (disability days, restricted days, sick days).

X = Individual and area-wide exogenous variables (age, sex, family size, race, education, locations).

e = Residual error term.

Although this utilization equation can be solved by statistical techniques, existing studies show wide disagreement in the relative strength and understanding of the interaction among these variables.

This review of health utilization research has emphasized socio-economic, demographic and behavioral influences over health care use. Other potential topics have been excluded, such as the effect of price, method of payment and supply. Andersen and Anderson (1967) and Pauly (1974) provide reviews of these latter subjects.

Examples of Health Care System Models

An ideal sought by many is for high quality health care to be made available to each person regardless of socio-economic status, geographic location, age and so forth. But the literature review has detailed the existence of great disparities in health service availability and use. In formulating health planning strategies it becomes necessary to find ways to measure the extent and location of these disparities. It has been quite common to estimate an ideal or optimal pattern of health care supply and demand which is then compared with the actual pattern and the disparities recorded.

Linear Programming Models

In geography, Garrison, et al. (1959) were the first to apply linear programming to a health care problem. They reason that a misallocation of patients per physician produces an oversupply per physician in one region and a deficit in another. Oversupply results in congested waiting rooms, delay in receiving appointments and other inconveniences. Linear programming reallocated patients in order to minimize the inconvenience (social cost) indicators. Supported by trade theory, Garrison, et al. (1959, p. 257) state:

> If the difference in internal prices of two regions is greater than the transport cost between them, trade will take place unless usurped by another region with a greater difference. Trade will raise the price of the exporting region and lower that of the importing region so that at equilibrium the net prices will differ by the amount of transport cost between them.

The operation of this model is quite simple. Given values for supply, demand and transport costs, reallocations are made to correct supply and demand imbalances. Extensions of this procedure could simulate optimality more closely if transport modes were weighted for disparities in ease and speed of travel. Also, the possibility of scale economies, including the formation of clinics and hospitals, and multiple purpose trips could be allowed.

In more recent research Morrill criticizes the application of linear programming (Morrill, 1967; Morrill

and Earickson, 1969a), indicating that the over-generalization of reality needed to simulate optimal conditions reduces the model's accuracy. For example, mathematical necessity restricts the number of routes to which an individual can be assigned, thus setting rigid limits on human behavior (Morrill and Earickson, 1969a, p. 260). Similarly, only one optimal destination exists for each individual ". . . even though other destinations may only be marginally less satisfying or even equally good" (Morrill and Earickson, 1969a, p. 269). Morrill (1967, p. 86) concludes that for a variety of reasons people will over or underestimate costs, and this will lead to some choosing less than optimal paths.

Gould and Leinbach (1966) provide another application of the linear programming model. They set out to locate three hospitals of equal capacity in western Guatemala. Knowing the distribution of the population to be served and the location of five potential sites, all combinations of hospital locations are evaluated. The particular combination that yields the least aggregate travel distance is the optimal. Once an initial solution is found, capacity adjustments are made to eliminate extremely long trips due to size limitations at intervening hospitals. Additional variations are performed to demonstrate the effects of highway improvements on simulated patient travel. These results emphasize:

> . . . the extent to which many planning decisions are interrelated, for in this particular example the problems of health, transport cost, network structure, and the locations and capacities of hospitals are all tightly interwoven. (Abler, Adams and Gould, 1971, p. 543)

Brown, et al. (1974) show the potential for linear programming within a four-stage planning strategy for locating public service facilities by determining:

1) The characteristics by which the target population may be identified.

2) The spatial distribution of the target population across meaningful areal units.

3) Which areal units should receive the population service facilities to be established, using rational locational criteria.

4) The exact location of the population service facility within each target area chosen to receive a facility.

A programming model is used in Stage 3 to evaluate a series of locational strategies for opening day-care centers in Columbus, Ohio. Each locational problem differed in the number of facilities allocated and the maximum distance users must travel. The researchers found that demand could be best met by concentrating additional facilities in areas of greatest need, rather than dispersing them more evenly throughout the city. Of course the ultimate test of this, or any planning strategy, comes after Stage 4 when the means must be found to incorporate the most appropriate

number of new facilities into the governmental budget.[5] This latter topic, incorporating the politics of public decision-making, is one which offers great potential for future geographic study.[6]

The Morrill-Earickson Simulation Model

Much recent attention has been given to a model that attempts to incorporate the distance/cost minimizing characteristics of the programming models with the behavioral components of the gravity model (Morrill and Earickson, 1969a; Earickson, 1970, pp. 70-86). Divided into two segments, the first measures and allocates trip patterns of patients to physicians by aggregating them into two separate sets of "clusters" that are spread throughout the region. Distances between patient and physician clusters are measured and a probability of visiting any one of the physician clusters is assigned to each patient "community."

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[5]Abernathy and Hershey (1972) give an additional example of spatial allocation given a variable set of objectives: maximize utilization, minimize distance/capita, minimize distance/visit, minimize percent decline in utilization. Using a distance decay function in travel estimates with each of these objectives altered the resulting allocation of centers and benefited different sections of the potential user population. It is re-emphasized that those groups for whom the new service outlets are meant must be spatially identified and the appropriate programming objective identified.

[6]Cox (1973, pp. 71-104) has defined some of the political aspects of the public allocation problem, particularly the spatial distribution of positive and negative externalities (spillovers) arising from decision making in the public sector.

This probability is based on the numbers of physicians in a given cluster and the intervening distance. Thus, physician services at distance "2X" are half as attractive as those at distance "X." When compared with the actual travel patterns, this simulation reveals the location of over- and under-utilized physicians. To eliminate the disparities, the model reallocates patients to the nearest under-utilized physician cluster.

This first segment of the model is operated subject to two constraints: the poor cannot afford physician care and substitute public clinics in their place, and Blacks prefer Black doctors, but due to shortages of Black doctors, white physicians are assigned unmet demands. In the last stage of this segment these conditions are relaxed and patient communities are allowed to visit the nearest physician cluster regardless of race or income. An indication of the social costs of discrimination and poverty can then be obtained by comparing the constrained and unconstrained allocations.

The second segment of the model allocates patients to hospitals in a manner similar to the patient-physician allocation. Here, hospital capacities are reallocated under a constraint of religious preference. This constraint is eventually eliminated in the final step of the segment in a manner similar to the patient-physician allocation.

Though the Morrill-Earickson model includes behavioral elements relating to the distance and size of a facility, certain shortcomings can be pointed out, particularly in the model's inability to disaggregate the population by either type of medical care demanded or physician specialty supplied. Also, distance minimization may be overstressed while the viability and quality of institutions are understressed. Finally, the exact relationship of poverty and race to utilization is subjectively chosen, leaving to other researchers the exact calibration of the model.

Further Health Planning Models

De Vise (1966) divides the Chicago metropolitan area into hospital service areas on the basis of patient travel patterns, in order to provide basic spatial units for health planning. First, hospitals are grouped into clusters within metropolitan political boundaries. Then, assuming an equal hospital bed occupancy rate per 1,000 population, a balance of trade index is computed for each cluster:

$$\text{Balance of Trade Index} = \frac{\text{Bed-Population Ratio of Zone}}{\text{Bed-Population Ratio of Metropolitan Area}} \times 100$$

An index of 150 indicates there are 150 beds for every 100 local patients; hence, there are fifty "imported" patients for every 100 local patients.

In the second model phase, maps are made of patient-to-hospital flows from each community in the metropolitan area. Using these flows, the original hospital clusters are modified to minimize service area overlap between clusters while including the maximum number of a hospital's patients within its service area. Once a basic districting has been made, the opportunity exists for aggregating several zones into larger districts for administrative purposes.

But this procedure has shortcomings since the model is deterministic and allows no opportunity for a patient to evaluate the characteristics of specific facilities. Also, though a disaggregation of patients is achieved on the basis of service need, the flows used are those of maternity patients, and there is no justification this one service is representative of the travel patterns for the majority of hospital patients.

Pyle (1974, pp. 166-175) applies a descriptive methodology to the health location problem by using two-dimensional graphic representations of the relationship between facility locations and their consumers.[7] With

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[7]The possibility exists for weighting the consumers by disease (or utilization) probability, or other ecological factors.

two hypothetical situations, one locating a radiation therapy unit given a number of possible hospital locations, the other locating an additional fifty hospital beds within a three county region, Pyle is able to analyze the advantages of locational alternatives. He also introduces other aspects of health planning, including the political interaction between various health planning agencies and their often conflicting spheres of influence.

Predictive Models

De Vise (1968, p. 168) classifies geographic research on hospitals into three planning phases: 1) the description of geographic patterns of hospital use and determination of factors affecting it, 2) the measurement of unmet hospital need, for prescriptive purposes, and 3) the prediction of future utilization. While this literature review has discussed models concerned with the first two of these planning phases, only one model has been found dealing with the final, predictive phase (Pyle, 1971, pp. 176-179).

Pyle's model uses areal demographic projections of Chicago in 1980. Then, with data on the morbidity characteristics of a given disease, and the location and capacities of existing facilities for the care of these diseases, the model projects the occurrence for each disease and computes where facilities need to be expanded or contracted. The spatial allocation mechanism is similar to that used by the Morrill-Earickson model except that completely new facilities

are located rather than simply shifting present units. During each simulation run, patients are allocated to the nearest facility until capacities are reached, then additional facilities are allocated. This process continues as additional thresholds are met. In Pyle's (1971, p. 176) words, ". . . the need aspect of treatment replaces previous measures of revealed demand."

In addition to problems with the Morrill-Earickson model, Pyle's model cannot adequately deal with the time lag between the attainment of a population threshold and construction of additional facilities. This lag may reach three times the theoretical threshold before hospital provision is actually made.

Problem Statement

This research studies and evaluates the availability of low cost, primary health care services available to all citizens of Guatemala City. This city provides an excellent study area because of the national commitment to provide free primary health care. However, since the demand for these services is far greater than the amount provided, there is a need for change in service capacities. This could be accomplished by adding new health care centers and, where feasible, relocating existing centers closer to areas of high demand. The question of identifying the best location for these service changes becomes very important.

A second question relates to service use. What are the characteristics of public health users? How frequently do they use these services? And what are the barriers that might limit service demand? To provide additional sources of care is half of the service problem; the other half concerns those variables associated with frequency of service use. The identification of these variables may indicate further health care changes that would encourage the use of the newly provided facilities.

To attain these objectives the following information is necessary:

1) The location of primary health services within Guatemala City.

2) The location of the user population for these services.

3) The identification of socio-economic and demographic subcategories within this user population.

4) The evaluation of behavioral attributes of each subcategory, such as familiarity with public health services, views of their effectiveness and existence of access barriers to these services.

With this information a more precise measurement of efficiency within this health system is made.

Questions to be Answered

1) How are free or low cost primary health services distributed throughout the study area?

2) How is the user population distributed throughout the study area?

3) What are the socio-econimic and demographic characteristics of the user population?

4) How does familiarity with the health service affect utilization?

5) What effect does change in distance and time have on service utilization by specific segments of the user population?

6) Can a change in the present distribution of health service outlets be made that would lessen the distance/time constraints of the user population?

Hypotheses

I. Due to the possibility of attaining scale economies and minimizing overall travel distances, low cost health service outlets are limited in number and confined to central locations.

II. Great locational disparities exist between service outlets and the user population. This is due to the dispersed location of users and the central locations of service outlets.

III. With the elimination of monetary costs, utilization will be influenced by:

A) The distance travelled and the time required to overcome this distance.

B) The user's evaluation of the services provided.

C) The socio-economic and demographic characteristics of the population.

Study Data

Data gathering was completed in four stages: 1) the authorization to conduct the study, 2) the preparation

of the questionnaire, 3) the user survey, and 4) the general population survey.

The Seeking of Authorization

Although I arrived in Guatemala City in late October, 1974, the first meetings with health officials were delayed until the first week of January, 1975. This occurred due to the difficulty of identifying those in the health bureau who could provide the authority to conduct the necessary sampling of clinical records. Also, many officials vacation during the month of December, and time was needed for familiarization with the study area, as well as with the work of the Geographic Studies Section of the Guatemalan Ministry of Public Works (with which I was associated during the period of data gathering as an urban planning advisor).

The health agencies and their representatives contacted were:

1) Guatemalan Institute of Social Security (IGSS); Sr. J. Benjamin Deleon G., Technical Chief of the Hospital Planning Commission, and Dr. Augusto Cesar Amaya, Medical Assessor of IGSS.

2) Municipal Health Department of the Municipality of Guatemala; Dr. Carlos Mazariegos Herrera, Director.

3) General Directorate of Health Services, Ministry of Public Health and Social Assistance; Dr. Leonel Barrios Santos, Chief of the Metropolitan Region.

4) General Directorate of Health Services, Ministry of Public Health and Social Assistance; Dr. Mario Roberto Gutierrez, Sub-Chief of the South Metropolitan Area, and Dr. Napoleon Diaz, Sub-Chief of

the North Metropolitan Area. This meeting also included medical assistants for social services, preventive medicine, medical education and nutrition for both the North and South Metropolitan Areas.

5) General Directorate of Health Services, Ministry of Public Health and Social Assistance; Sra. Miriam Suchini, Supervisor of Nurses of the Metropolitan Region.

In each case I explained the research, the advantages of this work for the various agencies, and the assistance desired.

Authorization was granted by the Municipal Health Department of the Municipality of Guatemala and the General Directorate of Health Services, Ministry of Public Health and Social Assistance--both North and South Metropolitan Areas. In the case of Municipal Health, Dr. Mazariegos informed me that a study of dispensaries under his authority had recently been completed by medical students from the national university;[8] nevertheless, he would cooperate

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[8]Some months later, after the survey had been completed, I went to the school of medicine in the national university to inquire about these studies. After searching through stacks of old reports, I located a few of the studies. An inventory of each dispensary had been made by a specific group of students to produce a term paper. All the equipment within each facility was listed (the number of tables, chairs, scales, etc.), along with staff work schedule. In a few of the studies the chief physician was asked the dispensary's area of influence and the response only distinguished the streets that were believed to approximate the service area limits. The studies varied greatly in quality, but most were poorly composed and there was a lack of coordination regarding format of presentation.

fully in the study. After several subsequent attempts to contact the officials in the Guatemalan Institute of Social Security went unanswered, I assumed that their participation would not be forthcoming and proceeded without this component. The absence of the Social Security Institute is not as serious since it limits service to members only. To be a member, one must be employed with a firm of five or more employees, thereby excluding the unemployed, self-employed as well as those working in small concerns. If the object of this study is to examine those primary health services that are available to all in time of illness, then the Social Security Institute may be eliminated because it is not available to the total population.

With the authorization of the two main components of the primary health care sector, I distributed special forms for recording the desired information to all dispensaries within the metropolitan area.[9] The information sought the names and addresses of patients that had visited each facility during the month of November, 1974.[10] More

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[9]Originally it had been hoped to include rural areas on the urban fringes of the capital; however, a lack of a street address system and the predominance of Indian dialects soon made it clear that this inclusion was not possible.

[10]November, 1974 was the last month without major holiday or vacation periods (I began the address collection during the first week of February, 1975). In Guatemala the normal vacation period is during December and January.

information would have been asked for if greater uniformity existed in record keeping among the health staff. Several weeks were allowed for the completion of this data gathering, and often several visits to a specific center were needed to insure completion of the sampling. Eventually all centers but one responded with the desired names and addresses.[11]

The Preparation of the Questionnaire

At the same time official authorization was sought and the lists of users compiled, the questionnaire was translated into Spanish, pre-tested among different population groups and revised. It asked a range of questions concerning: 1) frequency of service use, 2) socio-economic and demographic characteristics of the respondent and his family, and 3) attitudes and opinions of the respondent towards the public health system. Because a large proportion of respondents were expected to be ill-educated, care was taken to minimize potential misunderstanding and bias. Pre-testing, in addition to identifying poorly worded

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[11]The only non-reporting dispensary was No. 6 in the Colonia La Florida in Zone 19. As this is an enclave of the city surrounded by rural areas, its area of influence can be assumed to be those of the Colonia. A nearby health center in the Colonia 1° de Julio, very similar in living conditions, did report so the population of that area was sampled and interviewed.

questions, brought about a reduction in the size of the proposed questionnaire by one-third, and increased the number of open-ended questions. On scaled responses, the number of stated options was reduced to three or four (an English version of the questionnaire is found in Appendix A).

The User Survey

The total number of patients using the primary care facilities of the Municipal and Public Health departments during November, 1974 was just above 4100. For each dispensary a ten percent random sample was selected for interviewing, or a total of 410 users. The user addresses were plotted on a map of the capital, and the city was divided into sections to facilitate surveying.

Several investigators from the Geographic Studies Section, a planning branch of the Ministry of Public Works, were provided to assist with the interviewing.[12] Each investigator was provided a map of his survey area, with the locations of users along with a list of names and

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[12]Briefings were held with these investigators in which the questionnaire was reviewed, the specific goals of the study explained and the responsibility of each interviewer detailed. Each day of the survey, I accompanied a different investigator to insure not only that the work was being done, but to correct any problems the investigator may have had. During the afternoons I checked the previous day's questionnaires from those interviewers whom I hadn't accompanied.

addresses of families (users) to be interviewed. The interviews were conducted with the family member who was responsible for the family's health, usually the housewife and mother. If this person was not available during the first visit, a message was left as to what time the investigator would return. In certain cases where names or addresses were not valid another name was randomly selected from the clinical user lists.

The user survey was completed in four weeks during April, 1975, and included neighborhoods throughout the city, from middle income areas to squatter settlements on the urban margins. Only very highest class residential areas showed no utilization of public health services.

The General Survey

Once the user survey was completed, plans were made for a sample survey of the general population. The purpose of this general survey was to provide information from a broad range of individuals with which to compare the results of the user survey. To obtain this cross-sectional population, a zone of the city was selected that typified a broad range of socio-economic and demographic groups.[13] From personal experience and through discussions with individuals

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[13] By working in a specific zone, I was better able to control for street patterns in the spatially random sample technique that I employed.

in the Geographic Studies Section, Zone 12 of the city was selected as best fulfilling these criteria (Figure 2). Partly due to its elongated shape, Zone 12 extends from low income residences at the junction of CA 9 and CA 1 near the city core, to the very highest class housing on the outskirts of the city around the national university. A sample population was chosen by selecting one respondent from each square block within Zone 12. The respondents were selected by sequentially selecting a number from a random numbers table and locating the residence on the block whose street address matched with, or was closest to, the random number, then an interview was completed with that family member responsible for the family's health. This survey included 200 interviews.

The general survey was completed during May, 1975, and the final month of research, June, 1975, was spent compiling data from: the Guatemalan Census Bureau, the Planning and Statistics Branch of the Ministry of Public Health and Social Assistance, the Guatemalan National Economic Planning Council, the Organization of American States and the Geographic Studies Section of the Ministry of Public Works. A conclusion that becomes apparent when consulting data sources in Guatemala is that, although a great amount of health related socio-economic and demographic data is gathered by government agencies, very limited

attempts are made to compile these data into usable form. And, if the data are published, it is only at the highest levels of aggregation, thus limiting its use.

CHAPTER III

THE UTILIZATION ANALYSES

This chapter relates a family's utilization of a public health center to specific socio-economic, demographic, and attitude characteristics.[1] The literature review has indicated the complexity of the relationships between these variables primarily from studies made in developed societies. Before attempting an in-depth analysis of utilization within a less developed society, it is necessary to apply an exploratory statistical technique to identify the basic relationships among variables normally associated with health care delivery. To accomplish this, principal components analysis, the factor analytic technique common to geographic research, has been selected. Of the exploratory potential of factor analysis, Rummel (1970, p. 31) states:

> In a relatively new domain of interest in which the complex interrelations of phenomena have undergone little systematic investigation, factor analysis is useful for exploring the unknown. It can reduce

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[1] It is assumed that the opinions given by the respondent, the person who has responsibility for the family's health, are representative of those of the family group for several of the explanatory variables used in this analysis.

> complex linkages to a relatively simple linear expression, and it can uncover unsuspected relationships which may at first seem startling but later appear to be common sense. . . . It enables the social scientist to untangle interrelationships, to separate different sources of variation, and to control undesirable influences on the variables of concern.

The Principal Components Analysis[2]

Principal components analysis provides a method for summarizing, or generalizing, the associations among a set of input variables. In order of significance, it identifies a set of composite variables (components) and indicates the correlation of the input variables with each of these composite variables through indices known as factor loadings. The nature of each component is identified by its patterns of association with the original variables. Thus, components analysis provides a means of identifying empirical relationships between sets of variables in a manner distinct from the usual sense of correlation and explanation between individual variables.

In this analysis, the technique delineates the response patterns between the two data sets, thereby allowing a greater understanding of how the socio-economic,

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[2]Refer to Rummel (1970) for a detailed, yet clear, exposition of the terms and concepts connected with principal components analysis and other factor analytic techniques. This text was written by a social scientist for social scientists. See also Nie, et al. (1975, pp. 468-494) and Berry (1971, pp. 214-216).

demographic, and attitude characteristics relate within and between the two groups. Thus, the opportunity exists to compare and contrast response patterns between a general population, and a population of more limited social variation.

Geographic Applications of Principal Components Analysis

Before evaluating the results of the present component analyses a discussion of previous geographic applications would be helpful. The most familiar application of this technique by geographers, the urban factor ecologies, is an extension of social area analysis from sociology. Through this methodology, geographers have correlated the Shevky-Bell social typology of economic status (social rank), family status (urbanization), and ethnic status (segregation) with the three basic urban models, Hoyt's "sector growth," Burgess' "concentric zone" and Harris and Ullman's "multiple nuclei" (Murdie, 1969, pp. 1-38). Rees (1970, pp. 306-394) provides a detailed example of this research in his social geography of Chicago. The three most important dimensions in his analysis are: socio-economic status, stage in the life cycle (family status), and race and resources. He views the link between urban social distributions and the physical structure of the city to be the product of actions between home suppliers and home demanders (Rees, 1970, p. 386):

> . . . within the limits of the technology and resources at their command people choose to minimize, through living apart from those unlike themselves, the possibilities of conflict because of class (Dimension I), generational (Dimension II), racial (Dimension III), and religious or national differences (Dimensions IV, VI, VIII, and X).

The present application of principal components analysis differs from previous geographic work in that individual respondents are the basis of the analysis rather than spatial units, such as census tracts. The objective is to identify the fundamental patterns among the characteristics of public health center users and compare these with the patterns of the general population. One objective is to determine whether Gross' (1972) typology of health care utilization characteristics can be identified, while another is to find the degree to which individual components correspond to those found in previous geographic studies.

The Principal Components Analysis of the User Survey Population

The computer program used is from the Statistical Package for the Social Sciences (SPSS).[3,4] Table 3 shows

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[3]See Nie, et al. (1975, pp. 468-514) for the description of program Factor.

[4]Because the data used were based on two measurement scales, ordinal and interval, all variables were transformed into ranked data and a rank correlation matrix

Table 3. Loadings on the Principal Components of the User Population Survey.

Variable	Dimension I	II	III	IV	V
1. Service use (not applicable)					
2. Number of years use			.338		.277
3. Number of illnesses				.648	
4. Number of visits				.746	
5. Transport mode		.792			
6. Travel time		.823			
7. Travel distance		.630			
8. Waiting time					
9. Family size					.829
10. Persons per bedroom	.303				.717
11. Water service	.793				
12. Sanitary service	.796				
13. Health evaluation					
14. Frequency of health concern				-.343	.260
15. Illness response time					
16. Existing infirmities				.255	
17. Sex of family head			.274		
18. Age of family head			.803		
19. Education of family head	-.643		-.253		
20. Sex of respondent			-.299		
21. Age of respondent			.759		
22. Education of respondent	-.620		-.360		
23. Income	-.656			.279	
24. Personal barriers					
25. Adverse opinions					
26. Respondent's evaluation					
27. Alternate medical care sources				.468	
28. Health information sources					

Table 3. (Continued)

Variable	Dimension VI	VII	VIII	IX	X
1. Service use (not applicable)					
2. Number of years use	.323				
3. Number of illnesses					
4. Number of visits					
5. Transport mode					
6. Travel time					
7. Travel distance					
8. Waiting time	-.684				
9. Family size					
10. Persons per bedroom					
11. Water service					
12. Sanitary service					
13. Health evaluation	-.265	.647			
14. Frequency of health concern		.572			
15. Illness response time		.463		-.322	
16. Existing infirmities		.586			
17. Sex of family head					.667
18. Age of family head					
19. Education of family head					
20. Sex of respondent					.702
21. Age of respondent					
22. Education of respondent					
23. Income					
24. Personal barriers	.733				
25. Adverse opinions			-.771		
26. Respondent's evaluation			.624	-.360	
27. Alternative medical care sources			.320		-.301
28. Health information sources				.805	

the factor loadings matrix which has undergone a Varimax rotation in order to emphasize the strongest association patterns, while de-emphasizing the weaker patterns.[5] To simplify interpretation, only those variables loading higher than $\pm$.25 are included. Also, the number of components deemed significant are limited to those with eigenvalues over 1.000.[6] The procedure will describe the individual components in each analysis, then summarize health policy implications by comparing the results of both analyses.

The Interpretation of Components

Dimension I: Low Socio-Economic Status--Accounting for 12.4 percent of the total variance (Table 4), this is the most important group of related variables within the user survey. The variables and the direction of the relationships indicate lower

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generated by using Spearman's Rho (Siegel, 1956, pp. 202-213). The computer program used was Nonparametric Correlation and is available on the SPSS package (Nie, et al., 1975, pp. 289-292). See Appendix B for a complete description of the variables used in this analysis.

[5]Murdie (1969, pp. 70-72) gives a generalized explanation of the sequence of steps in principal components analysis from input of original data matrix, through the rotation of the factor loading matrix, to the generation of the factor score matrix.

[6]The eigenvalue of a component is the sum of the squared loadings of the variables on that component. Thus, eigenvalues are indices of the variance explained by a component, and a cut-off of 1.000 "ensures that only components accounting for at least the amount of total variance of a single variable will be treated as significant" (Nie, et al., 1975, p. 479).

Table 4. Eigenvalues and Percent Variance Explained in Ten Factors of Principal Components Analysis of User Survey.

Factor	Eigenvalues	Percent Variance Explained	Cumulative Percent Variance Explained
I	3.36	12.4	12.4
II	2.26	8.4	20.8
III	1.86	6.9	27.7
IV	1.78	6.6	34.3
V	1.51	5.6	39.9
VI	1.40	5.2	45.1
VII	1.28	4.7	49.8
VIII	1.17	4.3	54.1
IX	1.13	4.2	58.3
X	1.01	3.7	62.1

socio-economic status. The highest loadings are on lower quality water service[7] (.793) and sanitation service[8] (.796), and a high ratio of persons per room (.303). Also associated are low education levels for the family head (-.643) and respondent (-.620), as well as low family incomes (-.656).

Dimension II: Long Medical Trips--Accounting for 8.4 percent of the variance, this dimension is characterized by greater travel time (.823), higher quality transport mode (.792), and longer travel distances (.630). This is an expected association. It is interesting to note the absence of the utilization variable, number of visits. From most geographic theory, one would expect use to be closely related to travel distance and time. Its absence here suggests one of the important findings of this research.[9]

Dimension III: Stage of Family Life Cycle--These loadings identify an older population: age of the family head (.803), and age of the respondent (.759). This older group coincides with a greater number of years use of a specific facility (.338), and relatively low education levels for the family head (-.253) and the respondent (-.360). A female family head is implied (.274) along with a male respondent (-.299).

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[7]Though this value is positive it indicates decreasing quality of water because of the manner in which the responses were scored (Appendix B). A similar inverse interpretation must be given to sanitation services, the frequency of health concern, and personal health evaluation.

[8]"Room density" will be used in describing the results of "bedroom density" to indicate the true significance of the variable.

[9]Theoretically, the orthogonal nature of the components implies independence between dimensions, thus socio-economic status variables, which form a distinct component, are not associated with these transportation characteristics. However, in reality the distinctions may not be so absolute. See Herbert's (1972, pp. 174-176) discussion of socio-economic status versus family status.

Dimension IV: Utilization Correlates--Number of visits to a public health center (.746) loads highest here, thus this dimension identifies those variables most closely associated with frequency of use. Intuitively, there is a high number of family illnesses (.648); however, there is also a high number of alternative sources of health care (.468). Linking this with a high frequency of health concern (-.343) implies that frequent public health users are more aware of their health. This awareness is reflected in the cognizance of existing infirmities (.255). Finally, the positive relationship of income (.279) is expected given the findings cited in the literature review.

Dimension V: Family Size--A second component linking demographic characteristics of the user population includes large family size (.829), high room densities (.717), and to a lesser degree a long period of service use (.277). However, an infrequent health concern is also indicated (.260). Possibly the concerns inherent in having a large family to provide for has a depressing effect on health concerns. If true, this has negative implications for the present family planning campaign based on information availability in the health centers--the larger families are not likely to receive this information.

Dimension VI: Personal Barriers--Interpretation becomes difficult as dimensions isolate more peripheral associations. For example, though a large number of personal barriers (.733) are indicated, another potential barrier, waiting time (-.684), is quite low. Some compatibility may exist with an indication of long service use (.323), because someone who knows the center and its personnel may wait less time. Finally, an indication of a good health evaluation exists (-.265).

Dimension VII: Low Health Care Perception--The indication given here is of a population subgroup which gives itself a poor health evaluation (.647), has a high illness response (.463), a large number of existing infirmities (.586) and an infrequent concern for health (.572). This population subgroup is in great need of health education to better appreciate the advantages of maintaining good health. They recognize their poor health, numerous existing infirmities, but show a lack of concern.

Dimension VIII: Positive Public Health Opinions--This component shows an association between a set of users with a low number of adverse opinions (-.771), and a high evaluation of the services given (.624). In addition, a large number of alternative sources of medical care is indicated (.320), which implies a concerned population that is aware of its health.

Dimension IX: The "Informed" User--Linked here are several conflicting variables indicating persons with a large number of information sources (.805), and a low response time to diseases (-.322). Also indicated is a generally poor evaluation of public health services (-.360). Whether this means that truly informed individuals (or at least those who believe they are) have a low regard for these services cannot be assessed because other variables that might be expected to enter into a value judgement, such as education, are not associated with this dimension.

Dimension X: Female Family Heads--This final dimension with an eigenvalue over 1.000 only encompasses 3.7 percent of the total variance; thus, little weight can be attached to it. Because the great majority of respondents were women it is not surprising that they make up an independent component. Women are indicated by a positive loading on respondent's sex (.702). A lowered number of medical care sources (-.301) may indicate a lowered familiarity with the neighborhood, and a female family head (.667) suggests a working woman who may not be closely tied to community affairs.

The Principal Components Analysis of the General Survey Population

A principal components analysis was performed on the data of the general population survey. The rotated factor loadings are shown on Table 5, and the eigenvalues and variance incorporated by each component appear in Table 6. If the user analysis shows the basic relations among the variables for those persons who commonly utilize

Table 5. Loadings on the Principal Components of the General Population Survey.

Variable	Dimension I	II	III	IV	V
1. Service use	.445		.256		
2. Number of years use					
3. Number of illnesses					
4. Number of visits		-.420			
5. Transport mode	.405		.621		
6. Travel time			.821		
7. Travel distance	.361		.731		
8. Waiting time	-.341	.319			
9. Family size					
10. Persons per bedroom	-.611	.258			
11. Water service	-.652				
12. Sanitary service	-.660				
13. Health evaluation		.603			
14. Frequency of health concern		.797			
15. Illness response time		.770			
16. Existing infirmities					
17. Sex of family head				-.436	.353
18. Age of family head					.871
19. Education of family head	.798				
20. Sex of respondent			.334	-.324	
21. Age of respondent					.870
22. Education of respondent	.812				
23. Income	.780				
24. Personal barriers				.697	
25. Adverse opinions				.732	
26. Respondent's evaluation				-.649	
27. Alternative medical care sources	-.440				
28. Health information sources	.499				

Table 5. (Continued)

Variable	Dimension VI	VII	VIII	IX
1. Service use	-.643			
2. Number of years use	.749			
3. Number of illnesses		.745		
4. Number of visits		.654		
5. Transport mode	-.362			
6. Travel time				
7. Travel distance	-.382			
8. Waiting time	.666			
9. Family size			.835	
10. Persons per bedroom	.346		.369	
11. Water service		.324		
12. Sanitary service		.362		
13. Health evaluation				.441
14. Frequency of health concern				
15. Illness response time				
16. Existing infirmities				.892
17. Sex of family head	.268			
18. Age of family head				
19. Education of family head				
20. Sex of respondent	-.258			
21. Age of respondent				
22. Education of respondent				
23. Income	-.318			
24. Personal barriers		.255		
25. Adverse opinions				
26. Respondent's evaluation				
27. Alternative medical care sources			-.564	
28. Health information sources	.440			-.347

Table 6. Eigenvalues and Percent Variance Explained in Nine Factors of Principal Components Analysis of General Population Survey.

Factor	Eigenvalues	Percent Variance Explained	Cumulative Percent Variance Explained
I	5.83	20.8	20.8
II	2.81	10.0	30.8
III	2.49	8.9	39.7
IV	1.83	6.5	46.3
V	1.58	5.6	51.9
VI	1.26	4.5	56.4
VII	1.25	4.5	60.9
VIII	1.09	3.9	64.7
IX	1.02	3.6	68.4

these services, then the general population analysis reveals those relationships that are common to the broad range of the citizens in Guatemala City. Where and why similarities or divergences may exist between the user and general population are the questions to be answered following the explanation of the individual components of the general analysis.

The Interpretation of the Components

Dimension I: High Socio-Economic Status--with 20.8 percent of the variance, this dimension associates the same variables as the user survey analysis, but the signs on the factor loadings indicate the opposite relationship, i.e. high socio-economic status. The highest loadings are on the education of the respondent (.812) and family head (.798), along with high family income (.780). High quality water (-.652) and sanitary services (-.660) as well as low room densities (-.611) are all indicative of generally high living standards, much the opposite indication from Dimension I of the user analysis. Numerous health information sources (.499) denote an informed individual, while few alternative sources of medical care (-.440) signify a population with preferences for specifically physician services. A high loading on service use (.445) indicates private physician services. Because these are private services, waiting time is low (-.341), and as many private physicians' offices are in the central part of the city, longer travel distances (.361) are necessary, but can be provided by better transportation mode (.405).

Dimension II: Low Health Care Perception--Here exists a strong positive association between variables associated with low health awareness and concern. In the user components analysis this same association appeared much later, as Dimension VII. Shown are a low frequency of health concern (.797), a poor health evaluation (.603), a slow response to disease occurrence (.770), and a low number of health care visits (-.420). A longer waiting time (.319),

along with the fact that Dimension I appeared to indicate private services, might indicate public services; however, the first variable (Service use) does not load on this component, thus no service type is indicated. Finally, there is some indication of higher room densities (.258). This implies lower socio-economic status, and with longer waiting time indicating crowded clinics, this dimension appears to identify a lower class group of respondents.

Dimension III: Long Medical Trips--Another dimension similar to one uncovered in the user analysis (Dimension II). Here large travel times (.821) are associated with long travel distances (.731) and better quality transport mode (.621). Also there is an indication that these long distance travellers may be female because of the high loading on respondent's sex (.334); however, the respondent's sex isn't directly indicative of who actually used the medical services. Finally, there appears to be a slight association with private medical services.

Dimension IV: Negative Public Health Opinions--A negative opinion of public services (.732) and a low service evaluation (-.649) are linked with a large number of personal barriers to utilization (.697). Of interest is the fact that the respondents, as well as the family head, tend to be male (-.324 and -.436, respectively). These loadings indicate attitude barriers possibly due to a belief that it might be less masculine to be dependent on, or be in need of, medical services. This is quite representative of male values in Guatemala.

Dimension V: Stage of Family Life Cycle--Though not incorporating as many variables as Dimension III of the user's components analysis, the major variables remain the same here, namely respondent's age (.870), the age of the family head (.871) and the occurrence of female family heads (.353). The indication is of an elderly family, possibly with a widowed family head.

Dimension VI: Public Health User--Defines the characteristics of public health use (-.643). The patterns show individuals with long experience with a specific facility (.749), long waiting times (.666), and a large number of health information sources (.440), lower quality transport modes (-.362), but over short distances (-.346) and lower incomes (-.318). Finally, a curious implication of a male respondent (-.258) and a female family head (.268).

Dimension VII: Correlates of Utilization--In the general survey all types of medical visits were included, with no indication of service use, a private versus public health care distinction cannot be made. The emphasis appears to be on environmental variables, rather than the attitude variables of the user population analysis. The most important loadings are on the number of illnesses in the previous three months (.745) and the number of facility visits during the same time period (.654). Intuitively, need for health care and numerous visits could occur due to lower quality water (.324) and sanitary service (.362). Interestingly, there is an indication of a number of personal barriers to health service utilization (.255). These individuals may delay receiving care until reaching an advanced disease stage, then repeated health visits may be necessary.

Dimension VIII: Family Size--This dimension is of less explanatory power than the comparable Dimension V in the user analysis. Here large family size (.835) is associated, logically, with high room densities (.369). The second highest loading is on a low number of alternative sources of medical care (-.564).

Dimension IX: Poor Health--A dimension showing a great number of existing infirmities (.892) is associated with a poor health evaluation (.441) and, not surprisingly, a low number of possible sources of health information (-.347). Thus, a poorly informed person who lacks awareness of the need for health care is indicated. Such a group would benefit very little from expanded health services, unless preceded by health education to increase the group's awareness of the value of health services and of maintaining good health.

Summary of the Principal Components Analyses

The analyses shed considerable light on lifestyles in Guatemala City as well as the utilization of health services. Similar North American studies include components indicating socio-economic status, family status (stage of

family life cycle and family size) and mobility characteristics (Rees, 1970, pp. 306-394; Murdie, 1969; Berry, 1971).

An association is also found between the revealed dimensions and Gross' (1972, pp. 74-76) utilization typology. The components implied relationships between socio-economic, demographic, attitude, and mobility characteristics of the two populations. What hasn't been shown are the intervening variables which link these dimensions (Hyman, 1970). Just how the "enabling" and "predisposing" variables are combined with accessibility characteristics to create health service demand will be analyzed in later analyses.

Focusing on the actual results of the two components analyses, one might expect a broader population sample to reveal greater complexity in the number of independent associations of variables. However, this is not the case. The user analysis, based on a much narrower range of socio-economic groups, revealed ten independent dimensions explaining 62.1 percent of the variance (Table 4). On the other hand, the broader based general survey shows only nine dimensions and explained 68.4 percent of the variance (Table 6). The general population actually shows stronger, more consistent responses than the user population. Part of the explanation may be due to the larger sample size of the user analysis (359) compared with the general population (180).

Comparing the two analyses, it is seen that the user analysis is dominated by persons of low socio-economic

status (Dimension I, Table 3). Low quality of water and sanitary services, and low incomes are indicative of this group. The same variables are associated within the general population (Dimension I, Table 5), but the association is in the opposite direction, indicating higher socio-economic levels. Other loadings on this component indicate short waiting times and many sources of health information, though actual medical care is limited to private physicians. Greater travel distances and time, as well as the use of buses or cars, are also implied. Great distances are incurred by this group because of the central city concentration of private physicians, while Zone 12, where the survey was taken, is on the periphery of the city.

The component in each analysis dealing with utilization characteristics provides a second contrast. Ignoring the highest co-loading variable, the number of illnesses, the variables associated with use frequency within the user analysis imply health attitudes and behavior, while environmental characteristics, such as water and sanitary facilities, are associated with use frequency in the general population analysis. These are among the most important findings of this study and will be examined in detail in the next analysis. Though no cause and effect relationship can be assumed, the identification of those variables most closely associated with use gives insight into the policy methods that could prove the most successful for stimulating

health service utilization, e.g. those encouraging attitude change should probably be based on health education.

Third, components indicating large families are present in both analyses. Although the relative importance of this component is much higher in the user analysis, Dimension V compared with Dimension VIII in the general population, the implication is of continued large family importance throughout diverse urban population groups. With national population growth rates of 2.9 percent per year, planning programs may need to be encouraged if future population growth problems are to be avoided.

Fourth, dimensions implying low health care awareness exist in both analyses (Dimension VII in user analysis, Dimension II in the general population analysis). This shows a need to increase the health consciousness of various population groups. A serious problem is indicated in the user analysis by the recognition of a large number of infirmities along with low health care awareness. Thus, diseases are frequently recognized, but not acted upon. Efforts must be made to encourage individuals to respond to disease symptoms by seeking medical attention. This may imply the need for an improved policy of health education.

The true value of factor analytic techniques is their potential for being the basis of a research process (Rummel, 1970, p. 28). Beyond the findings evaluated here, each component shows independently related components

within each of which further research could take place. For example, further work might be directed at detailing the relationship within the set of variables composing the socio-economic components, or the demographic components of family size or stage of life cycle. The emphasis here is on utilization, so that specific aspect of the components analyses will now be examined in greater detail.

The Analyses of Utilization

Regression analysis originally had been planned as the basis for explaining the relations between use of public health care facilities and the socio-economic, demographic and attitude characteristics of the user group. However, the data obtained in the interview surveys proved to be neither normally distributed, nor could normal distributions be obtained through data transformations.[10] Therefore, in order to maintain a high degree of reliability in this analysis, non-parametric statistics were used.

The SPSS package offers a variety of non-parametric techniques, of which Goodman-Kruskal's Gamma coefficient is particularly suited for the characteristics of the data

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[10]The set of transformations used are available on the computer program Normality Check (Wittick, 1971, pp. 1-2). Transformations used included: log, log-log, square root, square, expodentiation. The few variables that were significant using the Kolmogorov-Smirnov normality test were so only with the weakest significance limits.

(Nie, 1975, pp. 222-230; Goodman and Kruskal, 1954, pp. 748-754). Gamma is meant for use with ordinal and interval data, set up in cross-table form, with no limits set on the size or symmetry of the table. As a measure of association, Gamma equals the probability, given a random selection, of finding like orders of magnitude (positive association) minus the probability of finding unlike orders of magnitude (negative association), between an independent and a dependent variable. If there is an equal probability of both like and unlike orders, then there is a zero association between the two variables.[11] Though this may be only

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[11]Costner (1965, pp. 346-347) defines Gammas as:

$$\text{Gamma} = \frac{S - D}{S + D}$$

where:

S = The probability that a pair of observations randomly drawn from the cross-classification, of dependent and independent variables, will fall in the same order, i.e. the probability of a concordant pair.

D = The probability that a pair of observations randomly drawn from the cross-classification, of dependent and independent variables, will fall in opposing orders on the two variables, i.e. the probability of a discordant pair.

Thus:

If S - D is greater than zero, then the order existing on the dependent variable is the same as the order on the independent variable for any pair selected, and the association is positive.

indirectly related to the usual notion of predictability, Costner (1965, p. 347) concludes that Gamma should be interpreted in the same manner as the R^2 statistic of the Pearson correlation.

The analyses that follow explain the utilization of health services, measured by the number of visits the family made to a health facility during the three months prior to the interview. As will be seen, most of these relationships have already been identified by the principal components analyses. However, while the principal components analyses defined the general patterns of related variables, the present analysis will show the exact explanatory relationship between the dependent variable, utilization, and a set of independent variables.

Only the raw Gamma between utilization and each significant independent variable is given and evaluated (Table 7). Attempts were made to identify the unique explanatory relationships with utilization, while holding third variables constant, i.e. approximating a multiple R^2.[12]

If S-D is less than zero, then the order existing on the dependent variable is the opposite of the order on the independent variable for any pair selected and the association is negative.

See also Goodman and Kruskal (1954) who originally proposed the Gamma coefficient.

[12]This option is available on the SPSS package (Nie, et al., 1975, pp. 230-234).

Table 7. Gamma Coefficients for the Two Dependent Variables and the Significant Independent Variables for Both the User and General Surveys.

	User Survey: Number of Visits	General Survey: Number of Visits
Service use	(Not applicable)	-.184*
Number of illnesses	.435*	.536*
Transport mode	----	-.341*
Travel time	-.079**	-.240*
Travel distance	-.068	-.263*
Persons per bedroom	----	.197*
Water service	----	.302*
Sanitary service	----	.324*
Health evaluation	-.190**	-.247*
Frequency of health concern	-.278*	-.333*
Illness response time	----	-.323*
Education of the family head	.135*	----
Sex of the respondent	.233*	----
Age of the respondent	-.128*	----
Education of the respondent	----	-.158**
Income	.198*	----
Respondent's evaluation	.143*	.198*
Alternative medical care sources	.177*	.197*

* Significance greater than .01.[13]
** Significance greater than .05.
---- Coefficient insignificant.

[13]The significance test used was formulated by Goodman and Kruskal (1963, pp. 322-330).

Unfortunately, the results of these attempts did not prove significant because the number of observations in the user survey (359) and the general survey (180) were not sufficiently large for the required disaggregation.

Utilization Analysis With Gamma of User Survey

One of the most important revelations is the lack of association between utilization and travel distance (G = -.068) and travel time (G = -.079). Logically, the strongest relationship exists between the number of illnesses (G = .435), followed by the health awareness variables, increased frequency of health concern (G = -.278) and a good health evaluation (G = -.190). The number of alternative sources of medical care is also directly related (G = .177), along with a positive evaluation of public health services (G = .143). These results imply that frequency of use among service users is most closely associated with personal health attitudes. A person who is concerned about his health, has many sources of health care, and has a positive opinion of public health care more frequently uses public health services. Knowing these relationships, planning priorities can be formed for encouraging use through programs to increase awareness of good health and the need for health services. The lack of significance of travel distance and time indicates that once a person

decides to use a public health facility, distance and time are not limiting factors. This may conform to certain expectations from the literature (Solien de Gonzalez, 1965; Weiss and Greenlick, 1970) that persons of low socio-economic status may delay receiving professional care until an illness has reached a stage where the sick person has no alternative but to seek care. At this point, travel distance and time may be eliminated as use barriers.

Two demographic characteristics are shown to be associated with use frequency, female respondents (G = .233) and age (G = -.128). The positive association with women is probably indicative of their responsibility for family health. This responsibility is stronger in Guatemala because of the common attitude among males that seeking health care is unmasculine. The negative association with age is not surprising because of the declining mobility as chronic crippling ailments increase. This is indicative of greater need for such care. A remedy for this situation is proposed in Chapter V, with health auxiliaries making home visits, thereby easing some of the less critical health problems of the aged.

Utilization Analysis with Gamma
of General Survey[14]

Table 7 also indicates the relationship between utilization and the set of independent variables for the general population survey. As with the user survey, the highest association was with number of illnesses (G = .536). In contrast to the user population, the general population revealed the expected negative relationship with travel distance (G = -.263) and travel time (G = -.240). Health attitude characteristics also remain important within the general population: high frequency of health concern (G = -.333), short illness response time (G = -.323), high personal health evaluation (G = -.247), multiple medical care sources (G = .197) and a positive public health care evaluation (G = .198).

The coefficients reveal other associations with health care use frequency. For example, elements of the social environment: poor quality of sanitary (G = -.324) and water services (G = .302), and high room densities (G = -.197). These variables are frequently cited as critical to health, and their significance here provides positive

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[14]Let me re-emphasize that frequency of service use within the general population allowed for all health trips to private and public facilities. This change was made to incorporate the use frequency of the higher social class.

evidence of their importance to service use. Instead of one policy mode, the general population indicates three: decreasing the barriers of distance and time, changing health attitudes, and improving environmental sanitation.

In contrast to expectations, none of the socio-economic or demographic variables show a significant relationship with service use, except for a negative relationship with respondent's education. This lack of significance may be due to the location of the general survey where there is a nearby public dispensary, allowing easy access to lower and middle class public health users, but private facilities are very limited. In fact, most of the private health users had to travel into the congested central business district to receive care. Thus, as socio-economic standards rise not only should demand increase, but a shift from public to private health care is also entailed. Linking this with the locational characteristics of physicians in Guatemala City, the shift from public to private health care substantially increases travel difficulties. The inhibiting influence of greater travel distance/time may offset the positive influence of rising socio-economic status. Education is the only significant socio-economic variable, but shows a negative relationship with use frequency. One explanation for this is the better educated are more able to prevent illness and more effective in treating it when it occurs. Thus, the demand for professional care is lowered.

Implications for the Hypotheses of the Utilization Analyses

Based upon the analysis with Gamma on the user survey, Part A of Hypothesis III must be rejected. Travel time and distance do not influence the utilization of health care services. Part B of Hypothesis III is accepted because the user's evaluation does have a positive influence on utilization, and, if general health awareness can be added to this evaluation, it is seen to have a strong influence on utilization. Finally, Part C of Hypothesis III is also accepted because both socio-economic variables, i.e. education of the family head and family income; and demographic variables, i.e. sex and age of the respondent, proved to have moderately high explanatory relationships with the utilization of health services.

As this is intended to be a study of public health service users, the conclusions and recommendations must be based on the findings of the user survey. However, the striking differences between the user and general populations on the effects of distance and time cannot be ignored. This dichotomy will be evaluated in the conclusion and recommendation section of this study.

CHAPTER IV

THE LOCATION-ALLOCATION ANALYSIS

This chapter develops a procedure for identifying areas within Guatemala City in need of additional public health facilities. Once identified, service needs can be fulfilled by either establishing new facilities and staff, or by relocating existing facilities from areas where a relative surplus exists. By either mode, the objective is to reduce disparities in health care availability. As such, the analysis in this chapter complements the user analysis presented in Chapter III.

Throughout this location analysis the Location-Allocation Package (LAP), described in Rushton (1973, pp. 85-113), performed the mathematical computations. To better understand the characteristics and potential of the LAP program, and its role in the analysis, the following distinctions are made: 1) the transportation versus the Weber problem, 2) heuristic versus optimal solutions, and 3) public versus private locational criteria.

The Transportation Versus the Weber Problem

In terms of the present study, the transportation problem allocates users to a set of health centers (spatially fixed), subject to capacity constraints. The objective of this allocation is to minimize some measure of travel distance or costs.[1] In algebraic terms, the transportation problem is stated as:

$$\text{Minimize} \quad \sum_{i=1}^{n} \sum_{j=1}^{m} I_{ij} C_{ij}$$

$$\text{subject to:} \quad \sum_{j=1}^{m} I_{ij} = S_i$$

$$\text{and} \quad \sum_{i=1}^{n} I_{ij} = D_j$$

where: I_{ij} is the allocation from source i to demand point j,

C_{ij} is the cost per unit allocated,

S_i is the supply available at source i,

D_j is the demand at point j.

Alternatively, the Weber problem seeks to minimize travel distance/costs by the opposite procedure, i.e. by locating health centers central to their patients.

The LAP program uses an iterative location-allocation process that combines aspects of both the transportation and

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[1] Hadley (1962, Chapter 9) provides a complete introduction to the transportation problem and its relationship to other linear programming models.

Weber problem. First, given the present location of health centers and the user's residence, an allocation is made of patients to these health centers, subject to the capacity constraints of individual facilities. If capacities are not sufficient to meet demand, any surplus is allocated other health centers.[2] During this first step extremely long trips may be engendered because of such capacity limitations, so if travel costs can be reduced through facility relocations, the centers are then relocated, and a subsequent allocation of patients to facilities is made. This location-allocation process continues until there is no change in the solution.

Heuristic Versus Exact Solutions

Procedures for identifying exact (optimal) solutions to location-allocation problems have been successful in only a narrow range of situations, the principal limitation being to very small problems. Therefore, heuristic methods have been most frequently used (Hall, 1973, p. 33; Scott, 1970, p. 111) which converge toward optimality, and, in fact, may be optimal, but there is no way of proving this. Although the LAP program uses a heuristic solution method, it has

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[2]Thus, because of capacity constraints, demand will not always be allocated to the nearest center, even in the optimal solution (Rushton, et al., 1973, p. 87). This point will be exemplified later in this chapter within the preliminary analytic stages of the present problem.

been demonstrated to be extremely accurate (Rushton, 1973, p. 89).[3] In a series of tests where the optimal solution was known, the LAP algorithm produced an exact solution in nineteen of twenty trials, and, of those non-exact solutions, none varied from the optimal by greater than one percent.

Public Versus Private Locational Criteria

Differences in locational objectives exist between the public and private sectors (Hall, 1973, pp. 2-11; Teitz, 1968). The essential difference is that the private health sector must consider certain variables, such as the spatial distribution of income, that may shift service locations away from points of maximum benefit to the overall population. Alternatively, the public health sector seeks locations where the greatest health needs are met. These divergent criteria result in very different final locations. In the present analysis, health needs are focused at the residence of the public health users. The criterion for measuring the efficiency of service locations is the minimization of airline distance between these user residences and the set of public dispensaries.[4]

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[3]For an in-depth discussion of the algorithm, see Cooper (1963 and 1964).

[4]A judgement inherent in this choice is that distance minimization represents a desirable social optimum, deserving to be a central planning goal (Scott, 1970, p. 96).

The question arises of which measure of distance/cost should be used. Several have been proposed: airline distance; rectangular distance, i.e. the sum of the vertical and horizontal distance of the right triangle in which the hypotenuse is airline distance; travel time; actual monetary expenditures. Comparisons of these different measures have shown no clear superiority (Hall, 1973, p. 96). Airline distance is used here because of its computational ease and conceptual clarity. Also, linear distance delineates the most compact service regions around central facilities, compared with cost values such as travel time or monetary expenditures. This characteristic of linear distance will be important to the proposed use of travelling health auxiliaries, detailed in Chapter V.

Several other qualities of the LAP program can be pointed out. Along with its efficiency in handling problems of large size, it is extremely flexible by allowing the researcher the opportunity to vary each facility's capacity,[5] to designate which facilities have the potential for relocation and to impose travel barriers across sections of the study area. The latter quality is particularly appropriate in this research due to the deep ravines that traverse many

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[5]The measure of capacity used here is the number of physicians present throughout the day in each facility.

sections of Guatemala City and interrupt the continuity of urban activities.

The Identification of Service Disparities

Though public dispensaries tend to be near major user concentrations, they are often peripheral to these concentrations, making a relocation of health centers appear beneficial (Figure 3). Even more striking are the actual travel patterns of users (Figure 4). Great disparities exist in concentrations of use and distances travelled, particularly the concentration of trips to the large dispensary in the central portion of Zone 3. This particular center is the headquarters of the Municipal Health Department of Guatemala City, which may raise the image of its services relative to other centers, thereby encouraging disproportionate use. Concentrations of use can also be seen in the small dispensaries in the poorer sections of the city, notably Zones 12, 5, and 6. Relative underutilization can be seen in the low frequency of health trips to the large facility at the southern end of Zone 3, near the intersection of the Interamerican Highway (CA 1) and the Interoceanic Highway (CA 9). The over-use of certain facilities represents increased time spent by patients in crowded waiting rooms, which may deter patients from future use. Meanwhile, other health centers are underutilized, with staffs not working at full efficiency.

Figure 3

Residential Location of the User Population

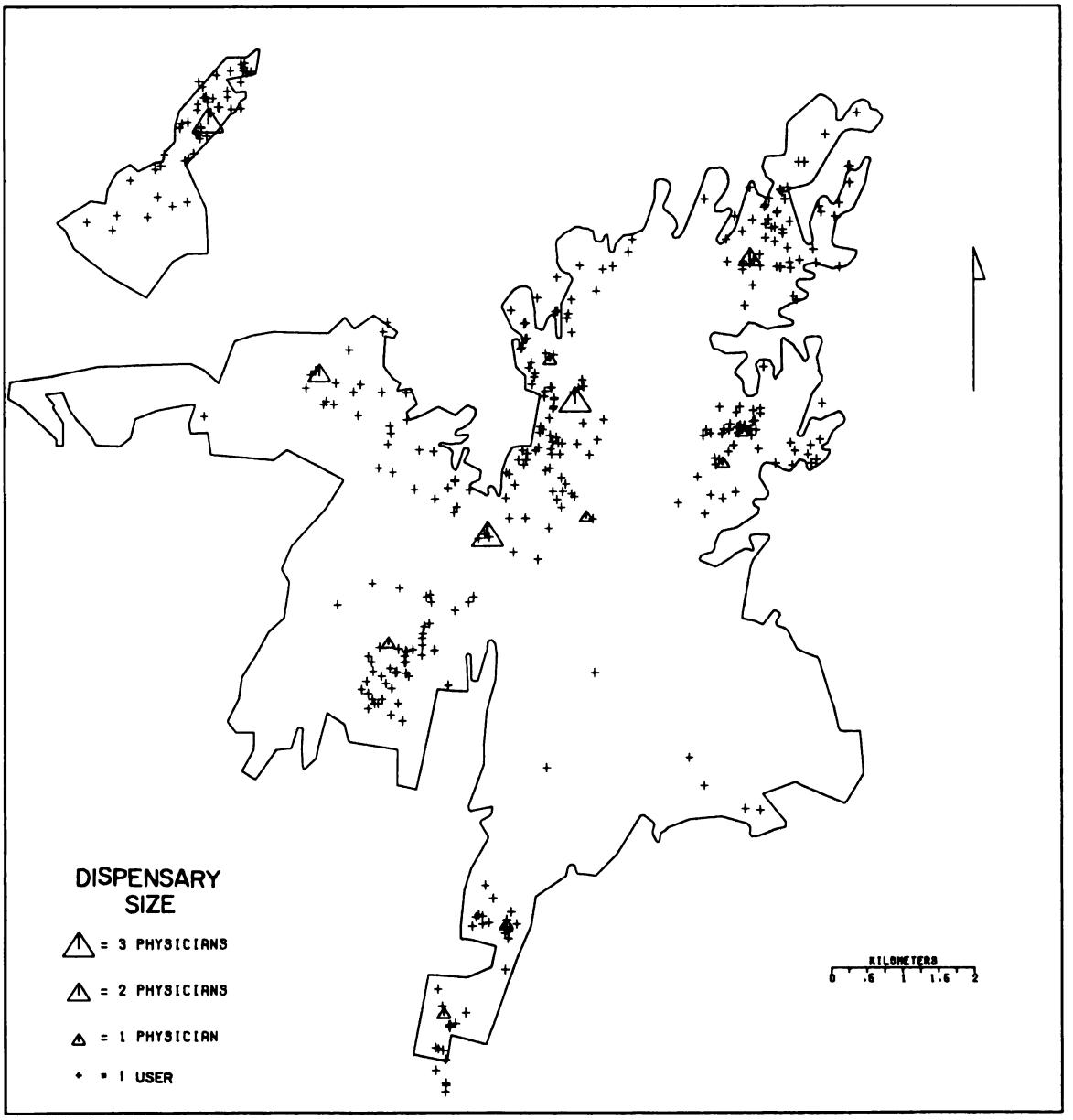
DISPENSARY
SIZE
= 3 PHYSICIANS
= 2 PHYSICIANS
= 1 PHYSICIAN
= 1 USER
KILOMETERS
0 .6 1 1.6 2

Figure 3

Figure 4

Actual Patient Travel Patterns

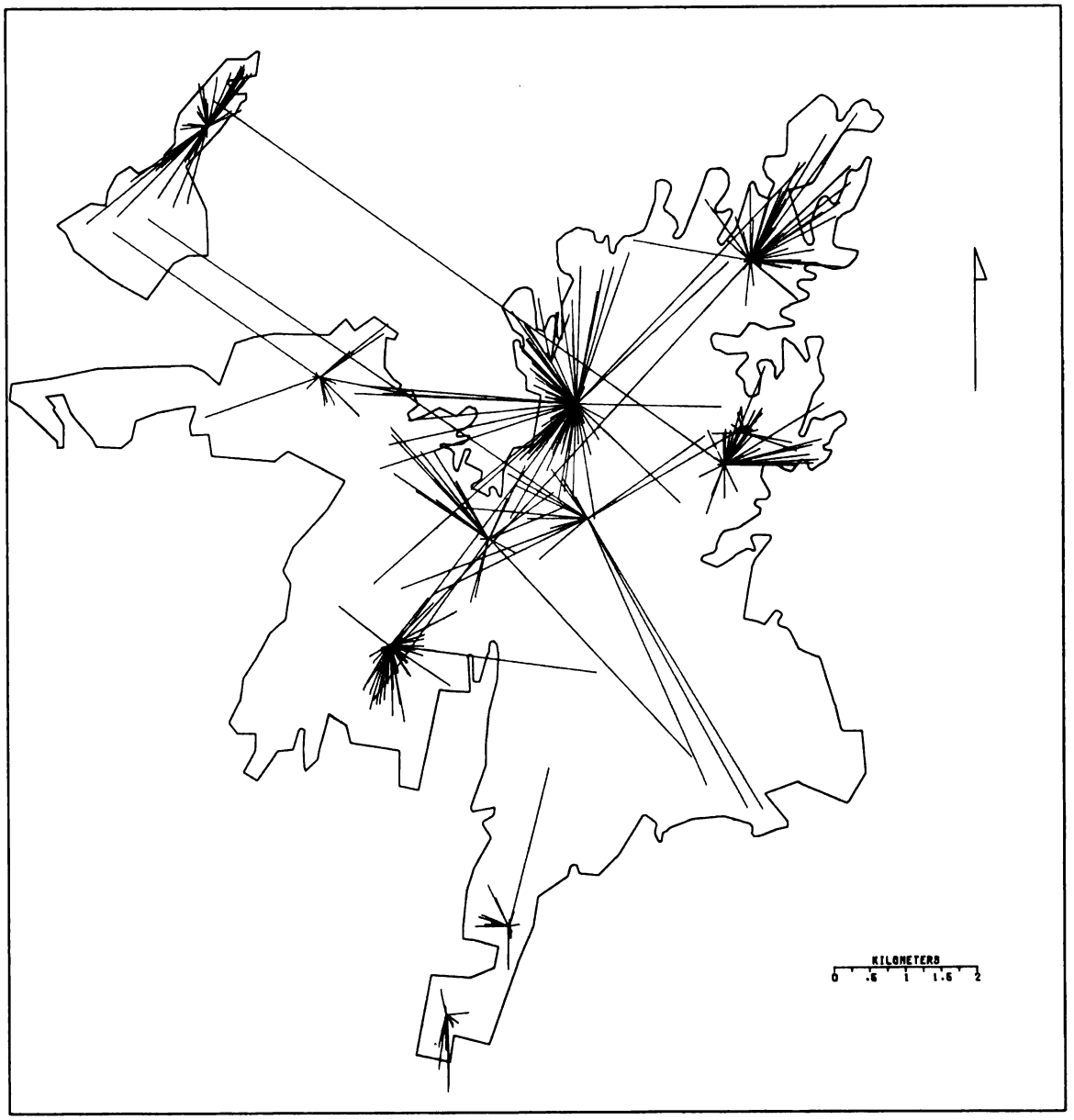

Figure 4

Having visually identified that service relocations can be made to improve accessibility of patients to health facilities, an explanation will now be given of the specific procedure followed in systematically identifying where service changes can be made to lower patient travel distances.

The Procedure for Identifying the Location of Needed Capacity Changes

The rule followed in determining needed capacity changes relies on a characteristic of the algorithm which solves the transportation problem within the LAP program. Once a facility's capacity is reached, excess demand is allocated to other centers whose capacity has not been met, necessitating long trips. Thus, allocations beyond nearby facilities indicate the capacity of these facilities has been met and service capacity additions at this point are warranted. Similarly, those centers to which lengthy allocations are made, indicate a relative excess capacity that could be reduced.[6]

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[6]Because of isolation from the central portion of the city where most of the other dispensaries and user population are located, two areas with a total of three health facilities have been detached from the main analysis, and run separately. These include the two small dispensaries in the southern portion of Zone 13, and the large facility just to the north of Zone 19. A separate analysis was run for these centers and the results presented on the same maps with the remainder of the dispensaries so that a complete visual impression of the results can be obtained.

The Location-Allocation Problem Analyzed

The solution to this problem of capacity adjustment is revealed in a series of stages: Stage One allocates patients to existing dispensary locations; Stage Two reallocates patients to an adjusted pattern of dispensaries in which centers of smallest size are allowed to relocate; Stage Three shows a number of capacity changes made at specific facilities throughout the system of health centers, with the smallest centers again relocatable. These locational and capacity adjustments are presented within the context of brief scenarios in which hypothetical health planners are given increasing power to make changes and analyze the results of their decisions. This is accomplished using the LAP program as a simulation tool that reveals the travel patterns which result from the locational choices made by decision-makers in previous time periods.

Stage One--Allocation of Patients to Fixed Center Locations

A preliminary run of the LAP program allocates patients to health centers that are fixed (Figure 5).[7] A shortage of service capacity is indicated by the long

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[7]Though certain allocations appear to cross the travel barriers, their distances have actually been computed around the ends of the travel barriers. The straight lines have been retained for ease of identifying health facility service areas.

Figure 5

Optimized User Travel Patterns, Stage One

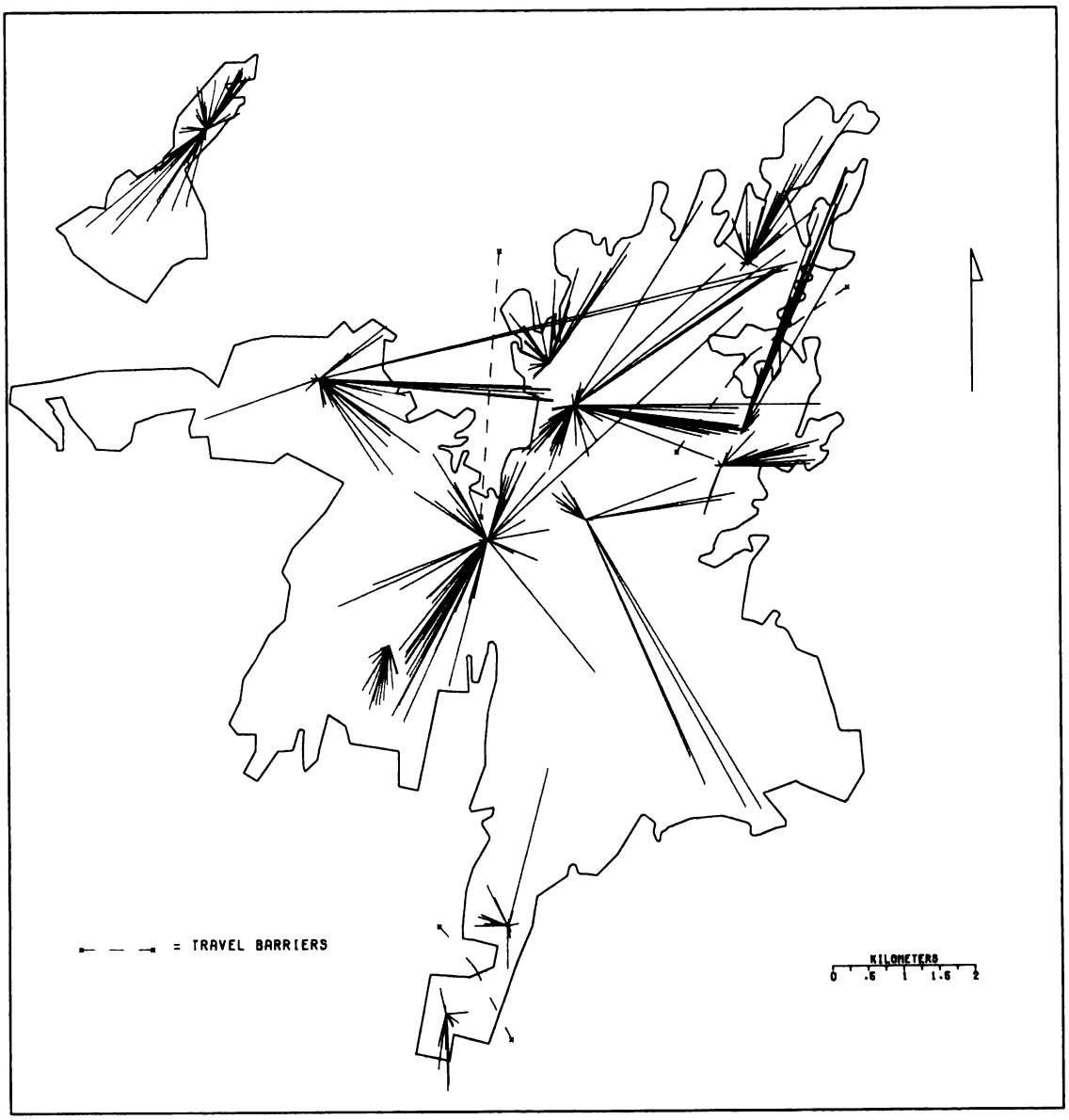

Figure 5

allocations made particularly from Zones 12, 5, and 6. Total distance increased significantly from the actual pattern (Figure 4) due to the strict observation of capacity constraints (Table 8). It is still realistic to view this

Table 8. Total Distances Travelled in Kilometers.

Actual Travel Patterns	343.49
Stage One Allocations	408.93
Stage Two Allocations	359.23
Stage Three Allocations	261.65

first allocation of patients to facilities as increasing total system efficiency over the actual travel patterns. Although greater travel distances are incurred, these increases are partially offset by less patient time spent in congested waiting rooms and a better use of medical personnel in centers that had previously been underutilized. In subsequent stages these travel distances will be drastically reduced.

Allocation of Patients--Stage Two

Here the hypothetical decision-makers are given the ability to relocate those health centers of smallest size. The reason for singling out these centers rests on my personal observation that all of these facilities were very

small, i.e. rented "store-fronts," with little equipment, thereby facilitating locational change if the need arose. On the other hand, centers with more than one physician occupy larger structures, specifically built for public health care and represent a significant fixed investment, thereby less likely to be relocated, thus restricting the ability to relocate health facilities to the smallest centers increases the realism of the location-allocation procedure.

Figure 6 shows the relocations of small centers to better serve the user population. The most striking shift moves one center from Zone 5 to Zone 6. Also, the center in the northern portion of Zone 3 is moved toward Zone 6. These shifts reveal the shortage of service capacity in this latter zone. The remaining center in Zone 5 and that in Zone 12 are both shifted toward the peripheries of the city which are densely populated, primarily by squatters. Small changes are also made in the locations of dispensaries in Zones 4 and 13.

Figure 7 shows patient travel patterns after the Stage Two relocations have been made. Compared with Figure 5, the added locational flexibility simplifies travel patterns. Though capacity shortages are still indicated by long health trips from Zones 5, 6, and 12, there has been a reduction in the number of long trips and in the total distance travelled (Table 8).

Figure 6

Dispensary Relocation, Stage Two

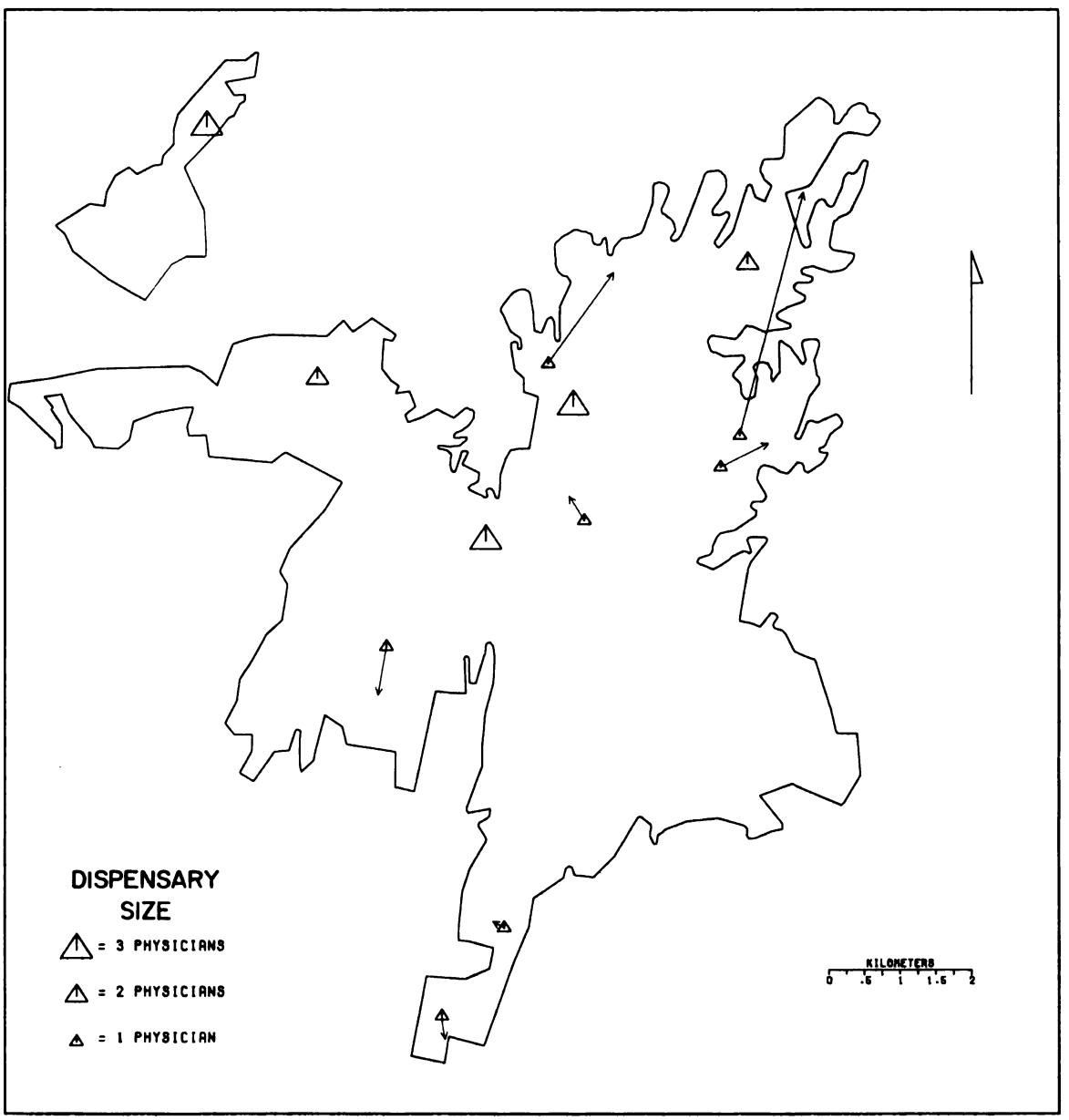
DISPENSARY
SIZE
= 3 PHYSICIANS
= 2 PHYSICIANS
= 1 PHYSICIAN
KILOMETERS
0 .5 1 1.5 2

Figure 6

Figure 7

Optimized User Travel Patterns, Stage Two

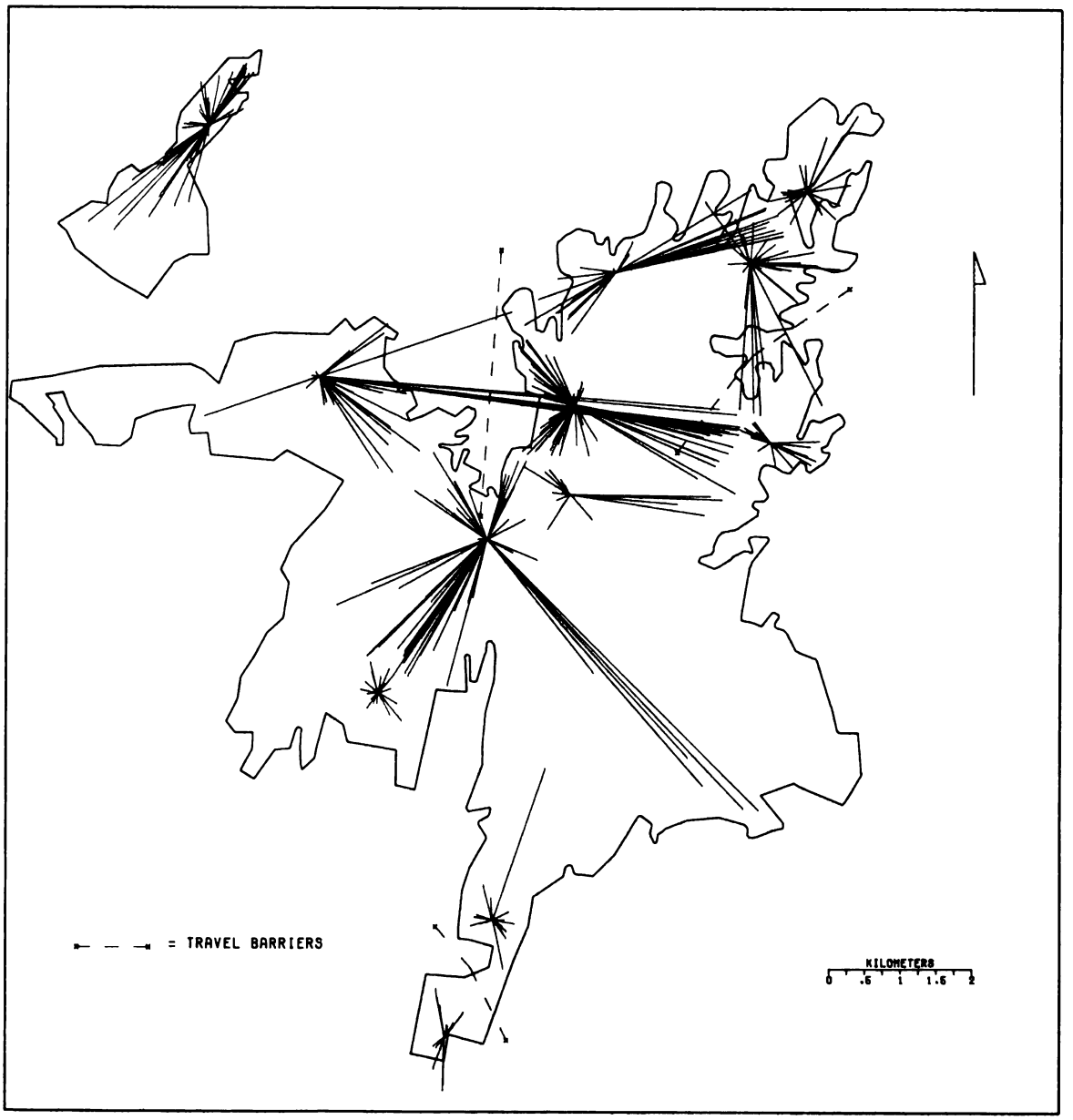

Figure 7

Allocation of Patients--Stage Three

In this stage the health decision-makers are given the ability to adjust capacities at individual health centers, and to add completely new centers when needed, in addition to being able to shift facilities with one physician. Given this additional flexibility the following decisions were made:

1. A new dispensary with the capacity of one physician was located in Zone 6 one kilometer northeast of the present facility in that zone.
2. The previously existing facility in Zone 6 was increased to a capacity of three physicians.
3. The south facility in Zone 5 was increased to the two physician capacity.
4. An additional physician was added to the dispensary in Zone 12.
5. The capacity of the dispensary in Zone 7 was reduced by one physician.

Figure 8 displays the relocations resulting from these capacity adjustments.[8] As can be seen, only slight shifts are necessary, the longest being a move toward the peripheral squatter settlements of the health center in the northern portion of Zone 3. Figure 9 shows the capacity adjustments to have greatly rationalized travel patterns by eliminating

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[8]The centers that were fixed and those available for relocation remain the same.

Figure 8

Dispensary Relocation, Stage Three

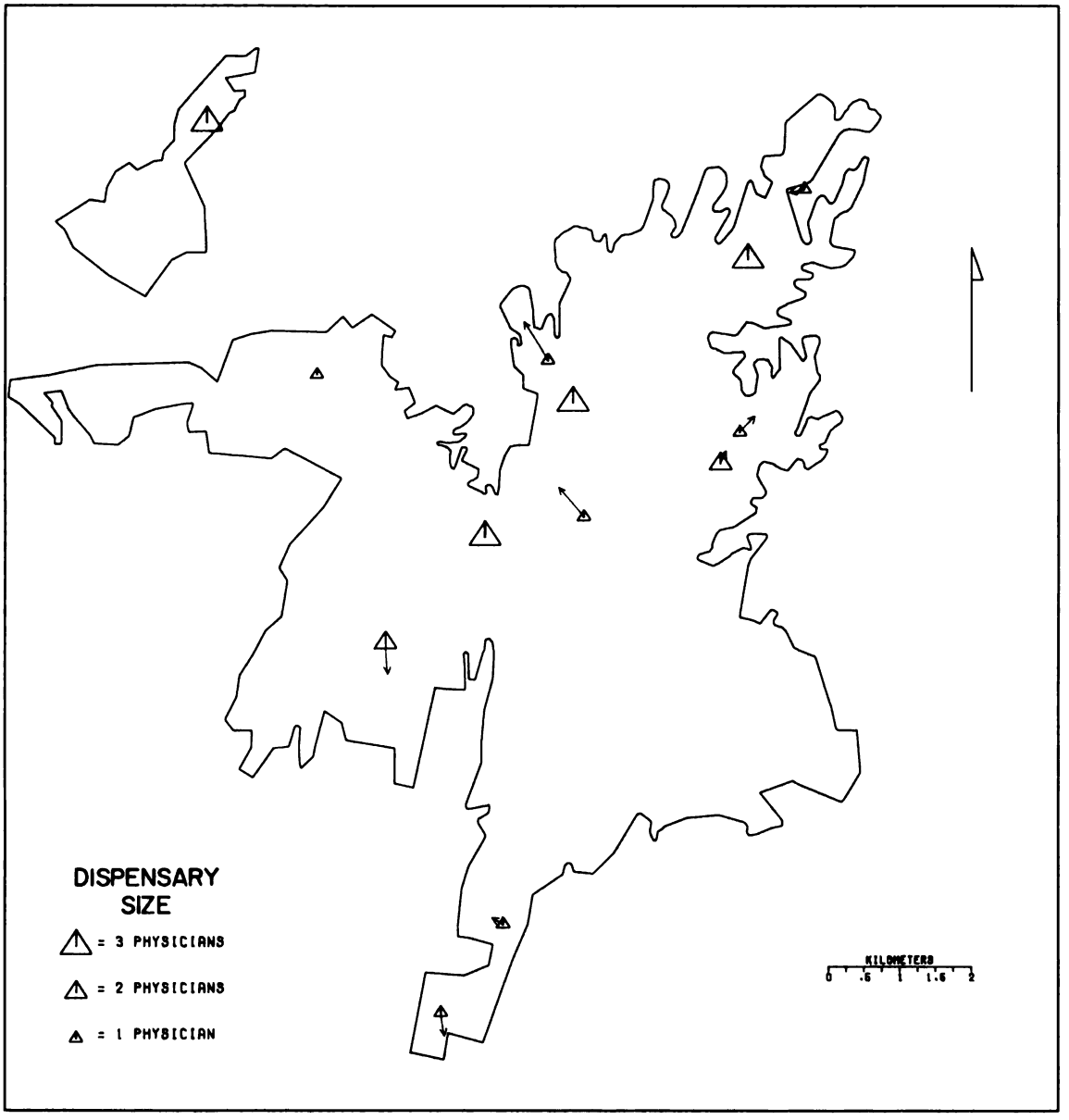
DISPENSARY
SIZE
= 3 PHYSICIANS
= 2 PHYSICIANS
= 1 PHYSICIAN
KILOMETERS
0 .5 1 1.5 2

Figure 8

Figure 9

Optimized User Travel Patterns, Stage Three

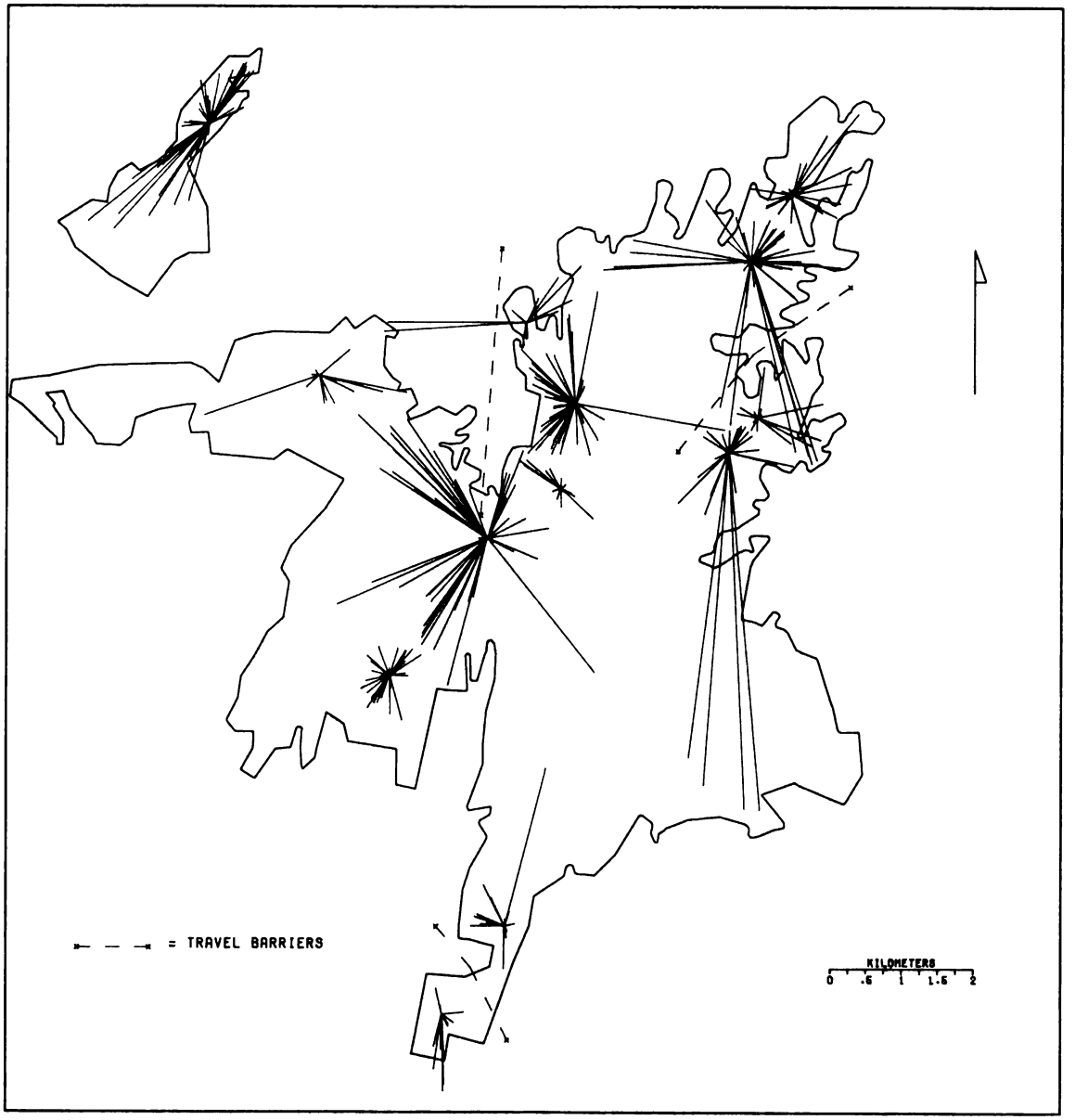

Figure 9

all but a very few excessively long health trips.[9] These changes further reduced the total distance travelled (Table 8).

Although these are travel patterns for theoretic optimums, Stage Three presents a very feasible solution to the locational problem. First, as mentioned previously, public health services have been shifted toward the peripheral low income housing areas that almost encircle the city, and are in greatest need of such care. Second, a present growth area of the city lies in Zone 6. This increase is due principally to rural-to-urban migration, and, because of the poverty and illiteracy of many in this population, public health care is greatly needed. Through this location-allocation procedure, the number of public health physicians in this zone of need has been doubled--the greatest increase of any zone of the city.

Additional Considerations

The strategy and solutions are simple enough to understand, but certain additional questions must be raised. First, what are the specific site characteristics of the

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[9]All of the remaining elongated trips are present in Zone 5. A slight adjustment was subsequently made on the next LAP run, by adding another physician to the smaller dispensary in Zone 5, but this proved to be a problem to which the program could not find a solution. The lowest total distance in this final sub-optimal solution actually increased to 277.63 kilometers.

new locations? If they are in ravines, at great distances from bus lines, or in other areas deemed undesirable, they may not be viewed as appealing by either the medical staff or potential patients. These and other site characteristics will force minor modifications of the computed optimal solutions.[10]

Second, some idea of additional costs must be estimated before an evaluation of alternative policies can be made. MSP&AS (1973) shows wages for each full-time doctor to be $2,080 per month, while public health nurses receive $160 per month and auxiliary nurses receive $100 per month. Given three new physicians and, at a minimum, three new auxiliary nurses, this present analysis adds $78,000 per year to the budget of the public health sector in wages alone. Other costs are entailed by modifications to the three facilities that added staff members, in addition to the acquisition (rental) of a completely new facility in Zone 6.

Third, a problem related to this cost analysis centers on the effectiveness to improved health care of increasing health service capacities, relative to alternative investments in improved water and sanitation facilities,

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[10]Hall (1973, p. 16) cites twenty-five site characteristics that must be considered before the ultimate locational decision can be made; these include site availability, cost, and utilities.

housing and education. These latter characteristics have been shown to be of great importance to health by the utilization analyses. A thorough evaluation of this problem is beyond the scope of this study; however, cost-benefit analysis of alternatives should be undertaken prior to any policy selection to estimate the costs of the various alternatives versus their benefits to the population in terms of increased health status.

A final consideration is the magnitude of additional demands that will be induced by the centralization and expanded service capacities suggested here. This question is widely recognized (Acton, 1973, p. 24; Hall, 1973, p. 24) but studied very little. One would expect the increased accessibility and decreased crowding within facilities to increase their appeal and be visited by persons who might otherwise have stayed away.[11] Supportive programs in health education would also tend to increase health demands. Again, a definitive answer to this question would require an in-depth analysis of propensities to consume health care within individual population sub-categories, and is beyond the scope of this study. My feeling is that there is a tremendous amount of potential demand that goes untreated due to factors that would be corrected by the recommendations of this study.

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[11]In fact, it has been observed that capacity creates its own demand, see Feldstein (1971).

These additional demands would necessitate another round of location-allocation analyses.[12]

Towards a Hierarchy of Public Health Services

The distinct size categories of public facilities provides the basis for a hierarchical organization. I believe that it is important to link these levels more closely by recognizing this organization and allocating specific services to different levels of this hierarchy--the more specialized functions to the largest centers, the less specialized to the smaller centers. Three hierarchical levels can be identified (Figure 10):

1) The dispensaries of one physician capacity would compose the base of the hierarchy. These would be numerically the greatest and the most dispersed. They would be equipped to handle the most common illnesses, that usually require the least sophisticated equipment.

2) An intermediate level would be made up of the larger dispensaries (health centers), with two or more physicians. These centers should be equipped to meet more specialized health needs that require more expensive and sophisticated equipment, possibly including a few beds for short-term patient treatment.

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[12]Burnett (1976) presents a recent example of the needed research by constructing a "linear learning model" showing the growth of banking trade areas through time. The model is composed of negative exponential curves that are fitted to the probability of an individual using the services of a specific bank and demonstrating trade area growth.

Figure 10

A Hypothetical Three Level Hierarchy
of Public Health Services

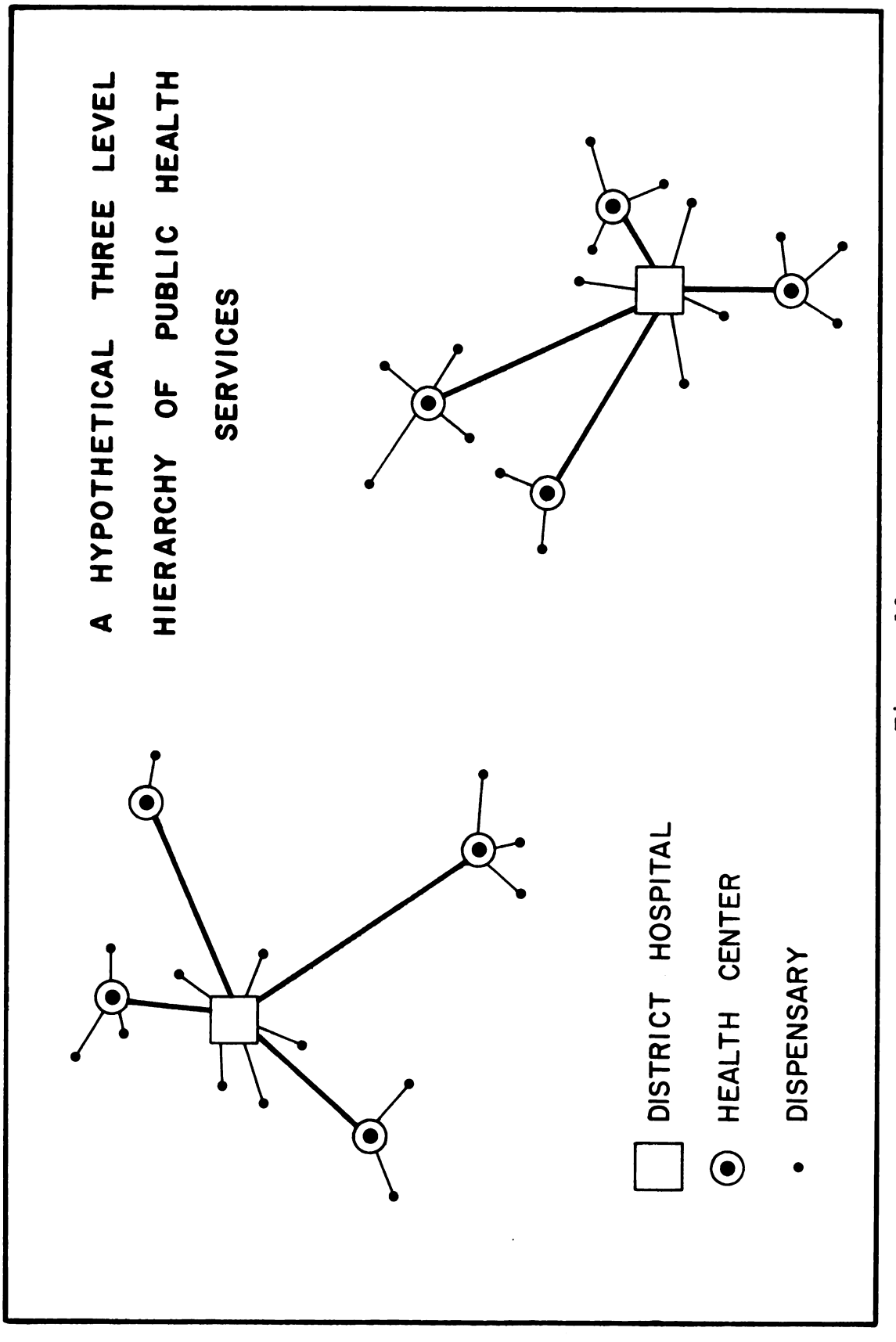
A HYPOTHETICAL THREE LEVEL
HIERARCHY OF PUBLIC HEALTH
SERVICES
DISTRICT HOSPITAL
HEALTH CENTER
DISPENSARY

Figure 10

3) At the highest level would be the district hospital possessing the most sophisticated equipment and serving virtually all the needs of the population.

By closely integrating the levels of this hierarchy, i.e. dispensaries with health centers, health centers with hospitals, a direct support link from one facility category to another will be forged. And, taking a different perspective, each level is responsible for specific categories of illnesses which should further encourage a more even allocation of patients throughout the health system.

A question arising from this hierarchical organization is whether a strict assignment of patients to health facilities should be adhered to. Though fixed boundaries may be appropriate for certain public services, such as schools or fire departments, the obligatory assignment of a population to a specific facility may constrain use in certain instances. For the use of health facilities, I believe the health district boundaries should not be absolute. If a person does not like the personnel at a specific facility, he should be free to travel to another. Also, assigning a family to a specific facility would necessitate verification problems, and further complicate record keeping. Finally, population shifts would require locational changes in dispensaries and personnel, and the adjustment of health district boundaries. In optimizing the districting of a health system, shifts needed in one area normally entail readjustments

throughout the system. Thus, a certain flexibility in boundary observance should prove more practical.

Implications for the Hypotheses

Hypothesis I has been proven false. It was based on incorrect knowledge of the number and distribution of public health centers in Guatemala City. As has been shown, there are many such facilities in the city, and these tend to be evenly distributed. Hypothesis II was related to the first hypothesis, and based on the same incomplete knowledge of the distribution of health centers in Guatemela City. However, Hypothesis II is accepted because it has been proved that the dispensaries are not placed centrally in relation to their user population. This maldistribution is due to poor locational planning and possibly to a lack of information on the part of potential health care users.

CHAPTER V

SUMMARY AND CONCLUSIONS

This chapter synthesizes the findings of the two analytic chapters, and formulates a set of proposals concerning changes that should be made in the organization, location, and delivery of public health services. Hopefully, by bringing together the knowledge gained through this study, a more effective health sector can be encouraged within national development planning.

The Utility of the Analyses in Health Planning

The connection between the data analyses and recommendations can be made more explicit by listing the major policy modes that can be used to improve health. Armstrong (1972) identifies three:

1) Medical care--the sources of preventive and curative medicine, and their accessibility to the public.

2) Environmental controls--sanitation, housing, and family nutrition.

3) Behavioral influences--health education and information availability.

The utilization studies applying principal components and Gamma coefficient analyses provide the bases for implementing

the last two modes, by identifying the relationships between the respondent and his environment. The location-allocation model pinpoints service bottlenecks in the accessibility of public health services and, thus, allows for dealing with the first entry mode. Because the public health care user is the basis for this study, and with the great majority of this group being composed of persons from the lower classes, the interpretation of the results emphasize projects and policies oriented toward the lower class person.

The Principal Components Analyses

These two analyses revealed differences in the relationship between the socio-economic, demographic, attitude, and utilization variables for the user and general populations. Variation was expected because of the sharp differences in the makeup of these groups. The user population was predominantly composed of persons from the lower social class--giving the impression that if a family had money to pay for private medical care, they would shift to private care. Alternatively, the general population included a much wider socio-economic range of respondents and, presumably, a wider range of opinions. Throughout this analysis it has been taken for granted that the general population sample is representative of the range of health care opinions within Guatemala City. This offers the opportunity to contrast the results of the user analysis.

Generally, the results of the general population analysis explained a greater amount of the total variance with one less dimension (Tables 4 and 6). This indicates that the responses of the general population showed stronger, more consistent patterns, than did those of the user population. A certain response inconsistency was expected from the user population because of a greater difficulty for lower class persons to respond to questions. This may be related to more limited backgrounds or a hesitancy to discuss their problems. The response error may be one of the hazards of administering a questionnaire among a predominantly illiterate population. A second reason for this disparity in explained variance could be that certain explanatory variables, important within each population group, were excluded from the analysis. However, given the range of data obtained through the questionnaire, it is difficult to identify what these other variables may be.

The Evaluation

Both component analyses revealed close similarities, in the types and relative strengths of individual dimensions, to similar analyses performed in the other areas of the world.[1] Also, the composition of the components

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[1]This included dimensions related to socio-economic status, family status, and mobility.

corresponded generally with Gross' (1972) typology of health care utilization, with dimensions conforming to his enabling, predisposing, and accessibility factors. What could not be controlled for, in Gross' terms, are the exogenous variables characterizing the neighborhood environment of the individual family, including: average age, education, income, and family size. This is primarily due to a lack of disaggregated census data--a problem that must be corrected if any extensive social research is to be accomplished in Guatemala.

Though there are similarities between the analyses, their specific contrasts provide the greatest insights into the two populations.

1) Dimension I in each analysis indicates interrelated socio-economic variables. However, the user population, being dominated by the lower social class, implies low socio-economic levels, while the general population reflects the opposite characteristics (Tables 1 and 3). This finding verifies the most obvious contrasts between the two populations.
2) Though not the strongest dimensions in either analysis, components dominated by utilization are present as Dimension IV in the user population analysis, and Dimension VII in the general population analysis. Within each component the variable co-loading highest with the number of visits is the number of

illnesses. In the user analysis all but one of the remaining variables are behavioral and attitude characteristics: the frequency of health concern, the number of existing infirmities, the number of alternative sources of medical care. On the other hand, in the general analysis utilization is associated with environmental variables concerning the quality of water and sanitary service. Regarding the user population, the indication is that those who are aware of their health and potential health problems are more likely to visit public health services. If increased utilization within the user population is to be fostered by health planners, the implication is that the strategy should focus on changing attitudes through health education.[2]

3) Dimensions indicating low health care perceptions offer a final contrast between the two populations. In the general population this low awareness was much more prominant than in the user population

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[2]Through such an education program potential health care recipients must be taught the capabilities and responsibilities of the various components of the health system, from family health care, through the various levels of the public health hierarchy. He must understand the need for health care, both preventive and curative, and should be taught to recognize the symptoms of disease and seek treatment when necessary. Potential users must not be timid or passive when in need of such care, but must be taught that public health services are meant for their use.

(Dimensions II and VII, respectively). The greatest danger lies with the user population where lowered health care concerns are matched with the recognition of large numbers of existing infirmities. This raises the question that if diseases are recognized, but not acted upon, what is needed to induce the individual to respond to these cues? Again this indicates the need for a change in health awareness. McKinley (1972, p. 119) conceptualizes the formulation of health service demand into four stages:

a. The existence of physiological or psychological conditions for disease.

b. The perception of the existence of such conditions.

c. The willingness to manage or control such conditions through health care services.

d. The ability to transform need into demand for health care.

The problem appears in the third stage. I believe this present lack of willingness is due to unfamiliarity with the benefits of good health maintenance, and, possibly, a timidity or uneasiness about medical visits--again, due to the lack of information and experience. Efforts must be made to acquaint this group with the advantages of good health care through education, and by making the trip to the health center more appealing. I believe the best

means of carrying out this education program is through a staff of health auxiliaries who would diffuse the necessary information in a more personal and acceptable manner to this lower class target group. These health auxiliaries could travel door-to-door throughout the community, or conduct neighborhood meetings to discuss local health problems and means of prevention. Also, by reducing crowded waiting rooms, through a reallocation of service capacity, the visit to the health facility can be made more appealing.

The Gamma Coefficient Analyses

The results of the user analysis with the number of visits as the dependent variable are:

1) As implied by the principal components analysis, the highest relationship lies with an increasing number of illnesses.[3]
2) Perceptual and behavioral variables make up the next strongest relationship: an increasing frequency that an individual is concerned about his health,[4] superior personal health evaluation of the

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[3]Refer to Table 7.

[4]Refer to Appendix B for explanation of individual variables.

individual, an increasing number of alternative sources of medical care that the individual uses, and a positive evaluation of public health services. The interpretation and evaluation of these relationships remain the same as that for the utilization dimension in the principal components analysis, i.e. attitude characteristics are of greatest importance among this population for the utilization of public health services.

3) Demographic characteristics are also closely associated with service use: females report greater use than males, and a decline in use is found with increasing age of the respondent. More frequent female use is probably related to their role within Latin families, as the individuals in charge of the family's health. Given the negative influence of age on utilization, it may be practical to examine the feasibility of providing additional home health service to the elderly--this could be included among the work of health auxiliaries.

4) Finally, two socio-economic variables, family income and education of the family head, are directly associated with increased use. This relationship would tend to predict improved health utilization as the national development process continues, but,

unfortunately, the general population analysis fails to confirm this.

Of interest is the lack of significance of either the travel time or distance variable, which counters theories that propose declining interactions with increased distance. Part of the answer to this apparent inconsistency is that the poor delay receiving care until some critical disease stage is reached.[5] At this point, distance or time may become of little perceived importance as a barrier to seeking professional care.[6]

The results of the general population analysis with frequency of health visits as the dependent variable are:

1) The highest association lies with an increased number of illnesses.
2) Perceptual and behavioral variables are also shown to be closely related to use: an increased frequency of health concern, superior personal health evaluation, a short illness response time, a positive evaluation of public health services, an increased number of alternative sources of medical care.

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[5]This is consistent with the findings of Iutaka (1966), Solien de Gonzalez (1965), Weiss and Greenlick (1970) evaluated in Chapters I and II.

[6]This may imply that distance minimization is not an appropriate measure to allocate public health services. However, if the proposed "outreach" services are added to clinics, the importance of a central location will increase in order to minimize the travel of health auxiliaries.

3) The transportation variables are also important: number of visits declined with increased travel distance and travel time, and with increasing use of buses and cars for health travel. Theory might attribute this normal distance/time relationship to the presence of higher social groups in the general population. Such individuals are educated and aware of their health, and, thus, are not faced with limitations or delay in receiving treatment. In this situation, distance may become an influence over individual choice to utilize care. However, as will be seen, socio-economic variables do not show significant association with use. This makes an explanation of the negative influence of distance and time difficult, and a topic for future research.[7]

4) Also of importance are several environmental variables: lower quality sanitary and water service, and a higher room density in the home. Given the consistently bad environmental characteristics of the population within the user group, it is not surprising that whatever minor variations that may

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[7]Spearman rank correlation coefficients show distance to be most associated with rising socio-economic status, i.e. income, education, lowering room densities, etc. Given the strong negative relationships of use frequency and distance, the explanation for a lack of association between socio-economic status and use frequency appears more justified.

be present have little effect on use. But when substantial quality variations are present, as in the general population, then the association with health care is significant.

5) Finally, none of the demographic and socio-economic characteristics of the general population enter significantly as explanatory variables, with the exception of a negative relationship with the respondent's education. This is surprising because all previous health research places a great amount of importance on socio-economic characteristics (Hyman, 1970; Ludwig and Gibson, 1969; Feldstein, 1966; Ross, 1969). To explain this apparent incongruity one must understand the spatial structure of Guatemala City. Zone 12, where the general survey was taken, is a "pie-shaped" sector with the middle and upper classes residing toward the outer fringe in a suburban style similar to that in North America (Figure 2). Conversely, most private physicians used by these groups have offices in the central part of the city. Thus, health trips entail travelling into the most congested part of town, and, if by car, then the added nuisance of finding a parking space near the doctor's offices. The problems associated with travel may negate the expected positive relationship between socio-economic status and

health care use in this zone. To test this belief would necessitate making a utilization study of a range of social groups in the central part of the city.[8] The expectation would be that the positive relationship between utilization and socio-economic status would appear.

The Location-Allocation Analysis

The accessibility of the user population to sources of public health care were evaluated and recommendations for redistribution of physicians and facilities presented. Those recommendations are:

1) That a new dispensary with one physician be located in Zone 6 approximately one kilometer northeast of the present two physician dispensaries in that zone.
2) That one physician be added to the capacity of the existing dispensary in Zone 6, Zone 12, and the south dispensary of Zone 5.
3) That the capacity of the dispensary in Zone 7 be reduced to one physician.
4) That locational adjustments be made in each of the remaining small dispensaries.

A formal recognition of the health facility hierarchy, by providing the intermediate sized facilities with

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[8]A great number of wealthy families remain within the central zone of the capital.

administrative and supply functions, would increase the efficiency of health care provision.

The Role of Health Services in National Development

Although the extension of basic health services will bring about some gains in community well-being, these improvements will be quickly negated by continuing poverty, illiteracy, low quality housing, and inadequate sanitary facilities. From a macro-scale viewpoint, illness must be seen as resulting from the existing political, economic, and social environment. Improvements just in health services will have little, if any, impact on these broader health-related issues. National development depends on a healthy, energetic population, and to improve health conditions requires a concerted effort on several dimensions of poverty in Guatemala (Gauthier, 1976).

Personal experience indicates that many elements of the government are isolated from social realities, as well as from one another.[9] This fosters a lack of response, or a wrong response, to critical problems facing the nation, poverty being just one of them. One aspect of this is the

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[9]McIntosh (1974) has made a detailed examination of the bottlenecks within the Guatemalan government bureaucracy. The communication between lower and upper levels is limited, thus few of the concerns of the common people reach decision-makers. Yet, it is this information that the decision-makers so sorely need.

over-emphasis, in public planning, on economic growth, rather than social development. Physicians and administrators of the public health sector possess a unique and respected position in society, and could more actively sponsor the needs of the common people they are in daily contact with.

Obviously, the approach proposed here requires a radical change in the philosophy that has guided national development in Guatemala; however, the alternatives appear limited. Although economic growth has recently made major advances (Mulvihill, 1972), Guatemala has failed to eliminate the barriers of poverty that block the achievement of healthy, fulfilling lives by a large percentage of its population. The equitable achievement of national development goals demands input at the local levels of planning and decision-making; in this way social development will accompany and support economic development. By this means, greater opportunities exist for reducing the health problems of the poor by reducing the social and economic disparities that exist throughout Guatemala.

APPENDICES

APPENDIX A

INTERVIEW SCHEDULE

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NOTE FOR THE INVESTIGATOR:

The questionnaire must be completed with the family member responsible for the health of the family group.

1. Date: _____ 2. Questionnaire No.: _____

3. Respondent's Address: _____

4. Time the interview started: _____ Ended: _____

5. Do you use the Municipal Dispensaries or the Public Health Centers? Yes _____ Which? _____

What is the address of this Dispensary or Center? _____

_____

What year did you begin using this Dispensary or Center?

_____ No _____ Then, what services or clinics do you use or visit in times of illness? _____

_____

5.1 Do you know the address of the Municipal Dispensary or Public Health Center that corresponds to this Zone?

Yes _____ What is the address? _____

No _____

6. During the last three months, approximately how many times were you, or a member of your family, sick and not able to do your regular work? _____

6.1 During the last three months, how many times did you go to:

a. A Municipal Dispensary _____

b. A Public Health Center _____

c. A Private Physician _____

d. Others _____

6.2 Usually, how do you travel to this health service?

a. On foot _____ b. By bus _____

c. By car _____ d. Others (specify) _____

6.3 During your last visit, approximately how much time did it take to travel to the Municipal Dispensary or other health service? _____

6.3.1 How much time did you wait to be attended? _____

6.4 Why do you use the medical service in this place?

a. It is very close to your home _____

b. You have the most confidence in this place _____

c. The service costs less money _____

d. Other reasons (specify) _____

_____

7. How many persons live in this house (respondent's household only)? Men _____ Women _____ Children _____

8. How many bedrooms does the house have, including that for the maids? _____

9. What type of water service do you have in this house?

a. Faucet for your own use _____

b. Faucet for several houses _____

c. Public faucet in your neighborhood _____

d. Well _____ e. River, lake, spring _____

f. Other (specify) _____

10. What type of sanitary service exists in this house?

a. Toilet for your own use _____

b. Toilet for several houses _____

c. A washable stool _____

d. Cesspool _____

e. Do not have sanitary service _____

11. How do you feel today, healthwise?

Very well _____ Well _____ Average _____ Bad _____

12. How often do you think of your health?

Very often _____ Some-times _____ Rarely _____ Never _____

13. When you begin to feel one of the following illnesses, how long do you delay before visiting a doctor?

NOTE FOR THE INVESTIGATOR:

Place a 1 if the response is: Immediately,
" " 2 " " " " One to three days,
" " 3 " " " " One week,
" " 4 " " " " More than one week,
" " 5 " " " " I would not see a doctor.

a. Chest pain _____

b. Persistent caugh _____

c. Feeling tired continually _____

d. A serious injury on the leg or some other part of of the body _____

e. Diarrhea _____

14. If you had the opportunity to talk with a doctor about your health or the health of a family member, would you have any questions to ask him?

Yes _____ No questions _____

14.1 Cite the three most important: _____

_____

_____

14.2 Why haven't you consulted at your clinic about these illnesses? _____

_____

15. What is the occupation of the head of the family?

_____ Sex _____

Age _____ Last grade completed in school _____

16. What is the occupation of the respondent (if it is different than No. 15)? _____

Sex _____ Age _____ Last grade completed in school _____

17. What is the total income of the family (as the case may be)?

Daily $_____ Weekly $_____ Monthly $_____

18. Thinking over your past experience, how many times have you failed to consult with a doctor when you needed to?

NOTE FOR THE INVESTIGATOR:

Place a 3 if the response is: Very often,
" " 2 " " " " Sometimes,
" " 1 " " " " Never.

Because:

a. I didn't know there were dispensaries and health centers with doctors to serve the public _____

b. I was very busy and didn't have time _____

c. I didn't think a doctor would be able to help me _____

d. The dispensary is very far and I didn't have means of transport _____

e. I would use the bus, but I don't know which goes towards the dispensary _____

f. I don't like to have the doctors examine me _____

g. There is another person with whom I can consult _____

h. Do you have other reasons why you have failed to consult a doctor when you may have need to? _____

_____

19. Now I have some statements about doctors in the Municipal Dispensaries and Health Centers and I want to know if you agree, agree sometimes, or do not agree.

NOTE FOR THE INVESTIGATOR:

Place a 3 if the response is: Total agreement,
" " 2 " " " " Agreement sometimes,
" " 1 " " " " Do not agree.

a. You must wait a long time to see the doctor _____

b. The doctors don't take any interest in your examination _____

c. The doctors don't listen for information from the patient, nor do they ask questions _____

d. The physicians give better service to paying patients _____

e. The doctors give you prescriptions that you don't need _____

f. Do you have any other opinions of the doctors in the dispensaries or health centers? _____

_____

20. Do you know of other persons that have encountered problems or been given poor attention in the Municipal Dispensaries or Health Centers?

Yes _____ No _____

Explain what happened, briefly: _____

_____

21. Are there sufficient medical services in this city for the poor? Yes _____ No _____. If no, what would you recommend to improve this situation for the poor? _____

_____

22. Besides a doctor, who do you consult when you are sick or a member of your family is sick?

a. A pharmacist _____

b. A friend or neighbor who knows about medicine ____

c. Another member of the family _____

d. Others (specify) _____

22.1 Why do you consult these persons?

a. They live close _____ b. There is no charge____

c. You have more confidence in them _____

d. To save time _____

e. Other reasons (specify) _____

23. What means are best for you to receive information about improving your health?

Radio _____ Newspapers _____ Television _____

Others (specify) _____

24. Do you have other comments to make about the attention that is given to the inhabitants of your neighborhood in the Municipal Dispensaries, and Public Health Centers? _____

_____

25. Cultural affiliation of the respondent:

Latin _____ Indian _____ Other (specify) _____

26. Attitude of the respondent:

Agreeable _____ Disagreeable _____

Very disagreeable _____

27. Signature of the investigator _____

APPENDIX B

DESCRIPTION OF THE VARIABLES USED IN ANALYSES

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DESCRIPTION OF THE VARIABLES USED IN ANALYSES

1. Service use: A measure of health service use. A bivariate, used in general survey only: 0 = use of public health services, 1 = use of private health services (Questionnaire Response #5).

2. Number of years use: A measure of familiarity with service facility. The number of years a family has used their public health center (Questionnaire Response #5).

3. Number of illnesses: A measure of service need. The number of times during the previous three months that there was a sick family member (Questionnaire Response #6).

4. Number of visits: A measure of health care utilization. In the user survey, the number of times a family visited a public health center within the previous three months; in the general survey, the number of times a family visited a public or a private health facility during the previous three months (Questionnaire Response #6.1).

5. Transport mode: A measure of socio-economic status. The usual transport mode used during a visit to a health facility. These are arranged in ascending order of quality: 1 = by foot, 2 = by bus, 3 = by car (Questionnaire Response #6.2).

6. Travel time: A measure of service accessibility. The estimated length of time an individual used in travelling to a health facility during the last visit (Questionnaire Response #6.3).

7. Travel distance: A measure of service accessibility. The linear distance in kilometers between the respondent's residence and the health facility of use (Questionnaire Responses #3 and #5).

8. Waiting time: A measure of the constraint of time. The estimated length of time a person waited in a health facility before seeing a doctor or nurse.

9. Family size: A measure of a demographic characteristic. The number of adults and children in the household (Questionnaire Response #7).

10. Persons per bedroom: A measure of housing quality and socio-economic status. The proportion of the number of family members to the number of bedrooms in the home. Bedrooms were specified because of the difficulty in identifying the number of total rooms within the homes of lower status families (Questionnaire Responses #7 and #8).

11. Water service: A measure of housing quality. The type of water service available in the home, in descending order of quality from 1 = private faucet to 5 = river, lake or spring (Questionnaire Response #9).

12. Sanitary service: A measure of housing quality. The type of toilet facility available in the home in descending order of quality, from 1 = private toilet to 5 = no toilet facility (Questionnaire Response #10).

13. Health evaluation: A measure of present health status. The respondent's evaluation of the present state of his health, from 1 = very well to 4 = bad (Questionnaire Response #11).

14. Frequency of health concern: A measure of general health awareness. The respondent's personal evaluation of how frequently he thinks about his health, from 1 = very often to 4 = never (Questionnaire Response #12).

15. Illness response time: A measure of health awareness and responsiveness to disease occurrence. Given a range of potential ailments, the respondent was asked how long he would delay seeking medical attention, if he had an illness. The response options ranged from 1 = immediately to 5 = would not seek physician's care. These scores

were then totaled to give an indication of response time over a variety of illnesses. Low values indicate quick response; high values indicate slow or no response to illness (Questionnaire Response #13).

16. Number of existing infirmities: A measure of service need and of "latent" demand. The estimated number of present family illnesses that could be reported if a physician were readily available (Questionnaire Response #14).

17. Sex of family head: A demographic measure. A bivariate in which 0 = male and 1 = female (Questionnaire Response #15).

18. Age of family head: A demographic measure. The family head's age in years (Questionnaire Response #15).

19. Education of family head: A measure of socio-economic status. The last grade in school completed by the family head (Questionnaire Response #15).

20. Sex of respondent: A demographic measure. A bivariate in which 0 = male and 1 = female (Questionnaire Response #16).

21. Age of respondent: A demographic measure. The respondent's age in years (Questionnaire Response #16).

22. Education of respondent: A measure of socio-economic status. The last grade in school completed by the respondent (Questionnaire Response #16).

23. Income: A measure of socio-economic status. The family's monthly income (Questionnaire Response #17).

24. Personal barriers: A measure of perceptual accessibility. The number and magnitude of perceived barriers to health service utilization. Values for individual barriers have been totaled to obtain a general barrier index (Questionnaire Response #18).

25. Adverse opinions: An evaluation measure of public health care. The number of adverse opinions held by the respondent about the personnel within public health facilities. These were also totaled to give a general index of adverse opinions (Questionnaire Response #19).

26. Respondent's evaluation: An evaluation measure of public health care. This value was an objective evaluation of the feelings expressed in two open-ended questions. The scale ran from -2 = very low evaluation to +2 = very high evaluation (Questionnaire Responses #21 and #24).

27. Alternative medical care sources: A measure of the relative importance of physician care. The type of medical services, besides those of a physician, available to the respondent (Questionnaire Response #22).

28. Health information sources: A measure of accessibility to health information sources. Indicates the number of media sources available to the respondent from which he can obtain information about health matters (Questionnaire Response #23).

SELECTED BIBLIOGRAPHY

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Abernathy, William J. and John C. Hershey (1972). "A Spatial-Allocation Model for Regional Health Services Planning," Operations Research, 20:3, pp. 629-642.

Abler, Ronald, John S. Adams and Peter Gould (1971). Spatial Organization: The Geographer's View of the World (Englewood Cliffs: Prentice-Hall, Inc.).

Acton, Jan Paul (1973). Demand for Health Care When Time Prices Vary More Than Money Prices (New York: The Rand Institute of New York).

Acuna, Hector (1976). "Teaming-Up for Health," Pan American Health, 7:3-4, pp. 4-5.

Anderson, Ronald and Odin W. Anderson (1967). A Decade of Health Services (Chicago: The University of Chicago Press).

Armstrong, R. W. (1972). "Medical Geography and Health Planning in the United States: Prospects and Concepts," in N. D. McGlashan (ed.), Medical Geography: Techniques and Field Studies (London: Methuen & Co., Ltd.), pp. 119-129.

Baldwin, Robert E. and Burton A. Weisbrod (1974). "Disease and Labor Productivity," Economic Development and Cultural Change, pp. 414-435.

Bergner, Lawrence and Alonzo S. Yerby (1968). "Low Income and Barriers to Use of Health Services," New England Journal of Medicine, 278:10, pp. 541-546.

Berry, Brian J. L. (1971a). "Comparative Factorial Ecology," Economic Geography, 47:2 (Supplement), pp. 209-367.

_____ (1971b). "Introduction: The Logic and Limitations of Comparative Factorial Ecology," Economic Geography, 47:2 (Supplement), pp. 209-219.

_____ and Frank E. Horton (1970). Geographic Perspectives on Urban Systems (Englewood Cliffs: Prentice-Hall, Inc.)

Berry, Ralph E. (1967). "Returns to Scale in the Production of Hospital Services," Health Services Research, 2, pp. 123-139.

Brown, Lawrence A., et al. (1974). "The Location of Urban Population Service Facilities: A Strategy and its Application," Social Science Quarterly, 54:4, pp. 784-799.

Burnett, Pat (1976). "Toward Dynamic Models of Traveller Behavior and Point Patterns of Traveller Origins," Economic Geography, 55:1, pp. 30-47.

Consejo Nacional de Planificacion Economica (1975). Plan Nacional de Salud (Guatemala City, C.A.).

Cooper, L. (1963). "Location-Allocation Problems," Operations Research, 11, pp. 331-343.

_____ (1964). "Heuristic Methods for Location-Allocation Problems," SIAM Review, 6, pp. 37-53.

Costner, Herbert L. (1965). "Criteria for Measures of Association," American Sociological Review, 30:3, pp. 341-353.

Cox, Kevin R. (1973). Conflict, Power and Politics in the City (New York: McGraw-Hill Book Company).

Davis, Kingsley (1965). "The Urbanization of the Human Population," in Cities: A Scientific American Publication (New York: Alfred A. Knopf, Inc.).

De Vise, Pierre (1968). "Methods and Concepts of an Inter-Disciplinary Regional Hospital Study," Health Services Research, 3:3, pp. 166-173.

_____ (1966). "Hospital Study Districts for Metropolitan Chicago: A Geographical Analysis and Methodology," Technical Report No. 2 (Chicago: Hospital Planning Council for Metropolitan Chicago).

_____, et al. (1969). "Slum Medicine: Chicago's Apartheid Health System," Report No. 6 (Chicago: Community and Family Study Center, University of Chicago).

Douglass, Chester W. (1971). "A Social-Psychological View of Human Behavior for Health Services," Health Services Research, 6:1, pp. 6-14.

Earickson, Robert (1970). "The Spatial Behavior of Hospital Patients: A Behavioral Approach to Spatial Interaction in Metropolitan Chicago," Research Paper No. 124, Department of Geography, University of Chicago.

Elling, Ray H. (1968). "The Design, Institutionalization and Evaluation of Change in Colombian Health Services," Milbank Memorial Fund Quarterly, 46:2 (Part II), pp. 258-273.

Feldstein, Martin S. (1971). "Hospital Cost Inflation: A Study of Nonprofit Price Dynamics," American Economic Review, 61, pp. 853-872.

Feldstein, Paul J. (1966). "Research on the Demand for Health Services," Milbank Memorial Fund Quarterly, 44:3 (Part II), pp. 128-165.

Fox, Robert W. (1975). Urban Population Growth Trends in Latin America (Washington, D.C.: Inter-American Development Bank).

Gale, Stephen and Eric G. Moore (1975). The Manipulated City (Chicago: Maaroufa Press, Inc.).

Garrison, William, et al. (1959). "Models of Physician Utilization in Service Areas: Measurements of Benefits," in Studies of Highway Development and Geographic Change (Seattle: University of Washington Press).

Gauthier, Howard (1976). "The Demise and Resurrection of Regional Geography," a lecture presented to the Department of Geography, Michigan State University, May 4, 1976.

Girt, John L. (1973). "Distance to General Medical Practice and its Effect on Revealed Ill-Health in a Rural Environment," Canadian Geographer, 17:2, pp. 154-166.

Goering, John M. and Rodney M. Coe (1970). "Cultural Versus Situational Explanations of the Medical Behavior of the Poor," Social Science Quarterly, 51:2, pp. 308-319.

Golledge, Reginald G. (1969). "The Geographical Relevance of Some Learning Theories," in K. Cox and R. Golledge, "Behavioral Problems in Geography: A Symposium," Studies in Geography No. 17, Northwestern University.

_____ and Lawrence A. Brown (1967). "Search, Learning and the Market Decision Process," Geografiska Annaler, 49B:2, pp. 116-124.

Goodchild, M. F. and B. Massam (1969). "Some Least-Cost Models of Spatial Administrative Systems in Southern Ontario," Geografiska Annaler, 52B:2, pp. 86-94.

Goodman, Leo A. and William H. Kruskal (1963). "Measures of Association for Cross Classification III: Approximate Sampling Theory," Journal of American Statistical Association, 58, pp. 310-364.

_____ (1954). "Measures of Association for Cross Classifications," Journal of American Statistical Association, 49, pp. 732-764.

Gould, Peter and Thomas R. Leinbach (1966). "An Approach to the Geographic Assignment of Hospital Services," Tijdschrift Voor Economische en Sociale Geografie, 57, pp. 203-206.

Graham, Saxon (1958). "Socio-Economic Status, Illness and the Use of Medical Services," E. Gartly Jaco (ed.), Patients, Physicians and Illness (New York: The Free Press), pp. 129-134.

Griffith, John R. (1972). Quantitative Techniques for Hospital Planning and Control (Lexington, Mass.: D. C. Heath & Co.).

Gross, P. F. (1973). "Urban Health Disorders, Spatial Analysis, and the Economics of Health Facility Location," International Journal of Health Services, 2:1, pp. 63-84.

Grossman, Michael (1972). "On the Concept of Health Capital and the Demand for Health," Journal of Political Economy, 80:2, pp. 223-255.

Hadley, George (1962). Linear Programming (Reading, Mass.: Addison-Wesley, Inc.

Hall, Fred L. (1973). "Location Criteria for High Schools," Research Paper No. 150, Department of Geography, University of Chicago.

Harvey, David (1973). Social Justice and the City (Baltimore: The Johns Hopkins Press).

Hefty, Thomas R. (1969). "Returns to Scale in Hospitals: A Critical Review of Recent Research," Health Services Research, 4, pp. 267-280.

Herbert, David (1972). Urban Geography: A Social Perspective (New York: Praeger Publishers).

Holtman, A. G. (1972). "Prices, Time, and Technology in the Medical Care Market," Journal of Human Resources, 7:2, pp. 179-190.

Hyman, Martin (1970). "Some Links Between Economic Status and Untreated Illness," Social Science and Medicine, 4, pp. 387-399.

Iutaka, Sugiyama (1966). "Social Status and Illness in Urban Brazil," Milbank Memorial Fund Quarterly, 44:2, pp. 97-109.

Kasl, Stanislav and Sidney Cobb (1966). "Health Behavior, Illness Behavior and Sick Role Behavior," Archives of Environmental Health, 12 (Part I), pp. 246-266; 12 (Part II), pp. 531-541.

King, Leslie J. (1969). Statistical Analysis in Geography (Englewood Cliffs: Prentice-Hall, Inc.).

Kisch, Arnold I. and Leo G. Reeder (1969). "Client Evaluation of Physician Performance," Journal of Health and Social Behavior, 10:1, pp. 51-58.

Lankford, Philip M. (1974). "Physician Location Factors and Public Policy," Economic Geography, 50:3, pp. 244-256.

Long, M. F. and P. J. Feldstein (1967). "Economies of Hospital Systems: Peak Loads and Regional Coordination," American Economic Review, 57:2, pp. 119-129.

Ludwig, Edward G. and Geoffrey Gibson (1969). "Self-Perception of Sickness and the Seeking of Medical Care," Journal of Health and Human Behavior, 10:2, pp. 125-133.

Mahler, Halfdan (1976). "Turning Threats to Challenges," Pan American Health, 7:3-4, p. 2.

Marble, Duane F. (1967). "A Theoretical Exploration of Individual Travel Behavior," in W. L. Garrison and D. F. Marble (eds.), "Quantitative Geography Part I: Economic and Cultural Topics," Studies in Geography No. 13, Northwestern University.

Marden, Parker G. (1966). "A Demographic and Ecological Analysis of the Distribution of Physicians in Metropolitan America, 1960," American Journal of Sociology, pp. 290-300.

McIntosh, Terry L. (1974). Local Government, Development, and Development Lag in Guatemala: Spatial and Process Considerations, a Ph.D. dissertation, Department of Geography, Michigan State University.

McKinley, John G. (1972). "Some Approaches and Problems in the Study of the Use of Services--An Overview," Journal of Health and Social Behavior, 13, pp. 115-152.

Mishan, E. J. (1973). Economics for Social Decisions: Elements of Cost-Benefit Analysis (New York: Praeger Publishers).

Morrill, Richard L. (1967). "The Movement of Persons and the Transportation Problem," in W. L. Garrison and D. F. Marble (eds.), "Quantitative Geography Part I: Economic and Cultural Topics," Studies in Geography No. 13, Northwestern University.

_____ and Robert J. Earickson (1969). "Problems in Modeling Interaction: The Case of Hospital Care," in K. Cox and R. Golledge (eds.), "Behavioral Problems in Geography: A Symposium," Studies in Geography No. 17, Northwestern University.

_____ (1968). "Variation in the Characteristics and Use of Chicago Hospitals," Health Services Research, 3:3, pp. 224-238.

Morrill, Richard L., Robert J. Earickson and Phillip Rees (1970). "Factors Influencing Distances Travelled to Hospitals," Economic Geography, 46, pp. 161-171.

Morris, Fred B. and Gerald F. Pyle (1971). "The Social Environment of Rio de Janeiro in 1960," Economic Geography, 47:2, pp. 286-299.

MSPAS--Ministerio de Salud Publica y Assistencia Social (1972). Poblacion y Nacimientos de Los Municipios del Departamento de Guatemala (Guatemala, C.A.: Unidad Sectoral de Planificacion de la Salud).

_____ (1973). Memoria Anual (Guatemala, C.A.: Region Metropolitana).

Murdie, Robert A. (1969). "Factorial Ecology of Metropolitan Toronto 1951-1961: An Essay on the Social Geography of the City," Research Paper No. 116, Department of Geography, University of Chicago.

Mulvihill, James L. (1972). International Trade and Economic Integration: A Study of the Central American Common Market, an M.A. thesis, Department of Geography, State University of New York at Buffalo.

Newman, Jeanne S. (1976). "Population Distribution and Health Services Planning in Less Developed Areas," a paper presented at the annual meeting of the Association of American Geographers, April 12, 1976.

Nie, Norman H., et al. (1975). SPSS: Statistical Package for the Social Sciences (New York: McGraw-Hill Book Company).

PAHO--Pan American Health Organization (1973). "Health Planning in Latin America," Scientific Publication No. 272 (Washington, D.C.: Pan American Sanitary Bureau).

Pauly, Mark V. (1974). "Economic Aspects of Consumer Use," in Selma Muskin (ed.), Consumer Incentives for Health Care (New York: Milbank Memorial Fund).

Portes, Alejandro (1971). "The Urban Slum in Chile: Types and Correlates," Land Economics, 47:3, pp. 235-248.

Press, Irwin (1969). "Urban Illness: Physicians, Curers and Dual Use in Bogota," Journal of Health and Social Behavior, 10:3, pp. 209-218.

Pyle, Gerald F. (1974). "The Geography of Health Care," in John M. Hunter (ed.), The Geography of Health and Disease: Papers of the First Carolina Geographical Symposium (Chapel Hill: University of North Carolina), pp. 154-184.

_____ (1971). "Heart Disease, Cancer, and Stroke in Chicago," Research Paper No. 134, Department of Geography, University of Chicago.

Rees, Philip H. (1970). "Concepts of Social Space: Toward an Urban Social Geography," in Brian J. L. Berry and Frank Horton, Geographic Perspectives on Urban Systems (Englewood Cliffs: Prentice-Hall, Inc.), pp. 306-394.

Roemer, Milton I. (1968). "Colombian Health Services in the Perspective of Latin American Patterns," Milbank Memorial Fund Quarterly, 46:2, pp. 203-212.

_____ (1964). "Medical Care and Social Class in Latin America," Milbank Memorial Fund Quarterly, 42, pp. 54-64.

Rosenblatt, Daniel and Edward A. Suchman (1969). "Awareness of Physician's Social Status," Milbank Memorial Fund Quarterly, 47, pp. 94-102.

Rosenstock, Irwin (1966). "Why People Use Health Services," Milbank Memorial Fund Quarterly, 44:3 (Part 2), pp. 94-127.

Ross, John A. (1962). "Social Class and Medical Care," Journal of Health and Human Behavior, 3:1, pp. 35-40.

Rummel, R. J. (1970). Applied Factor Analysis (Evanston: Northwestern University Press).

Rushton, Gerard, et al. (1973). "Computer Programs for Location-Allocation Problems," Monograph Number 6, Department of Geography, University of Iowa.

Scott, Allen J. (1970). "Location-Allocation Systems: A Review," Geographical Analysis, 2, pp. 96-119.

Sepulveda, Orlando (1966). "Research on Behavioral Science and Medicine in Latin America," Milbank Memorial Fund, 44:2, pp. 52-69.

Siegel, Sidney (1956). Nonparametric Statistics for the Behavioral Sciences (New York: McGraw-Hill Book Company).

Simmons, Ozzie (1955). "Popular and Modern Medicine in Mestizo Communities of Coastal Peru and Chile," Journal of American Folklore, 68, pp. 57-71.

Smith, Robert H. T. (1970). "Concepts and Methods in Commodity Flow Analysis," Economic Geography, 46:2, pp. 404-416.

Solien de Gonzalez, Nancie (1966). "Health Behavior in Cross-Cultural Perspective: A Guatemalan Example," Human Organization, 25:2, pp. 122-125.

_____ (1965). "Medical Beliefs of the Urban Folk in Guatemala," America Indigena, 25:3, pp. 321-328.

Suchman, Edward A. (1965). "Social Patterns of Illness and Medical Care," Journal of Health and Human Behavior, 6, pp. 2-16.

Teitz, Michael B. (1968). "Toward a Theory of Urban Public Facility Location," Paper--Regional Science Association, 21, pp. 35-51.

Teller, Charles H. (1972). Internal Migration, Socio-Economic Status, and Health: Access to Medical Care in a Honduran City, Ph.D. dissertation, Cornell University.

Thomas, Robert N. (1968). Internal Migration to Guatemala City, C.A., a Ph.D. dissertation, Department of Geography, Pennsylvania State University.

Tucker, Murray A. (1970). "Effect of Heavy Medical Expenditures on Low Income Families: Incidence and Impact," Public Health Reports, 85:5, pp. 419-425.

Weiss, James E. and Merwyn R. Greenlick (1970). "Determinants of Medical Care Utilization: The Effects of Social Class and Distance on Contacts with the Medical Care System," Medical Care, 8:6, pp. 456-462.

Wheeler, James O. and Robert N. Thomas (1973). "Urban Transportation in Developing Economies: Work Trips in Tegucigalpa, Honduras," Professional Geographer, 25:3, pp. 113-120.

Wittick, Robert I. (1971). "Some General Statistics Programs Used in Spatial Analysis," Technical Report 71-1, Computer Institute for Social Science Research, Michigan State University.

Woods, Clyde M. and Theodore D. Graves (1974). The Process of Medical Change in a Highland Guatemalan Town, Latin American Studies Center, University of California--Los Angeles.

Yeates, Maurice (1963). "Hinterland Delimitation: A Distance Minimizing Approach," Professional Geographer, 15:6, pp. 7-10.

Zschock, Dieter K. (1970). "Health Planning in Latin America: Review and Evaluation," Latin American Research Review, 5:3, pp. 35-56.

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