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A LOCATION-ALLOCATION STUDY FOR PRIMARY CARE HEALTH CENTERS: A SURVEY OF THE DOCTORED AND UNDOCTORED POPULATIONS IN THE LANSING, MICHIGAN AREA

Michigan State University

PH.D.

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By

William David Bennett

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A DISSERTATION

Submitted to Michigan State University in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

Department of Geography

ABSTRACT

A LOCATION-ALLOCATION STUDY FOR PRIMARY CARE HEALTH CENTERS: A SURVEY OF THE DOCTORED AND UNDOCTORED POPULATIONS IN THE LANSING, MICHIGAN AREA

By

William David Bennett

In recent decades few issues have generated more social, economic, and political interest in the United States than has the subject of health care. Geographic inequities in health care provision have been noted at regional, state, and local levels for physicians as well as facilities. This study examined locational alternatives and characteristics of potential users for primary care health facilities being established in the Lansing, Michigan area under a grant to a local hospital.

Two location-allocation algorithms were used to determine facility locations and associated user allocations, based on the distribution of undoctored households reported in a mail-out survey conducted in the study area. Respondents to this same survey were also asked a variety of health care related and socioeconomic questions which, when examined in light of the location-allocation user assignments, yielded informative profiles of the anticipated users which could bear upon the staffing, facilities, and programs offered at each of the primary care centers.

It was the original intent of the hospital to establish four facilities scattered across the study area to complement a central center located at the hospital itself. Given the concentration of undoctored households in the Lansing urban area, the location-allocation analyses performed for this study led to the conclusion that three outlying facilities would be preferable to four. Compared with the latter, the three outlying centers would only slightly increase the aggregate travel distance, while producing more tenable utilization levels for all units and improving the equity of utilization expected for each facility. Furthermore, when the location-allocation analyses were repeated to account for projected population changes in the study area through 1990, these same locational findings were essentially unaltered.

Differences in the characteristics of the groups linked to the four facilities were investigated using crosstabulations and chi-square tests for significance. In general, the sharpest distinctions among these groups were noted in socioeconomic characteristics and in the incidence of certain medical problems, with the contrasts primarily reflecting rural and urban service areas. Households allocated to the urban-based service centers commonly were smaller than average, with age composition more strongly oriented toward the elderly than toward dependents. Heads of households in the urban service areas also reported above average educational levels, and relatively short periods of residential tenure.

Overall, however, the inter-group differences discovered among the households in the facility service areas were of less magnitude than the contrasts between the doctored and undoctored households sampled in the survey. In the latter dichotomy, the undoctored households indicated dissatisfaction with the U.S. health care system and favor for a program of national health insurance as well as interest in joining a pre-paid health maintenance organization. Households in the undoctored group were of smaller than average size, containing few elderly and few children; many were headed by students and women and, in terms of residency, transiency was high. Surprisingly, the undoctored group was responsible for only slightly above-average hospital emergency room use despite the substantial difficulty noted by the group in getting a prompt appointment with a physician and even simply finding an available physician. Other impediments to health care procurement for this group included their relatively high reliance on public transportation for physician visits and their unusually strong preference for scheduling physician visits for the early evening hours.

Beyond the application of these findings to the expansion of primary care health services in the Lansing area, this study was only partially supportive of many of the conclusions and methods associated with previous work reported in the literature, as well as suggesting certain other areas and topics of concern in health care delivery which have not been directly addressed in past studies.

ACKNOWLEDGEMENTS

The completion of this study is an event made possible by the shared efforts of numerous groups and individuals. Above all, appreciation is extended to the several thousand Lansing area residents who voluntarily participated in the mailed survey. The information they provided about their personal health, habits, and attitudes was central to the study. The author's gratitude is also extended to those persons at Saint Lawrence Hospital, and especially to Edward "Ted" Otto, for their interest and encouragement in the project.

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CHAPTER I

INTRODUCTION

Over the past two to three decades few, if any, issues have generated a higher or more sustained level of social, economic, and political interest in the United States than has the subject of health care. The most immediate concern over health care has been the rapid escalation of costs, although there have been numerous other symptoms of malaise, too. Some of these other problems include a growing number of malpractice suits, charges of discrimination in medical school admissions, reports of regional hospital-bed excesses creating local operating inefficiencies, concern with the shrinking numbers of general practice physicians and the increasingly limited service they offer (no house calls), and lastly a growing awareness of geographic inequities in physician distribution, health care cost, health care availability, and health care quality.

HEALTH CARE IN AMERICA

The rise in health care expenditures by Americans has been both sharp and persistent. Scheffler and Paringer (1977, 194) summarize the health care cost issue:

> In fiscal year 1975, health care expenditures reached \$118.5 billion and accounted for 8.3 percent of the economy's gross national product. A total of \$547.03 was spent on health care for each member of the population. In contrast, in fiscal year 1929, medical care expenditures totaled \$3.6 billion (\$29.16 per person) and accounted for only 3.6 percent of the GNP. Health expenditures have not only risen dramatically

in the past 45 years; their growth rate has also been considerably faster than the growth rate in the GNP. If this trend continues, a rising share of the total economic output will be devoted to health care.

The same authors also note that health care prices have risen faster than the prices of all other consumer goods (services) throughout the past three decades, with the single exception of the period 1971-1974 when action by the Federal Government imposed price controls on the health care industry.

For the most part, however, government action in the area of health care was scattered and of little significance well into the post-World War II era. The first major changes in this situation came during the "Great Society" reforms of the Johnson administration when the Medicare and Medicaid programs were begun. These two programs were key elements of the Social Security Amendments passed by Congress in 1965 and set into operation in 1966; both programs represented a major shift from the private to the public sector for the payment of health care costs. Medicare was an effort to federally fund health care costs for the elderly and disabled, while Medicaid was a program of joint federal, state, and local funding for the health care of the poor. In the mid-1970s these two programs together were paying out almost \$30 billion annually in health care costs, or roughly one-fourth of all expenditures for health care in the country.

In a longitudinal perspective there can be little doubt that Medicare and Medicaid are the forerunners of a comprehensive program of national health insurance for all citizens. The more important questions concern not if such a program will be initiated, but when and what form it will take. At present there are no less than six proposed national health insurance plans, ranging in scope from coverage of catastrophic illnesses

only to total health care coverage (Current History, 1977). The most publicized of these plans has been the so-called Kennedy-Corman Health Security Act for the total health care of all Americans. Recently, however, President Carter has offered a less comprehensive alternative for Congressional consideration. The Medicare, Medicaid, and national health insurance programs are all indicative of an attitudinal groundswell in this country treating health care increasingly as a right rather than a privilege. Indeed, public opinion is clearly oriented in this direction, with a variety of national opinion polls showing one-half to two-thirds of the population favoring some form of national health insurance (Fine, 1977), and debate on the issue rampant in the health care profession itself (Sade, 1971, 1288; Page, 1975, 7; 1977, 5).

The crisis in health care costs has certainly been a key element serving as a catalyst for the investigation of other problematical aspects of the health care system. The rising costs of health care not only have affected an ever-widening and powerful segment of the population but also have encouraged an unprecedented, critical appraisal of the inequities in the health care available to Americans which heretofore had gone largely unnoticed or at least without remedy. Some of the most serious inequities were found in the distributions of health care quality, personnel, and facilities—and at virtually every system level, including national, regional, and local. Shannon and Dever (1974) offer just one of numerous works substantiating the disadvantaged status of the South, rural areas, and inner city areas on all three of these health care criteria.

HEALTH CARE IN AMERICAN CITIES

None of the geographic inequities in the American health care system is more pronounced or more deplorable than that in large cities. The locations and/or actions of hospitals and physicians in many cities result in serious barriers to health utilization by certain population segments. It is commonplace for physicians to be attracted to cities rather than rural areas; however, within the cities, physicians tend to establish practices in the suburban areas and outside of the central cities (de Vise, 1973). The locations of health care institutions and physicians are perhaps less of a problem than other discriminatory controls on their utilization which serve as impediments to the health care of certain population groups.

One of the primary means of assessing variations in health care availability is the use of a physician/population ratio. The optimal, or at least adequate, level for this ratio has been the subject of much debate, with proposed figures ranging between 118/100,000 (Pennell, 1949) and 165/100,000 (Pastore, 1945). A report by the U.S. Surgeon General ultimately recommended a figure of 132.7/100,000 (U.S. Public Health Service, 1959). Using such a physician/population ratio, Joroff and Navarro (1971) examined physician specialties and population characteristics in nearly three hundred U.S. cities. Their findings supported an earlier study by Marden (1966) showing the percent of the population over age sixty-five to be the best predictor of general practitioner numbers; however, they did not share Marden's finding that race was also a significant factor explaining general practitioner numbers. Most of the other physician specialties examined by Joroff and Navarro were found to

correspond more closely with the presence or absence of a medical school(s) and the number of available hospital beds. The findings of these latter two studies go far toward explaining inter-city variations in physician numbers and even the factors which attract physicians to more populated locations. Unfortunately, studies at such a scale belie the more serious problems of physician availability within individual cities. Given that Joroff and Navarro examined the aggregate characteristics for individual cities, it is not surprising that race, income, and education characteristics did not assume more importance as factors in physician distribution.

A more disparaging, indeed appalling, picture of intra-urban health care in America is presented by Norman (1969) writing about medical care in the ghetto. For example, Norman notes a physician/population ratio of 33.3/100,000 in the Watts and Willowbrook areas of Los Angeles (Norman, 1969, 75), and, in Chicago, only 20.6/100,000 for the East Garfield Park district and 11.0/100,000 for the Kenwood-Oakland area (Norman, 1969, 89). Chicago's health care system is further attacked by de Vise (1971, 9) who cites selective restrictions on the use of Chicago's hospitals by the city's poorer population. The significance of such shortcomings in the health care system lies not in the simple presence of such inequities but in their effect on health care quality. Shannon and Dever (1974, 61) note the increased incidence of infant mortality, tuberculosis, and deaths due to cancer of the cervix in the ghetto neighborhoods of Chicago.

The examination of spatial inequities in health care quality and the attendant causal or associative factors is a worthwhile pursuit, wellsuited to the expertise of the geographer. The balance of this chapter

presents the problem statement, rationale, and aims for the research reported on in this paper.

STATEMENT OF THE RESEARCH PROBLEM

In July of 1977 Saint Lawrence Hospital of Lansing, Michigan, was awarded a \$500,000 grant from the Robert Wood Johnson Foundation intended to "improve people's access to medical services by establishing and sponsoring primary care group medical practices" (Johnson Foundation, 1974). The 1976-1980 grant provides seed money for new group medical practices in needed geographic areas, with the new practices expected to reach economic self-sufficiency by the end of the five year period. Within the grant guidelines, the Johnson Foundation (1974) defined primary care group practices in the following terms:

> Each group will include three or more full-time physicians . . . Typically, a group will include a mix of family practitioners, internists, pediatricians, and other primary care specialists, plus a full-time administrator skilled in group practice management.

Saint Lawrence Hospital is a nonprofit, 306-bed facility located on the west side of Lansing. The core of the hospital's service area is the inner city of Lansing, although the functional service area includes parts of Ingham, Eaton, Clinton, and Ionia Counties. Maps showing this service area are presented in Chapter III.

Prior to the receipt of the grant, officials at Saint Lawrence Hospital found that more than thirty percent of those treated in the facility's emergency room had no family physician. In addition, one-half of this group required continued medical care, placing an additional burden upon the hospital's staff. It was expected that the new primary care practices, made possible through the foundation grant, would reduce

the proportion of undoctored individuals seeking emergency care at the hospital to five percent within five years. In short, the new practices were seen as a means of improving physician availability in the at-large population as well as easing demands placed upon the staff and facilities of the hospital.

Underlying these health care delivery problems and the award of the foundation grant is the continued dearth of physicians in the Ingham County area. Kantner (1974, 3) comments upon this physician shortage in the journal of the Ingham County Medical Society:

> Today there are 54 family physicians in practice as opposed to 51 five years ago. The net gain in three. In 1969. . .eight or ten more family physicians were needed. . .but twenty more would be better. . .

> Pediatricians now number ten in practice. There were eight in 1969. The 1969 estimate. . .was that four more were needed. . .

There are 22 specialists in Internal Medicine today. Five years ago there were twenty. . .in 1969 six to ten more were needed. . .

The plain facts are that supply does not yet meet the demand and probably will not for some time.

There is no doubt that the group practices established under the funding of the foundation grant will substantially augment the number of physicians in the community.

Specifically, the foundation program calls for the creation of five new group practices. One is to be located on-site at Saint Lawrence Hospital, and the remaining four to be located as needed in the hospital's service area. The grant further stipulates that the new practices are to provide 24-hour primary care, ultimately for at least 15,000 people (Johnson Foundation, 1974). The maximum utilization of the new group practices as well as the very success of the entire program depends, in a large part, upon the locations selected for each of the four outlying community practices.

The primary goal of the research described in this paper was to determine the best locations for the group practices to be established in outlying areas of the community. The performance of this task included: (1) a survey of the service area population to determine the physician demand pattern; (2) consideration of population projections for the study area which might affect the locational choices; (3) analysis of reliance upon surface transportation among the study area population; and (4) utilization of a location-allocation model to assess locational alternatives. Further discussion of the methodological details is presented in Chapter III.

A secondary aim of the study was the abstraction of geographicallybased sociomedical profiles for the populations within the service areas for each of the proposed group practices. This phase of the research examines salient characteristics of the anticipated user populations for dimensions such as age composition, mobility, and disease incidence. This information was gathered in the questionnaire survey and, following statistical analyses suggested certain characteristics of the potential users which could influence the staffing, facilities, and programs offered by each of the health care units.

Specifically, this research answers the following questions:

- (1) What is the spatial distribution of the undoctored population in the Saint Lawrence Hospital service area?
- (2) What is the role of private and public transportation among the undoctored population?
- (3) Based upon the findings for Questions (1) and (2), which locations for the group practices will provide the greatest overall accessibility for potential users, i.e. minimize aggregate travel distances?

- (4) What are the projected changes in population numbers and distribution for the service area of the Hospital?
- (5) Do the findings from Question (4) warrant a re-evaluation of the optimal locations for the proposed medical practices? If so, what is that futuristic set of locations?
- (6) What might one reasonably expect to be the allocation of users for each of the group physician practices, considering the suggested optimal locations?
- (7) What are the social and medical characteristics of the populations within the service areas of the proposed practices?
- (8) Based upon the suggested locations for the practices and their respective user allocations, are there significant allocation disparities which would give some priority order to the establishment of the practices?

To the extent which these questions are successfully resolved by the findings of the study presented in this paper, it is certain that this research will be of immediate interest and utility to the staff of Saint Lawrence Hospital directing the primary care health program and, more importantly, will contribute significantly to the future improvement of health care services available in the Lansing area.

Beyond answering these specific questions, the findings of this study will document the degree to which the population of the Lansing, Michigan area shares the problems in health care availability and accessibility noted in other U.S. cities. The following chapter, which reviews the literature pertinent to this study, will identify and define these issues in greater detail.

CHAPTER II

LITERATURE REVIEW

This second chapter is offered as a perspective on the study in the context of the geographic discipline and pertinent literature. The completed study under discussion represents a practical application of geography geared toward producing specific information and recommendations. Nonetheless, it is both customary and useful to review previous work and thought within and outside the discipline which bear upon the problem at hand. The format of the discussion here first focuses on a brief assessment of the study as geography then turns to consider published research dealing with health care demand and utilization, location-allocation models, and other locational strategies and considerations, respectively.

THE STUDY AS GEOGRAPHY

In general, the problems investigated in this study lie within the realm of social geography, an encompassing sub-unit of the discipline concerned with both individual spatial behavior and the resultant aggregate geographical patterns (Jakle, Brunn, and Roseman, 1976, xi). More precisely, the study represents the applied interface of medical and transportation geography.

The prominence of social geography today is primarily a phenomenon of the past one to two decades. During this period social geography has

come to be identified with both certain topics and certain approaches aimed toward theory building (Brunn, 1977, 15). Outside of health care issues, some recent social geography research topics have included crime (Harries, 1974), land use (Horvath, 1974), federal spending (Browning, 1973), poverty (Morrill and Wohlenberg, 1971), bank-loan redlining (Darden, 1977, 29), and urban territoriality (Ley and Cybriwsky, 1974) among others. Other promising work in social geography and oriented toward the development of new approaches has included studies of diffusion processes (Brown, 1974, 1975), migration (Roseman, 1977), cognitive structuring (Gould and White, 1974), and behavioral patterns (Cox and Golledge, 1967).

Medical geographers have pursued numerous themes in their research, however disease ecology, nutrition, and health care delivery and planning are perhaps the three best defined areas of their work (Hunter, 1973; Schiel, 1973).¹ The study dealt with in this paper clearly belongs in the latter of these categories. However, as such, health care delivery and planning have not received a great deal of attention from geographers. Shannon and Dever (1974) have produced one of the few geographical treatments of the subject, although their work is primarily intended to document some of the general areas and problems in the health care field which are suited to the geographer's expertise. At a finer scale, de Vise (1973) has produced a rather detailed accounting of inequities in the health care system of the city of Chicago. Finally, Pyle (1979) has just

¹Kaz Kawata (1973), a colleague of the noted Jacques May and an Associate Professor at the Johns Hopkins University School of Hygiene and Public Health, views medical geography as primarily concerned with epidemiology and ecology, ignoring the subject of health care delivery and planning.

published a text on applied medical geography; in the final chapter he suggests the possibilities offered by location-allocation models and automated mapping--two of the methodological techniques applied in the study reported in this paper.

In the context of this study the location-allocation analyses associated with transportation geography serve a methodological purpose, and are equally suited to a variety of such applications. In essence, the location-allocation modelling solves complex service location problems, utilizing high-speed computer technology to mathematically derive optimal or near-optimal facility locations and user assignments, as in the case of medical facilities. A more detailed treatment of the location-allocation procedures to be used here is provided in Chapter IV. Because the location-allocation methodology is dependent upon the capabilities of modern computers, its development and application is relatively new. Operations research, a technical field concerned with applied problems of public services, foreshadowed the contributions of transportation geographers in the areas of location-allocation models, linear programming, and the like. Cooper (1963) and Scott (1970, 1971) have produced three of the more comprehensive reviews of locationallocation strategies, although the scope and depth of their works only makes the literature's sparsity of reports on location-allocation applications more pronounced. Nonetheless, their reviews are useful in understanding the methodology of this study.

HEALTH CARE DEMAND AND UTILIZATION

This literature contains a variety of studies dealing with health care demand and utilization. In all fairness, far more of the published

work in this area focuses on the patient-to-hospital relationship than on the patient-to-physician (private) relationship.

It is probable that no other single city's health care system has received more study than has that of Chicago, particularly considering work done by geographers. Morrill and Earickson (1968) used factor analysis to examine a ninety-nine variable data set for Chicago area hospitals. Their analysis yielded nine dimensions or collapsed variables summarizing the health care system. The nine dimensions, in order of their statistical strength were (1) service volume; (2) service area extent; (3) visit duration and quality of care; (4) emphasis upon obstetrics and pediatrics; (5) results of recent service capacity adjustments; (6) competition; (7) service to non-whites; (8) personnel range, expenses per bed, and the proportion of public aid patients; and (9) emphasis upon elderly patients. The same study showed too that the service range (area) of the hospitals examined corresponded closely with the variety of services offered and with the number of personnel.

The principle of distance decay has been documented in the case of hospital utilization, although such decay shows considerable variation from hospital to hospital and limited sensitivity to intervening opportunities (Morrill, Earickson, and Rees, 1970, 161). Apparently, as has been suggested, the services and staff associated with each hospital play an important role in distance decay.

Several studies have suggested the paradox of cost-effectiveness through hospital consolidation and maintenance of health care accessibility. Economies of scale have been shown to reach an optimum among hospitals in the two to three-hundred bed size; smaller hospitals are economically less efficient as are most larger hospitals with complex infrastructures

(Hefty, 1969). Reduced to cost-benefit terms, the consolidation of smaller hospitals for economic reasons must be weighed against the subsequent sacrifice in user accessibility (Long and Feldstein, 1967).

Ideally, under a system stressing need-responsiveness health care delivery can be optimized. In reality, many factors diminish the responsiveness of the system. The first of these realities is the "lag time" between need recognition and need fulfillment (Earickson, 1970, 47). The intervening period between the two is necessary for the procurement of staff and funding, let alone the time necessary for planning, purchase, and construction. Secondly, a more general observation notes that health care facilities represent fixed investments which, once made, surrender any need-responsiveness mobility (Teitz, 1968, 48). Lastly, there is the simple fact that health care facilities have never been equitably distributed between the affluent and the poorer communities (Pyle, 1971, 136), although this latter situation is not necessarily indicative of a system which is not demand responsive.

Thus far, the literature discussed has been hospital-oriented, and only marginally applicable to physician services offered under other arrangements. In a more general context, Earickson (1970, 8) has identified six factors influencing the individual's spatial behavior in seeking health care: (1) the relative need for care; (2) the travel distance or travel cost involved; (3) the ability to pay for care; (4) the social characteristics of the physician or facility; (5) past experiences; and (6) the individual's current social environment. Among those travelling less than ten miles for health care, higher socioeconomic status is associated largely with care on an appointment basis while walk-in care is more prevalent among those of lower status; beyond ten miles the latter

group is inclined to schedule appointments while those of higher socioeconomic status tend to substitute telephone consultation for office visits (Weiss and Greenlick, 1970, 456). This same study also verified a tendency for those of lower status to make greater use of emergency room facilities; interestingly, however, this characteristic was attributed to the stoicism of the group toward illness rather than their lack of a family physician. Similarly, research has shown that those with higher incomes prefer the services of private physicians to those of public clinics, presumably because of their willingness to pay more in return for speedier service; the lower income group, on the other hand, appears to sacrifice time for lower cost service (Holtman, 1972, 179).

Demographic factors also influence the demand for health care services. Earickson (1970, 23) notes that the progression of individuals through the life cycle affects their health care needs. Younger, growing families accentuate the demand for pediatricians and obstetricians. The elderly are confronted by more chronic health problems, often including sight and hearing impairment (Bettinghaus and Bettinghaus, 1976, 130). Notably, however, Estes (1969) has concluded that the greatest obstacle to health maintenance among the elderly is the delivery system itself rather than actual illnesses. Overall, though, the fact that housing patterns coincide to some degree with the life cycle, as Abler, Adams, and Gould (1971) have noted, suggests the inherent utility of a geographic approach to health care service.

Racial factors also represent an important force upsetting equity in the health care system. Both Morrill, Earickson, and Rees (1970, 165) and de Vise (1971, 12) level criticism at the hospitals and health care system of Chicago for using discriminatory practices intended to selectively

control facility utilization by blacks. A more subtle but equally powerful racial influence on the health care system is the comparative lack of physicians in minority communities. It is not entirely clear whether this inequity is due directly to a racial factor, income potential, or some combinations of these and/or other considerations (Shannon and Dever, 1974, 78). Lankford (1971, 70), however, is more definitive, noting:

> The general hypothesis that physicians locate to maximize the present-value of their income stream is upheld by several studies. . .although on a percent basis the increase in physicians in poorer areas seems dramatic, on the absolute scale of physicians per capita the difference between wealthy and poor counties is still substantial.

Yet another aspect in the study of health care delivery focuses upon the user as a consumer exhibiting a particular travel behavior. Marble (1967) and others have suggested that consumer travel behavior reflects a trial and error process. Under this logic the travel behavior of the consumer is assumed to be erratic and unpredictable as behavioral alternatives are tried and assessed, perhaps unconsciously. Ultimately, one alternative emerges as the most satisfactory and the consumer's behavior then becomes conditioned or habitual. In terms of travel behavior this habitual response is predictable, reflecting established principles such as that of least effort (Zipf, 1949) and economic man (Golledge and Brown, 1967, 116). One should not over simplify travel behavior, however. Not only is a certain element of irrationality inescapable in travel behavior but there are other variables to consider. Dear (1977, 224) has examined the utilization of mental health care facilities and found: The influence of location on utilization is complex. Empirical evidence from Lancaster County, Pennsylvania, supports the notion that the location variable can be decomposed into four elements: physical distance, location as catchment, social distance, and relative location.

Also, the ability and the means of the health care consumer to determine a satisfactory response in his search are perhaps as important as his outright travel behavior. Consumers of a lower socioeconomic status have been shown to be more subjective when evaluating health care services, leading to the conclusion that health services aimed at this group should not overlook the marketing psychology associated with the intangible qualities of image, impression, and atmosphere (Rosenblatt and Suchman, 1969). On the other hand, this same population segment was found to be capable of highly objective assessments of physician quality, in substantial agreement with the physicians' evaluations of one another (Kisch and Reeder, 1969, 57).

LOCATION-ALLOCATION MODELS

In the past decade there has been a rather noticeable waning of interest in the more abstract forms of transportation analyses, including the ideas associated with graph theory, networks, and flows. Instead, there has been more concern with the humanistic, behavioral elements affecting transportation (Muller, 1975, 208; Stutz, 1976, 1; and Wheeler, 1973). Throughout this trend, however, there has been a sustained interest in location-allocation thought and application, perhaps because the techniques are still evolving, large experimental, and short of a consensus on their ultimate utility. The general aim in using location-allocation models is to determine the locations for a known number of centers which will best provide a set of known demand points or destinations with some good or service. While this task is relatively simple when locating a single supply center, the problem becomes immensely more difficult as the number of centers is increased. Geographers, mathematicians, operations researchers, and others have examined this very problem in a variety of contexts.

The pertinent literature contains reports on the application of location-allocation models to problems of fire station location (Hogg, 1968; Valinsky, 1955), public school districting and desegregation (Yeates, 1963; Hall, 1973; and Lord, 1976), day care centers (Holmes, Williams, and Brown, 1972; Brown, <u>et al</u>., 1974), industrial processing and supply centers (Kadas, 1963; Wanty, 1958; Vietorisz, 1964), and retailing centers (Lawrence and Pengilly, 1969).

A further review of the literature reveals several cases in which location models have been applied to problems in health care delivery. For example, Garrison, <u>et al.</u> (1959) employed a transportation approach when examining patient assignments to physicians, as did Godlund (1961) in a study of hospital locations in Sweden. Likewise, Gould and Leinbach (1966) have shown how one might hypothetically use a network transportation model to assess potential health clinic sites in western Guatemala. Using data from a Chicago health care study, Morrill and Kelley (1969) developed a simplistic model optimizing the number and location of health care facilities for the area based on demand thresholds and service capacity constraints. In yet another study, Abernathy and Hershey (1971) have produced a locational model for health care facilities incorporating both distance decay and demand differentials among socioeconomic strata;

however, the authors fail to indicate the source of data for such parameters in a real world application. Most recently, the same location-allocation model which was used in this study was also employed by Mulvihill (1976) to examine health clinic locations in Guatemala City. Mulvihill's study, however, differed from this research in at least three respects: first, he was forced to rely primarily upon existing facility use as a surrogate for actual demand because of problems in securing data; second, Mulvihill was more concerned with assessing existing facility locations and service provision than examining expansions in services; and, last, the status and aims for health care provision in Guatemala clearly differ greatly from those of the United States today.

OTHER LOCATIONAL STRATEGIES AND CONSIDERATIONS

It is apparent that the strategies associated with facility location and public services provision have covered the full spectrum in terms of sophistication, accuracy, and utility. Gross (1972) provides some additional thoughts on facility location planning in the health care field, and engenders mention of still other work in other disciplines.

Of legislative programs, the Hill-Burton Act of 1946 was an early governmental attempt to plan for hospital growth in response to changing population density in the post-war era. This legislative measure, however, not only failed to take into account a variety of other important population characteristics but also relied solely upon the expansion of existing hospitals to fulfill any increase in public need. Perhaps the greatest fault with the Hill-Burton strategy was the fact that it ignored the

critical issues of spatial and temporal variations in morbidity. Although the effects of the Hill-Burton Act have been significant and lingering upon the health care system, it has received more criticism than analysis from geographers who are understandably more concerned with the improved delivery of service in the horizontal (spatial) plane than in the vertical plane.

A second locational approach is based in the economic principle that service demand may at times exceed or otherwise override nearestfacility service provision, thereby "spilling over" to another, presumably nearby, center. This strategy is founded upon empirically verified patterns in consumer travel behavior associated with market service areas (Clark, 1968), as well as the desire to avoid marginal service capabilities. This type of approach has led to the development of hierarchical facility systems for fire (Teitz, 1968) and hospital (de Vise, 1966) services, although the strategy has not been without criticism when applied to urban areas where the resultant service areas are all but impossible to delineate (Cherniack and Schneider, 1967).

Descriptive methodologies have provided a less sophisticated means for assessing the locations of public service facilities. Using this approach, the spatial distributions of potential users and potential or existing facilities are graphically represented, then analyzed visually. One obvious advantage of this method is that virtually any number of ecological variables can be graphically superimposed as desired, and with particular ease where computer-generated graphics are available. This technique has been utilized both to examine hospital locations relative to patient residences (Drosness, Reed, and Lubin, 1965) and detailed morbidity characteristics (Michigan Department of Public Health, 1970).

It should be apparent that such a descriptive approach sacrifices much in terms of analytical objectivity.

It would seem from a review of the pertinent literature that the bulk of the more recent services delivery studies have been based on analytical methodologies; that is, approaches focusing upon an entire region and seeking to determine the optimum number and geographic placement of service facilities. This category of investigation, of course, would include the location-allocation studies already mentioned. Holmes, Williams, and Brown (1972) also suggest a procedure involving the generation of a demand or need surface for a service, with facilities then being located at the peaks on this modelled surface. In some cases of demand distribution such a plan would produce different results than the more commonly used aggregate-distance-minimizing model. This type of distinction has been addressed by Morrill and Symons (1977) in a statement concerning locational efficiency and equity:

> Despite problems of defining efficiency and equity, it is useful to assess the equity and efficiency implications of various optimal location strategies. Most location criteria have been efficiency oriented, and if there is area variability in density or income, or very strong returns to scale, equity may well be sacrificed.

At face value, equity in travel distance for all users would appear to be a worthwhile goal; but in the reality of a democratic and free enterprise system, aggregate distance minimization is generally deemed preferably, with the majority of the population travelling a shorter distance while a smaller segment travels further. Most analytical strategies represent some variation of the traditional cost-revenue analysis, either through the minimization of the costs incurred by the service facilities themselves or the costs borne by the users such as

their transportation costs (Davies, 1974). Also, most of the analytical approaches share the problems of defining the target population and determining the appropriate areal units to be used. Unfortunately, the literature provides all too few practical applications of these approaches and models to give a firm idea of their ultimate utility and individual assets and problems.

The technology of the computer graph plotter has also made possible the combination of descriptive and analytical techniques to produce multi-dimensional analogue models of the distribution of service demand and service facilities. This approach was employed to depict the areal distributions of both quantitative and qualitative data associated with medical care facilities in Cleveland, Ohio. The major criticism made of this methodology was its lack of capability to effectively incorporate the system-wide response resulting from a change introduced at any one facility in the system (Bashur, et al., 1970).

Another methodology, the simulation approach, focuses upon flow patterns and linkages between service facility and service user (Earickson, 1970). The utility of this strategy appears limited, however, to those situations where intermediary persons or institutions play an important role in determining the use of facilities by individuals. Private physicians in the health care system offer one example of such an intermediary role in terms of their referrals to hospitals. Very recently, White (1979, 18) has expressed great favor for more consideration of such linkages in location studies:

The concept of accessibility of service facilities to target populations is an inadequate criterion for public facility location problems, since it overemphasizes dispersed facilities as location solutions. Without consideration of interactions and linkages between services in public facility systems, the complete range of facility location patterns that can be observed in urban settings cannot be characterized. . .the criterion of facility accessibility should be considered along with the criterion of facility linkage or agglomeration in any comprehensive location analysis of public facilities.

Lastly, there is the so called sampling and evaluation strategy which focuses upon the service need among the population, rather than the service demand per se (Western New York Health Planning Council, 1970). This methodology is unique in its implications for it suggests that some recipients of a service may not be entitled to the service while others in the population who are entitled may fail to utilize the service out of ignorance, indifference, or protest. Such sampling and evaluation clearly lends itself to the critical evaluation of existing service provision and to the future expansion or modification of a service.

This chapter has reviewed some of the more prominent locational strategies and considerations for the delivery of services. Emphasis has been given to the distinctive elements of each strategy although, in practice, locational tasks would more often incorporate several of these methods in the solution process. The following chapter in this study outlines a methodology in which the products of "sampling and evaluation" are applied in an aggregate-distance-minimizing location-allocation model to determine the best locations for primary health care facilities in the Lansing, Michigan area.

CHAPTER III

STUDY METHODOLOGY

As already noted, the central theme of this study is the planned expansion of primary care health services to those in the population currently without a family physician. Recent data of sufficient detail to be used in this study were not available from existing sources. Therefore, a survey instrument and sampling design were selected to secure the necessary data. This chapter explains how these data were obtained and used, including discussions of the study areas, the sampling design, the survey instrument, and the methods of analysis.

THE STUDY AREA

The study area as defined by the intent of the research was the service area of Saint Lawrence Hospital, located in Lansing, Michigan. Administrators of the Hospital were able to delimit this service area using the results of a previous survey of the recorded addresses provided in the Hospital's patient files. This area included parts of Ingham, Eaton, Clinton, and Ionia Counties in mid-Michigan as indicated in Figure 1. While the service area defined here does not account for fully one-hundred percent of the Hospital's utilization, facility use by those from outside this area is minimal. A more exacting delineation of the Hospital's service area was not considered critical to this study since the principal concern with the study was to offer assurance that the



Figure 1
ultimate locational recommendations would be consistent with the goal of helping to alleviate over-use and misuse of the facilities and staff at Saint Lawrence Hospital.

The bulk of the study area lies within the Lansing, Michigan Standard Metropolitan Statistical Area (SMSA), a U.S. Census unit which includes Ingham, Eaton, and Clinton Counties. This three-county area is the state's second fastest growing metropolitan area, according to the Tri-County Regional Planning Commission (1973). Included in this area is Michigan State University, Oldsmobile Division of General Motors, Fisher Body Assembly Plant, Motor Wheel Corporation, and the State Government and Capitol offices, all contributing to a diverse economic base and population. The 1970 U.S. Census showed about 4 percent of the area's population to be black; persons of Spanish descent represented the second largest minority, including some 8,000 full time residents and a substantially greater number providing migrant labor in the area during the summer months. Health care services in the tri-county area are offered by roughly 450 allopathic and osteopathic physicians, 5 hospitals, and more than a dozen walk-in clinics, although not all these services are located within the study area designated in Figure 1. Also, beyond the study area boundaries in East Lansing, Michigan State University's Schools of Allopathic and Osteopathic Medicine add further to the medical resources of the area.

SAMPLING

A basic premise of this research was that unmet physician need would vary geographically, not only in proportion to the distribution of population but also along other social and economic dimensions. An areally

stratified sample survey of households in thirty-tree zones (shown in Figure 2) was designed to uncover these variations in primary care physician need.¹

In general, the sampling zones employed for stratification corresponded to township political units. However, within Lansing Township the areal extent of the zones was based upon combination of Lansing City Census Tracts.² In addition, the two other largest political units of the study area, the cities of Grand Ledge and Holt, were also treated individually in the sampling due to their population size, density, and urban character.

The selection of these sampling units was arbitrary in a sense but also reflective of a conscious effort to meet the following goals:

- to achieve regularly-shaped units where the zone centers fairly represent the geographic location of the constituent population,
- (2) to define boundaries of units to coincide with those of the U.S. Census Tracts so that the overall population numbers are known for each zone, and
- (3) to reach a compromise between units sufficiently small to disclose variations in health care and socioeconomic characteristics and yet limited in number out of practical considerations for the overall sample size.

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The boundaries referred to here were those of the 1970 U.S. Census of Population. Unfortunately, no more recent comprehensive Census figures were available at the time of the study.

Berry and Baker, writing in Berry and Marble (1968), provide a good discussion of stratified areal sampling as well as other sampling strategies commonly used in geographical work.



Within each of the zones, households were sampled in a systematic fashion. Households surveyed in Lansing and adjacent townships were selected in alphabetical order from the <u>Lansing City Directory</u> and the <u>Lansing Suburban Directory</u>; those surveyed in outlying townships were selected in the same manner from area telephone directories.³ The described sampling method was not random since not every household in each zone had an equal chance of selection; nonetheless, this method provided a practical, effective means for conducting a large-scale survey.⁴

Survey questionnaires were sent by first-class mail to selected households in each of the thirty-three zones during the months of May through August of 1978. Addressed and stamped return envelopes were included with the mailed surveys. In total, 4,074 questionnaires were sent to 3,065 different households in the study area. In some zones second mailings were necessary to bring the number of responses above thirty, a suggested number for statistical accuracy in sampling.⁵

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It has been suggested by King (1969, 68) that a sample size of thirty usually provides a sufficient number to adequately represent a population.

Specifically, these sources were: <u>Polk's Lansing City Directory</u>: <u>1977</u>, <u>Polk's Lansing Suburban Directory</u>: <u>1976</u>, <u>Lansing Area Telephone</u> <u>Directory: 1977-1978</u>, <u>Charlotte Area Telephone Directory</u>: <u>1978-1979</u>, <u>Portland Telephone Directory: 1978</u>, <u>St. Johns Telephone Directory: 1978</u>, <u>Sunfield Telephone Directory: 1976</u>, and the <u>Westphalia Telephone</u> <u>Directory: 1977</u>.

The author acknowledges the risk of bias inherent in this stratified systematic sampling method. Norcliffe (1978) has commented upon the chance of ethnic bias when surnames are used in an alphabetical sampling. In the sampling for this study each surname was used only once per sampling zone. This latter measure was expected to minimize the risk of ethnic bias and, especially for the rural areas, prevented the surveying of related households which would likely share similar health care characteristics. Also, the use of telephone directories creates an additional bias since not all households have telephone service and, among those that do, some are unlisted.

Among all the thirty-three zones 1,326 usable questionnaires were returned, representing 43.3 percent of the sampled households and 32.6 percent of all questionnaires sent. Response rates for the individual zones are shown in Table 1. A total of 4,045 persons were reported as family or household members among all the households returning questionnaires. Comparing this figure with the 112,679 persons reported in the study area in the 1970 U.S. Census, the computed sampling fraction for the survey was 3.59 percent. Among the individual sampling zones this fraction varied between 0.59 percent and 13.20 percent, primarily because of substantial variations in the base populations for the various zones.

As a simple check on the quality of the sampling, the tabulated survey results on the questions of household size and age composition were compared with figures from the 1970 U.S. Census (1972) for all households in the Lansing, Michigan SMSA. On these items, the U.S. Census reported 6.9 percent of the population to be age sixty-five or older, 35.0 percent to be under age eighteen, and the average household to include 3.2 persons. In the survey conducted for this study, 9.2 percent of the population were reported to be age sixty-five or older, 35.3 percent were noted in the under age eighteen category, and, on the average, the surveyed households included 3.1 persons. While the 1970 U.S. Census for the Lansing, Michigan SMSA and the study survey are not identical in their geographic coverage or time frame, nonetheless, the relative similarities of the two data sets on these three items suggest that the survey sample reflects an acceptable cross-section of the study area population.

TABLE 1

QUESTIONNAIRE	RESPONSE	RATES	BY	ZONE	
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	Usable	For Hou	seholds	Overal1	l Total
	Number	Number	Percent	Number	Percent
Zone	Returned	Sampled	Returned	Sent	Returned
1	45	99	45.4	166	27.1
2	43	99	43.4	179	24.0
3	38	99	38.4	135	28.2
4	41	99	41.4	143	28.7
5	39	119	32.8	119	32.8
6	39	120	32.5	121	32.2
7	41	99	41.4	99	41.4
8	44	99	44.4	99	44.4
9	42	99	42.4	99	42.4
10	39	85	45.9	105	37.1
11	42	97 .	43.3	132	31.8
12	48	89	53.9	151	31.8
13	46	99	46.5	99	46.5
14	36	99	36.4	109	33.0
15	38	75	50.7	85	44.7
16	38	75	50.7	106	35.9
17	37	85	43.5	141	26.2
18	37	82	45.1	127	29.1
19	37	99	37.4	174	21.3
20	42	85	49.4	111	37.8
21	40	99	40.4	143	28.0
22	36	· 99	36.4	150	24.0
23	37	85	43.5	132	28.0
24	37	75	49.3	80	46.3
25	36	85	42.4	133	27.1
26	40	75	53.3	117	34.2
27	41	75	54.7	120	34.2
28	39	99	39.4	144	27.1
29	49	99	49.5	105	46.7
30	38	99	38.4	159	23.9
31	39	99	39.4	99	39.4
32	44	99	44.4	107	41.1
33	38	75	50.7	85	44.7
Avg./ Total	1326	3065	43.3	4074	32.6

Note: Overall total figures include instances where second mailings were made to some households to augment the response rate.

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THE SURVEY INSTRUMENT

The survey instrument included sixty-eight items to be answered by each household included in the survey. The items addressed household characteristics in six categories: (1) overall opinions toward existing health care, (2) health care utilization and transportation, (3) problems encountered in seeking health care, (4) interest in ancillary health programs, (5) specific health problems, and (6) household socioeconomic characteristics. The format of the questionnaire and wording of the individual items can be seen in the Appendix A.

The content of the questionnaire was developed in collaboration with officials of Saint Lawrence Hospital. The group of items dealing with specific health problems was based upon a medical survey developed and used by the University of Illinois Medical School at Rockford.

Prior to use, the questionnaire and survey procedures used in this study were reviewed and approved by the Michigan State University Committee for Research Involving Human Subjects.⁶ Appendix B contains copies of the materials submitted to the Committee as well as the approval notice.

POPULATION PROJECTIONS

Population estimates and projections were sought for the study area in order to assess the locational impact of ongoing and future

⁶It is the purpose of this Committee to protect the rights and welfare of human subjects involved in research. On survey-based research special attention is given to the matters of informed consent and protection of anonymity.

population shifts on unmet physician need.⁷ In recent years there has been increasing attention given to the development of methods for population projections for small areal units similar to the sampling zones employed in this study. Yet despite this effort considerable variation has been noted in the quality and means of projection (Irwin, 1977, 11).

Among the most commonly used methods of projecting future populations are those based on mathematical extrapolations, ratios, cohort-components, and economic factors.⁸ Mathematical extrapolation is perhaps the simplest technique, with a projected population figure extrapolated from some form of mathematical curve. Using a ratio method, the populations of the areal units are considered as ratios of a larger unit for which a projection already exists; the temporal trend of the ratios is projected into the future and multiplied by the projection for the larger unit. The cohort-component approach deals directly with only natural change, examining the successive experiences of population subgroups as they age over time. Economic based methods are used primarily to predict migration; they rely on the proven associations between population change and economic factors such as unemployment,

⁷Estimates are distinguished from projections, where: an estimate is a population figure representing some date in the past arrived at by carrying forward the immediately preceding census count using statistics for elements related to population change, and, a projection is a figure for a future date obtained by carrying forward assumed trends without modification of the projected numbers once the assumptions are defined and established (Irwin, 1977, 82-84).

Irwin (1977) has provided an excellent explanation and review of many prevalent population projection methods suited to local areas in a technical paper published by the U.S. Bureau of the Census.

wages, labor force size, and distance (Lowry, 1966). Depending upon the need or circumstances it is common for some combination of the above-mentioned strategies to be used.

In this study the population estimates and projections for the study area zones were based upon the data supplied by three sources. First, the Tri-County Regional Planning Commission provided projections from a cohort-component analysis for civil divisions in Ingham, Eaton, and Clinton Counties. Projections for the study zones in Ionia County were secured from the West Michigan Regional Planning Commission. These latter figures were based on a vaguely defined interpretation of building construction and other growth rate factors.

Upon inspection, the population numbers projected by both planning agencies appeared to be overly optimistic of future growth when compared with recent Census report updates specially issued for scattered areas. As a further check, comparable projections were obtained from the Office of Management and Budget for the State of Michigan. This set of figures too, based on a regression model, showed considerable contrast with those provided by the planners. Apparently the regression model used by the OMB had no capability for dynamically evaluating the impact of density changes, instead simply projecting the continued growth of growing areas and the continued decline of declining areas ad infinitum.

Ultimately it was decided that the projected populations for the study area zones would be most fairly represented by the average of

the figures provided by the State OMB and the regional planners.⁹ The resultant population projections figures associated with each of the thirty-three study zones for the years 1976, 1980, and 1990 are shown in Table 2.

This chapter has focused on the methodology for the study, with special emphasis given to the mail-out survey which provided the principal source of data for the investigation. Other discussions included the definition of the study area and an explanation of the population projections used in the analyses. The following chapter shifts attention to the location-allocation procedures, beginning first with a brief explanation of the technique itself and followed by the presentation of the findings when the approach was used in this study.

⁹Figures for the year 1976 are considered as projections here since, with but a few exceptions, no population census has been taken in any of the study zones after 1970. Projections for study zones 16 through 27, located in the city of Lansing, were determined using the ratio method with each zone's fraction of the 1970 population applied to the averaged projection for the city as a whole. Also, there was a concern expressed by the State of Michigan OMB that their projections not be disclosed due to the sensitivity of the revenue-sharing issue among local civil divisions.

TABLE	2
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	Census	Avera	ged Projecti	on For	-
Zone	1970	1976	1980	1990	
1	2,882	3,134	3,279	3,717	-
2	2,182	2.316	2,338	2,502	
3	5,532	6,183	6,607	7,648	
4	2,139	2,232	2,323	2,609	
5	1,222	1,281	1,275	1,347	
6	1,907	2,101	2,179	2,521	
7	1,621	1,744	1,935	2,259	
8	1,594	1,780	1,849	2,126	
9	3,146	3,599	3,871	4,814	
10	11,738	12,756	13,415	16,300	
11	1,710	1,940	2,091	2,492	
12	1,671	1,723	1,738	1,798	
13	2,632	2,885	3,059	3,510	
14	6,032	7,048	7,633	9,168	
15	18,588	21,890	24,019	30,500	
16	5,815	5,828	5,767	5,623	
17	5,670	5,683	5,623	5,483	
18	12,302	12,330	12,200	11,896	
19	11,125	11,151	11,033	10,758	
20	13,171	13,201	13,062	12,736	
21	7,186	7,202	7,126	6,948	
22	16,052	16,089	15,919	15,522	
23	12,271	12,299	12,169	11,865	
24	7,794	7,812	7,729	7,537	
25	9,629	9,650	9,549	9,311	
26	13,951	13,983	13,835	13,490	
27	12,944	12,973	12,836	12,516	
28	1,734	1,885	1,966	2,205	
29	1,205	1,172	1,110	97 9	
30	3,034	3,565	3,901	4,808	
31	4,483	5,319	5,838	7,282	
32	19,176	21,419	22,921	27,730	
33	6,980	7,504	7,833	9,080	

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PROJECTED POPULATIONS FOR STUDY AREA ZONES

Sources: 1970 figures are from the 1970 U.S. Census of Population and Housing; projections for 1976, 1980, and 1990 are derived from figures provided by the Office of Management and Budget for the State of Michigan, the West Michigan Regional Planning Agency, and the Tri-County Regional Planning Agency.

CHAPTER IV

THE LOCATION-ALLOCATION ANALYSES

This chapter presents the first of the analytical findings associated with the study. The discussion begins with an explanation of the location-allocation technique. Subsequent attention is directed to the spatial pattern of persons without physicians as reported in the study area. Later, results are provided and discussed from the application of the location-allocation routine to the physician demand pattern in the study area. The chapter closes with an investigation of the potential impact of anticipated future population shifts on physician locations and user allocations.

LOCATION-ALLOCATION ROUTINES

Location-allocation routines are symbolic models designed to solve problems where the objective is to determine the location, number, and size of centers which will best supply a known set of destinations with some good or service (Cooper, 1963). The usual objective in locationallocation problems is the minimization of aggregate distance separating supply centers and weighted demand points. Other objectives can also be served by placing constraints on maximum allowable travel distances or the capacities of the supply centers.

Among location-allocation models there are three characteristics which merit comment. First, problems suited to the use of locationallocation models are subdivided into those treating locations on a continuous surface and those restricted to a finite set of locations on a network. The problem addressed in this study belongs in the former category due to the continuity of the demand surface and the relative freedom of choice for potential facility locations.

A second distinction exists between exact solution and heuristic algorithms. Exact solutions, by nature, require a systematic examination of every possible combinatorial set of sources and destinations. Heuristic algorithms, on the other hand, examine only a subset of the potential combinations, and may or may not yield the locational solution which is truly optimal. Thus exact solutions are economical only for relatively small problems. Most problems of consequence, including that dealt with in this study, presuppose a heuristic approach.

Finally, the objective sought in the application of the locationallocation algorithm represents an implicit motive. In most instances, aggregate distance minimization represents a societal goal serving the public sector.¹⁰ The imposition of constraints on travel distance or facility capacity can accentuate private sector goals, as can the manipulation of demand weights. In this study the choice of aggregate distance minimization is consistent with both central planning goals and the objectives of Saint Lawrence Hospital.

¹⁰

Scott (1970, 96) cites aggregate distance minimization as a common goal of central planning where overall equity is of prime importance.

THE LAP AND MULTI ALGORITHMS

The two location-allocation algorithms used in this study, LAP and MULTI, were programmed by Michael Goodchild and Lawrence Ostresh, respectively.¹¹

LAP is a heuristic program which alternates between locating sources and allocating demand points. The algorithm searches for a stable condition in which all destinations are assigned to their nearest source and these sources are similarly positioned at locations minimizing their distances from their respective demand points. With most data sets or patterns of demand this solution stability is attainable under more than a single location configuration. Therefore, while it is possible that the algorithm may yield a truly optimal solution, there is no certainty of this result.

MULTI is an algorithm which produces an exact, or guaranteed optimal, solution. Operationally, the program executes an ordered examination of potential solutions where branching and bounding within the combinatorial solution set efficiently limit the search to feasible solutions.

Originally it was intended in this study that LAP serve as the sole algorithm to determine locations and allocations. However, some precautionary experimentation with LAP's initial (starting) location configuration indicated that the algorithm was not iterating to or near the desired optimum. In other words, manipulation of the algorithm's starting set of locations consistently improved upon the aggregate

¹¹ The code and documentation for LAP, MULTI, and other algorithms are provided in the monograph <u>Computer Programs for Location-Allocation</u> <u>Problems</u> (1973), edited by Rushton, Goodchild, and Ostresh.

distance obtained with the final solution. To circumvent a more exhaustive set of trials with the LAP routine, the same data were analyzed using the exact solution algorithm of MULTI. Although the MULTI routine was unable to run to completion because of the data set size, it did produce an intermediate solution superior to those previously obtained with the LAP heuristic.¹² At this point the intermediate solution from MULTI was used as input to the heuristic. After several iterations based on this input the LAP algorithm reached a stable assignment of locations and allocations presumed to be optimal or near optimal.¹³ This same solution strategy, combining both the LAP and MULTI algorithms. was employed in all the subsequent locationallocation analyses performed in the study.

PHYSICIAN DEMAND

The spatial pattern of persons in the study area's population unserved by a physician was determined from the responses to the survey questions concerning household population and association with a family physician. Within each sampling zone the proportional incidence of household members with a negative or uncertain response regarding their

¹² It is possible that a final, optimal solution could have been obtained using MULTI, although at great expense. Solution complexity in such problems compounds rapidly as both demand points and supply centers are increased in numbers; problems involving more than perhaps twenty demand points and four centers are too complex for exact solution. In this case, an exact solution was not sought because of cost and because the MULTI algorithm lacks LAP's capability of dealing with fixed location sources (i.e. the Saint Lawrence Hospital facility).

¹³ For discussion purposes the locations and allocations obtained in this manner will be considered as "optimal" throughout the remainder of the study. The author acknowledges that this quality cannot be verified.

affiliation with a family doctor was considered to be representative of the zone's entire population.¹⁴

The resultant pattern of physician demand among the thirty-three zones of the study area is shown in Figure 3 and detailed in Table 3.¹⁵ It should be noted here that Figure 3 and all other choropleth maps produced in this study are based on an interval scheme devised by Jenks (1977) and designed to maximize between-class differences and minimize within-class contrast.¹⁶ Across the study area the highest incidence of persons without a physician was reported for zones in the city of Lansing, especially in the central city area where more than one-fourth of the population noted no family doctor. However, there are striking variations in this pattern within the city of Lansing, perhaps indicative of underlying social, economic, or racial factors. In the outlying, rural townships of the study area the reported proportion of those in the population unserved by a family physician was lower, typically less than ten percent.

¹⁵ Again for the purposes of this study, the lack of a family doctor is equated with physician demand. One might content, however, that some portion of the population, voluntarily or involuntarily, will always remain outside the health care of doctors.

¹⁶ Under this mapping system observation frequencies vary from class to class, as do the interval ranges among the various classes. In some instances where the data are skewed, such as in the highest class depicted in Figure 3, this system produces an individual class which contains a single observation unit.

¹⁴ It was presumed that households uncertain of their association with a family physician probably had not recently utilized such services. Since many doctors today periodically take on new patients to replace inactive cases, respondents in this group were interpreted as lacking a family physician. It might be noted that this category of uncertainty was indicated by only fourteen of the 1324 households responding to the question on the survey.



Figure 3

Zone	Percent W/O Physician	Sample Size
1	0.0	134
2	6.2	162
3	4.0	101
4	16.5	139
5	5.2	135
6	8.8	114
7	5.4 `	149
8	1.8	163
9	4.2	143
10	12.6	111
11	7.6	118
12	0.0	150
13	3.6	167
14	7.4	95
15	4.5	133
16	13.8	109
17	17.0	100
18	8.0	100
19	26.9	78
20	16.8	131
21	27.9	68
22	18.9	95
23	34.3	105
24	2.7	111
25	16.3	129
26	16.5	97
27	3.0	99
28	5.6	125
29	7.5	159
30	4.1	122
31	4.2	119
32	6.5	154
33	13.8	130

TABLE 3

PERCENT OF POPULATION LACKING A PHYSICIAN BY STUDY AREA ZONE

Before applying the location-allocation models, the appropriate demand weights and locations were determined as well as the characteristics of the sources to be located. For each zone, demand weights attributed to zone centers were calculated by multiplying the fractional incidence of undoctored persons by the projected population count.¹⁷ Based on the demand across the study area, the location-allocation algorithm was programmed to determine the optimum locations and allocations for five centers, with one of the centers at a fixed location representing the existing facility at Saint Lawrence Hospital. No constraints were placed on the capacities of any of the five sources.

LOCATION-ALLOCATION FINDINGS

The optimal facility locations and associated user allocations for five centers are shown in Figure 4. Two of the centers, including the facility at Saint Lawrence Hospital, are located within the city of Lansing. A third center is located in Delhi Township, and the two remaining centers are in Danby and Dallas Townships.

The concentration of facilities in Lansing and adjacent Delhi Township is the result of two factors. First, the highest rates of persons in the population without a family physician were reported in the Lansing urban area. Second, the higher population density associated with this same portion of the study area also increased the resultant demand weights. This uneven pattern of demand is reinforced by Table 4 which shows the potential demand or utilization for each of the five centers.

¹⁷ There is an implicit assumption made here that the distribution of population in the study area has not changed significantly since 1976, the most recent year for which population estimates are available.



Figure 4

TABLE 4

POTENTIAL USERS AND MEAN TRAVEL DISTANCES FOR FACILITIES

UNDER FIVE-CENTER AND FOUR-CENTER SERVICE PROVISION

Five Centers			rs		Four Centers			
Cer	iter Location	Potenti Number	al Users Percent	Mean Travel	Center Location Number Percent	Mean Travel		
1.	Saint Lawrence	13,430	45.7	2.30	1. Saint Lawrence 12,910 44.0	2.04		
2.	South Lansing	11,740	40.0	1.15	2. South Lansing 7,860 26.8	0.67		
3.	Delhi Township	2,797	9.5	1.56	3. Delhi Township 6,677 22.7	2.23		
4.	Danby Township	1,254	4.3	7.87	4. Eagle Township 1,921 6.5	7.90		
5.	Dallas Township	145	0.5	0.00				

Note: Mean travel distance is in miles.

It would be unrealistic to expect full utilization of the facilities from among the undoctored group; nonetheless the figures do offer some index of each center's possible utilization and are particularly meaningful in comparison with one another. Clearly the bulk of the demand is associated with the centers at Saint Lawrence Hospital and in south Lansing. These two centers alone would theoretically serve 85.7 percent of the total demand in the study area. One conclusion to be drawn from this finding would be that the existing primary care facility at the fixed Saint Lawrence Hospital location in fact is located rather favorably to serve those persons without physicians.¹⁸ A less positive point, however, concerns the Dallas Township center which, by these estimates, would serve only a trivial one-half percent of the total demand. One can surmise that such a low demand level would fail to sustain a viable operation.

ALTERNATIVE NUMBERS OF FACILITIES

The latter finding, that is, the low potential utilization of the Dallas Township center, raised the issue of whether five centers indeed were necessary to best serve physician demand in the study area. This prompted an examination of other alternatives using fewer service centers. Figures 5, 6, and 7 show the optimum center locations and demand allocations as the number of service-providing facilities is reduced to four, three, and two, respectively.

¹⁸ There is, however, another less beneficent interpretation possible here. Since primary care health services have been available through the Hospital facility for some time, one could argue that the program has failed to reach many of the undoctored in the population, even among those residing near the Hospital itself.

FOUR-CENTER LOCATIONS/ALLOCATIONS FOR PHYSICIANS, LANSING AREA, 1976 5 MILES BASED ON DISTANCE MINIMIZING MODEL



Figure 6



Under the four-center scheme the Dallas Township center disappears and the Danby Township center shifts eastward into Eagle Township; the locations of the other three centers remain essentially the same as before in Lansing and Delhi Townships.

When the number of centers is reduced to three, the optimal locations are just beyond Lansing in Delhi Township and at the border between Danby and Portland Townships. The third center remains at Saint Lawrence Hospital, of course.

Optimum service facility locations under a two-center system include a position near the juncture of Delhi, Windsor, Delta, and Lansing Townships, as well as the stationary Hospital location.

Earlier, an apparent inadequacy was noted in the five-center solution in which one center, located in Dallas Township, served but two townships and a scant 145 potential users now without a doctor. However, alternatives using fewer service centers were shown to improve the viability of the respective centers through more equitable allocations. Further support for an alternative service plan using fewer than five centers is offered by the aggregate travel distance measures.¹⁹

Table 5 shows the aggregate distance or user-miles associated with optimal systems based on five, four, three, and two service centers. Compared with the aggregate distance value of 58,622 miles for the fivecenter plan, one notes that the reduction of service to four centers increases this travel mileage by 5.2 percent, while further reductions in the number of facilities to three and two yield much sharper increases of 21.0 and 44.6 percent, respectively.

¹⁹ The aggregate distance or user-miles measure represents the total mileage incurred if each center received one visit from all its respective allocatees. The actual aggregate distance value has little value in itself but is useful for comparative purposes such as illustrated here.

TABLE 5

AGGREGATE DISTANCES OR USER MILES

INCURRED UNDER DIFFERENT NUMBERS OF SERVICE CENTERS

Number of Aggregate Centers Distance		Percent Change
5	58,622	· · · · · · · · · · · · · · · · · · ·
4	61,671	+ 5.2
3	70,932	+ 21.0
2	84,755	+ 44.6

Another distance value to be considered here is the mean travel distance for the potential users allocated to each of the proposed facilities.²⁰ A reference to Table 4 shows that under both the fivecenter and the four-center plans there is very little difference in the average travel distances for the potential users of each of the centers. In either case, users of the centers in and near Lansing typically would travel less than two miles, while those residing in the rural, western townships of the study area would travel almost eight miles on the average for service.

One final point favoring the four-center plan concerns the equity of the demand or potential utilization associated with each of the facilities. Referring again to Table 4, it can be seen that the fourcenter plan, as compared to the five-center scheme, allocates a greater proportion of the users to the Delhi and Eagle Township facilities at the expense of the center in south Lansing. Presumably such an improvement in utilization equity would constitute a desirable goal in the interest of achieving economically viable facilities.

THE FOUR-CENTER SERVICE PLAN

On the bases of the preceding location-allocation analyses and findings it would seem that the four-facility plan might well be preferable to a five-center system. This conclusion is supported by the following reasoning.

Using the optimal location model for five centers, the resultant user allocations cast doubt upon the economic and functional viability

²⁰ Again one should bear in mind that these values are generalized in the sense that each zone's demand is attributed to the zone center, regardless of any internal population distribution variations.

of the Dallas Township center, barring the possibility of significant incidental utilization coming from adjacent territory beyond the present study area. In any event, the scant number of potential users from Dallas and Lyons Townships would have little impact on overall physician care among those living in the service area of Saint Lawrence Hospital. Also the four-center option would not increase greatly the distances that most users would travel to obtain service, either in the aggregate overall or among the individual centers. Furthermore, aside from the Saint Lawrence facility, greater equity in demand allocations to the other centers under the four-center plan would presumably enhance the competitive viability of the centers. Lastly, the four-center plan would free additional resources to develop the four centers with higher anticipated utilization levels and/or investigate other service alternatives.²¹

Another alternative worthy of consideration would be a mobile physician unit capable of delivering local health care in the outlying western townships of the study area. Service demand in these areas is scattered and travel distances to the physician are otherwise significantly greater.

THE IMPACT OF PROJECTED POPULATION CHANGES

In the spirit of long range planning, the location-allocation analyses were broadened to include the impact of future trends in the population of the study area. Using the same procedure employed in

²¹ The four-center plan will form the basis for much of the discussion in later chapters. Hereafter, the service centers derived under this plan will be identified by their locations, i.e. Saint Lawrence Hospital, South Lansing, Delhi Township, and Eagle Township.

the preceding location-allocation analyses, the four and five-center plans were examined with the demand weights of the zones adjusted to represent the projected populations of the thirty-three study zones for the years 1980 and 1990.²²

Neither the 1980 nor the 1990 population projections yielded any significant change in the allocations of potential users for the fourcenter or the five-center plans. Under both schemes the new demand projections did produce some minor shifts in the optimal locations for certain facilities as indicated in Tables 6 and 7.

For the four-center plan, anticipated population changes through 1990 shifted the optimal locations for two of the centers. The Delhi Township facility was moved to the south approximately one-half mile and to the west negligibly. The Eagle Township center similarly shifted south about one-third mile and just slightly to the east.

Under the five-center system the lone facility shift was associated with the Danby Township unit which was moved roughly one-fifth mile west and very slightly to the north based on the 1990 projections.

In summation, this chapter has not only presented evidence favoring a four-center service alternative over the planned five-facility plan but also shown that the expected locational changes in the population of the study area through 1990 result in only minor shifts in the optimal locations of facilities under either of the two plans. The following chapter turns to a discussion of the population characteristics determined from the questionnaire survey and based, in part, on the allocations to proposed facilities presented in this chapter.

²² The population projections used here were described in detail in Chapter III. It was assumed that the existing proportions of zone populations lacking physicians would not vary during the projections periods.

TABLE 6

LOCATIONAL CHANGES FOR FOUR FACILITIES

UNDER POPULATION PROJECTIONS FOR 1980 AND 1990

		Location	al Coord	inates :	for Year	•	
Center	19	1976		1980		1990	
Saint Lawrence	25.73	10.12		(no cl	hange)		
South Lansing	26.24	8.58		(no cl	hange)		
Delhi Township	25.56	6.57	25.52	6.44	25.50	6.04	
Eagle Township	13.87	14.73	13.91	14.41	13.97	14.37	

Note: Coordinates are in x and y mileage units from an arbitrarily defined zero point; positive changes in the coordinates can be interpreted as shifts to the east on the x axis and to the north on the y axis, while negative changes reflect shifts to the west on the x axis and to the south on the y axis.

TABLE 7

LOCATIONAL CHANGES FOR FIVE FACILITIES

UNDER POPULATION PROJECTIONS FOR 1980 AND 1990

Center	19	Location 76	al Coordinates 1980	for Year 1990
Saint Lawrence	25.73	10.12	(no c	hange)
South Lansing	26.24	8.58	(no c	hange)
Delhi Township	26.24	3.09	(no c	hange)
Danby Township	11.70	17.83	11.58 17.82	11.50 17.91
Dallas Township	9.09	27.03	(no c	hange)

Note: Refer to Table 6 for explanation of coordinate values.

CHAPTER V

CHARACTERISTICS OF FACILITY USERS

This chapter continues the presentation of findings from the study with attention directed to the characteristics associated with the surveyed households and the potential users of the physician facilities. The discussion is intended to draw attention to certain characteristics of the potential user population which might influence the staffing, facilities, and other planning for each of the centers. In addition, the findings here are expected to help define the target population of undoctored households and to assist in a better understanding of the factors underlying the physician to family relationship.

The discussions encompass six broad areas: (1) general attitudes towards health care, (2) utilization and transportation, (3) problems in seeking health care, (4) interest in ancillary health programs, (5) specific health problems, and (6) socioeconomic characteristics. In general, responses to questions in these areas are examined within and among groups representing all the surveyed households, households with and without a family doctor, and the households allocated to each of the four proposed physician facilities.

In this latter group, that is, those allocated to each of the proposed facilities, respondents were segregated on the basis of their linkage with the four facilities described in the preceding chapter since this partitioning was judged to be superior overall to that of the fivecenter plan. These four groups included all respondents in each of the

respective proposed service areas, regardless of whether or not the respondents reported current affiliation with a family physician. Both the doctored and undoctored were included here not only to augment the sample size but also because one would reasonably expect that the utilization of physician services at new locations would not be restricted to only those in the population currently without a physician.

The findings described in this chapter are based on a crosstabulation of the information obtained in the previously discussed mail survey of households in the study area. These survey data were primarily at the nominal and ordinal levels of measurement. As a result of these restrictive data measurement levels, the chi-square statistic was used to evaluate relationships among the crosstabulated variables.

CHI-SQUARE

Chi-square is a test of statistical significance suited to nominal or higher level data measurements.²³ It indicates, for any desired confidence level, whether two variables share a systematic relationship. However, chi-square does not indicate the strength of any apparent relationship among variables. Functionally, the chi-square statistic represents a comparison between the observed and the expected cell frequencies for crosstabulated variables, based on the formula:

²³ Throughout this study, computation of the chi-square statistics were performed using the computer programming available in the <u>Statistical</u> <u>Package for the Social Sciences</u> or SPSS, edited by Nie, <u>et al.</u> (1975). The chi-square statistic is discussed in most texts for introductory level statistics; those unfamiliar with chi-square may wish to consult Blalock (1972, 276), Harnett (1972, 436), Taylor (1977, 108), or Norcliffe (1977, 92).

$$x^{2} = E_{i} \frac{\left(f_{o}^{i} - \left(\frac{c_{i} r_{i}}{N}\right)\right)^{2}}{\frac{c_{i} r_{i}}{N}}$$

where: f_0^{i} is the observed frequency in each cell, c_i is the summed frequency of each column, r_i is the summed frequency for each row, and N is the total number of cases.

The magnitude of the chi-square statistic is indicative of the difference between the observed and expected cell frequencies. Larger chi-square values are less likely to occur by chance and intuitively suggest a systematic relationship between the variables. In short, chi-square provides a useful means of determining whether or not an association exists between two variables.

GENERAL ATTITUDES TOWARD HEALTH CARE

The surveyed households were asked three questions dealing with general health care attitudes. These items questioned their overall rating of the U.S. health care system, their disposition toward a national health insurance program, and their interest in health maintenance organizations which are of growing popularity across the nation.²⁴

²⁴ Originally these three items were intended simply to serve as an introductory vehicle for the survey instrument. It was thought that such non-personal, opinion-type questions would promote respondent confidence and encourage completion of the full questionnaire. Upon tabulation, the responses to these questions seemed to merit comment along with the main body of questions.

Table 8 summarizes the responses to these questions among the various groups examined.

Among the entire group of survey respondents, one-third gave the U.S. health system better than average marks, while roughly one-fifth gave a rating of less than average. Those without a family doctor, however, were more critical of the system. Here 36 percent gave a subaverage mark versus 26 percent expressing positive evaluation. Among the four different facility-based zones, the households allocated to Facility Two in south Lansing were the only group with a predominantly negative assessment of the overall health care system. This is at least partially explained by Figure 5 which confirms the fact that the South Lansing facility is at a location squarely in the midst of the greatest concentration of undoctored households.

Opinions toward a program of national health insurance were rather evenly split among all the surveyed households. About one-third expressed favor, opposition, and uncertainty, respectively. Such a program was received with greater favor, however, among the undoctored households where about 44 percent said "yes" to national health insurance. Geographically, the greatest support for health insurance came from among the allocatees to Facilities Two and Three in south Lansing and Delhi Township where roughly 40 percent of the surveyed households were in favor of such a program.

Household interest in becoming part of a health maintenance organization was again rather evenly divided among the entire sampled population. Surprisingly, more than one-fourth of the households responded with a "yes" to this question. Because of the question's implicit commitment, one might have expected more guarded and defensive
TABLE 8

	Response	A11	With & W/O Doctor			Service Facility		
Question	Category	Respondents	With	Without	1	2	3	4
Overall Rating of U.S.	above avg.	33.0	33.8	25.9	34.5	28.8	34.2	32.4
Health System?	below avg.	20.8	19.1	35.6	20.6	31.0	21.0	18.1
National Health	favor	33.0	31.7	43.9	33.6	41.7	38.6	27.6
Insurance Opinion?	oppose	34.2	35.6	23.0	33.3	32.5	30.5	36.9
Interest in Health	yes	27.1	25.3	42.3	27.9	34.7	31.9	22.3
Maintenance Organization?	no	28.6	30.1	16.1	31.6	26.5	22.3	29.8

RESPONSE PERCENTAGES ON SURVEY ITEMS CONCERNING GENERAL HEALTH CARE

Note: Response rates for neutral or median categories are not shown here although they were used in the chi-square tests for significance. Any figures in parenthesis did not have statistical significance at the .05 confidence level.

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negative responses. The greatest affirmation on the HMO question was among the respondents without a family doctor. In this group 42 percent expressed positive interest and only 16 percent of the households indicated that they would prefer not to become part of such a program. Positive answers to this item also outweighed negatives among households associated with the facilities proposed for south Lansing and Delhi Township. Support from households in these areas may also be a reflection of both the areas' high proportions of undoctored households and their familiarity with the health maintenance organization currently operating in the south Lansing area.²⁵

Overall, the responses to these questions dealing with general health care showed that the families without a physician also registered the greatest dissatisfaction with the total health care system as well as the greatest interest in both a program of national health insurance and membership in a health maintenance organization. Geographically, this pattern was most characteristic of households located in south Lansing and associated with proposed Facility Two.

UTILIZATION AND TRANSPORTATION

Six questions dealing with health care utilization and transportation were posed to the surveyed households. Specifically, these questions from the survey were the following:

²⁵ Health Central is an HMO which has been operating in the Lansing area since December of 1977. It has grown rapidly and currently serves some 22,000 enrollees with a staff of about 200. The bulk of its enrollment is made through various employers in the mid-Michigan area, according to Hugh, Hufnagel, Marketing Director for Health Central.

- (1) How far from your residence is your doctor's office or, if you have no doctor, what distance would you consider reasonable to travel to a doctor?
- (2) How many persons in your household require some type of special transportation assistance in getting to the doctor's office?
- (3) What mode of transportation do or would you normally use in getting to the doctor's office?
- (4) Would you use the public bus system to get to the doctor's office if the office were near a bus stop?
- (5) How many total times in the past year have those in your household used the emergency room of a hospital?
- (6) What hours of the day or night would your household generally find the most convenient for visits to the doctor, if the doctor's office was open 24 hours a day?

A summary of the responses to these questions is presented in Table 9.

In terms of travel distance to the doctor, perhaps the most interesting finding was that 28 percent of those with a family doctor reported travelling a distance in excess of ten miles. Expected travel distances among those without a family physician were generally less, with only one-fifth of this group anticipating a travel distance over ten miles. Among the groups allocated to the four proposed centers, the actual or expected travel distances were less for the households linked to the urban-based Facilities One and Two in Lansing, somewhat higher for the suburban Delhi Township facility, and greatest for the anticipated users of the rural Eagle Township center.

The need for special transportation assistance did not vary greatly among the groups examined. Considering all the surveyed households, 5 percent reported one or more member needing such assistance. Among the doctored group this figure was 5 percent, versus 6 percent for the undoctored households. The differences among the various facility-based groups were not statistically significant at the .05 level.

	Response	A11	With & W/O Doctor			Service Facility			
Question	Category	Respondents	With	Without	1	2	3	4	
Distance from Residence	0-3 miles	32.5	32.3	33.7	38.2	56.7	24.9	25.7	
to the Doctor?	3-10 miles	40.0	39.4	46.4	42.8	34.2	52.5	34.3	
	10+ miles	27.5	28.3	19.8	19.0	8.9	23.5	40.0	
Use of Hospital Emergency	none	53.5	54.2	48.6	(51.3)	(49.0)	(47.2)	(59.0)	
Room in Past Year?	1-2 times	34.5	34.7	33.6	(36.4)	(39.1)	(38.1)	(30.6)	
	3+ times	12.0	11.1	17.8	(12.3)	(11.9)	(14.7)	(10.4)	
No. in Households Needing	none	94.8	94.9	93.6	(94.6)	(94.0)	(92.7)	(95.8)	
Special Transportation?	1+	5.2	5.1	6.4	(5.4)	(6.0)	(7.3)	(4.2)	
Normally Used Mode of	automobile	95.5	96.3	88.6	94.1	91.4	96.6	97.2	
Transportation?	bus or taxi	2.2	1.2	10.0	3.9	4.3	2.1	0.0	
Would Bus Be Used If	yes	22.3	20.8	35.3	25.3	29.1	20.0	19.3	
Conveniently Located?	no	60.2	62.5	40.3	55.6	53.0	63.0	64.3	
Preferred Hours for Visits	6-9 A.M.	5.1	5.0	5.6	(5.7)	(2.2)	(6.6)	(4.8)	
To the Doctor?	9–12 Noon	24.5	25.0	19.8	(21.7)	(24.5)	(23.2)	(27.0)	
	12-3 P.M.	14.2	15.1	6.3	(14.4)	(16.5)	(14.0)	(13.6)	
	3-6 P.M.	25.7	26.5	18.3	(24.7)	(18.0)	(27.2)	(27.7)	
	6-9 P.M.	28.1	26.3	43.7	(30.4)	(35.3)	(26.3)	(25.4)	

RESPONSE PERCENTAGES ON SURVEY ITEMS CONCERNING UTILIZATION AND TRANSPORTATION

TABLE 9

Note: Response rates for neutral or median categories are not shown here although they were used in the chi-square tests for significance. Any figures in parenthesis did not have statistical significance at the .05 confidence level.

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Automobiles, either personally owned or belonging to a friend, represented the overwhelming mode of transportation used in visits to the doctor, even among urban dwellers. The automobile was the reported mode of transportation for 96 percent of all households surveyed. Public buses and taxis were noted as transportation by only 2 percent of the households. However, for households lacking a family physician, buses and taxis were much more important, garnering 10 percent of the responses as compared to only 89 percent for the automobiles. Also, of course, there was no bus or taxi use reported by households in the rural area associated with Facility Four proposed for Eagle Township.

The survey responses indicated, too, that the use of public buses for trips to the doctor would be augmented by office locations near bus stops. In the group of all sampled households 22 percent affirmed that they would use the bus under such circumstances. This figure was rather characteristic across all the study area although somewhat higher among those allocated to Facilities One and Two in Lansing and somewhat lower for the groups associated with the other two facilities. Finally, the greatest interest in potential bus use was among the undoctored group, of whom more than 35 percent reported that they would rely on public buses for transportation to the doctor's office.

The use of hospital emergency rooms showed a high level of consistency among the various groups examined. About one-half of the households noted utilizing such facilities one or more times during the past year. There was some distinction in the data among households making three or more trips to the emergency room; in this category of high usage were 18 percent of the undoctored households, compared with 11 percent

of the households reporting a family doctor. The figures for the four allocation-based groups for the proposed facilities were not statistically significant.

Lastly in this group of survey questions, respondents were asked which time of day or night their household would find most convenient for visits to the doctor. Across the entire sample the most popular of the time periods was the early evening between 6:00 P.M. and 9:00 P.M. which was the choice of 28 percent of the respondents. Late afternoon was also a preferred period among another 26 percent of the households, as was later morning which 25 percent of the sampled population selected. Most of the remaining households opted for either the early afternoon hours between 12:00 Noon and 3:00 P.M. (14 percent), or the 6:00 A.M. to 9:00 A.M. early morning hours (5 percent). In addition, there was a rather sharp contrast between the households having a family physician and those without. In the latter group the early evening hours were even more popular, chosen by 44 percent of the group primarily at the expense of the afternoon options.

In sum, the survey items concerning health care utilization and transportation uncovered some important distinctions among the examined groups. Travel distances to the doctor appeared to vary reasonably depending upon geographic location of residence, although the travel expectations among the undoctored group were generally somewhat less than the distances reported by their counterparts presently served by a family physician. Special transportation assistance did not seem to represent a major obstacle in securing physician care since similar proportions of both the doctored and undoctored households noted such a

dependency. Automobiles were by far the preferred mode of transportation to the doctor's office, although significant numbers indicated that they would utilize the public buses if the doctor's office was located near a bus stop. Also, the undoctored group showed substantially greater reliance upon public buses than did the group presently served by a physician. Hospital emergency room use was shown to be somewhat more frequent among the undoctored group, too.²⁶ Lastly, in terms of preferred hours for visits to the doctor, the survey results showed the early evening hours to be the most desired, especially among the households without a family physician.

PROBLEMS IN SEEKING HEALTH CARE

In order to better understand problems encountered in seeking health care, the survey respondents were asked to evaluate their experiences in the areas covered by the following six questions:

- (1) Does the head of your household have some type of health insurance coverage, such as Blue Cross/Blue Shield, Medicare or Medicaid, or a commercial policy?
- (2) How great a problem do you have finding an available doctor who will see you or a member of your household?
- (3) How great a problem do you have in getting a prompt appointment when you or a member of your household needs medical attention?
- (4) How great are any language differences which make it hard for you to talk to the doctor?
- (5) How great a problem do you have in paying for the doctor's services?
- (6) How great a problem do you have in finding transportation to the doctor's office?

Considering the importance attached to the issue of emergency room use as a rationale for health care expansion in the Lansing area, the findings here were not especially supportive. This point will receive additional treatment in the following chapter.

Table 10 summarizes the responses to these questions among the population sampled.

Considering all the surveyed households, most (96 percent) confirmed that at least one household member had some form of health insurance coverage. Among the group lacking a family physician, however, a substantial 13 percent reported having no health insurance.

Across the entire survey group the greatest problems encountered in seeking health care from doctors were reported to be obtaining a prompt appointment, simply finding an available physician, and paying for the services rendered. In each of these three areas roughly 10 percent of all the households questioned noted a "great problem." Language differences and transportation arrangements, on the other hand, were indicated to be a "great problem" by less than 2 percent of all those sampled.

In contrast, however, for each of these five potential problem areas the respondents without a family physician noted significantly greater problems than did their counterparts served by a doctor. The percentage of respondents in the former group reporting a "great problem" in finding an available doctor and getting a prompt appointment was almost six times larger than the percentage for those having a family physician. Similarly language differences and transportation were both categorized as a "great problem" by about five times as many of those in the undoctored group as compared to the group reporting a family doctor. Lastly, there was less divergence among the two groups on the question of paying for the doctor's services, although even here the proportion experiencing a "great problem" was three and one-half times larger in the undoctored group than among those with a physician.

TABLE 10

	Perpoper All With & W/O Dector Corrigo							
Question	Response Category R	AII Respondents	With & With	W/U Docto Without	or 1	Service 2	facility 3	4
Personal Health Insurance Coverage?	yes no	95.7 3.8	96.9 2.6	85.7 12.8	(96.5) (3.5)	(94.5) (3.4)	(93.4) (5.7)	(96.4) (3.2)
Difficulty in Finding an Available Doctor?	great proble small proble no problem	em 8.9 em 24.5 66.6	5.8 22.6 71.5	35.3 40.6 24.1	11.5 23.3 65.1	9.7 29.7 60.7	9.1 30.4 60.4	6.7 21.3 71.9
Difficulty in Getting a Prompt Appointment?	great proble small proble no problem	em 10.8 em 31.7 57.5	7.1 30.5 62.3	42.5 41.8 15.7	(13.3) (31.5) (55.2)) (11.3)) (35.9)) (52.8)	(11.6) (34.1) (54.3)	(8.6) (29.7) (61.8)
Language Difficulties in Talking to the Doctor?	great proble small proble no problem	em 1.9 em 7.6 90.5	1.4 6.9 91.7	6.7 13.3 80.0	(1.9) (5.9) (92.2)) (0.0)) (6.2)) (93.8)	(1.7) (6.5) (91.8)	(2.6) (9.5) (87.9)
Difficulty in Paying for the Doctor's Services?	great proble small proble no problem	em 9.9 em 29.6 60.5	7.9 29.1 63.0	27.6 32.8 39.6	(10.4) (30.4) (59.2)) (12.5)) (24.3)) (63.2)	(13.4) (28.4) (58.2)	(7.4) (30.9) (61.6)
Difficulty in Finding Transportation to Doctor?	great proble small proble no problem	em 1.6 em 9.4 89.0	1.2 8.5 90.2	5.3 16.5 78.2	(1.6) (11.2) (87.2)) (1.4)) (8.4)) (90.2)	(1.7) (8.7) (89.5)	(1.7) (8.6) (89.7)

RESPONSE PERCENTAGES ON SURVEY ITEMS CONCERNING PROBLEMS IN SEEKING HEALTH CARE

Note: Response rates for neutral or median categories are not shown here although they were used in the chi-square tests for significance. Any figures in parenthesis did not have statistical significance at the .05 confidence level. Such inter-group comparisons between those with and those without physicians may tend to obscure the overall patterns in these problem areas for seeking health care. Special attention should be given to the fact that substantial proportions of the households lacking a family physician noted a "great problem" in finding an available doctor (35 percent), getting a prompt appointment (43 percent), and paying for the physician's services (28 percent). Clearly these findings identify some of the critical factors in the link between physicians and population, although further work would be necessary to establish whether these variables are causal or resultive in the failure of households to secure a family doctor.

Last in this set of questions, there were generally no significant differences noted in the responses among the groups based on the allocations to the four proposed facilities. The only exception here was on the question of finding an available doctor, where the urban and suburban residents associated with Facilities One, Two, and Three were more inclined to report a "small problem" or a "great problem" than were the rural dwellers associated with Facility Four in Eagle Township.

In review, the potential problems encountered in seeking health care which were investigated here generally proved to be more important factors separating households with and without family physicians than factors distinguishing among the four facility-based groups. Most importantly, there were substantial numbers reporting problems in finding an available doctor, getting a prompt appointment, and paying for the doctor's services. These compaints were especially common among the undoctored group. In other areas of questioning, relatively

few reported transportation to be a serious problem in visits to the doctor, and the vast majority of surveyed households noted at least one member covered by personal health insurance.

INTEREST IN ANCILLARY HEALTH PROGRAMS

In recent years health care services in many areas including Lansing have been expanded to include a variety of ancillary programs and counseling. Households involved in the study survey were asked whether they desired additional information on the available programs dealing with birth control, diet and nutrition, alcohol abuse, medical social services, visiting nurses, health care of the elderly, and mental health. Tabulated response rates on these questions are provided in Table 11.

Considering first the entire group of surveyed households, the area of greatest interest was the diet and nutrition program for which 28 percent of the households gave a positive response. Among the other programs, affirmative response rates were 19 percent for the health care for the elderly, 15 percent on mental health services, 14 percent for medical social services, and 12 percent for the visiting nurse program. The birth control and alcohol abuse programs registered less interest, with each securing only about 9 percent positive responses among the entire sample.

When the surveyed households were divided into those with and those without a family physician, the latter group consistently expressed a higher level of interest in the various allied health programs. Although the differences reported between these two groups were not of a significant magnitude for all the programs, the areas which were noteworthy included birth control, diet and nutrition, medical social services,

TABLE 11

	Recoonse	A71	With &	W/O Docto	Doctor Service Facility				
Question	Catagorise	Deependente	Lideb	Without	1 1	JEIVICE	2	-y /	
Question	category	Respondents	WILII	WILHOUL	Ŧ	2	J	4	
Interested in Birth Control	yes	9.0	8.2	15.8	(8.4)	(9.1)	(8.2)	(9.8)	
or Sex Education Programs?	unsure	5.3	5.1	7.5	(3.2)	(6.3)	(4.7)	(6.8)	
	no	85.7	86.7	76.7	(88.4)	(84.6)	(87.1)	(83.4)	
Interested in Diet or	yes	28.4	27.1	39.1	(26.9)	(29.2)	(28.3)	(29.2)	
Nutrition Programs?	unsure	5.6	5.6	6.0	(3.8)	(6.9)	(6.1)	(6.4)	
6	no	66.0	67.4	54.9	(69.4)	(63.9)	(65.7)	(64.4)	
Interested in Alcohol	yes	8.5	(8.0)	(12.8)	(7.8)	(4.9)	(7.8)	(10.3)	
Abuse Programs?	unsure	4.0	(3.8)	(5.3)	(3.2)	(2.1)	(3.0)	(5.4)	
-	no	87.5	(88.1)	(82.0)	(88.9)	(93.1)	(89.2)	(84.2)	
Interested in Medical	yes	14.2	12.4	30.3	12.7	13.9	16.1	14.6	
Social Services Programs?	unsure	11.5	11.0	15.9	9.2	5.6	13.9	13.7	
	no	74.3	76.6	53.8	78.2	80.6	70.0	71.9	
Interested in Visiting	yes	12.4	(12.0)	(16.5)	(12.1)	(13.1)	(12.1)	(12.6)	
Nurses Programs?	unsure	7.7	(7.6)	(9.0)	(5.7)	(6.2)	(7.8)	(9.6)	
-	no	79.8	(80.5)	(74.4)	(82.2)	(80.7)	(80.1)	(77.9)	
Interested in Programs	yes	19.1	(18.6)	(23.9)	(18.5)	(19.3)	(15.6)	(21.0)	
for the Elderly?	unsure	7.4	(7.1)	(9.7)	(7.5)	(5.5)	(8.7)	(7.3)	
-	no	73.5	(74.3)	(66.4)	(73.9)	(75.2)	(75.8)	(71.7)	
Interested in Mental	yes	15.2	14.1	24.1	(13.2)	(15.9)	(13.4)	(17.3)	
Health Programs?	unsure	8.4	8.2	9.8	(7.6)	(6.2)	(9.1)	(9.2)	
-	no	76,4	77.7	66.2	(79.2)	(77.9)	(77.5)	(73.5)	

RESPONSE PERCENTAGES ON SURVEY ITEMS CONCERNING ANCILLARY HEALTH PROGRAMS

Note: Any figures in parentheses did not have statistical significance at the .05 confidence level.

and mental health services. Positive statements of interest ran particularly high among the undoctored households with regard to the dietary programs (39 percent) and the medical social services (30 percent).

Based on the households allocated to each of the four proposed health facilities, there was generally little geographic variation in the interest expressed for ancillary health services. Among the seven programs examined, only the query about medical social services produced statistically significant results when crosstabulated with the facility assignments, and even here the findings were indicative of only a mildly greater interest among the suburban and rural dwellers of Facilities Three and Four.

Ancillary health programs, on the whole, generated a range of interest levels among the surveyed households. Programs focusing on diet and nutrition, the elderly, mental health, medical social services, and visiting nurses were among the most popular, especially in the undoctored households.

SPECIFIC HEALTH PROBLEMS

In addition to the findings already discussed from the survey, the households sampled were also asked to report the health problems associated with members of their respective households. Table 12 shows the percentage incidence of a variety of chronic and acute health problems reported among the population of the surveyed households. Rather than attempting to comment upon all the health problems in detail, the ensuing discussion focuses on two areas: first, the most prevalent of the medical problems noted from the survey and, second, certain chronic problems widely attributed to environmental factors.

TABLE 12

PERCENTAGE INCIDENCE OF SELECTED HEALTH PROBLEMS

AMONG THE POPULATION OF SURVEYED HOUSEHOLDS

	Health Problem	Percentage Incidence
1.	Allergies (any type)	20.6
2.	Hemorrhoids and Piles	16.5
3.	Digestive System Problems	15.1
4.	Arthritis and Rheumatism	14.4
5.	Strep Throat	10.6
6.	Foot Problems	9.9
7.	Frequent Nervousness	9.8
8.	Hypertension	9.7
9.	Skin Problems	8.9
10.	Untreated Dental Problems	7.7
11.	Respiration Problems	7.0
12.	Varicose Veins	6.6
13.	Uncorrectable Sight Difficulty	4.9
14.	Uncorrectable Hearing Difficulty	4.0
15.	Chickenpox	3.9
16.	Cancer (any form)	3.8
17.	Heart Problems	3.3
18.	Menstruation Problems	3.1
19.	Diabetes	2.8
20.	Pneumonía	2.4
21.	Red Measles	2.4
22.	German Measles	2.0
23.	Mumps	1.8
24.	Anemia (other than sickle cell)	1.6
25.	Whooping Cough	0.6
26.	Mononuceosis	0.5
27.	Uncorrectable Speech Problems	0.5
28.	Shingles	0.4
29.	Gonorrea	0.4
30.	Hepatitis	0.3
31.	Scarlet Fever	0.3
32.	Encephalitis	0.2
33.	Sickle Cell Anemia	0.1
34.	Diptheria	0.1
35.	Meningitis	0.1
36.	Rheumatic Fever	0.1
37.	Syphilis	0.0

Note: The percentages shown here represent the averaged figures for the entire study area, based on a survey of 1282 households containing a total of 4014 persons. Also, figures for some acute diseases should be considered suspect since some responding households apparently reviewed their entire medical history for these diseases rather than just the past year.

Prevalent Medical Problems

Across the study area the most frequently reported medical problems were allergies, hemorrhoids, digestive system difficulties, and arthritis. Allergies of all types were a problem noted by more than 20 percent of the overall population sampled. Figure 8 shows that allergies were reported at a lower rate in the Lansing urban area and at a higher rate among the rural sampling zones. The reported occurrence of allergies as a health problem in the population of the study area ranged from a high in excess of 30 percent to a threshold low level of 13 percent. Four of the five study zones reporting the lowest levels of allergy incidence were within the boundaries of Lansing Township and the city of Lansing.

Hemorrhoids and piles were indicated to be a problem for about one out of every six persons included in the survey. Higher incidence rates were generally noted among the population residing in the city of Lansing although the overall pattern was perhaps more random than systematic, as indicated in Figure 9. Across the thirty-three sample zones established for the study area, the incidence of hemorrhoids and piles as a health problem varied from just over 8 percent in the population of some zones to a high of nearly 23 percent in other areas.

From zone to zone across the study area, digestive system problems were reported to affect as few as 10 percent of the population in some areas and as much as one-fourth of the population in other areas. On the average, however, roughly 15 percent of the surveyed population reported suffering from digestive system ailments. With some exceptions the higher rates of incidence were associated with the study zones in and around the city of Lansing, as shown in Figure 10.



Figure 8



Figure 9



Lastly, over 14 percent of all those questioned in the survey complained of arthritis and rheumatism, and again higher rates of occurrence were characteristic of, although not restricted to, the urban zones of the city of Lansing as revealed in Figure 11. The same figure also shows the incidence of reported arthritis and rheumatism ranging between 8 and 25 percent in the population of the study area zones.

There were no statistically significant variations in the incidence of these four leading health problems at the .05 level when the investigation was shifted to consider the groups allocated to the four proposed facilities. Table 13 shows that among the groups the incidence of allergy complaints was the most variable, ranging from 16 percent to 24 percent among the four, although achieving significance only at a .07 confidence level.

Other Selected Health Problems

With the available data secured for this study one would be remiss for failing to comment upon the findings in this study associated with some of the chronic medical problems commonly attributed to environmental factors.²⁷ Singled out for the discussion here were the reported occurrences of respiratory problems, cancer, heart attack and stroke, and pneumonia. Of these ailments, respiratory problems were the most numerous, reported by 7 percent of the total sampled population, while the other health problems were noted by 4, 3, and 2 percent of those sampled, respectively.

²⁷ Murray (1962), for example, examined mortality rates and causes in England and Wales and found most, but not all, of the examined causes for death to be more common in urban-industrial environments.



Figure 11

TA	BLE	13	

Health Among All By Service Facility Problem Respondents 1 2 3 4 20.6 (20.9) (16.1) (24.0) (19.6) Allergies 16.5 Hemorrhoids & Piles (16.6) (15.8) (14.5) (17.4) Digestive System Problems 15.1 (15.6) (16.3) (14.2) (14.5)(14.7) (16.1) (12.0) (14.8)Arthritis & Rheumatism 14.4

Note: Figures in parentheses indicate that none of the crosstabulated health problems and facility assignments produced values of statistical significance at the .05 confidence level.

PERCENTAGE INCIDENCE OF THE MOST PREVALENT HEALTH PROBLEMS

There was no clear pattern in the incidence of respiratory problems reported across the study area. Figure 12 shows varying frequencies of respiratory problems mixed among the populations of both the rural and urban study zones. Similarly, there was no significant variation noted for this health problem among the four groups allocated to the proposed health facilities, as revealed in Table 14.

Unlike the preceding medical problem, both heart problems and especially cancer, showed a marked elevation of frequency in the population of the urban zones of Lansing. Of the thirty-three sampling zones established for the study, all six of the zones characterized by cancer incidence in excess of 6 percent of the population were within the boundaries of Lansing Township and the city of Lansing proper (Figure 13). Stated in other terms, the incidence of cancer in the population sampled averaged 6 percent among the twelve study zones established for Lansing Township, compared to only 3 percent on the average among the other twenty-one rural and suburban zones. Furthermore, this spatial variation also produced a statistically significant difference in the incidence of cancer reported among the groups allocated to the four health centers. Table 14 shows that the population associated with Facilities One and Two, located within the city of Lansing, both reported a cancer rate of 5 percent. In contrast, those allocated to the Delhi Township facility noted a 3 percent cancer rate, and those linked to the rural Eagle Township center indicated only a 2 percent incidence of cancer among their household members.

A similar but somewhat less striking pattern was revealed in the incidence of heart attack and stroke in the population of the zones



Figure 12

TABLE	14
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Health	Among All	By Service Facility						
Problem	Respondents	1	2	3	4			
Respiratory Problems	7.0	(6.4)	(8.5)	(6.8)	(7.1)			
Cancer (any form)	3.8	5.2	5.1	3.1	2.2			
Heart Attack and Stroke	3.3	(3.8)	(4.9)	(2.5)	(2.9)			
Pneumonia	2.4	(2.5)	(2.4)	(3.1)	(2.2)			

PERCENTAGE INCIDENCE OF OTHER SELECTED HEALTH PROBLEMS

Note: Figures shown in parentheses indicate crosstabulations which did not produce results of statistical significance at the .05 confidence level.

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Figure 13

comprising the study area. Again, higher rates of disease occurrence generally were noted for the zones of Lansing Township where the average rate of incidence was 5 percent as compared to the 2 percent average in the population of the other twenty-one zones (Figure 14). Although this pattern was also obvious among the groups allocated to the four proposed facilities, Table 14 shows that the results in this case fell short of statistical significance at the .05 confidence level. Despite this lack of significance, it is noteworthy that the survey respondents assigned to Facility Three and Facility Four in the location-allocation plan noted a heart ailment incidence of only 3 percent, while those ultimately allocated to Centers One and Two in the city of Lansing reported such medical problems at a higher 4 and 5 percent rate, respectively.

The last of the selected health problems examined here was pneumonia. Figure 15 reveals the incidence of pneumonia in the surveyed population ranging from none to 7 percent across the study area. Indeed the pattern from zone to zone appears to vary independently of the rural to urban configuration or any other spatial arrangement. Table 14 also reflects this lack of any apparent clustering, with pneumonia incidence in the sampled population spread rather evenly among the four allocation-based groups.

The preceding section of this chapter has discussed the survey findings dealing with the incidence rates for eight different medical problems, including the four most frequently reported health problems in the surveyed population and four other illnesses often linked to environmental causes. Allergies were the single most reported problem, affecting roughly 20 percent of the surveyed population. Cancer,



Figure 14



however, was the only disease or ailment among the eight which showed a statistically significant variation in incidence among the groups for the proposed health centers. In particular, higher cancer incidence was noted in the urban areas associated with Facilities One and Two and lower rates in the suburban and rural areas of Facilities Three and Four. Mapped incidence patterns in detail for all thirty-three sampling zones also suggested a similar distribution in other medical problems, notably heart attack and stroke, hemorrhoids and piles, digestive system problems, and arthritis and rheumatism. Allergies, on the other hand, showed much the opposite pattern, with the lower incidence rates primarily in the urban area of Lansing and higher rates reported in the outlying zones.

SOCIOECONOMIC CHARACTERISTICS

The final segment of this chapter deals with the findings of the survey questions about socioeconomic characteristics. The eight questions on this topic posed to the survey group were:

- (1) How many persons are there now in your household?
- (2) How many persons in your household are sixty-five years old or older?
- (3) How many persons in your household are seventeen years old or younger?
- (4) What is the employment status of your head of household?
- (5) What is the highest level of formal education completed by your head of household?
- (6) How long have you lived in the Ingham, Eaton, Clinton, or Ionia County area?
- (7) How long have you lived in your present neighborhood?
- (8) What was your total household income in 1977, before taxes were paid?

A summary of the tabulated responses to these questions is presented in Table 15.

The initial socioeconomic question, concerning the number of persons in each surveyed household, served two purposes. First, this question provided the population count for the survey which was needed to compute the various rates for diseases, proportions undoctored, and so forth. Second, the responses to the question were informative in their own right for determination of varying family size characteristics among the groups under scrutiny.

Among all the households surveyed, two-member families were the most numerous, accounting for almost one-third of the total. These were followed in frequency by four-member and three-member units, respectively. Single-member households constituted only 13 percent of all the 1374 households examined in the survey. Interestingly, the undoctored group in the survey findings was predominantly comprised of smaller household units; together, the one-member and two-member households represented nearly 60 percent of the households without a family doctor. The larger households, on the other hand, tended to be already served by a family physician.

Among the four groups based on the proposed facility allocations there was also a significant pattern in household sizes. Here the observed pattern was for smaller households among those allocated to Facilities One and Two in Lansing, with larger-sized households more common in the groups associated with Facility Three in Delhi Township and Facility Four in rural Eagle Township. Two and three-member households represented roughly one-half of the households in each of the four groups.

	Response	A11	With & W/O Doctor			Service Facility			
Question	Category	Respondents	With	Without	1	2	3	4	
Number of Persons in	one	13.4	12.5	21.2	18.5	20.3	11.5	8.8	
the Household?	two	32.0	31.3	38.0	34.1	35.1	29.9	30.6	
	three	15.6	15.5	16.8	16.1	16.2	14.5	15.5	
	four	19.7	20.2	14.6	14.3	14.2	23.5	23.3	
	five	12.2	13.1	5.1	9.8	8.1	14.5	14.0	
	six +	7.1	7.4	4.4	7.1	6.1	6.0	7.9	
Number of Persons in	none	79.7	78.7	88.3	78.4	78.2	88.0	77.4	
Household and Age 65+?	one	12.0	12.5	8.0	13.6	15.6	8.1	11.6	
-	two	8.3	8.8	3.6	8.0	6.1	3.8	11.0	
Number of Persons in	none	49.0	47.1	64.7	55.8	64.1	41.6	43.3	
Household and Age 17	one	13.4	13.3	14.7	14.1	11.0	15.0	12.8	
or Less?	two	22.7	23.9	12.5	17.3	13.8	28.3	26.6	
	three	9.6	10.2	4.4	8.0	6.9	11.2	10.7	
	four	3.9	4.0	2.9	3.5	2.1	3.0	5.1	
	five +	1.5	1.5	0.7	1.4	2.1	0.9	1.6	
Employment Status of	employed	73.2	73.2	73.5	75.8	65.5	77.4	71.6	
Head of Household?	unemployed	2.2	1.9	4.4	1.1	3.4	5.1	1.3	
	retired	21.7	22.7	13.2	20.5	25.0	14.5	24.8	
	other	2,9	2.3	8.8	2.7	6.1	3.0	2.2	
Educational Level of	grade schoo	01 14.6	(14.6)	(14.6)	10.6	10.8	12.0	19.6	
Head of Household?	high school	53 . 3	(53.6)	(50.4)	49.7	47.3	51.7	58.3	
	college	32.1	(31.8)	(35.0)	39.7	41.9	36.2	22.2	

RESPONSE PERCENTAGES ON THE SURVEY ITEMS CONCERNING SOCIOECONOMIC CHARACTERISTICS

TABLE 15

Note: Any figures in parentheses did not have statistical significance at the .05 confidence level.

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TABLE 15 (Continued)

	Response	A11	With & W/O Doctor			Service Facility			
Question	Category Re	espondents	With	Without	1	2	3	4	
Length of Residence in the	under 1 yr.	1.4	1.0	5.1	1.3	3.4	1.7	0.7	
Four County Study Area?	1-2 years	3.4	2.6	10.3	5.3	3.4	3.4	2.1	
	2-3 years	2.9	2.2	8.8	3.2	6.1	3.0	1.7	
	3-5 years	4.4	4.1	7.4	6.6	4.1	3.8	3.2	
	5-10 years	8.5	7.9	14.0	9.0	9.5	12.0	6.4	
	10+ years	79.4	82.3	54.4	74.6	73.5	76.1	86.0	
Length of Residence in	under 1 yr.	9.5	7.7	24.8	10.6	18.2	12.0	5.2	
Current Neighborhood?	1-2 years	10.3	9.9	13.9	12.2	5.4	13.2	9.0	
_	2-3 years	7.3	6.5	14.6	7.1	8.1	9.8	6.2	
	3-5 years	10.7	10.9	9.5	11.9	12.2	12.4	8.8	
	5-10 years	17.0	17.9	9.5	16.1	12.8	16.7	18.9	
	10+ years	45.1	47.1	27.7	42.1	43.2	35.9	51.9	
Household Income in 1977,	under \$2999	2.3	1.9	6.0	(3.3)	(3.5)	(1.8)	(1.6)	
Before Taxes?	\$3000-\$4999	5.2	5.0	7.5	(3.3)	(8.5)	(3.9)	(6.3)	
	\$5000-\$6999	7.4	7.2	9.0	(6.9)	(10.6)	(7.9)	(6.7)	
	\$7000-\$9999	9.7	9.6	10.5	(10.0)	(7.7)	(7.5)	(11.0)	
	\$10000-\$14999) 17.9	17.5	20.3	(18.9)	(19.0)	(19.3)	(16.2)	
	\$15000-\$24999	9 35.5	36.2	30.8	(34.2)	(29.6)	(33.3)	(39.1)	
	\$25000 +	21.9	22.7	15.8	(23.3)	(21.1)	(26.3)	(19.2)	

RESPONSE PERCENTAGES ON THE SURVEY ITEMS CONCERNING SOCIOECONOMIC CHARACTERISTICS

Note: Any figures in parentheses did not have statistical significance at the .05 confidence level.

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Single-member households were more prolific in the urban-centered groups while four and five-member units were more numerous in the population of the outlying areas.

Age composition within the households was examined, focusing on the elderly over age sixty-four and the children under age eighteen. Among all the households questioned, about 20 percent reported one or more aged persons, and just over one-half reported one or more children under age eighteen. In both cases it was observed that the households with larger numbers of aged or children were more likely to have a family doctor. Nonetheless, it is noteworthy that 35 percent of the undoctored households contained one or more children, and nearly 12 percent included one or more elderly persons.

In the modelled service areas of the proposed health centers the most striking age characteristics were the lower proportion of elderly in the households linked to the suburban Delhi Township facility and the larger proportions of childless households associated with the two Lansing-based health facilities. Across most of the study area the proportion of the households containing one or more elderly persons was close to 22 percent. However this latter figure was a full 10 percent lower among the households centered around the proposed Delhi Township facility. Also, childless households accounted for 56 and 64 percent of the surveyed households, respectively, connected with Facilities One and Two in Lansing, as compared to 42 and 43 percent of the households around the Delhi and Eagle Township centers.

Overall, most household heads questioned in the sample were either actively employed (73 percent) or retired (22 percent). There was

some contrast in employment status between the doctored and undoctored households. The latter group included noticeably fewer retirees and a larger proportion of household heads classified in "unemployed" or "other" categories.²⁸ Specifically, the proportion unemployed was 2 percent among households with a family physician versus 4 percent for those without. Likewise, 2 percent of the undoctored group were headed by an individual in the "other" category, compared to 9 percent among the undoctored households.

Differences in employment status were observed, too, among the potential users allocated to each of the proposed health centers. Respondents affiliated with Facility Two in south Lansing, for example, indicated that only about two-thirds of the household heads were actively employed, as compared with roughly three-fourths across the balance of the study area. This same South Lansing group also showed the highest proportions of household heads in the "retired" and "other" categories. Lastly, the Delhi Township group registered the greatest proportion in the "unemployed" category (5 percent), as well as the least in the "retired" class (15 percent).

Educational levels for household heads did not vary significantly except among the groups allocated to the four health facilities. Within these groups, higher educational levels were characteristic of households in the service areas of the proposed facilities in Lansing and in Delhi Township, while those grouped with the Eagle Township center reported typically lower schooling levels for their heads of household. Among all survey respondents, the tallied educational levels reported for

²⁸ The term "other" among the response categories for employment status was purposely defined loosely, although on the questionnaire it was suggested to include both students and housewives.

heads of household showed 15 percent to be grade school educated, 53 percent high school educated, and 32 percent college educated.

Length of residency, both in the four-county study area and in the individual neighborhoods, appeared to be an important discriminatory factor in family doctor affiliation as well as geographic location. It is significant, for instance, that the households new to the study area over the past three years accounted for fully 24 percent of the undoctored group compared with only 6 percent of the households with an established family physician. Similarly, households new to their neighborhood in the past three years comprised 53 percent of the group lacking a doctor, versus 24 percent of the doctor affiliated households. Geographically, the households allocated to Facility Four in Eagle Township showed the greatest stability in residential tenure; within this group fewer than 30 percent had changed neighborhoods in the past five years and fewer than 8 percent had migrated in from outside the study area over the same time period. In contrast, the questionnaire responses indicated a significantly higher level of residential change among households in the urban and suburban areas. This point was illustrated in the proposed Delhi Township center service area where more than one-fourth of the surveyed households were new to their neighborhood during just the past two years.

Household income was the final socioeconomic area addressed in the survey. Among all the households surveyed in the study area, more than one-half reported annual incomes in excess of \$15,000 and only about one-fourth were identified with income levels below \$10,000. This pattern was not altered significantly among the groups representing

allocations of potential users to the proposed health facilities. There was, however, mild evidence in the findings to suggest that the households without a family physician were more typical of the lower income categories than were their doctor-affiliated counterparts. To document this latter statement, it was found that the surveyed households with incomes under \$10,000 in 1977 represented 33 percent of all the undoctored households but only 24 percent of the households with an established family physician.

In general, most of the socioeconomic characteristics examined through the survey showed significant differences among the groups with and without a family physician and assigned to the various proposed service facilities. The undoctored households typically were smaller in size and less likely to contain members either over age sixty-five or under age eighteen. This same group also included a higher proportion of households headed by someone either unemployed or belonging to a category including students and housewives. There was no significant difference observed in the educational attainments of the doctored and undoctored heads of households. Length of residency, both in the study area and individual neighborhoods, was dramatically shorter for most undoctored households than for those served by a family physician. Finally, the undoctored group also reported somewhat lower incomes on the average than did their counterparts affiliated with a physician.

In terms of geographic differences it was found that household sizes generally were smaller among the urban-dwelling groups associated with Facilities One and Two, and larger among the suburban and rural residents. Age composition characteristics showed fewer elderly in the Delhi
Township facility group and also fewer children in the households of Lansing linked to Facilities One and Two. The suburban Delhi Township group also stood apart with higher unemployment and relatively few retired persons. Educational levels reported for household heads were higher overall for urban and suburban dwellers and generally lower among the rural residents grouped with the Eagle Township facility. Residential tenure was longer among the rural group, too, and commonly shorter in the groups associated with Facilities One, Two, and Three. Annual household incomes did not vary significantly among the facilitybased groups in the survey findings.

Thus far, the presentation of findings from the survey has been offered in an item by item format and related to the overall averages noted for the entire group sampled. The following chapter re-examines these same findings, concentrating on the characteristics of the undoctored group and those associated with each of the four proposed facilities.

CHAPTER VI

SYNTHESIS: FACILITIES AND USER CHARACTERISTICS

The two preceding chapters have presented a location-allocation solution strategy for primary care health facilities and selected findings from a survey of prevalent population characteristics across the study area and among specific groups. Thus far, however, the linkage of these two methodological elements has been addressed only indirectly. It is the purpose of this chapter to bring the population survey findings to bear more directly upon the location-allocation solution. The contents of this chapter are not greatly different in substance from the preceding discussions; however, the format of the presentation here is designed to offer a more concise view of the targeted population without a family doctor and the other groups identified with the proposed facilities.

SERVICE USERS AS CONSUMERS

Many public and quasi-public agencies have adopted a more aggressive posture in the provision of services in recent years. This trend, in part, stems from a growing recognition that the most needy in society are often the furthest removed from the social mainstream. As a consequence, these needy frequently show a voluntary or involuntary reluctance to utilize available services. One aggressive approach to this problem has stressed the redefinition of service users as

consumers.²⁹ Such a view of service users as consumers aptly suggests that service providers shift to the marketing techniques heretofore in the domain of the private sector. When viewed from a marketing perspective, health care service provision such as investigated in this study is heavily reliant upon a clearly defined target population.

In this study it is especially important that the envisoned role of the proposed facilities be well understood. As stated earlier, the planned primary care health facilities are being funded initially with the intention of remedying current over reliance upon the emergency care facilities at Saint Lawrence Hospital (and elsewhere presumably). Ultimately, however, it is expected that these same proposed facilities will revert to ordinary, privately owned and operated family physician practices.

Based on this understanding, it is evident that the initial facility locations and appeal to those in the population lacking family doctors will largely determine their success in relieving the pressure on emergency care staff and facilities. Over the longer term, it is likely, indeed probably, that the new physician practices established under the program will simply assume the care of many in the population either already doctored or migrating into the community. In short, any impact such physician expansion may exert toward reducing undoctored households or emergency facility misuse in the area will be realized largely during the initial phases of the program.

²⁹ Robert Perlman (1975) in his book <u>Consumers and Social Services</u> points out the subtle differences between the "client" and the "consumer" of public services.

In recognition of this situation, the location-allocation methodology of this study is focused on the undoctored segment of the study area population, but broadens the investigation of potential user characteristics to include all elements in the sampled population. The ensuing discussion profiles first the targeted population lacking a family physician and, second, each of the four groups representing the service area populations for the respective facilities proposed in the location-allocation modelling.

THE UNDOCTORED TARGET POPULATION

Across the entire study area 10 percent of 1326 responding households, or 9 percent of the actual population, reported having no family doctor or indicated uncertainty as to having a doctor.

Geographically, this undoctored population was heavily concentrated in a small portion of the study area in and around the city of Lansing. As a result, the two proposed physician facilities in south Lansing and at Saint Lawrence Hospital could be expected to jointly serve more than two-thirds of the study area's estimated undoctored persons, based on the location-allocation model. The third center, located in Delhi Township, would be utilized by another one-fourth of the group under such a system, and the final Eagle Township center would theoretically serve only a scant 7 percent of the estimated undoctored population residing in the study area.

The survey conducted for the study revealed a variety of similarities and differences between the doctored and undoctored groups. A summary profile of these two groups is presented in Table 16. Responses among the undoctored group generally were predictable on the topic of overall

TABLE 16

Area of Induiry		Response Sum Undoctored Group	Response Summary for Undectored Group Dectored Group				
1.	General Attitudes Toward Health Care	1. mild dissatisfaction with U.S. system; in favor of national health insurance and HMO membership	1. generally satisfied with U.S. system; opposed to national health insurance and HMO membership				
2.	Health Care Utilization and Transportation	2. realistic travel distance expectations; hospital emergency room use only slightly above average; little reliance on special transportation assistance; bus and taxi use well above average; strong support for early evening doctor visitation	2. three to ten mile travel distance common; average hospital emergency room use; little reliance on special transportation; overwhelming use of autos for physician visits; lat morning, late afternoon, and early evening all equ as hours for doctor visit				
3.	Problems Encountered in Seeking Health Care	3. substantial difficulty in getting a prompt appoint- ment and finding an available physician; minor difficulty in paying for doctor's services, finding transportation, and commu- nicating with the doctor; largely covered by health insurance	3. paying for doctor's services and getting a prompt appointment minor problems; almost universal personal health insurance				

SUMMARY PROFILE OF UNDOCTORED AND DOCTORED HOUSEHOLDS

TABLE 16 (Continued)

		Response Summary for				
	Area of Inquiry	Undoctored Group	Doctored Group			
4.	Interest in Ancillary Health Programs	4. strongest interest in diet/nutrition and medical social services programs; less interest in mental health and birth control programs	4. substantial interest in diet/nutrition programs; minor interest in mental health and medical social services programs			
5.	Socioeconomic Characteristics	5. smaller-sized households with fewer elderly and fewer dependents; above average number of house- holds headed by students and housewives; terms of residence in study area and individual neighbor- hoods shorter than the average; household incomes somewhat below the average	5. households of slightly above-average size, and more often including elderly and children; either actively employed or retired; lengthy terms of residence in study area and neighborhoods; household incomes somewhat above the average			

SUMMARY PROFILE OF UNDOCTORED AND DOCTORED HOUSEHOLDS

health care attitudes. The group, on the whole, registered mild dissatisfaction with the existing U.S. health care system while expressing a predominantly positive interest toward both a program of national health insurance and membership in a pre-paid health maintenance plan.

The survey questions regarding health care utilization and transportation provided important information about the undoctored group. First of all, as a matter of record, the undoctored group did not stand out appreciably from the at large population on the subject of (expected) travel distances to the doctor or needs for special transportation. The majority of the households surveyed without a family physician expressed a willingness to travel a distance between three and ten miles to see a doctor, and only 6 percent of the undoctored group noted the need for special transportation assistance. More importantly, a substantial 10 percent of the undoctored households indicated their reliance upon public buses and/or taxis for transportation. Also, more than one-third of the group said these latter modes of transit would be used in trips to the doctor if the physician's office was located conveniently nearby a transit stop. A surprisingly large portion (44 percent) of the group lacking a family doctor chose the early evening hours over other times of the day or night for their visits to the doctor.

Perhaps most notable, however, was the lack of any clear evidence to suggest that the undoctored group was responsible for any inordinate amount of hospital emergency room use. About one-half of the group indicated the use of such facilities on one or more occasions in the past year, but this figure was not greatly different than that observed for those already served by a family doctor. This finding is important

since it discredits the premise that the undoctored population is responsible for a disproportionate share of hospital emergency facility use.

The survey examination of problems encountered in seeking health care uncovered several topics of special consequence to the undoctored households. Heading this list was "difficulty in getting a prompt appointment" which 84 percent of the households described as either a small problem or a great problem. More than three-fourths of the group also reported that simply "finding an available doctor" was a problem area. The final area of difficulty for a majority of the undoctored group was "paying for the doctor's services," where 60 percent again noted a small or great problem. In other areas, only about one-fifth of the group found either transportation or language to constitute a problem in visits to the doctor. Lastly, even among this group lacking a family physician, most households (86 percent) included at least one individual covered by health insurance. A note of caution should be made here, however, to point out that these problems encountered by many of the undoctored when seeking health care may represent either causes or effects associated with their undoctored status.

Household interest in all ancillary health programs examined was higher for the undoctored group than among their counterparts with an established family physician. In the former group positive declarations of interest were highest for the diet and nutrition program and the medical social services programs, which recieved affirmations from 39 percent and 30 percent of the surveyed households, respectively. An additional one-fourth of the undoctored households reported their interest

in mental health programs and special programs for the elderly. Lastly, only about 15 percent expressed interest in each of the allied health programs on birth control and sex education, alcohol abuse, and visiting nurses.

Demographically, the undoctored households were characterized from the survey as primarily small in size and predominantly comprised of persons in the middle age categories. Less than 10 percent of the households exceeded four members in size, and nearly 60 percent included only one or two persons. By age composition, almost nine of every ten households without a family physician contained no one over age sixtyfive and about two-thirds reported no children under age eighteen.

Income, education, employment, and length of residency were the final socioeconomic characteristics probed in the survey of undoctored households. Incomes reported by the group were somewhat lower than the average among the remainder of the population, although only 14 percent of the undoctored households earned an income below the \$5,000 level in 1977. Educationally, the heads of the undoctored households presented something of a paradox, with reported schooling levels equal to, if not exceeding, those of the heads of households served by a doctor. In terms of employment, most of the heads of undoctored households were noted as employed (74 percent); among the remainder, 13 percent were retired, 4 percent were currently unemployed or laid off work, and nearly 9 percent were classified in a miscellaneous group of students, housewives, and so forth. In the final area, residency, the undoctored typically reported shorter lengths of residency than the population average, both for the four county study area and individual neighborhoods. Most notably,

more than one-half indicated a residency of under three years in their current neighborhood.

The preceding discussion has outlined prominent characteristics of the households lacking a family physician as indicated in the survey conducted in the study area. The remainder of this chapter presents a similar report on the four groups representing the potential users of the facilities proposed in the location-allocation analyses.

POTENTIAL USERS IN THE PROPOSED FACILITY SERVICE AREAS

Earlier, in Chapter IV, the findings of a series of locationallocation analyses were shown, ultimately proposing locations for four primary care health facilities and identifying their respective service areas. It was one goal of this research to examine the nature and extent of any variations in characteristics among the expected user populations of these facilities. The final segment of this chapter reexamines the findings of the population survey in light of the health center service assignments recommended in the location-allocation modelling. The discussions include all the surveyed population, both with and without family physicians, focusing only on those characteristics which were statistically significant at the .05 confidence level or higher when crosstabulated with the service area assignments. Table 17 summarizes the profiles of these four groups based on the findings of the survey.

TABLE 17

SUMMARY PROFILE OF THE GROUPS ASSOCIATED WITH THE FOUR PROPOSED FACILITIES

	Area of Inquiry	Sa	int Lawrence Hospital	Se	Response Summar outh Lansing D	y for elhi Township	Eag	le Township
1.	General Attitudes Toward Health Care	1.	positive rating of U.S. health system; split on national health insurance and narrowly against HMO membership	1.	negative 1. rating of U.S. health system; in favor of both national health insur- ance and HMO membership	positive rating of U.S. health system; in favor of both national health insurance and HMO membership	1.	positive rating of U.S. health system; against both national health insurance and HMO membership
2.	Health Care Utilization and Transportation	2.	short travel distances experi- enced or expected; above average reliance on buses and taxis	2.	short travel 2. distances experienced or expected; high reliance on buses and taxis	longer travel distances ex- perienced or expected; average reliance on buses and taxis	2.	very long travel distances experienced or expected; total reliance on autos for transport
3.	Problems Encountered in Seeking Health Care	3.	considerable difficulty in finding an avail- able doctor	3.	considerable 3. difficulty in finding an available doctor	considerable difficulty in finding an available doctor	3.	less difficulty in finding an available doctor

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TABLE 17 (Continued)

SUMMARY PROFILE OF THE GROUPS ASSOCIATED WITH THE FOUR PROPOSED FACILITIES

	Area of Induiry	Saint Lawrence Hospital	for	shin Facle Termshin	
4.	Interest in Ancillary Health Programs	4. little interest in medical social services programs	4. little 4. interest in medical soc- ial services programs	greater inter- est in medical social services programs	4. greater interest in medical social [•] services programs
5.	Socioeconomic Characteristics	5. smaller households with more elderly and fewer children; most household heads well-educated and actively employed; somewhat shorter than average residencies in the study area and neighborhoods	5. smaller 5. households with more elderly and fewer children; most household heads well- educated and many retired; somewhat shorter resi- dencies in study area and neighborhoods	larger house- holds with few elderly and many children; most household heads with average educa- tions and actively employed; most with lengthy residencies in study area but shorter tenure in neighbor- hoods	5. large house- holds with both many elderly and many dependents; most household heads with less education and many retired; most with long periods of residency in the study area and neighborhood

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FACILITY ONE --- SAINT LAWRENCE HOSPITAL

The Saint Lawrence Hospital facility, also referred to as Facility or Center One, was the lone unit at an existing, fixed location. When the figures of Table 3 are coordinated with the proposed service areas illustrated in Figure 5, it can be seen that about 14 percent of the households within the expected service area of Facility One were reported to be without a family physician. Combining this 14 percent figure with the high density of the population in this central Lansing area, it can also be estimated that the Saint Lawrence Hospital center would likely serve an overwhelming 44 percent of the undoctored households in the study area, or almost twice that of any of the other three proposed centers. This observation, of course, assumes rational, distance-minimizing travel behavior on the part of the users as well as equity in the patronage levels among the undoctored households all across the study area.

Attitudes towards general health care issues were rather typical among the Saint Lawrence group, although they did report most favorably among the four groups on their overall opinion of the U.S. health care system.

On the subject of transportation, about 4 percent indicated their reliance on public buses or taxis, and 20 percent said they would utilize buses for visits to the doctor providing that the physician's office was located near a bus stop. Also, the actual or expected travel distances for trips to the doctor were reasonable based on the group's urban location.

Among the examined problems in seeking health care only one question, concerned with difficulty in finding an available doctor, yielded results

of statistical significance in the four facility-based groups. In this case, 12 percent of the Saint Lawrence allocatees noted a "great problem" in finding an available physician, a higher proportion than in any of the other groups. On the other hand, more than 65 percent in the Facility One group noted that finding an available doctor was "no problem," indicative of some polarization of attitudes on this issue.

Again, among the ancillary health programs there was but a single item of statistical significance in crosstabulation with the facility assignments. This item, evaluating interest in medical social services, showed only average interest among the Saint Lawrence group with only 13 percent of the group expressing positive interest and nearly fourfifths indicating no interest in such services.

In the preceding chapter some comment was offered on the geographic distribution of specific health problems, although not in the context of the four facility-based groups. When viewed from this latter perspective, two health problems, cancer and skin problems, showed statistically significant findings. In the first case, cancer incidence was sharply higher in the Lansing urban area with 5 percent of the population in the service area of the proposed Saint Lawrence facility reported to be affected by the disease. The comparable cancer rate across all the study area averaged only 4 percent, and was below 3 percent in many parts of the study area. The variation in the incidence of skin problems was less striking although the ailment was reported to affect a larger part of the population. Among the group allocated to the Saint Lawrence facility, the reported incidence of skin problems was 9 percent, roughly the same as the average across the entire study area.

A host of socioeconomic questions produced significant results in the crosstabulations with the proposed service facility assignments. Among the Saint Lawrence group, these questions produced responses more representative of the rule than the exception. One-member and two-member households were the most common, together accounting for 53 percent of the households in the group. In terms of age composition, 78 percent and 56 percent of the households reported no elderly members and no children under age eighteen, respectively. Most household heads in the Saint Lawrence facility group were reported to be either actively employed (76 percent) or retired (21 percent), with an above average proportion (40 percent) noting a college education. Lastly, the group was rather typical in length of residency. A large majority (75 percent) of the households had been in the four county area more than ten years, although 60 percent had changed neighborhoods over a similar time period.

FACILITY TWO -- SOUTH LANSING

Like the Saint Lawrence unit, Facility Two located in South Lansing would theoretically serve a primarily urban clientele. In the service area modelled for the South Lansing facility, the undoctored numbered nearly 15 percent of the population but, because of a smaller service area, the proposed facility would serve only about 27 percent of the study area's undoctored population.

In the South Lansing group there were strong feelings expressed on the general health care issues. Of the four facility-based groups, those in South Lansing were the only group in which "below average" marks outnumbered "above average" appraisals of the overall U.S. health care system. Similarly, no other group showed such high favor (42 percent)

for national health insurance or interest in becoming part of a prepaid health maintenance organization (35 percent). As was noted earlier, the group's interest in joining an HMO may be due in a large part to familiarity with the Health Central HMO now operating in the south Lansing area.

On the transportation topics the South Lansing group reported the shortest actual or expected travel distances for doctor trips of the four groups, and also expressed the greatest level of interest in public transit use for visits to the physician. Almost 57 percent of the households sampled and allocated to the South Lansing facility indicated an actual or anticipated residence to physician travel distance of less than three miles. It might be noted that the computed mean travel distance was 0.67 miles for the potential users of Facility Two, as shown in Table 4. In terms of transportation mode, 4 percent said they would utilize the public buses for such trips provided that the physician's office was located near a bus stop.

In the only significant findings concerning problems encountered in seeking health care, about 10 percent of the households in the South Lansing group reported a "great problem" in finding an available doctor, and nearly 30 percent noted this to be a "small problem."

No other facility-based group reported less interest than those of the South Lansing center with regards to the ancillary medical social services programs. More than 80 percent of the group said they were uninterested in the programs.

Both cancer and skin problems were reported with above average frequency by the South Lansing facility allocatees. Cancer in the group was reported by 5 percent, nearly the same rate as among the Saint

Lawrence group, and well above the 4 percent average across the study area. Similarly, skin problems were noted as a health problem by 11 percent of the population in the South Lansing group, as compared to an average incidence of 9 percent in the four county study area.

On the subject of household composition, the South Lansing group included proportionately more small households than any of the other groups, a rather typical number of elderly, and more childless households than any of the other facility groups. More than 55 percent of the group's households contained only one or two members and almost two-thirds reported no children under age eighteen.

In terms of employment, only 66 percent of the group's heads of household were reported as actively employed, the fewest of any group. Most of the remainder was accounted for by the retired (25 percent) and those classified in a miscellaneous category (6 percent) which included students and housewives.

Educationally, the South Lansing group included the largest proportion of college graduates (42 percent) heading households among the four health facility groups, and most of the remainder reported to be high school educated (47 percent).

Finally, the South Lansing group was characterized by shorter than average terms of residency in the four county area and, especially in the last year, an unusually high amount of neighborhood moves. Seventeen percent of the group reported moving into the four county area within the past five years and more than 18 percent had changed neighborhoods within the past year.

FACILITY THREE -- DELHI TOWNSHIP

The third of the proposed primary care health facilities was located in the northwest corner of Delhi Township, south of Lansing. The anticipated service area of the center includes the populations of southwest Lansing, the city of Holt and surrounding Delhi Township, in addition to Windsor and Benton Townships to the wouthwest of Lansing. Although the discussions thus far have referred to the "suburban" character of this area, the sample zones allocated to Facility Three also include urban elements of Lansing and more rural elements in the townships to the southwest. In this service area 10 percent of the sampled population were reported to be without a family physician. Based on the total population of the area, the facility proposed for Delhi Township would serve 23 percent of the undoctored households in the entire study area, or somewhat less than the South Lansing center and considerably fewer than the Saint Lawrence facility.

On the topic of general health care, the Delhi Township group gave predominantly above average marks on the existing U.S. health care system but also expressed interest in alternatives offered by national health insurance and health maintenance organizations. More than one-third of the group rated the U.S. health care system above average while about one-fifth gave the system a sub-par grade. On the question of alternatives, 39 percent expressed positive interest in becoming part of a pre-paid health maintenance organization. More negative comments were offered by 31 percent of the group in opposition to national health insurance and 22 percent who said "no" on becoming part of a health maintenance organization.

In visits to the doctor, 97 percent of the surveyed households in the Delhi Township group indicated reliance on automobiles, and only 2 percent reported using public buses or taxis although 20 percent said they would turn to using buses if the location of their doctor made doing so convenient. Also, the majority of the group reported an actual or expected residence to physician travel distance of between three and ten miles, with the remaining households rather evenly split in the under three miles category and the over ten miles distance.

In the area of problems encountered in seeking health care the Delhi Township group responded similarly to the South Lansing facility allocatees, with about 40 percent noting a "small problem" or "great problem" in finding an available doctor.

Interest in medical social services programs was as high among the Delhi Township group as among any of the other three groups. Positive statements of interest in the programs came from 16 percent of the group and an additional 14 percent were "unsure" as to whether they desired additional information on the available programs.

Among the examined medical problems, cancer incidence was lower than average in the Delhi Township facility group as was the reported incidence of skin ailments. Cancer was reported to affect 3 percent of the group's population, compared with a 4 percent rate for the total study are population. Skin problems were noted by 9 percent of the population associated with Facility Three, or about the same as the incidence rate in the total surveyed population.

Responses to the socioeconomic questions showed the Delhi Township group to be above average in size, with relatively few elderly persons and an atypically large number of children under age eighteen. Two-

member and four-member households were the most common in the group, accounting for 30 percent and 24 percent of the households, respectively. In terms of age composition, 88 percent of the households associated with Facility Three contained no persons age sixty-five or older, while 58 percent included at least one dependent under age eighteen.

Heads of households in the Delhi Township group showed a nontypical pattern in employment status but reported educational levels close to the norm in the study area. Only 15 percent of the household heads in the group were reported to be retired, a figure sharply lower than the 22 percent average for the survey of the entire study area. Most of the household heads in the Delhi Township facility group were reported to be actively employed (77 percent), and an unusually large 5 percent were classified as unemployed or laid off from work. Also, the majority of the heads of households in the group indicated having a high school level education while slightly more than one-third were college graduates.

In the final area dealing with length of residency, the Delhi Township group reported about average dwelling periods for individual neighborhoods, perhaps indicative of the residential shifts to the suburbs from other local areas. Only about 36 percent of the Facility Three group surveyed had lived in their current neighborhood more than ten years and roughly one-fourth had moved into their current neighborhood during the past two years. On the other hand, more than threefourths of the group reported they had resided in the four county area at least ten years.

FACILITY FOUR -- EAGLE TOWNSHIP

Facility Four in Eagle Township was the only service center proposed for a location in a clearly rural, outlying area. Despite the large geographical area to be served by the proposed facility, estimates from the location-allocation model suggest that the center would likely serve only 7 percent of the study area's undoctored households. This circumstance is not due to chance but reflects the combined effects of the lower population density in the outlying townships and the low 5 percent of the population without a family physician.

On the attitudinal items concerning general health care the Eagle Township allocation group offered conservative responses, favoring the existing health care system while rejecting the two alternatives of national health insurance and health maintenance organizations. Almost one-third of the group gave the current health care system an above average rating and less than one-fifth gave a mark of below average. Only 28 percent of the households associated with the Eagle Township facility endorsed a national health insurance program, while almost 37 percent rejected such a plan. Interest in becoming part of a health maintenance organization followed a similar pattern in the group, failing by a margin of 30 percent to 22 percent.

Calculations from the location-allocation model indicated that the typical travel distance for the undoctored households assigned to the facility in Eagle Township was nearly eight miles. This average, however, would seem to be acceptable judging from the responses to the question of actual or expected residence to doctor travel distances. On this item, 40 percent of the Eagle Township center group noted a travel distance of ten or more miles and more than one-third indicated a distance of between three and ten miles.

On the related subject of transportation modes for visits to the doctor, the Eagle Township center group displayed an overwhelming reliance on automobiles, but also a willingness to utilize public buses provided that doing so was convenient. To be exact, 97 percent of the group cited the automobile as their normally used mode of transportation in such trips and none specified public buses or taxis. However, 19 percent of the survey group allocated to the Eagle Township facility affirmed that their households would utilize public buses provided that the bus stops were located near the physician offices. Realistically, such potential reliance on buses is highly unlikely among this group considering their outlying locations, residential dispersal, and low density.

The reported difficulty in finding an available doctor was the least for the Facility Four allocatees of the four facility groups examined. Only 7 percent of the group's households had experienced a "great problem" in this area, and about one-fifth noted a "small problem."

The interest expressed by the Eagle Township facility group on the subject of medical social services programs was rather typical for all the households surveyed across the study area. In the Facility Four group 15 percent of the surveyed households noted a desire for further information about the programs while nearly 72 percent responded negatively.

In the area of medical complaints, both skin problems and especially cancer were reported at below average rates among the population linked to the proposed Eagle Township health center. Cancer was reported to afflict only 2 percent of the group's population, well below the

4 percent average for the entire study area and significantly less than the rates in excess of 5 percent in the urban service areas of Facilities One and Two. Similarly, the incidence rate for skin problems was 8 percent in the Eagle Township facility group, compared with a 9 percent average among the entirety of the study area population.

The survey items dealing with household composition showed larger families to be more common in the Eagle Township facility group than among the households linked to the other proposed facilities and, among the Facility Four households, there were generally both more elderly persons and more youthful dependents. More than 45 percent of the households in the Eagle Township center group included at least four persons and only 9 percent were single-member units. Like Facilities One and Two in Lansing, the Eagle Township facility group reported that more than one-fifth of its households contained one or more elderly persons and, furthermore, 11 percent of the latter group's households included two persons over age sixty-four. Also, 57 percent of the Facility Four households surveyed contained one or more dependents under age eighteen.

Among the heads of households in the Facility Four group, most were reported to be actively employed (72 percent), and, among the remainder, nearly one-fourth were retired. Also, the group's heads of households indicated the lowest educational levels of the four facility-based groups. The majority in the group were high school educated (58 percent), with 22 percent college schooled and nearly one-fifth grade school educated.

Finally, residency tenure was reported to be longer for the Eagle Township group than among the other households surveyed in the study area. Eighty-six percent of the households in the Facility Four group

had been in the four county area for ten or more years, and 96 percent reported a tenure of at least five years in the area. Similarly, more than one-half of the group had not changed neighborhoods within the past ten years, and nearly 80 percent had remained in their current neighborhood for at least the last five years.

In summation, the portion of this chapter focusing on the survey findings for the four facility-based groups generally indicated the sharpest distinctions among the groups to be socioeconomic in nature, although there were also dissimilarities in certain other areas as well. Furthermore, the households linked to the proposed Eagle Township facility were perhaps the most atypical of the four groups. Households in the group associated with the proposed Delhi Township facility displayed characteristics departing from the norm to a lesser extent, and households in the allocation groups for Facilities One and Two in Lansing closely paralleled one another in most respects.

It would be a fair assessment to say that the survey group allocated to the Eagle Township facility typically reported households of above average size, including above average numbers of both elderly and children, and headed by individuals with less than average formal schooling and often retired. Households in this group were also predominantly satisfied with the existing health care system and opposed to the alternatives of national health insurance or health maintenance organizations. The group noted comparatively little difficulty in finding an available family physician, a willingness to travel considerable distances in their trips to the doctor, and an overwhelming reliance on the private automobile for such trips. The two medical complaints with a statistically significant variation among the four groups, cancer and skin problems, both were reported with less than average frequencies in the service area of the proposed Eagle Township facility. Lastly, no other group reported longer periods of residency, both in the four county study area and in individual neighborhoods.

The Delhi Township center group in review also gave the U.S. health care system largely high marks, although at the same time expressing favor toward a national health insurance program as well as membership in a health maintenance organization. Although still noting a very heavy reliance on automobiles for visits to the doctor, significant numbers of the Facility Three group indicated their use of public buses for such trips would increase if the physician's office was located near a bus stop. The group also expressed the greatest interest of the four facility-based divisions in available medical social services programs. Households in the group allocated to the proposed Delhi Township center were somewhat above average in size and noticeably more youthful in composition, including few retired heads of household. Most of those surveyed and included in the Facility Three group had resided in the four-county area well over a decade but far fewer had remained in their current neighborhood a similar period of time.

Households surveyed and ultimately apportioned to Facilities One and Two in Lansing shared many characteristics in common, including relatively few members per household and fewer numbers of children. Many households in these two groups were reported to be headed by highly educated individuals and, not uncommonly, retirees. Residential tenure among the households of both groups was shorter than average, especially with regard to transient changes of neighborhood. Incidence rates for cancer in both allocation groups were inflated sharply.

Skin problems were reported by an above average number in the South Lansing facility group, but were below the norm for the Saint Lawrence center allocatees. Interest in medical social services programs was low in both groups. The South Lansing center group reported greater difficulty in finding an available doctor than did those in the service area of the Saint Lawrence unit. The two groups shared an above average utilization of public buses for trips to the doctor as well as a substantial potential increase in bus use for such trips providing that physician offices are located near bus stops. Lastly, the South Lansing facility group stood apart as the only group giving the U.S. health care system a predominantly below average rating, although only by a slight margin. At the same time, this South Lansing group joined those of the Delhi Township facility in favoring both a program of national health insurance and membership in a health maintenance organization.

Many of the findings from this study's survey, at best, lend only qualified support to the conclusions of previous work reported in the literature. More importantly, however, the findings of this study suggest certain other areas and topics of concern in health care delivery which have not been addressed in past studies.

Although this study did uncover significant numbers of undoctored households in the Lansing area, other related findings did not bear out the types of criticisms which have been made of health care provision in other urban settings by Morrill, Earickson, and Rees (1970) and de Vise (1971), among others. At an aggregate level, the income and especially the educational levels of household heads in the undoctored group were sufficiently high to suggest that the households were

undoctored largely by their own volition. Such a conclusion also implies that the so-called sampling and evaluation strategy used by the Western New York Health Planning Council (1970) and concentrating upon seeking out a disenfranchised element in the population may have limited utility as a methodology for evaluating and improving health care provision.

Beyond this, the findings of this study also downplay the importance of transportation as a factor or impediment in seeking health care, despite conclusions to the contrary offered by Earickson (1970) and Weiss and Greenlick (1970). This study not only showed the undoctored willing to travel the distances necessary to receive health care but also noted fewer undoctored households in the outlying, rural area.

At the same time, the study uncovered several other factors of apparent importance in the provision of health care services. Regardless of whether or not households were currently served by a physician, there was substantial agreement that getting a prompt appointment with the physician was a serious problem. Also, there was considerable concern over the hours which physician services are normally available, with a large share of the undoctored group clearly desiring physician services to be available during the early evening hours. Lastly, length of residence in the study area and/or individual neighborhoods appeared to be a significant element, too, in the patient to physician association; the undoctored households identified in this study were clearly a more transient group than those served by a physician.

The following and final chapter of this study summarizes the findings of the three previous chapters which have dealt with the location-allocation analyses and the survey of population characteristics.

The last chapter also offers recommendations based on these findings and suggests topics which warrant further research beyond that of this study.

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CHAPTER VII

CONCLUDING SUMMARY AND RECOMMENDATIONS

The preceding chapters of this study have described a research problem and examined the literature bearing upon the problem. Other chapters have outlined a solution methodology and reported the subsequent findings. It is the purpose of this final chapter to conclude the study, recounting the most salient of the findings, offering plannin recommendations based on these findings, and suggesting certain topics worthy of further research.

Very briefly, there were at least three findings from the study which were considered to be of paramount importance. First, it was found that four health care centers could provide virtually the same level of service to the study area's undoctored population as could the proposed five facilities. At a more esoteric level, the findings from the study area survey cast doubts upon the potential success of the entire program in achieving its stated aims. For example, there was no significant evidence that the undoctored population accounts for a disproportionate share of the area's hospital emergency room use. Lastly, the incidence of some health problems showed significant variations in the population across the study area.

The balance of this chapter will address these and other points in greater detail. First, however, comments will be directed toward the findings of the location-allocation analyses since the later

discussions are premised in part upon the locations for the proposed health care facilities and their respective service area populations.

FACILITY LOCATIONS

A basic rationale for the establishment of the proposed primary care health centers is to bring such care to those in the population currently without a family physician. The sample survey of households in the study area showed 10 percent of the households and 9 percent of the actual population to be either without a family doctor or uncertain of their association with a general physician. The same survey revealed this undoctored population to be proportionately and numerically greater in the city of Lansing than in the surrounding area. In many areas of the city this undoctored segment approached or even exceeded one-fourth of the population, while the comparable rate in the outlying suburban and rural districts was typically closer to 10 percent.

To determine optimal locations for service facilities, this pattern in the distribution of the undoctored population was analyzed using a distance-minimizing symbolic or mathematical model. In a series of iterative steps this simulation model produced the optimal locations for the five health care service facilities presented in Chapter IV. However, one of the five proposed facilities, at a location in rural Dallas Township, was shown in the model to be impractical due to its small service area and low level of anticipated utilization.

An alternative service plan using four centers rather than five appeared to offer superior results. Based on the model, this alternative produced greater equity of demand among the service centers with only a very modest increase in aggregate travel distance and more tenable demand levels at each of the four centers. In addition to the existing facility at the fixed Saint Lawrence Hospital site, service centers under this plan were also proposed for locations in south Lansing, Delhi Township south of Lansing, and Eagle Township to the west of the city.

Other points should be mentioned here, too. In further trials, revisions of the location-allocation model to conform to projected population growth and losses across the study area for 1980 and 1990 did not yield any appreciable changes in the optimal locations for the four health centers. In these latter trials the demand for physician services was not adjusted beyond the projected changes in the base populations for the various zones within the study area, i.e. the proportion of undoctored individuals was assumed to remain constant over time in each of the respective zones established for the study's survey.

Also, it might be noted that the service area for the fivecenter plan's Dallas Township facility is subsumed by the Eagle Township facility under the preferred four-center plan. This point is made to underscore the fact that the findings of this study need not be considered solely for implementation of the four-center service plan. In the event that the five-center plan is deemed preferable, the characteristics of the potential users of Facilities One, Two, and Three do not vary radically under the two plans, and the population in the service area of the Dallas Township center could be assumed to share many of the characteristics of the group allocated to the Eagle Township facility under the four-center plan.

One final option to the four-center service plan which would augment the delivery of service in the rural areas west of Lansing would utilize

some form of a weekly or bi-weekly mobile physician unit serving the smaller and scattered communities. Such a mobile delivery of service would effectively cut the travel distances otherwise separating physician care and residences in this outlying district. The service capabilities of a mobile unit, of course, could also be offered in other geographical areas and utilized as needed for special situations demanding on site health care.

Clearly, these findings which have been suggested to favor a four-center service plan over the original five-facility plan represent the most important and far reaching product of the study. Other factors in the planning and decision-making processes may preclude such a significant departure from the anticipated program design; however, it would seem prudent to give serious consideration to these findings which point toward a more viable and successful program to expand primary care health services.

THE UNDOCTORED GROUP

As stated earlier, the distribution of the undoctored population was used in the location-allocation analyses to determine the optimal locations for the health care facilities and their respective service areas. In many respects this undoctored group showed striking contrasts to their counterparts already served by a family physician. A better understanding of the former group's characteristics is important both to ascertain the causes of their undoctored status and to better single them out as the targeted population for the proposed health facilities.

Understandably, the undoctored group did not give the existing U.S. health care system a high rating and also expressed much more

interest in national health insurance and health maintenance organizations than did the households currently served by a family physician.

Socioeconomically, most of the undoctored households were below average in size, often containing just one or two persons, and seldom including persons either over age sixty-four or under age eighteen. These same households without physicians typically reported shorter than average periods of residency both in the four county study area and in individual neighborhoods. Incomes indicated by the undoctored group were only very slightly below the norm for the study area, although the group included fewer retirees heading households and an average to above average proportion actively employed. There was no significant difference in educational levels for household heads on the basis of family physican association.

Many of these findings raise serious questions concerning the intent and potential efficacy of the program to enlist the undoctored group in the planned expansion of primary care health services. First, the undoctored households surveyed in this study did not lend strong support to the program's premise that such households rely unduly upon hospital emergency room facilities in lieu of family physician services. Second, the findings suggest that many of the households without a family physician are undoctored by choice and may elude any concerted efforts by others to bring them under primary health care. Relatively few of the undoctored households included children or elderly, the age categories commonly making the most use of physician services. A high degree of residential transiency was typical of the households without a family physician, and income, education, and employment characteristics for the group all pointed toward the fact that the group is not ignorant

of the importance of health care or the availability of health care services.

These findings and conclusions suggest that the primary care health program should not be aimed solely at the undoctored population but instead should anticipate that a substantial portion of the persons ultimately utilizing the proposed new physician services will likely come from outside the existing undoctored group--both from among new migrants into the study area and from among the clientele of other established physicians. In line with this reasoning, the subsequent examination of prominent characteristics among the populations associated with the service areas for each of four proposed centers was expanded to include the members of all the surveyed households, regardless of their affiliation or lack of affiliation with a family doctor.

POPULATION CHARACTERISTICS FOR EACH OF THE PROPOSED SERVICE FACILITIES

Generally, the most distinctive responses on the survey items came from the households associated with proposed Facility Four in rural Eagle Township and, to a lesser extent, from the households in the suburban Delhi Township center group. Survey respondents ultimately linked to the facilities at Saint Lawrence Hospital and in south Lansing shared many of the same characteristics, based on their answers to the survey items. However, in sum the differences noted in the population groups allocated to each of the four facilities lacked the degree of contrast seen between the doctored and undoctored households.

The group allocated to the Eagle Township service center generally reflected a rather staid, conservative population. On the whole, this group expressed satisfaction with the existing health care system and

relatively little interest in the alternatives of national health insurance and health maintenance organizations. The periods of residency reported by this group, both in neighborhoods and in the study area, were longer than those of the other three groups. Above average numbers of both elderly and children in the group's households contributed to typically large households, headed by individuals with lower levels of formal education and frequently retired. Relatively few in the group reported difficulty in finding an available doctor, although actual or anticipated residence to physician travel distances were long as one might expect.

High marks for the existing health care system also came from the Delhi Township facility group, although the majority here tempered their approval with expressions of favor for a program of national health insurance and membership in a health maintenance organization program. The group showed a high level of interest in available medical social services. Automobiles were still the overwhelming travel mode for trips to the physician, although many indicated that they would utilize public buses for such trips if the doctor's office was located near a bus stop. Households in the group were of slightly above average size, with substantial numbers of dependent children and very few retired heads of household. Finally, the suburban character of the Facility Three service area was reflected in the residential tenure pattern for the group which showed most of the group had resided in the study area for at least ten years but in their current neighborhoods for a far shorter period of time.

Among the households surveyed and ultimately allocated to either the Saint Lawrence Hospital facility or the South Lansing facility,

many were headed by individuals with extensive formal educations and, often, retired from active work. Households in these two groups were also small in size with relatively few children. Residential transiency was yet another shared characteristic and especially prevalent in terms of neighborhood changes. Both groups shared an above average utilization of public buses and taxis for trips to the doctor as well as the potential for even greater public transit use in such trips providing the physicians' offices are located near a bus stop. Despite these similarities, the group linked to the South Lansing facility reported greater difficulty in finding an available doctor than did those in the service area of the Saint Lawrence Hospital service center. Lastly, although the South Lansing center group expressed overall favor toward both national health insurance and health maintenance organization membership, they also represented the lone group giving predominantly negative marks to the existing U.S. health care system. The Saint Lawrence Hospital allocatees, on the other hand, rejected the idea of joining a health maintenance organization, split their opinions on national health insurance, and gave a decidedly favorable assessment of the existing health care system.

In addition to these differences among the facility-based groups, there were also some significant contrasts in the incidence of particular health problems; however, these variations were not limited to just the four groups and, in some cases, were noticeably more pronounced among the thirty-three sampling zones established for the study.
VARIATIONS IN THE INCIDENCE OF SELECTED HEALTH PROBLEMS

Only two of the examined health problems, cancer and skin problems, showed a statistically significant variation among the four facilitybased groups. In the first case, cancer incidence was reported at a sharply higher rate in the groups surveyed and allocated to Facilities One and Two in Lansing; much lower rates were typical of the groups linked to Facility Three, and especially Facility Four in rural Eagle Township. Skin problems, on the other hand, showed the highest incidence in the population surveyed in the service area of the proposed South Lansing facility, with below average rates of reported occurrence among all three other groups.

Among all the thirty-seven health problems examined in the survey, the four most frequently reported were allergies, hemorrhoids and piles, digestive system problems, and arthritis and rheumatism. With the exception of allergies, these health complaints were all reported with greater frequency in the sampling zones within the city of Lansing, although each case also included some aberrations in this pattern. Allergies generally showed the reverse pattern, with the lowest rates of incidence almost exclusively among the sampling zones within the city boundaries of Lansing.

Four other medical problems, cancer, heart attack and stroke, respiratory difficulties, and pneumonia, which are often attributed to environmental factors were also examined in terms of incidence across the study area. Both respiratory problems and pneumonia appeared to vary in incidence randomly and independently of the rural to urban configuration or any other geographic pattern. In other cases, however, both heart attack and stroke and particularly cancer showed a sharply

increased rate of incidence in the urban zones of Lansing.

PLANNING RECOMMENDATIONS

The products of this study include both the knowledge gleaned from a fact finding survey and the results generated from the application of a computer-assisted location-allocation model. To the extent which these two elements have been successful individually and in complement to one another, subject to the study's assumptions and limitations, the following recommendations are seemingly supported by the findings:

- (1) Four facilities, rather than the originally proposed five, should be established. The concentration of the undoctored target group in and near to Lansing creates a situation where a fifth service center, even if optimally located, would not significantly improve the accessibility of primary care for residents of the study area.
- (2) In addition to the existing facility at Saint Lawrence Hospital, other primary care centers should be built at locations in south Lansing, Delhi Township, and Eagle Township.
- (3) Although the locational studies of this research were not site specific, the survey findings suggest that the south Lansing and Delhi Township service centers should be located on or near the routes serviced by public buses. Substantial population numbers in these areas indicate reliance on public transit for trips to the doctor, and many more noted the potential for bus utilization in such trips, provided that doing so was convenient.
- (4) Resources previously set aside for a fifth primary care center might be directed toward a mobile service unit making visits to the outlying areas west of Lansing where physician demand is relatively low and scattered but where residence to physician travel distances are greater.
- (5) Recommended facility locations should be considered as permanent locations for all practical purposes. Foreseeable population shifts in the study area through 1990 will not appreciably change the optimal locations for the proposed facilities.

- (6) The south Lansing facility should be established first, followed by the Delhi Township and Eagle Township centers, respectively. This order of priority will maximize the immediate impact of the program by first placing the service centers in the areas with the greatest concentrations of undoctored population.
- (7) The proposed primary care service facilities should not expect large scale or immediate utilization from the study area's undoctored population. Substantial numbers of the undoctored households possess socioeconomic characteristics which suggest that they are without a family physician by free choice and may remain so.
- (8) Even following their establishment, the proposed primary care facilities may not significantly reduce the demand on the emergency room staff and facilities at hospitals in the area. Survey results show that the undoctored households and those with doctors are relatively similar in their frequency of emergency room use.
- (9) Personnel staffing the proposed facilities should consider offering their services in the early evening hours. Nearly one-half of the undoctored population stated their preference for this time period for visits to the physician.
- (10) In the planning, staffing, and facilities for each of the four proposed centers, attention should be given to the following special characteristics found from the survey:
 - a. in the population of the service areas of the Saint Lawrence Hospital and south Lansing facilities--large numbers of retirees and well-educated persons heading one and two member households, and an elevated incidence of cancer and skin problems.
 - b. in the population of the service area of the Delhi Township center-households of above average size, often including children under age eighteen but few elderly.
 - c. in the population of the service area of the Eagle Township facility--larger households including both elderly and children and often headed by retirees and individuals with lower levels of formal education.

As is the case with most research, especially in the social sciences, this study has raised as many questions as it has answered. It is fitting to close this chapter and this study with some ideas about areas of further research which would complement the goals and findings of this study.

TOPICS FOR FURTHER RESEARCH

One of the most important shortcomings of this study, and realized only near its end, was the lack of first-hand information on why the undoctored were indeed undoctored. It would be highly informative to conduct a selective survey of the undoctored, asking their personal explanation as to why they have not enlisted the services of a general physician. The same survey could be used to determine if, and to what extent, their health may have suffered as a result of being without a physician. Ultimately, such a study might confirm or reject the tentative conclusions from this completed study which suggest that many of the undoctored are without a physician by their own choice.

A second outgrowth of the research presented here would focus on the group utilizing the emergency room facilities of the area hospitals. It was found in this study that many of the undoctored households would prefer to make physician visits in the evening hours. Since most doctors are not available for private services except during the day, emergency room use may be higher during the evening and night because of the lack of other alternatives. If this was found to be true, the most effective strategy would be an educational program encouraging the chronically and non-critically ill to seek the aid of a physician before a crisis develops and there is no alternative short of emergency

room care. Also, there is the problem of health insurance regulations which clearly exacerbate the problem of emergency facility over use. In many cases, insurance policies require that medical treatment must be of an emergency nature to qualify for reimbursement. This situation, unfortunately, encourages many individuals to seek emergency room services at hospitals for non-emergency types of problems. The end result is a paradox, because the insurance firms invariably must pay the inflated costs associated with emergency care; eventually of course these higher costs are passed on to the consumer as higher insurance premiums. An in depth study of emergency room use could document the nature and extent of any problems attendant to health insurance regulations, perhaps suggesting measures to solve any problems found to be present.

The locational recommendations produced in this study were purposely not site specific, but geared toward evaluating more general locational alternatives based on the distribution of undoctored households. Implementation of the primary health care expansion should go beyond this study's recommendations to also consider the impact of any planned facilities in the local neighborhoods. In some instances, public sentiment and considerations regarding such development may affect the success of the center adversely.

Officials of Saint Lawrence Hospital or other health care planners in the Lansing area should also consider conducting a follow-up study after the primary care centers become established. Such a study would serve to evaluate the program's effectiveness among the undoctored population of the study area and among those expected to use each primary care facility.

Also, additional research seeking locations for the primary care centers to be established under this program might re-examine the problem from the viewpoint of morbidity patterns in the study area. Such an approach could perhaps focus more directly upon the actual need for such health care services, and lend supporting evidence or adjustments to the conclusions reached in this study.

Finally, it would seem that the findings in this study should serve as a mandate for additional investigations of the incidence of specific medical problems in the population of the Lansing area. The completed study showed sharply higher rates in the occurrence of cancer and heart attack in the city of Lansing. Further research could verify or refute this observation and, if it is found to be true, seek to identify and correct the underlying causes.

APPENDIX A

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Survey Questionnaire

DEPARTMENT OF GEOGRAPHY

EAST LANSING · MICHIGAN · 48824

A COMMUNITY HEALTH CARE NEEDS SURVEY

TO: Residents of Clinton, Eaton, Ingham, and Ionia Counties

SUBJECT: A Survey of Community Health Care Needs

Dear Householder:

Over the next several years a number of community health facilities will be established in the Lansing area to increase the availability of family doctors. As part of my educational program at Michigan State University, I have agreed to make this survey of community health care needs. Those of us involved with the project feel that you will want to contribute to the planning for these health care facilities and services in your community. The attached questionnaire will help communicate your needs and desires to us.

Your participation in this survey is voluntary, of course. We realize that some of the information on the questionnaire is of a sensitive nature. We have taken measures to ensure that your name will in no way be used in the results of the survey; nor will the information be stored in any way which could reveal your identity. Your responses to this questionnaire will be combined with the answers provided by more than 2000 other households which have also been selected randomly from the Lansing area.

A questionnaire and pre-addressed, stamped envelope are enclosed. Please take the few moments necessary to complete the questionnaire and mail it back as soon as possible. We would like to have the completed questionnaire returned within three days.

We are grateful for your participation in this survey. If you have any questions about this survey, please call me at (517) 351-5898 or 355-4657. Thank you again for assisting in our planning efforts.

Sincerely,

D. Den V

William D. Bennett

COMMUNITY HEALTH CARE NEEDS SURVEY

A. General Opinions Towards Health Care

Please circle the one choice you feel best answers each question.

1. How would you rate the overall system of health care in the United States today?

EXCELLENT ABOVE AVERAGE AVERAGE BELOW AVERAGE POOR

2. Do you favor or oppose a national health insurance program which would combine federal government, employer, and employee contributions into one federal health insurance system that would cover all medical and health expenses for everyone?

FAVOR OPPOSE NOT SURE

3. Would you be interested in having your household become part of a pre-paid group medical care program, such as a health maintenance organization or HMO?

YES NO NOT SURE

B. Household Health Care Characteristics .

Please circle the one choice you feel best answers each question.

4. Does your household have a doctor to whom you can go if someone in the household is sick or injured (other than a hospital emergency room)?

YES NO NOT SURE

5. How far from your place of residence is your doctor's office? <u>or</u>, if you do not have a doctor, what is the farthest you feel is reasonable to travel to see one?

O-half mile half-1 mile 1-2 miles 2-3 miles 3-5 miles

5-10 miles 10-15 miles over 15 miles

6. How many total times in the past year have any of the persons in your household used a hospital emergency room?

NONE ONE TWO THREE FOUR FIVE SIX SEVEN EIGHT OR MORE

7. How many persons in your household require special transportation to get to the doctor's office (because of a physical handicap, etc.)?

NONE ONE TWO THREE FOUR FIVE SIX SEVEN EIGHT OR MORE

8. Other than special transportation, how do (or would) those in your household normally get to the doctor's office?

WALKING PERSONAL CAR WITH A FRIEND IN A TAXI ON A BUS

9. If the public busses stopped very near your doctor's office would you use the bus to get to his or her office?

YES NO NOT SURE

- 10. If your doctor's office was open 24-hours-a-day, which time would you generally find the most convenient for those in your household to visit the doctor?
 - 12 NOON 3 PM 3 PM 6 PM 6 PM 9 PM 9 PM 12 MIDNIGHT 12 MIDNIGHT - 3 AM 3 AM - 6 AM 6 AM - 9 AM 9 AM - 12 NOON
- 11. Does the head of your household have some type of health insurance coverage, such as Blue Cross/Blue Shield, Medicare or Medicaid, or a commercial policy?

YES NO NOT SURE

The following list includes some of the problems people have found when seeking medical care from doctors. How serious is each of these problems for you?

12. Finding an available doctor who will see me or a member of my household.

GREAT PROBLEM SMALL PROBLEM NO PROBLEM

13. Getting a prompt appointment with the doctor when I or a member of my household needs medical attention.

GREAT PROBLEM SMALL PROBLEM NO PROBLEM

- 14. Language differences which make it hard to talk to the doctor. GREAT PROBLEM SMALL PROBLEM NO PROBLEM
- 15. Paying for the doctor's services.

GREAT PROBLEM SMALL PROBLEM NO PROBLEM

16. Finding transportation to the doctor's office.

GREAT PROBLEM SMALL PROBLEM NO PROBLEM

A great variety of health-related programs are available in the Lansing area today. Do you feel your household needs more information about any of the following subjects, programs, or services?

17. Birth control, sex education, or other sex-related matters?

YES NO NOT SURE

18. Diet and nutrition information?

YES NO NOT SURE

19. Alcohol treatment programs or other drug-related programs?

YES NO NOT SURE

20. Medical social services?

YES NO NOT SURE

21. Visiting nurses programs?

YES NO NOT SURE

22. Health care for elderly persons?

YES NO NOT SURE

23. Mental health care services?

YES NO NOT SURE

C. Household Medical Characteristics

Please fill in the blank to indicate the <u>total number of persons</u> in your household now who have the following health problems:

- _____ 24. arthritis or rheumatism
- 25. diabetes
- _____ 26. foot problems
- _____ 27. hearing impairment (non-correctable)
- 28. speech impairment (non-correctable)
- 29 eyesight impairment (non-correctable)
- _____ 30. allergies or hay fever

- _____ 31. untreated dental problems
- 32. menstrual problems
- 33. high blood pressure (hypertension)
- 34. sickle cell anemia
- 35. other forms of anemia
- _____ 36. frequent nervousness or the feeling that "your nerves are shot"
- _____ 37. frequent skin troubles, such as eczema, psoriasis, rashes, hives, etc.
- _____ 38. frequent respiratory problems, such as bronchitis, asthma, emphysema, etc.
- _____ 39. frequent digestive system problems, such as upset stomach, ulcer, heartburn, gas, diarrhea, constipation, gall bladder attacks, etc.

Please fill in the blank to indicate the total number of persons in your household who have ever had the following health problems:

- 40. a heart attack or stroke
- 41. a form of cancer
- 42. hemorrhoids or piles
- 43. trouble with varicose veins

Please fill in the blank to indicate the total number of persons in your household who have had the following diseases in the past year:

- _____ 44. chicken pox
- _____ 45. diptheria
- _____ 46. encephalitis (sleeping sickness)
- 47. German measles (rubella, 3-day)
- _____ 48. gonorrhea (clap)
- _____ 49. hepatitis (yellow jaundice)
- 50. measles (8-day or red)
- _____ 51. meningitis
- 52. mononucleosis (kissing disease)

- _____ 53. mumps
- 54. pneumonia
- 55. rheumatic fever
- 56. scarlet fever
- _____ 57. shingles
- _____ 58. strep throat
- _____ 59. syphilis
- _____ 60. whooping cough

D. General Household Characteristics

Please circle the one choice you feel best answers each question.

- 61. How many persons are there now in your household? ONE TWO THREE FOUR FIVE SIX SEVEN EIGHT OR MORE
- 62. How many persons in your household are 65 years old or older? ONE TWO THREE FOUR FIVE SIX SEVEN EIGHT OR MORE
- 63. How many persons in your household are 17 years old or younger? ONE TWO THREE FOUR FIVE SIX SEVEN EIGHT OR MORE
- 64. What is the employment status of the head of your household? EMPLOYED UNEMPLOYED OR LAID OFF RETIRED OTHER (student, housewife, etc.)
- 65. What is the highest level of formal education <u>completed</u> by the head of your household? NONE GRADE SCHOOL HIGH SCHOOL COLLEGE
- 66. How long have you lived in the Ingham, Eaton, Clinton, or Ionia County area? LESS THAN 1 YEAR 1-2 YEARS 2-3 YEARS 3-5 YEARS 5-10 YEARS MORE THAN 10 YEARS

- 67. How long have you lived in your present neighborhood?
 LESS THAN 1 YEAR 1-2 YEARS 2-3 YEARS 3-5 YEARS
 5-10 YEARS MORE THAN 10 YEARS
- 68. What was the total income for your household in 1977, before taxes were paid--including earnings, social security, pensions, interest, dividends, etc.?

0-\$2,999 \$3,000-\$4,999 \$5,000-\$6,999 \$7,000-\$9,999 \$10,000-\$14,999 \$15,000-\$24,999 \$25,000 or more

Thank you for completing all of the questions in this survey. Please return the survey in the enclosed envelope. No postage is necessary.

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APPENDIX B

Request and Approval Statement for Survey from the University Committee on Research Involving Human Subjects

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DEPARTMENT OF GEOGRAPHY

EAST LANSING + MICHIGAN + 48824

November 16, 1977

To: University Committee on Research Involving Human Subjects

From: William D. Bennett, Ph.D. Candidate

SUBJECT

This report deals with a questionnaire survey to be administered as a basic data gathering device for a Ph.D. study in Geography tentatively entitled "A Location-Allocation Planning Study for Primary Health Care Facilities in the Lansing, Michigan Area." Briefly, the research is designed to assess spatial variations in community health care conditions and needs, ultimately leading to recommendations concerning the locations and services for future health care facilities in the Lansing area to be established by the Saint Lawrence Hospital. The Saint Lawrence Hospital is supporting this study to the extent of paying some or all of the postage and printing costs associated with the mail-out questionnaire; however, the Hospital is not funding the project otherwise.

PROJECT OVERVIEW

An overview of the project is provided from the following dissertation proposal excerpts:

In July of 1977 Saint Lawrence Hospital of Lansing was awarded a \$500,000 grant intended to "improve people's access to medical services by establishing and sponsoring primary care group medical practices." It is hoped that the creation of five new primary group practices, made possible through the grant, will reduce the presently high proportion of "undoctored" patients seeking emergency room care at the Hospital.

The primary goal of the proposed study will be to determine the optimal locations for the group practices in the community. A secondary goal of the study will be the abstraction of geographically-based sociomedical profiles for each of service areas determined for each "optimally" located group practice. This latter phase of the research will examine the salient characteristics of the user populations for dimensions such as age, mobility, and disease incidence. This information will be gathered in a questionnaire survey and, following statistical analyses, may suggest user characteristics which will influence the staffing, facilities, and programs of the individual clinics.

QUESTIONNAIRE AND SAMPLING

The questionnaire will be administered in a mail-out, mail-back procedure to some 3,000 households in the greater Lansing area--selected from the <u>Polk City and Suburban Directories</u> and the <u>Lansing Area Telephone Directory</u>. Since the research design requires a minimum 50% return rate of the surveys within each of about 30 discrete geographic zones, it will be necessary to maintain a list matching households and coded questionnaire identification numbers until this 50% return rate is secured. In other words, this procedure will allow a follow-up phone call to those households which fail to return questionnaires; this follow-up call will <u>not</u> coerce a response or harass the party, but rather verify the receipt of the mailed questionnaire, learn if the household wishes to participate in the survey, and, if necessary, to send these households a replacement for a lost or unreceived questionnaire. Identifying names and addresses of sampled households will be destroyed as questionnaires are returned, and all names and addresses drawn for the survey sample will be similarly destroyed when the desired sampling fraction is achieved for each geographic zone. Furthermore, all analytical phases of the study will involve only aggregated data--in no event will the study focus upon health or other characteristics which would be identified with a single household. Nor, of course, will the study otherwise identify any individual household by name or address.

A copy of the questionnaire and cover letter is attached.

FACULTY APPROVAL

Dr. Stanley D. Brunn, Chairman of my dissertation committee, as well as the other members of the committee have found the proposed dissertation study satisfactory, including the questionnaire survey phase. Dr. Brunn is currently out of town; however, you may contact him at 353-8760 if necessary.

QUESTIONNAIRE PRE-TEST

A pre-test of the questionnaire will be administered to approximately fifty households in the Lansing area for a general evaluation of the questions and responses on the survey instrument. Any substantive changes in the questions as a result of the pre-test will be brought to your committee's attention. It is hoped to begin the pre-test in early to mid-January.

I believe that the above summary and the attached questionnaire and cover letter will be sufficient for your committee's review. If you require any additional information or clarifications, please call me at 355-4657.

Thank you for your attention to this matter.

Sincerely,

William D. Bennett

MICHIGAN STATE UNIVERSITY

OFFICE FOR RESEARCH DEVELOPMENT

EAST LANSING · MICHIGAN · 48824

December 6, 1977

Mr. William D. Bennett Department of Geography 315 Natural Science Building

Dear Mr. Bennett:

Subject: Dissertation Project Entitled "A Location-Allocation Planning Study for Primary Health Care Facilities in the Lansing, Michigan Area"

The above referenced project was recently submitted for review to the University Committee on Research Involving Human Subjects (UCRIHS).

We are pleased to advise that this review indicated that the rights and welfare of the human subjects appear to be adequately protected and the Committee, therefore, approved this project at its meeting on December 5, 1977.

Thank you for bringing this project to our attention. If we can be of any future help, please do not hesitate to let us know.

Sincerely,

Henry E. Bredeck Chairman, UCRIHS

jms

cc: Dr. Stanley D. Brunn

SELECTED BIBLIOGRAPHY

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SELECTED BIBLIOGRAPHY

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