

.

#### AN APPROACH TO PLANNING A PRIMARY HEALTH CARE DELIVERY SYSTEM IN JEDDAH, SAUDI ARABIA

by

Abdulaziz Sagr Al-Ghamdi

#### A DISSERTATION

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

DOCTOR OF PHILOSOPHY

Department of Geography

#### ABSTRACT

#### AN APPROACH TO PLANNING A PRIMARY HEALTH CARE DELIVERY SYSTEM IN JEDDAH, SAUDI ARABIA

by

Abdulaziz Sagr Al-Ghamdi

As urbanization in less developed countries accelerates, the absence of planning and appropriate social services becomes increasingly problematic. One important social service component is a health care delivery system. The urban areas in Saudi Arabia have grown rapidly in the last decade because of the high immigration but experience a lack of vital public services, including health care delivery. The purpose of this study is to study the inadequacy of primary health care services and to present a quantitative model that may be used to plan for an equitable delivery system in Saudi Arabian cities. The City of Jeddah was selected for detailed analysis.

The objective of the study is to develop a program for locating governmental health care service dispensaries that will be within access, not exceeding ten minutes travel time, for every inhabitant of Jeddah. Three major steps were used in the study: (1) study of the users' perceptions regarding existing facilities; (2) a determination of the total number of potential service centers needed for the city based on varying trip time thresholds and the district areas of the city assuming the existing traffic flow system; and (3) assignment of potential service centers in the city (for selected areas). To achieve these goals, a field investigation was conducted. A sample of 400 users were interviewed, most of whom preferred using the public dispensaries to other facilities. The majority wanted primary services, located within ten minutes travel time and more than half were found to use public dispensaries for emergency cases.

Within the city 42 selected potential service centers (with regard to trip time) were identified. The final goal was to assign the potential service centers for various trip thresholds. The enumeration technique of integer linear programming was employed to obtain the minimum number of service centers for various time constraints. Results indicated that within five minutes, 39 centers can be considered. Within 10 minutes 27 centers are possible and within 15 minutes 23 centers can be assigned in the city. Recommendations for implementation and further study are stated. To the memory of my father--

I dedicate this work

#### ACKNOWLEDGEMENTS

I wish to express my gratitude and appreciation to Professor Ian M. Matley, committee chairman, for his guidance and comments. I am also indebted to Professor Assefa Mehretu who devoted several hours to directing me with his helpful suggestions. My thanks to Professor David Campbell and Professor Sanford Farness for their willingness to serve on the committee and their helpful comments. Sincere appreciation and gratitude are extended to Professor Stanley Brunn, Chairman of the Geography Department at the University of Kentucky for his suggestions, comments and encouragement. To those in governmental offices who provided helpful information my deep thanks. I also want to thank the Department of Geography at King Abdulaziz University, Jeddah, and express my appreciation for the financial and moral support provided by the University of Umm Al-Qura, Mekkah.

Finally, my deep love and gratitude to my family, relatives and friends for their efforts, patience and support throughout my years of study and work that have culminated in this dissertation.

ii

# TABLE OF CONTENTS

Page

DEDICATION	i
ACKNOWLEDGEMENTS	ii
LIST OF TABLES	vi
LIST OF FIGURES	vii
Chapter	
I. INTRODUCTION	1
Statement of the Problem	2
The Objective of the Study	3
The Study Area	4
Organization of the Study	7
II. LITERATURE REVIEW OF LOCATION ANALYSIS OF HEALTH CARE DELIVERY IN CITIES	8
Contributions by Geographers to the Study of Public Services	8
Socioeconomic and Demographic Variations	9
The Hierarchy of Health Services	11
Attempts to Optimize the Location of Health Facilities	12
Utilization of the Emergency Room	14
Relevance of Literature to the Exist- ing Situation in Jeddah	17
III. METHODS OF THE STUDY	19

The Survey Method .... 19

Chapter

	The Travel Speed Movement Rates	22
	The Application of Linear Programming	23
IV.	CURRENT PATTERNS OF DISPENSARIES' USE AND CONDITIONS OF URBAN	20
		20
	The Socioeconomic Status of the Users	28
	Type of Transportation Used to Seek Health Care and Travel Time	
	Required	31
	Type of Medical Care Assistance Sought by Respondents	35
	Accessibility of Dispensaries and Their Demand	38
	Reasons for Choosing Dispensaries and How Users Rate Health Care	
	Services	43
	Preference for Dispensaries for Emergency Use	49
	The Existing Conditions of	52
	The Travel Speed on Current Poads	57
	me fraver speed on current koads	74
v.	ASSESSMENT OF POTENTIAL SERVICE CENTERS FOR HEALTH DISPENSARIES	61
	Selection of Potential Service Centers (PSC's)	61
	PSC's within the Five Minute	65
	PSC's within the Ten Minute	00
	Threshold Constraint	68
	PSC's within the Fifteen Minute Threshold Constraint	70

# Chapter

•

# Page

	Relocatin ilities	ng the Ex	isting F	ac- •••	•••	• •		74
	PSC's whi TTT's	ich Appea	r in all	Three		•••		76
VI. CO	NCLUSIONS	AND RECC	MMENDATI	ONS	• •	•••		80
	Conclusio	ons			••	•••		80
	Recommend	lations		• • •	•••	•••		83
	Strategy	for Impl	ementati	on .	••	•••		85
	Need for	Further	Study on	Healt	'n			
	Care .	• • • •	• • • •	• • •	••	••		86
• • • • •	• • • • •	• • • •	• • • •	•••	• •	•••	••	•••
BIBLIOGRAP	ну	• • • •	••••	•••	• •	•••		87
APPENDIX		• • • •		• • •	••			94

# LIST OF TABLES

Table		Page
1.	Occupations of Survey Respondents	29
2.	Type of Housing in which the Respon- dents Live	30
3.	The Respondents Travel Time Prefer- ence to Seek Health Care	34
4.	Types of Medical Facilities Patronized by Respondents	36
5.	Respondents' Perceptions of Dispen- sary Accessibility	43
6.	Respondents' Reasons for Choosing a Dispensary	45
7.	Types of Medical Facilities Pre- ferred for Emergency Cases	50
8.	Purposes for which Respondents Use Dispensary Services	51
9.	Assigned PSC's within Five Minutes TTT	66
10.	Assigned PSC's within Ten Minutes TTT	69
11.	Assigned PSC's within Fifteen Minutes TTT	72
12.	PSC's which Appear in all three TTT's .	77

# LIST OF FIGURES

Figure		Page
1.	Map of the Study AreaJeddah City	5
2.	The Location of Existing Public Health Dispensaries	21
3.	District Boundaries within Jeddah	24
4.	The Respondents' Monthly Income Levels	32
5.	Types of Transportation Respondents Use to Travel to the Dispensaries	33
6.	The Percentage of Respondents Using the Four Types of Medical Facilities	37
7.	Distances Travelled to the Dispen- saries, by Percentage	40
8.	Distances Travelled by Respondents to Reach each Dispensary, by Percentage	41
9.	Maximum Distances Respondents are Willing to Travel to a Dispensary	44
10.	Respondents' Attitudes toward Health Services at Dispensaries	47
11.	Respondent Ratings of Services Avail- able at Existing Dispensaries	48
12.	Purposes for which Respondents Use each Dispensary	52

# Figure

13.	Speed Travel Time Measurements at 8:00 a.m	56
14.	Speed Travel Time Measurements at 4:00 p.m	57
15.	Speed Travel Time Measurements at Midnight	59
16.	The 42 Selected PSC's for Jeddah	63
17.	Population Gravitational Points in Jeddah	64
18.	Selected PSC's within Five Minutes TTT	67
19.	Selected PSC's within Ten Minutes TTT	71
20.	Selected PSC's within Fifteen Minutes TTT	73
21.	Relocating Existing Health Facilities	75
22.	The PSC's that Appear in all Three	78

#### CHAPTER I

#### INTRODUCTION

Urban and social geographers are aware of the political, economic and social problems facing urban areas, of which health care delivery is one component (Cox, 1973; Brunn, 1974; Berry, 1968; Johnson, 1976; Haggett, 1977; Herbert, et al. [eds], 1979). During the last two decades most studies of health care have emphasized the importance of distance, time, socioeconomic conditions and accessibility of medical care services in cities. Morrill, et al. (1970) focused on the factors influencing distance travelled to hospitals. With the modern life saving technologies available, response time has become increasingly significant in the survival of patients who could not have been saved even a few years ago (Mayer, 1980). The characteristics of location have thus become worthy of study as planners seek the optimum location for a city's medical services (Rushton, 1979). Health care delivery planning is one of the areas in which geographers have made significant contributions to solving people's problems especially in the developed countries.

The spatial behavior and welfare of the patients ultimately are the most important considerations in health care delivery studies (Earickson, 1970, 1972; de Vise, 1973).

The main purpose of geographical and non-geographical studies regarding health care delivery has been to increase availability, accessibility, quality and distribution of health centers. An attempt has been made to locate these centers to improve the accessibility of each and to insure that patients can easily reach a facility within a short time. Unlike the advanced health care delivery available in the urban and industrialized nations, most of the less developed countries face a lack of availability, inaccessibility and low quality of health care facilities and delivery planning that can offer basic services in urban and rural areas simultaneously (Good, et al., 1979; Kleozkowski, 1976).

#### Statement of the Problem

As urbanization in less developed countries continues to increase at unprecedented rates, the issues of planning and implementing appropriate social services have become increasingly complex. One of the major urban problems in these countries is a lack of efficient and equitable systems of health care delivery. Since everyone has a basic need for, and the right to, medical care; services need to be available at reasonable cost within reasonable proximity for all inhabitants. The urban areas in Saudi Arabia have grown rapidly in the last decade but they experience a lack of vital

public services, including health care. Health care delivery systems in urban areas currently do not insure a reasonable level of service. The purpose of this research is to measure the seriousness of the inadequacy and to present a quantitative model that may be used to plan for an equitable delivery system in Saudi Arabian cities. The City of Jeddah is selected for detailed analysis because it is one of the major cities in the country and because it presents useful research possibilities for investigating the spatial dimensions of health care delivery in some detail. It is hoped that the results of the research will have useful applications in other cities of Saudi Arabia, or elsewhere in urban areas of the developing world.

#### The Objective of the Study

The main objective of this study is to develop a program for locating governmental dispensaries of health care services that will be within access, not exceeding ten minutes travel time, for every inhabitant in Jeddah City. To achieve this objective, three steps will be followed: (1) study of the users' perceptions regarding existing dispensaries and their conditions; (2) a determination of the total number of potential service centers needed for the city based on the trip time threshold and the areas of the city with the

existing traffic flow systems; and (3) assignment of potential service centers for the selected facilities.

In order to achieve the previous objectives, a field investigation has been conducted, the design which is explained in Chapter III and the results summarized in Chapters IV and V.

#### The Study Area

Jeddah is situated in western Saudi Arabia on a coastal plain east of the Red Sea at 21° 30' north and 39° 12' east (Figure 1). Jeddah's location enables it to dominate the western region, since it has the major international airport, seaport, major wholesaling and retailing facilities for the region. Jeddah is also the main transit point for most travelers making their pilgrimages to the Holy City of Mekkah. It, thus, is called upon to provide comprehensive services, not just for the western region but for the whole country.

The city is increasingly expanding outward to the north and east, its direction of growth influenced by main transport routes north to the new airport and Medina City, and east toward the City of Mekkah. Implementation of the government's five year plan has contributed loans to businesses and the public for project and residence construction.



Figure 1. Map of the Study Area - Jeddah City

Major commercial and bank activities are concentrated in the city's central business district while retail services are distributed throughout the city's districts. Expansion of the city usually involves a mixture of residential and commercial development (Al-Ghamdi, 1979). In the residential areas the socioeconomic groups are mixed. In every district there are both high income people and low income people living side-by-side. No segregated districts for specific classes exist, although there are areas for those groups that like to live close to each other.

Within the last decade, Jeddah has experienced a growth that has more than doubled the population. In 1971 the population was estimated at 381,000 (Ministry of Interior, 1972), while it may now exceed 800,000. Of the present population, about 47 percent are Saudis and 53 percent are non-Saudis (Ministry of Municipality and Rural Affairs, 1980). Jeddah's growth is related to the variety of its job opportunities, that draw immigrants from the rural areas to the city, and a large influx of laborers from other Arab countries, such as Africa, India, Pakistan and southeast These laborers work in both the private and public Asia. sectors in industries such as constructions and manufacturing. European and North American immigrants are generally employed in the technical areas.

Many of the problems the city currently faces are the result of rapid growth and the lack of a carefully planned system of social services. There is currently no coordination or policy for formal cooperation between public service agencies to provide comprehensive services and avoid future service gaps and duplication. Among Jeddah's major problems is the lack of an adequate health care delivery system.

#### Organization of the Study

This study is divided into six chapters. In Chapter II the literature on the location analysis of health care delivery in cities will be reviewed. The survey design and methodology are discussed in Chapter III while the current patterns in use of dispensaries and conditions of urban accessibility are analyzed in Chapter IV. In Chapter V the selection and assessment of potential service centers for health dispensaries are presented. The final chapter will present conclusions and recommendations.

#### CHAPTER II

#### LITERATURE REVIEW OF LOCATION ANALYSIS OF HEALTH CARE DELIVERY IN CITIES

A number of research contributions have been made by geographers and non-geographers in the field of health care delivery in the last two decades. These include a study by Godlund (1961) of planning locations for regional hospitals in Sweden; Gould and Leinbach's (1966) presentation of an approach for the geographic assignment of hospial services in Guatemala; and the evaluation by Shannon, et al. (1975) of the geographic accessibility of health services in the Cleveland metropolitan area. These studies have provided a useful conceptual framework for this study as well as suggesting techniques which may be used for planning systems of health care delivery in urban areas of less developed countries.

#### Contributions by Geographers to the Study of Public Services

Most of the attention in public service location research has been devoted to developing locations for shopping centers, while social services, such as for health care, have been neglected until recently (Thomas, 1976). In determining the optimum location of such public services as clinics and

hospitals the pertinent literature indicates that many factors need to be considered. These include: (1) centrality (to population served); (2) accessibility (to ensure that service locations approximate the density and distribution of population for any metropolitan area); and (3) optimization that satisfies the demand for services and thereby avoids under-utilization of facilities (Jackle, et al. (1976). Brunn (1977) has also stated that social geographers can make contributions to public policy by investigating the accessibility of the public to physicians, hospitals and other social services. Providing an efficient and equitable delivery system is closely tied to the location of such public facilities. Health care delivery is considered an essential service for the public and geographers have increasingly been contributing to the study of such policies and problems (Bashshur, 1970; Dear, 1978; Pyle, 1979).

#### Socioeconomic and Demographic Variations

Variations in socioeconomic and demographic characteristics, such as income, occupation and religion, have an important influence on hospital care and the utilization and types of services people receive. For instance, high income people are able to purchase a greater variety of

health services and thereby have improved health, partly as a result of better housing and diet. Their level of education and ability to purchase certain goods and services, which increases with income, permits them to create the foundation for a better level of health (Pauly, 1974; Marden, 1966). As Earickson (1972) stated, "poverty is the crucial variable for the poor who have the greatest need for health services" (p. 1). In contrast, families with greater resources to spend for medical care can patronize private physicians, rather than wait for available public services. Anderson and Anderson (1967) also indicate that high income families are the greatest users of private physicians. These economic factors have become important in determining physicians' office locations. Physicians take into consideration those factors which affect the inflow of money for their services, including population size, proximity of existing medical facilities, and the propensity for health services consumption (Lankford, 1972; 1974). Planners concerned about reducing inequities should understand and be able to measure the impact of these various economic and demographic factors in providing for more effective utilization of health care services (Reinke, et al. 1967).

#### The Hierarchy of Health Services

Health services are characterized by a hierarchy of functions. A good example can be demonstrated with hospitals. Hospitals vary in size by number of beds and other services provided. Only a few large hospitals within any major metropolitan area can usually provide a highly specialized treatment. Small hospitals are unable to provide such services, so consumers desiring them may have to travel long distances. Schneider (1967) classified Cincinnati hospitals into three hierarchial levels: (1) a few very large hospitals; (2) several of large and medium sizes; and (3) a number of small hospitals. Morrill and Earickson (1968 classified Chicago hospitals into the following categories: (1) teaching and research hospitals; (2) large regional or district hospitals; (3) regional or district hospitals; (4) community hospitals; and (5) very small hospitals. Hospitals with highly specialized services are usually located close to city centers, transportation modes, and centers of population (Morrill and Earickson, 1968; Shannon, et al. 1975; Bashshur et al. 1970). All hospitals, whether in Cincinnati, Chicago or Cleveland may be classified according to: (1) their size and number of the beds; (2) range of facilities: (3) size of the medical staff; (4) population

distribution in the cities; and (5) types of programs offered. Morrill and Earickson (1968) used a principal component analysis for 99 variables to describe and classify each hospital within the Chicago area. As a result, nine major dimensions were identified as being important: (1) service volume; (2) the character of the service area; (3) quality of care and length of stay; (4) the emphasis upon obstetrics and pediatrics; (5) recent service capacity surveys; (6) competition; (7) services for non-white patients; (8) the range of personnel, expense per bed and the proportion of public aid patients; and (9) the emphasis on elderly patients. Morrill (1970) also noted that the number of patients using the hospitals declines with intervening opportunities and distance as all hospitals cannot provide needed specialized care.

#### Attempts to Optimize the Location of Health Facilities

The location of health care facilities is a major aspect of any health care services operation. A hospital should, ideally, be centralized to be optimally accessible for the greatest number of the population, so that people can reach it in the minimum time and for the least cost. The locations of health services are important to people of different classes, levels of income, and ages. Hunter

(1974) stated that locational planning must take into account the scope of services to be provided, the dimensions of the catchment area, the geographical distribution of the population, and the rate of increase in the number of residents within the planned area.

Various humanistic, behavioral and transportation models have been adopted to study the location and distribution of health facilities. Schneider (1967) and Abernathy et al. (1972) indicated that locational efficiency is a function of the cost of operating a hospital in a given location and the users' costs in terms of time and money to get to the hospital. Godlund (1961) determined several alternative sites for regional health centers and hospitals in Sweden through the use of various geographic techniques. Demographics, economics, transportation and travel time to various centers were taken into consideration. Gould and Leinbach (1966) in western Guatemala used a linear programming model to assign hospital locations which yielded the lowest travel costs. A study of the location of primary health services in Guatemala City used a location-allocation model to assign patients to a set of existing dispensaries. Minor relocations and capacity changes were permitted for specific dispensaries (Mulvihill, 1979). Morrill, et al. (1969) explained the optimum allocation of

health services, using central place theory in a heuristic approach. A simulation model was developed in which the probabilities of patients from different areas visiting various hospitals are estimated from the modified construct for an initial estimate of hospital use (Morrill and Earickson, 1960; Earickson, 1969). Bennett (1979) indicated in his location-allocation study of primary health care centers in the Lansing area, where five new centers need to be located. He devised two location-allocation algorithms to determine facility locations and associated user allocations based on the distribution of undoctored households reported in an area mail survey. These studies and approaches to planning and allocating medical care facilities have been adapted for more efficient treatment in health care delivery planning based on the specific needs of people (Pyle, 1974; Dear, 1978).

#### Utilization of the Emergency Room

Another area in which contributions have been made in health care delivery is concerned with emergency health care where accessibility is of prime importance. Emergency departments of hospitals in the United States were, at one time, used almost exclusively for the treatment of accidents and injuries. Since World War II the emergency rooms have grown rapidly in importance with increasing utilization.

Emergency departments have become out-patient clinics and places where patients can receive regular treatment and where most private physicians can practice after office hours and on weekends.

Because of the large increase in the number of uses of emergency room services during the 1960's, studies to examine the extent of the problem this creates have been done by analyzing hospital emergency room data in different cities (Weinerman, 1965, 1966; Vaughn, 1965; Coleman, 1967). Perkoff (1970) explained the results of two studies of the Barnes hospital emergency room in St. Louis, Washington. Charts from 6,688 visits were reviewed to find interlationships between social and demographic factors and the use of the emergency room. The study revealed that primarily two groups used the room: poor white and poor black ward patients who lived in the area close to the hospital. It was clear that nonurgent illness predominated in the two groups. Emergency floor records at Boston City Hospital were investigated to classify patient visits in terms of accident/non-accident and emergency/non-emergency use. About two-thirds of the patient visits were non-accident, non-emergency cases (Kirkpatrick, 1967). The increasing tendency of patients to use emergency rooms for non-emergency reasons can be attributed

to the difficulties poor people have in obtaining primary health care. Some specific factors influencing non-urgent use of the emergency room are: lack of a relationship with a personal physician, age, residential mobility, minority group status, and the geographical location of health centers in the city (Weinerman, 1966).

In regard to valid emergency cases, the ABC-TV program "20/20" on Thursday, April 24, 1980 indicated in its report on emergency services that between 18,000 and 20,000 accident victims out of the 115,000 who die annually in the United States might be saved if immediate care were rendered. Mayer (1980) found, in a geographical study of Seattle emergency medical services, that the response time was dependent on three major objectives: (1) to minimize response time; (2) to minimize cost; and (3) to insure that most of the emergency calls will be answered within specified periods of time. Roghmann and Zastowny (1979) and Mayer (1979a, 1979b) concluded that quick reponse is the main objective of most emergency medical services. In separate studies they found that an average difference of three minutes in responding to an emergency can save many lives. The Los Angeles countywide coordinating council studied emergency medical services in 1975 and classified the victims' conditions as mildly, moderately, or severely critical. The bulk of lives lost

were within the first ten minutes of when the emergency services were required (Navin and Stevens, 1979).

Delivery and location of emergency medical services and ambulance services are still under investigation by planners, economists, operations researchers and geographers. Planning is still considered the key issue in solving the problem of less than optimum location of such services (Achabal, 1978; Toregas, et al., 1972; Hamilton, 1974).

# Relevance of Literature to the Existing Situation in Jeddah

In the City of Jeddah two types of health services are available--public and private. The cost of private health services is very high, as only the rich can afford them, whereas public health services are provided by the government at no cost to the users.

Jackle, et al. (1976) state that many factors need to be considered in proposing plans dealing with such aspects as centrality, accessibility and optimization to satisfy the demand for services. During the current rapid urban development in Jeddah, these factors and others have not been given priority in planning.

Location of health service outlets within Jeddah is

not based on population density, accessibility or centrality. Nor is the allocation of services based on classified hierarchial levels, such as teaching and research hospitals, large regional hospitals, small community hospitals, dispensaries and clinics. Instead, seven government hospitals and seven dispensaries, under the supervision of the Ministry of Health, have been built at random to serve the entire population of the city. As a result, the emergency services are extremely poor. There is only one major emergency room functioning in the Central Hospital of Jeddah. There is a great demand for emergency services as there are more accidents and injuries occurring and recorded every day. In case of an emergency in Jeddah, while the rich can afford quick services at private health facilities, it is often difficult for the poor to get to the emergency room at a public hospital within less than an average of thirty minutes. This may be too long for the most serious cases. As Mayer (1979b) points out, quick response time is very critical and one of the main targets in saving lives in emergency situations.

The data collection procedures and techniques used to analyze the field data collected are outlined in Chapter III.

#### CHAPTER III

#### METHODS OF THE STUDY

In order to achieve the goals of this study, three approaches were used in the field: (1) a survey method was developed to collect and analyze data from a selected sample of users of public dispensaries within the city; (2) the travel speed movement rates at various times of the day were collected to help understand the existing transportation constraint in the city; and (3) application of the method of linear programming was used to analyze the data at various levels of trip time thresholds (TTT's) to determine the need for future additional health facilities in the City of Jeddah.

#### The Survey Method

Seven major assumptions were made regarding the existing situation of the prime health facilities in Jeddah.

- 1. The majority of user respondents use their own cars for seeking health assistance.
- 2. The majority of user respondents prefer a trip time of less than ten minutes.
- 3. The majority of health facility users prefer to use public dispensaries.

- 4. The proximity of dispensaries is a major factor in their use.
- 5. The user respondents do not see significant differences in services between the public dispensaries.
- 6. Most of the respondents' emergency cases are taken to the public dispensaries.
- 7. Most of the emergency cases for which people seek help are minor complaints for which dispensaries offer effective assistance.

Answers to these and other questions provided a general profile of the residents' perceptions about the health care system in Jeddah. Also, they provided some idea of what is needed to improve health care delivery and where specific future facilities might be located (Appendix A).

There are seven free public dispensaries in the city. These are under the supervision of the City's Directorate General of Health Affairs (Figure 2). A sample of 400 users from these dispensaries was selected to be interviewed regarding their perceptions about the services available at these dispensaries. The sample for each dispensary was chosen in the following way. For each dispensary a percentage was computed between the number of users of that dispensary and the total number of users of all seven dispensaries during the month prior to the field survey. The number of users



Figure 2. The Location of Existing Public Health Dispensaries

to be interviewed from each dispensary was based on the percentage for that dispensary in the total sample (Lansing, 1971). Then, systematic random sampling based on the random table was used to select the actual interviewees (Blalock, 1979). Frequency analysis was used to analyze the data and the Michigan State University Computer was employed.

Four senior students experienced in conducting field surveys, from the Department of Geography at King Abdulaziz University in Saudi Arabia, helped in conducting the interviews. The interviews were scheduled in the evenings to ensure that the sampled population included those who worked in different sectors during the day. The survey was carried out from November 1980 through January 1981.

#### The Travel Speed Movement Rates

Measurements of road travel speed movement for various time periods were conducted in Jeddah. A field measurement was carried out around locations of the seven existing public dispensaries. The threefold purpose behind conducting these measurements was: (1) to get an idea of the travel speed in the city; (2) to determine the length of trip time it would take an emergency vehicle to travel to the closest dispensary from an accident site or a patient's residence; and (3) to

determine the threshold time experienced by the inhabitants in getting to the existing health facilities at various times.

Usually the public dispensaries are open from 7:30 a.m. to 12:30 p.m., and from 4:30 p.m. to 7:30 p.m. every day, except on Thursday afternoons and all day Friday. Accordingly, the travel speed measurements were taken at three times of the day: 8:00 a.m., 4:00 p.m. and at midnight. At each of these hours, measures of distance travelled in every direction from each of the seven public dispensaries were recorded every five minutes up to a maximum of twenty minutes travel time. All of the recorded measures were then transferred to the city map to create a contour map for the various periods of measurements.

#### The Application of Linear Programming

In order to assign the appropriate number of potential service centers (PSC's) for future health dispensaries in Jeddah, a linear programming technique was employed. Data came from the field survey, especially the travel speed movement rates of urban traffic, and the following pieces of information were used to operationalize the model:

> Jeddah city map and its subdivisons, referred to as districts in this study (Figure 3). There are no official boundaries between the districts. The district boundaries used for the purposes


Figure 3. District Boundaries within Jeddah

of this study are statistical areas which were used in the 1978 socioeconomic survey based on a previous 1971 social survey (Ministry of Municipal and Rural Affairs, 1980).

- 2. size of each district in  $km^2$ ;
- 3. the population density in each district based on a 1978 survey.
- 4. average effective traffic speed limit in each district.
- 5. the location of 133 selected population gravitational points (PGP's) in the city including 42 potential service centers (PSC's) of the public health dispensaries, based on the field observation and criteria outlined in Chapter V; and
- 6. binary 0/l matrix between the 42 PSC's and the 133 PGP's on the basis of accessibility, using the three trip time thresholds (TTT's).

In this study the enumeration techniques of integer programming were used in order to minimize the PSC's for a given TTT constraint (Cohen and Stein, 1978). The output of the program is MPOS input file defining a 0/l integer programming problem to minimize the number of facilities selected, given the constraints. The objective function will be satisfied if the sum of the assigned sites gives the minimum number of locations that would be accessible to all of the 133 PGP's within each of the specified TTT's. The constraints of the problem were set up to force each PGP to at least one or more PSC for a given TTT constraint. In summary: 1. Objective function is to minimize the number of PSC's from each of the TTT's.

Minimize =  $\bigvee_{j=1}^{42} x_j \cdot a \cdot j \quad x_j \stackrel{(= 1 \text{ if selected}}{= 0 \text{ if else}}$ a. j = 1 j = 1, ..., 42 Where x = number of services for TTT = K K = 5, 10, 15 minutes aij j = 1, ..., 42 i = 1, ..., 133 aij = 1 if TTT  $\leq K$ = 0 if TTT > K

- 2. Subject to constraints,
  - Each PGP should be assigned to at least one PSC.
  - b. PSC services itself.
  - c. Maximum time TTT which equals 5, 10 and 15 minutes.

Additional information was collected through several meetings with officials in the Ministry of Health in Riyadh,

officials of the Directorate General of Health Affairs in Jeddah, physicians who are working in the existing public dispensaries, the officials of Jeddah municipality. These meetings were useful since they provided overview about the existing situation and the future plans for health care delivery in the city.

In the following chapter, current patterns of dispensary use and conditions of urban accessibility will be discussed.

#### CHAPTER IV

# CURRENT PATTERNS OF DISPENSARIES' USE AND CONDITIONS OF URBAN ACCESSIBILITY

It is useful to describe existing travel patterns to the seven public dispensaries in the city. A general discussion of the users' perceptions regarding existing travel patterns to the dispensaries and their conditions is divided into eight sections. They are: (1) the socioeconomic status of the users; (2) type of transportation used for seeking health care and travel time required; (3) type of medical care assistance sought by users; (4) accessibility of dispensaries and their demand; (5) reasons for choosing dispensaries and how users rate health care services; (6) preference for the dispensaries for emergency use; (7) the existing conditions of dispensaries; and (8) the travel speed on current roads.

#### The Socioeconomic Status of the Users

In this section the demographic data relating to age, size of family, occupation, housing, and monthly income are discussed. About 29 percent of the respondents were over 34 years old, 15 percent were 30 to 34 years, 28 percent

were 25 to 29 years, 20 percent were 20 to 24 years, and about 8 percent were less than 19 years of age. Almost half of the respondents were between 20 to 29 years. The survey results indicated an average family size of six persons. The highest percentage of large households were among the residents of Hindawia, Ruwais and Bani Malik districts.

A classification of the respondents' occupations is shown in Table 1.

Туре	of Occupation	Respondents	% of Respondents
1.	Goverment Official	146	36.5
2.	Businessman	36	9.0
3.	Laborer	165	41.3
4.	Student	22	5.5
5.	Unemployed	31	7.7
6.	Other		
	Total	400	100.0
		has been 1000	

Table 1. Occupations of Survey Respondents

Source: Field Survey by author, 1980

A high percentage of the respondents were laborers and a majority of those laborers were non-Saudi. The companies which employ them do not provide health insurance benefits for them. Another 37 percent of the respondents were government officials. Less than ten percent were businessmen.

In regard to type of housing, survey results revealed that about 36 percent of the respondents owned their homes while 64 percent did not. The majority of the respondents were found to live in traditional houses, which are less expensive than apartments and villas (Table 2).

Table 2. Type of Housing in which the Respondents live.

Type of Occupation		Respondents	% of Respondents	
1.	Villa	15	3.7	
2.	Apartment	121	30.2	
3.	Traditional House	247	61.9	
4.	Shack	16	4.0	
5.	Other	01	0.2	
	Total	400	100.0%	

Source: Field Survey by Author, 1980.

The average monthly income of the respondents is shown in Figure 4. About 34 percent receive from \$600 to \$799 monthly. Only about 17 percent receive an income higher than \$1,000 per month. These figures show that most of the respondents do not have a high income relative to the cost of private hospitalization. For example, the cost of three days of in-patient medical care at a private hospital in Jeddah may exceed \$1,000.

#### Type of Transportation Used to Seek Health Care and Travel Time Required

Almost half of the respondents indicated that they have their own cars. The survey revealed that about 48 percent use their own car for seeking health care, while about 17 percent use a taxi, and another 17 percent ride buses. Only about 14 percent of the total respondents walk to the dispensary. It seems that there are variations in types of transportation used by respondents from one dispensary to another (Figure 5). However, access to automobiles for transport is very easy, especially in cases of illness.

Respondents were also asked how long it would take them to drive to the nearest dispensary. About 28 percent indicated that it would take them less than ten minutes, while about 18 percent within 15 to 19 minutes, about 12 percent within 20 to 24 minutes, and only 5 percent would be delayed



Note: One U.S. dollar = 3.5 Saudi Riyal





more than 25 minutes in reaching the nearest dispensary. The respondents were also asked their opinions regarding travel time to reach the nearest dispensary. About 88 percent wished to have the dispensary located within less than 10 minutes travel time from their homes. Only 12 percent indicated they would not mind travelling more than 10 minutes from their homes to visit a health facility (Table 3).

	Time	Respondents	% of Respondents
1.	Less than 10 minutes	350	87.5
2.	10 to 14 minutes	49	12.3
3.	15 to 19 minutes	1	.2
	Total	400	100.00

Table 3. The Respondents Travel Time Preference to Seek Health Care

Source: Field Survey by Author, 1980

The fact that most of the respondents would like to be able to reach a dispensary in less than 10 minutes is an important factor to be considered in planning for health care delivery systems in the future.

## Type of Medical Care Assistance Sought by Respondents

Patients usually seek more than one source of medical care assistance. Previous studies have shown that the patient's income plays an important role in the source of health care assistance sought. People with high incomes usually frequent the private hospitals for many obvious reasons. These include faster services, prolonged individual attention by medical personnel, and the feeling that private hospitals offer a better quality of service than the public hospitals. About 72 percent of the respondents indicate use of the dispensaries, 15 percent frequent public hospitals, 12 percent patronize private hospitals, and only one percent visit family doctors (Table 4).

The percentages of respondents utilizing each of the four types of medical care facilities in each of the seven districts is shown in Figure 6. The results reveal that family doctors are not sought by most of the respondents, a finding which may be due to socioeconomic reasons. Only 4 of 400 respondents, three in Nuzla and one respondent in Bani Malik call at a family doctor's clinic.

Regarding the use of private hospitals, a rather low percentage (8 to 13 percent) of respondents who use public

	Malik	Resp.	1.8	13.0	14.8	70.4	100.0
	Rant	No.	г	٢	8	38	54
	dara	Resp.		11.1	7.4	81.5	100.0
	Kan	No. Resp.		m	2	22	27
ries	, c	Resp.		12.9	8.1	79.0	100.0
spensar	Rites	No. Resp.		8	Ŋ	49	62
the Dis	aut a	Resp.		13.3	13.3	73.4	100.0
n of	hind	No.		Ų	6	33	45
Locatio	12	Resp.	3.2	12.8	16.0	68.0	100.0
	Nus	No. Resp.	m	12	15	64	94
	151	Resp.		8.2	23.5	68.3	100.0
		No. Resp.		8	23	67	98
	us- lal	Resp.	ł	10	10	ко	100.0
	Ind trj	No. Resp.		2	5	16	20
		% of Re- spondents	1.0	11.5	15.2	72.3	100.0
	General	No. of Re- spondents	4	46	61	289	400
		Type of Facility	Family Doctor	Private Hospital	Public Hospital	Dispen- sary	TOTAL

Source: Field Survey by Author, 1980

Table 4. Types of Medical Facilities Patronized by Respondents



Figure 6. The Percentage of Respondents Using the Four Types of Medical Facilities

dispensaries also use private hospitals. This limited use of private hospitals may be attributed to their high cost for services and the free public health facilities available elsewhere. Between 7 to 23 percent of dispensary users also seek treatment at the general public hospitals. This low percentage may be due to the location of the hospitals, types of selected specialized services these hospitals offer, traffic congestion and the difficulty in finding parking facilities there. It also takes longer and costs too much to reach most of the public hospitals. The main hospital is the general hospital in town which provides all types of services.

The situation at the dispensaries is altogether different and most of the respondents often use these facilities. About 80 percent of the users seek health care at the closest dispensary. The free service, the relative proximity of the location, and the primary nature of the medical treatment offered attract these users. It is understandable that, providing easily accessible facilities will be helpful for this group of users.

# Accessibility of Dispensaries and Their Demand

The respondents were asked to indicate how accessible

the dispensaries were to their residences. About 22 percent travel less than 2 kilometers, 40 percent from 2 to 3 kilometers, 19 percent from 3 to 5 kilometers, 13 percent from 5 to 10 kilometers, and 6 percent travel more than 10 kilometers (Figure 7). Nearly 60 percent travel less than 5 kilometers. The data were further analyzed to determine the travel behavior patterns of respondents in each of the seven districts (Figure 8).

Respondents from the industrial district, Ghulail, and Nuzla dispensaries shared similar travel patterns. While almost 50 percent of the Hindawia dispensary users travel 2 to 3 kilometers, none travel more than 10 kilometers. Travel patterns of users of the Ruwais dispensary are somewhat equally distributed: 21 percent of respondents travel less than two kilometers, about 23 percent from 2 to 3 kilometers, and 21 percent travel from points 4 to 10 kilometers distant. The largest percentage (14.5 percent) of respondents traveling more than 10 kilometers was found among the users of the Ruwais dispensary; this pattern may be attributed to the lack of dispensaries in the north districts of the city. About 11 percent of the respondents travel less than 2 kilometers to the Kandara dispensary, 41 percent between 2 and 3 kilometers, 37 percent between 3 and 5 kilometers and only 11



Figure 7. Distances Travelled to the Dispensaries, by Percentage





percent travel beyond 5 kilometers because the dispensary is within a very crowded residential area. Thirty-seven percent of the respondents travel less than 2 kilometers to Bani Malik dispensary; another 35 percent from 2 to 3 kilometers while less than 10 percent travel from points 4 to 10 kilometers distant. Another 13 percent travel more than 10 kilometers. Accessibility to Bani Malik dispensary is similar to the situation in Ruwais district. Most of the north districts in Jeddah are without health facilities.

When questioned about the location and accessibility of the seven dispensaries, in a four stage response pattern, 17 percent of the respondents found the existing locations of the dispensaries very accessible. Another 50 percent found them accessible. More than one quarter of the respondents felt the locations of the dispensaries were inaccessible; about 6 percent perceived them to be very inaccessible (Table 5).

In order to determine users' perceptions regarding the accessibility of dispensary locations, the respondents were asked about the distance they were willing to travel to obtain health care. Almost 77 percent of the respondents would prefer to seek health care within a traveling distance of less than 2 kilometers; the remaining 23 percent are will-

Perceived Level of Accessibility		Respondents	% of Respondents
1.	Very Acces- sible	69	17.3
2.	Accessible	198	49.6
3.	Inaccessible	109	27.2
4.	Very inacces- sible	22	5.5
5.	Do not know	02	. 4
	Total	400	100.0

# Table 5. Respondents' Perceptions of Dispensary Accessibility

Source: Field Survey by the Author, 1980

ing to travel 2 to 3 kilometers (Figure 9). No one surveyed would prefer to travel further. These results show that users are unwilling to travel long distances, a factor which needs to be considered in planning future health care facilities.

# Reasons for Choosing Dispensaries and How Users Rate Health Care Services

There are both medical and non-medical reasons for choosing a particular dispensary. The non-medical reasons



Figure 9. Maximum Distances Respondents Are Willing to Travel to a Dispensary

may be related to accessibility, a particular physician who treats his patients well, or faster services in one dispensary than another. The survey results identify three major categories of responses that need to be considered (Table 6).

Roughly 77 percent of the respondents indicated that they chose dispensaries because they are close to their residences while 13 percent believed that the dispensary they frequent has good physicians. Seven percent of the respondents felt that services at their dispensaries are faster than

Cat	egories of Reasons	Respondents	% of Respondents
1.	Because it is close to my residence	307	76.8
2.	Because it has a good physician	53	13.2
3.	Because it is faster than others	29	7.2
4.	Do not know	11	2.8
	Total	400	100.0

Table 6. Respondents' Reasons for Choosing a Dispensary

at the other medical facilities in the city. More than 60 percent of the respondents believed the dispensaries to be crowded. Distance, that is close proximity, is the primary reason given by the majority of the respondents choosing a local dispensary.

An attempt was also made to examine the users' attitudes toward the quality of the health care services offered by the dispensaries. Of the total sample about 29 percent of the respondents rated the services as excellent, 37 percent above average, 25 percent average, and less than 5 percent below average (Figure 10). These ratings, however, vary slightly for each of the seven dispensaries. About 30 percent of the respondents who use the Industrial District dispensary, or Ghulail, Nuzla, Hindawia and Ruwais dispensaries rated the services as excellent, while about 60 percent of the respondents at Kandara dispensary rated the services as excel-Users of the Bani Malik dispensary, have a lower opinlent. ion of the services provided there. Only 15 percent of the respondents rated the services as excellent (Figure 11). This could be related to the type of physicians in the dispensary, the low quality of services providing medical treatment. Sometimes, language is a barrier to communication with the physicians there since most of them are Pakistanis.



Figure 10. Respondents' Attitudes toward Health Services at Dispensaries





The majority of the users in the sample consider the dispensaries' health services to be above average. Less than 5 percent of the users of Ghulail, Nuzla, Hindawia, Ruwais, and Kandara dispensaries, and about 11 percent of those who go to the Bani Malik dispensary rated the services as below average. Ratings are dependent on many factors including the reason for visiting a dispensary, the type of illness suffered, level of education of users and providers, quickness of services, length of waiting time, adequacy of treatment, nationality of physicians, and misunderstandings between patients and providers.

## Preference for Dispensaries for Emergency Use

Emergency treatment is an important function in health care delivery. The respondents were asked where they would take a member of the household in event of any emergency. About 30 percent of the respondents would chose to use the public hospitals because they believe that the hospitals are better equipped than the dispensaries (Table 7). Those who would prefer to travel to the closest dispensary represented 54 percent; these individuals felt an emergency case must reach the medical facility quickly and that it would take too long to reach the emergency room of a public hospital. Only

ility	Respondents	<pre>% of Respondents</pre>
Public hospitals	119	29.8
Dispensaries	218	54.4
Private hospitals	63	15.8
Total	400	100.0
	Public hospitals Dispensaries Private hospitals Total	Public hospitals119Dispensaries218Private hospitals63Total400

Table 7.		Types	of 1	Medic	al	Facilit	ties
		Prefei	red	for	Eme	rgency	Cases

Source: Field Survey by Author, 1980

about 16 percent of the sample prefer the private hospitals and feel these are better equipped and provide faster services than the public facilities.

In order to discern the specific uses the respondents make of the dispensaries, a list of common ailments was provided. The results are that 37 percent frequent the dispensary for minor cuts and bruises (Table 8). Another 25 percent utilize them in cases of colds and influenza; 30 percent travel there for minor accidents. Only about 8 percent prefer dispensaries in cases of a communicable disease. There are variations in the responses among users of the dispensaries (Figure 12). Almost half of the respondents from the

	Type of Ailment	Respondents	% of Respondents
1.	Minor cuts and bruises	146	36.5
2.	Cold and in- fluenza	102	25.5
3.	Minor accidents	119	29.8
4.	Communicable Diseases	32	8.0
5.	Other	1	.2
	Total	400	100.0

# Table 8. Purposes for which Respondents Use Dispensary Services

Source: Field Survey by Author, 1980

Industrial District dispensary, Ruwais, and Bani Malik dispensaries travel there to have minor cuts and bruises treated. A high percentage of cases at Hindawia and Kandara dispensaries are patients with colds and influenza. The second major category of patients who visit the dispensaries are those who experience minor accidents. Roughly 40 percent of the cases at Nuzla and Ruwais dispensaries and more than 30 percent of the cases at Industrial District, Ghulail, and Hindawia dispensaries are minor accidents. Only about 15 percent of the





users of Bani Malik dispensary, 10 percent of Nuzla and Ruwais dispensaries, and 5 percent of Hindawia and Kandara dispensaries use the services for communicable diseases. In most cases patients with communicable diseases will travel to the main general hospital.

### The Existing Conditions of Dispensaries

The locations of dispensaries were not based on any definite plan. Most of the existing dispensaries were not built or owned by the government. Therefore, for some of them the floor plan designs do not meet the specifications for organized medical systems and for acceptable levels of sanitation. These locations have no parking lots.

Due to lack of radiology units, dental laboratories, psychiatrists, and ambulance vehicles, the existing medical facilities in the dispensaries are adequate for general cases only. All of the physicians are general practitioners. They treat general cases such as gastro-intestinal disorders, wounds, fractures, burns and minor accidents, and refer the patients to the public hospitals for extensive diagnostic tests.

Altogether there are thirteen physicians. They complain that there are too many patients to treat in a day, and there is no patient medical record system. Approximately 150

to 500 patients use the services at the dispensaries every day. The survey indicated that the average time a physician sees a patient is about three minutes. This daily overcrowding of patients at each dispensary can be attributed to the shortage in the number of dispensaries to serve the population efficiently. Because of this, the physicians find it extremely difficult to adequately diagnose the patients and keep track of their progress.

### The Travel Speed on Current Roads

The flow of traffic in Jeddah is congested. Except for a few STOP signs, traffic regulations or speed limit controls are lacking. This causes many inconveniences for private and government vehicles including ambulances and police and fire units. The heavy traffic should be better controlled to avoid the hundreds of daily traffic accidents and allow the emergency vehicles to move easily and quickly.

To determine the road travel speed to reach a dispensary, the researcher conducted field measurements (Chapter III). It is difficult to give precise measures because the locations of dispensaries in districts like Ghulail, Nuzla, Ruwais, and Bani Malik are rather unplanned. The narrow roads in most of these districts have no signs and they extend to the main

streets. The measurements were focused on the vehicle movement speed in the four directions from each dispensary. The main reason for taking these measurements was to determine the flow of traffic around each dispensary in relation to time of day, speed limits, signals, signs, pedestrian crossings, and the unorganized flow of vehicles. The travel time is a factor to determine how long and how far an emergency vehicle must travel to reach the closest dispensary from the site of an accident or a patient's house.

The travel speed of the vehicles at 8:00 a.m. is heavy and fast because students are on their way to school, and businessmen, officials and laborers are on their way to work (Figure 13). However, there are variations in the flow of traffic around each dispensary. For instance, the flow of traffic in the industrial district is light because there are few dwellings and narrow roads in that area. But the traffic flow around the Ghulail, Nuzla, Handawia, Kandara, and Bani Malik dispensaries is heavy due to a large number of dwellings and inadequate roads. It is different from Ruwais dispensary. Since its location is on a main street, the traffic movement is faster here than in other places.

The travel speed of the vehicles at 4:00 p.m. is similar to that at 8:00 a.m. (Figure 14). Daily business hours



Figure 13. Speed Travel Time Measurements at 8:00 a.m.



Figure 14. Speed Travel Time Measurements at 4:00 p.m.

in Jeddah are from 8:00 a.m. to 2:00 p.m., and from 4:00 p.m. to about 9:00 p.m. there were no major differences between the two measurements.

The travel speed of vehicles at midnight reflects the possibility of easy traffic movement (Figure 15). In contrast to the morning and afternoon traffic flow, at midnight there is less traffic and fewer pedestrians. The location of a dispensary on the main street has advantages in districts like Ruwais, Medina Road and the northern parts of the city. But for inside the city, important factors such as the main traffic arteries and the population density should be considered in the planning process to erect new dispensaries.

In summary, the survey indicated that most of the users prefer using the public dispensaries to other facilities. They want primary services to be located within less than ten minutes travel time. The locations of the existing dispensaries are unfeasible and unsatisfactory for their intended purposes. The congested traffic flow on the narrow roads along which some of the unplanned dispensaries are located, often obstructs emergency vehicles from reaching the closest dispensary from an accident site or patient's residence in the shortest possible time.



Figure 15. Speed Travel Time Measurements at Midnight
In the following chapter the assessment of potential service centers for public health dispensaries in Jeddah will be given.

#### CHAPTER V

## ASSESSMENT OF POTENTIAL SERVICE CENTERS FOR HEALTH DISPENSARIES

The overriding aim of this study is to present a plan for locating public dispensaries so that the inhabitants of the city will have access to a dispensary within a reasonable amount of time. The focus of this chapter is on the assessment of potential service centers for public health dispensaries in Jeddah. Discussion will deal with: (1) the selection of potential service Centers (PSC's); (2) assignment of PSC's within possible trip time thresholds (TTT's) of 5, 10, 15 minutes; (3) relocation of existing facilities; and (4) potential service centers that are selected for all trip time thresholds.

## Selection of Potential Service Centers (PSC's)

To select PSC's in a crowded and complex city like Jeddah could be difficult. However, 133 "population gravitational points" (PGP's) were identified within the city. Using personal experience as a guide, the city's PGP's were determined by employing the following criteria: (1) the 1978 population survey results; (2) the peak points of population

concentration in each district; and (3) the major landmarks in each district, such as schools and mosques. As it is unrealistic to locate 133 health facilities in the city, it was necessary to select the best PSC's from these PGP's. Based on the results of field observations in Jeddah and the following criteria, 42 PSC's were selected (Figure 16). The criteria were: (1) the traffic movement, direction and speed measurements already discussed in Chapter IV; (2) consideration of trip time from inhabitants' residences to the potential service centers in every district; (3) accessibility of the PSC's to the selected PGP's; and (4) rough estimates of the total number of PSC's needed for the three TTT's based on the formula  $\leq n_i = \frac{A_i}{2.598 R_i^2}$  where  $A_i$  = area of the iith district,  $k^{R}i = trip$  distance that can be covered in the i th district within the TTT's constraint and  $N_i = number$ of PSC's required for k th TTT in district (Mehretu, 1980).

These 42 PSC's served as a pool of possible health service locations from which varying numbers of locations were generated, depending on the maximum TTT used. The study then focused on travel time from the 133 PGP's to the 42 PSC's (Figure 17). Trip time was estimated between each of the 42 PSC's and the 133 PGP's, including the 42 PSC's to the closest service center has been determined to range between 5 and 15



Figure 16. The 42 Selected PSC's for Jeddah



Figure 17. Population Gravitational Points in Jeddah

minutes. The PGP's form links using TTT's to selected PSC's.

The goal of the above exercise was to select sites from among the total of 42 PSC's to satisfy specified constraints on TTT's to a facility. The end result was to designate a minimum number of facilities placed to best serve the surrounding population within the specified TTT.

### PSC's within the Five Minute Threshold Constraint

According to the study results, 39 of the 42 PSC's selected for new health care facilities would be required to satisfy the constraint of five minutes TTT from each of the PGP in most of the 21 districts of the city (Table 9).

From these results, it is apparent that the northern parts of the city will require five facilities while Nuzla Sharkia and Mekkah Road Kilo 6-10 districts will need four facilities. The rest of the districts will vary requiring one to three facilities. The selected PSC's are thus diversely spaced (Figure 18). The spatial distribution pattern of the selected PSC's is a function of the TTT's.

The pattern of spatial distribution for selected PSC's around the downtown districts is relatively dense. The congested traffic and dense population in those districts makes additional facilities necessary. Similar situations exist for Mekkah Road Kilo 1-5 and Nuzla Sharkia districts. In

	District	No. of Existing Facilities	PSC Code	No. of Additional Centers Needed	PSC Code
1.	Karantina	1	01	1	02
2.	Ghulail	1	03	1	04
3.	Guryat, Thalbaa			2	05,07
4.	Nuzla Yemina	1	08		
5.	Bukharia			1	21
6.	Hindawia	1	20		
7.	Shati				
8.	Sabeel			1	22
9.	Harat Barah				
10.	Sahaifa				
11.	Nuzla Sharkia			4	9, 10, 11, 12
12.	Mekkah Rd. Kilo 6-10			3	17, 18, 19
13.	Mekkah Rd. Kilo 1-		4	13, 14, 15, 16	
L4.	Harat Yemen Ascham			2	23, 24
15.	Baghdadia, Amaria			2	25, 26
16.	Kandara	1	28	1	27
L7.	Sharafiyah			1	29
18.	Bani Malik	1	31	2	30, 32
19.	Ruwais, Hamera,				
	Medina Rd.	1	35	1	36
20.	Musharifah			1	33
21.	Northern parts			5	37,38,39,41,42
		7	+	32 =	39

Table 9. Assigned PSC's within Five Minutes TTT



Figure 18. Selected PSC's within Five Minutes TTT

southern districts like Guryat and Karantina, there is medium population density with less traffic congestion. Therefore, fewer PSC's are required than in the downtown loop. In the northern parts of the city districts are not heavily populated and traffic is light. This allows swift traffic movement and only five widely-spaced PSC's are needed.

The number of locations discussed above results from the location-allocation design, based on five minutes TTT to reach a health facility in the city. These results have the advantage of accessibility and limit the trip time needed to reach a facility.

## PSC's within the Ten Minutes Threshold Constraint

The study has indicated that within 10 minutes TTT constraint, only 27 of the 42 PSC's are needed to satisfy the objective function (Table 10). Distribution of the selected 27 PSC's varies from one district to another. Basically, travel speed is important in order to determine the required locations. The dense population and congested traffic in downtown districts require more facilities there than in the northern parts of the city. The same situation applied in the Nuzla Sharkia and in Mekkah Road Kilo 6-10 districts.

District	No. of Existing Facilities	PSC Code	No. of Additional Centers Needed	PSC Code
l. Karantina	1	01	1	02
2. Ghulail	1	03		
3. Guryat, Thalbaa			2	05,07
4. Nuzla Yemina	1	08		
5. Bukharia				
ó. Hindawia	1	20		
7. Shati				
3. Sabeel			1	22
9. Harat Barah				
). Sahaifa				
l. Nuzla Sharkia			3	10, 11, 12
2. Mekkah Rd. Kilo 6-	10		2	17, 19
3. Mekkah Rd. Kilo 1-	5		1	16
4. Harat Yemen Ascham			1	23
5. Baghdadia, Amaria			1	25
6. Kandara	1	28	1	27
7. Sharafiyah			1	29
3. Bani Malik	1	31	1	30
9. Ruwais, Hamera,				
Medina Rd.	1	35	1	36
). Musharifah			1	33
L. Northern parts			3	38, 39, 41

Table 10. Assigned PSC's within Ten Minutes TTT

Low population density and less congested traffic flow in Mekkah Road Kilo 1-5 and Ruwais districts require fewer facilities to serve these and neighboring districts (Figure 19). The northern parts of the city have even more sparse populations and less traffic on their more accessible roads. Therefore, only three selected PSC's are needed to serve that part of the city.

These 27 PSC's within ten minutes TTT are the ultimate goal of this study. The accessibility will thus be flexible in order to reach a facility in optimal time.

## PSC's Within the Fifteen Minute Threshold Constraint

Results have indicated that within the fifteen minute TTT constraint, 23 out of the 42 PSC's will be required (Table 11). The selected 23 PSC's are scattered throughout the city. In this section the TTT interval is greater than in previous sections.

Essentially, there will be only one selected PSC in each district (Figure 20). The downtown districts, however, still require more facilities than the southern and eastern parts of the city. In the northern parts just a few PSC's need to be located in less populated areas.



Figure 19. Selected PSC's within Ten Minutes TTT

	District	No. of Existing Facilities	PSC Code	No. of Additional Centers Needed	PSC Code
1.	Karantina	1	01		
2.	Ghulail	1	03	1	04
3.	Guryat, Thalbaa			1	05
4.	Nuzla Yemina	1	08		
5.	Bukharia			1	21
6.	Hindawia	1	20		
7.	Shati				
8.	Sabeel				
9.	Harat Barah				
10.	Sahaifa				
11.	Nuzla Sharkia			2	10, 12
12.	Mekkah Rd. Kilo 6-1		2	17, 18	
13.	Mekkah Rd. Kilo 1-5		2	13, 15	
14.	Harat Yemen Ascham			1	23
15.	Baghdadia, Amaria			2	25, 26
16.	Kandara			1	27
17.	Sharafiyah				
18.	Bani Malik	1	31	1	30
19.	Ruwais, Hamera,				
	Medina Rd.			1	36
20.	Musharifah			1	34
21.	Northern parts			2	39, 41

Table 11. Assigned PSC's within Fifteen Minutes TTT



Figure 20. Selected PSC's within Fifteen Minutes TTT

Therefore, the spatial distribution of the fifteen minute PSC's is almost equitable among the districts. It could be more possible to implement such a plan to serve the population in different districts.

### Relocating the Existing Facilities

As indicated earlier, there are currently seven public dispensaries. Only one (PSC-01) of the existing sites has been selected among the 42 PSC's. The rest of the existing facilities have not proved to be feasible using the criteria for the selection of PSC's. Included in the 39 selected PSC's for the five minutes threshold constraint, existing facility No. 01 has been retained. In place of other existing facilities, new PSC's very close to the old ones have been selected (Figure 21). It seems from the figure that existing facilities could be moved, relatively easily, to the nearby selected sites. Ghulail Dispensary would be moved to the intersection of the main roads within the district to be accessible more easily on major roads. Nuzla Dispensary would be moved to the main road of its district, while Hindawia Dispensary could be relocated on the main road in the northern part of its district to serve both Hindawia and Shati districts. Also, Ruwais Dispensary would be moved



Figure 21. Relocating Existing Health Facilities

farther north along the same main street, while Kandara Dispensary could be moved toward the eastern end on the major road. Finally, Bani Malik Dispensary would be relocated to the southern portion of the main street.

Assignment of the selected PSC's close to the main streets, intersections, and major roads in the districts was attempted. Since most streets have no names and the houses are not numbered, this was considered the best possible solution in assigning sites so that they are more easily accessible to users.

### PSC's which Appear in all Three TTT's

According to the study analysis, there would be 39 PSC's within the five minutes TTT, 27 for ten minutes and 23 for fifteen minutes. Thus, some PSC's are selected at all three TTT's (Table 12). There were 16 PSC's selected under these three constraints (Figure 22). The five and ten minute TTT's selected 26 common PSC's and 17 PSC's were selected for the ten and fifteen minute TTT's. These commonly selected PSC's present various possibilities for assigning appropriate facilities at different time constraints.

In summary, the study has proposed several alternatives

PSC	5 Minutes	10 Minutes	15 Minutes	PSC	5 Minutes	10 Minutes	15 Minutes
No. 1	x	x	x	No. 22	x	x	
No. 2	x	x		No. 23	x	x	x
No. 3	x	x	x	No. 24	x		
No. 4	x		x	No. 25	x	x	x
No. 5	x	x	x	No. 26	x		x
No. 6				No. 27	x	x	x
No. 7	x	x		No. 28	x	x	
No. 8	x	x	x	No. 29	x	x	
No. 9	x			No. 30	x	x	x
No.10	x	x	x	No. 31	x	x	x
No.11	x	x		No. 32	x		
No.12	x	x	x	No. 33	x		
No.13	x		x	No. 34		x	х
No.14	x			No. 35	x	x	
No.15	x		x	No. 36	x	x	х
No.16	x	x		No. 37	x		
No.17	x	x	x	No. 38	x	x	
No.18	x		x	No. 39	x	x	x
No.19	x	x		No. 40			
No.20	x	x	x	No. 41	x	x	x
No.21	x		x	No. 42	x		

Table 12. PSC's which Appear in all Three TTT's



Figure 22. The PSC's that Appear in All Three TTT's

for locating PSC's at various TTT's. At the 5 minute TTT the PSC's selected will be very accessible to all the inhabitants. At the 10 and 15 minute TTT's the numbers of selected PSC's are very similar. Selection of an appropriate number of centers could be carried out based on the alternatives described in this chapter.

#### CHAPTER VI

## CONCLUSIONS AND RECOMMENDATIONS

In the last decade the urban areas in Saudi Arabia began to grow rapidly. Unplanned and unprecedented, this growth has lacked adequate social services for the expanding populations. Health care delivery is one of those essential public service components. One of the major cities in the country, Jeddah, is growing without sufficient quantity and quality primary health facilities. The purpose of this study has been to develop a plan to propose potential service centers within Jeddah that are accessible to the inhabitants within a short travel time. A field work investigation was carried out to achieve the objectives of the study.

F

### Conclusions

The three major objectives of this study were, (1) to identify the user characteristics and the conditions of the existing facilities; (2) to obtain an estimation of the potential service centers needed; and (3) to provide an assessment of potential service centers for public health dispensaries. The major findings are as follows:

First, the study has indicated that the socioeconomic characteristics of users of the public dispensaries are varied, although it is apparent that the majority of users are laborers. About half of the study respondents indicated that they use their own cars in seeking health care. As for the travel time involved, the respondents preferred a trip time threshold less than 10 minutes. The majority of the users patronized and preferred to seek health care offered by public dispensaries. One-third of the respondents rated the existing dispensary services as excellent while thirty-eight percent considered them above average. Three quarters of the users reported that the main reason for choosing a dispensary was its proximity to their residences. More than half of the users preferred to use the public dispensaries for emergency cases and most of the emergency cases are minor complaints the dispensaries can treat effectively, such as minor accidents, cold and influenza and so on. These discussions centered on the user's perceptions regarding existing facilities.

Most of the existing dispensaries are located in unplanned districts, which adds to the complexity of traffic movements. Fast travel speeds during the day are difficult, while the congestion is relieved after 9:00 p.m. The

absence of speed limit controls has caused inconvenience for public safety vehicles such as ambulances, police and fire units.

The second objective of the study was to estimate the potential service centers needed for the public health dispensaries as there is a lack of primary health facilities that can serve the population in a short time within easy access. Based on the field observations, 42 selected potential service centers (with regard to the trip time) were identified in the city. An estimated 133 populations gravitational points were identified including the 42 potential service centers with an average time constraint between each center of 5 to 15 minutes.

The final objective of the study was to assign the potential service centers for various trip time thresholds. The enumeration technique of integer linear programming was employed to obtain the minimum number of service centers for various time constraints. The results indicated that, based on five minutes as trip time between one or more of the selected potential service centers, there are 39 potential service centers that can be considered. With ten minutes travel time, which is the ultimate goal of this study, there were found to be 27 potential service centers. Finally, with

fifteen minutes proposed as travel time, there are 23 potential service centers to be assigned in the city. At the same time, the study produced three sets of coincident potential service centers for the three travel times proposed (5, 10 and 15 minutes). There were 16 potential service centers for all those trip times, 17 potential service centers for 10 and 15 minutes, and 26 potential service centers for 5 and 10 minutes.

### Recommendations

Based on the results of this study, the following recommendations are made:

1. Of the three sets of alternatives available to locate health care services in Jeddah, the 27 potential service centers, which would place dispensaries within 10 minutes reach from individuals' residences, be given primary consideration.

2. The existing facilities could be relocated on new sites to be more available and accessible to patients.

3. Even though there may be problems in locating the dispensaries exactly on the selected potential service centers, it is recommended that the facility be located within a radius of 250 meters to avoid problems with

government agencies or landowners.

Based on the researcher's observations and the study results, the following additional recommendations are made to facilitate appropriate and acceptable health care services:

1. All of the feasible facilities be designed for medical purposes and must be owned by the government.

2. Each facility provide a parking lot for users' vehicles when they come to consult a physician.

3. Users be charged a nominal fee so that they will not misuse the facility's services.

4. Ongoing records be kept for every individual in the city. This could be done by assigning the individuals of each district to a specific facility. An individual should not use other facilities unless it is an emergency case and records should be kept strictly confidential. It is further recommended that strict regulations be established between the Ministry of Health and the Ministry of Interior regarding this matter.

5. Since the city lacks a general emergency system, it is recommended that emergency units be established in order to serve seriously ill cases.

6. Each dispensary be equipped well enough to meet

a wide variety of patient needs, and reduce the heavy pressure on the main hospitals.

7. The existing dispensary hours be extended until midnight so that services can be available to the patients a majority of the time and thus reduce pressure on the main emergency rooms in the hospitals as well as the patient's time and cost involved in obtaining care.

8. Each dispensary user be assigned to a specific hospital in the city so as to avoid overcrowding and misuse of hospital facilities.

9. A well-developed program in the daily newspapers, schools and on radio and television be instituted to educate the people on how to use the health facilities and their rules.

10. There be a planning department in the Ministry of Health to manage and coordinate future health planning with other agencies.

### Strategy for Implementation

This plan could be established since the Saudi Arabian government does not lack the capability for carrying out every aspect of the scheme heretofore presented. A lack of appropriately trained manpower could be a short term problem.

It would be necessary to import trained medical manpower until Saudi Arabian medical schools and training programs produce sufficient staff to meet the high demand for these persons from their own programs.

#### Need for Further Study on Health Care

Health care delivery systems can make many contributions to solving health problems in the less developed countries. Geographers and non-geographers (e.g., planners) can study cooperatively the current health care situations and do what is necessary to resolve these problems. Due to the lack of available first-hand information, detailed additional field work should be conducted in many of the following areas: (1)the emergency services to develop a more comprehensive program; (2) existing hospital distribution needs to determine if they need to be relocated to meet the needs of the newly assigned facilities; (3) the private hospitals evaluated on the basis of their locations and the cost and types of services they provide; and (4) a follow-up of the present study on potential service centers for the public dispensaries needs to determine how accessible these are in actuality and how fast the patients can reach health care.

#### BIBLIOGRAPHY

- Abernathy, William J. and J. C. Hershey. A Spatial Allocation Model for Regional Health Services Planning, <u>Operation Research</u>, 1972, Vol. 20, No. 3, pp. 629-642.
- Achabal, Dale D., The Development of a Spatial Delivery System for Emergency Medical Services, <u>Geographical Analysis</u>, (1978), Vol. 10, No. 1, pp. 47-64.
- Al-Ghamdi, Abdulaziz S., "Water Distribution, Availability and Problems in Jeddah City, Saudi Arabia: A Household Survey," Unpublished Masters Thesis, Michigan State University, Department of Geography, 1979.
- Anderson, Ronald and Odin W. Anderson, <u>A Decade of</u> <u>Health Services</u>, (Chicago: The University of Chicago Press, 1967).
- Bashshur, R. L., G. W. Shannon and C. A. Metzner, The Application of Three-Dimensional Analogue Models to the Distribution of Medical Care Facilities, <u>Medical Care</u>, (1970), Vol. 8, No. 5, pp. 395-407.
- Bennett, William, "A Location-Allocation Study for Primary Care Health Centers: A Survey of the Doctored and Undoctored Populations in the Lansing, Michigan Area." Unpublished doctoral dissertation, Michigan State University, Department of Geography, (1979).
- Berry, Brian J. L., <u>Geography of Market Centers and</u> <u>Retail Distribution</u> (Englewood Cliffs: Prentice-Hall, 1968).

- Blalock, Hubert, Jr., Social Statistics, (New York: McGraw-Hill Book Company), 1979.
- Brunn, Stanley D. <u>Geography and Politics in America</u>. New York: Harper and Row, 1974.

, Research Frontiers in Applied Social Geography in Harold Winters and Marjorie Winters (eds.), <u>Applications of Geographic Re-</u> <u>search</u>, Department of Geography, Michigan State University, East Lansing, Michigan, 1977, pp. 13-27.

- Cohen, Claude and Jack Stein. <u>Multipurpose Optimization</u> <u>System</u>. Manual No. 320, Evanston, Illinois, Vogelback Computing Center, Northwestern University, 1978.
- Coleman, Jules V., Psychiatric Studies of Patient Needs in Emergency Services of General Hospitals, <u>Med-</u> ical Care, (1967), Vol. V, No. 4, pp. 255-259.
- Cox, K. R. <u>Conflict</u>, Power and Politics in the City: A Geographic View, New York: McGraw-Hill, 1973.
- Dear, Michael, Planning for Mental Health Care; A Reconsideration of Public Facilities Location Theory, <u>International Regional Science Review</u>, (1978), Vol. 3, No. 2, pp. 93-111.
- de Vise, Pierre, <u>Misused and Misplaced Hospitals and</u> <u>Doctors: A Location Analysis of Urban Health</u> <u>Care Crisis</u>, Washington, D.C.: Association of American Geographers, Commission on College Geoggraphy, Resource Paper No. 22, 1973.
- Earickson, Robert, The Spatial Behavior of Hospital Patients: A Behavioral Approach to Spatial Interaction in Metropolitan Chicago, <u>Research Paper</u>, (1970). No. 124, Dept. of Geography, University of Chicago.

, Poverty and Race: The Bane of Access to Essential Public Services, Antipode, (1972), Vol. 3, No. 1, pp. 1-8.

- Godlund, Sven, <u>Population</u>, <u>Regional Hospitals</u>, <u>Trans-</u> <u>port Facilities and Regions</u>: <u>Planning the Loca-</u> <u>tion of Regional Hospitals in Sweden</u>, Lund Studies in Geography, (1961), Series B, No. 21, (Lund: C.W.K. Gleerup Publishers).
- Good, Charles M. and Others, The Interface of Dual Systems of Health Care in the Developing World: Toward Health Policy Initiatives in Africa. Social Science and Medicine, Vol. 13 D, No. 3, pp. 141-154 (1979).
- Gould, Peter and T. Leinbach, An Approach to the Geographic Assignment of Hospital Services, <u>Tijd-</u> schrift voor Economische in Social Geographie, (1966), Vol. 57, pp. 203-206.
- Haggett, Peter, Andrew D. Cliff and Allen Frey, Location Analysis in Human Geography, Vol. I and II, New York: John Wiley and Sons, 1977.
- Hamilton, William F. C., Systems Analysis in Emergency Care Planning, Medical Care, (1974), Vol. XII, No. 2, pp. 152-162.
- Herbert, David T. and R. Johnston (ed.), Geography of the Urban Environment, in <u>Progress in Research and</u> Applications, New York: John Wiley & Sons, 1979.
- Hunter, John M., The Challenge of Medical Geography, in John M. Hunter (ed.), The Geography of Health and Disease: Papers of the First Carolina Geographical Symposium, (Chapel Hill: University of North Carolina), 1974, pp. 1-31.
- Jakle, John A., S. Brunn and C. Roseman, <u>Human Spatial</u> <u>Behavior: A Social Geography</u> (North Scituate, Massachusetts, Duxburg Press, 1976).

- Johnston, R. J. Residential Area Characteristics Research for Identifying Urban Sub-Areas--Social Area Analysis and Factorial Ecology. In D.T. Herbert and R. J. Johnston (eds.), <u>Social Areas</u> <u>in Cities</u>, 1. Spatial Processes and Forms, Wiley, London (1976).
- Kirkpatrick, John R. and L. Taubenhaus, The Non-Urgent Patient on the Emergency Floor, <u>Medical</u> <u>Care</u>, (1967), Vol. V, No. 1, pp. 19-24.
- Kleozkowski, B. M. Health Care Facilities in Developing Countries, <u>WHO Chronicle</u>, Vol. 3, No. 9, 1976, pp. 363-369.
- Lankford, Philip, The Changing Location of Physicians, Antipode, (1972), Vol. 3, No. 1, pp. 68-72.

, Physician Location Factors and Public Policy, Economic Geography, (1974), Vol. 50, No. 3, pp. 244-255.

- Lansing, John B. and James N. Morgan. Economic Survey Methods. Ann Arbor, Michigan: Institute for Social Research, The University of Michigan, 1971.
- Marden, Paker G., "A Demographic and Ecological Analysis of the Distribution of Physicians in Metropolitan America, <u>American Journal of Sociology</u>, 1966, Vol. 72, No. 3, pp. 390-300.
- Mayer, Johnathan D., Paramedic Response Time and Survival from Cardiac Arrest, <u>Social Science and</u> Medicine, (1979b), Vol. 13 D, No. 4, pp. 267-271.

, Response Time and Its Significance in Medical Emergencies, Geographical Review, (1980) Vol. 70, No. 1, pp. 72-87. , Seattle's Paramedic Program: Geographical Distribution, Response Time and Mortality, Social Science and Medicine, (1979a), Vol. 13 D, No. 1, pp. 45-51.

Mehretu, Assefa. Procedures for Locating Basic Needs Services in Rural Areas: An Application to Problems in the Eastern Region of Upper Volta. Department of Agricultural Economics, Michigan State University, East Lansing, Michigan, 1980.

Morrill, Richard and R. Earickson, "Problems in Modeling Interaction: The Case of Hospital Care," in K. Cox and R. Golledge (eds.), <u>Behavioral</u> <u>Problems in Geography</u>, A Symposium, Studies in <u>Geography</u>, (1969), No. 17, Northwest University.

, Variation in the Character and Use of Chicago Area Hospitals, <u>Health Services</u> <u>Research</u>, (1968), Vol. 3, No. 3, pp. 224-238.

- Morrill, Richard L., R. Earickson and P. Rees, Factors Influencing Distance Travelled to Hospitals, Economic Geography, (1970), Vol. 46, No. 2, pp. 161-171.
- Morrill, R. L. and P. Kelley. "Optimum Allocation of Services: A Hospital Example," <u>Annals of Re-</u> gional Science. 3 (1969), pp. 55-66.
- Mulvihill, James, A Location Study of Primary Health Services, <u>The Professional Geographer</u>. (1979), Vol. 13, No. 3, pp. 299-305.
- Navin, Robert E. and R. Stevens, Estimating the Cost of Small Scale Ambulance Operations, Agricultural Economics Report, (1979), No. 243, Department of Agricultural Economics, Michigan State University, East Lansing, Michigan.

- Pauly, Mark V. C., "Economic Aspects of Consumer Use," in Selma Muskin (ed.), <u>Consumer Incentives for</u> <u>Health Care</u>, (New York: Milbank Memorial Fund, 1974.
- Perkoff, Gerald T. and M. Anderson, Relationship between Demographic Characteristics, Patient's Chief Complaint, and Medical Care Destination in an Emergency Room, <u>Medical Care</u>, (1970), Vol.VIII, No. 4, pp. 309-323.
- Pyle, Gerald F., "The Geography of Health Care," in John M.Hunter (ed.), <u>The Geography of Health</u> and Disease: Papers of the First Carolina Geographical Symposium, (Chapel Hill: University of North Carolina), 1974, pp. 154-185.

\_\_\_\_\_, Applied Medical Geography, (Washington, D. C., V.H. Winston & Sons, 1979).

- Reinke, William A. and T. D. Baker, Measuring Effects of Demographic Variables on Health Services Utilization, <u>Health Services Research</u>, (1967), Vol. 2, No. 1, pp. 61-75.
- Roghmann, Klaus J. and T. Zastowny, Proximity as a Factor in the Selection of Health Care Providers: Emergency Room Visits Compared to Obstetric Adminissions and Abortions, <u>Social Science and Medicine</u>, 1979, No. 1, pp. 61-69.
- Rushton, Gerard. Optimal Location of Facilities. Trustees of Dartmouth College & Compress, Inc. Wentworth, N. H. 1979.
- Saudi Arabia, Ministry of Interior, Municipal Affairs, Regional and Town Planning Department, Master Plan Report for Jeddah, 1972.

- Saudi Arabia, Ministry of Municipal and Rural Affairs, Deputy Ministry of Town Planning. Existing Conditions of the Metropolitan Area, Jeddah. Technical Report, Vol. 3, No. 5, Unpublished Report, 1980.
- Schneider, Jerry B. C., Measuring the Locational Efficiency of the Urban Hospital, <u>Health Services</u> <u>Research</u>, (1967), Vol. 2, No. 2, pp. 154-169.
- Shannon, Gary W. and C. W. Spurlock, A Method for Evaluating the Geographic Accessibility of Health Services, Professional Geographer, (1975), Vol. 27, No. 1, pp. 30-36.
- Thomas, C. J. Sociospatial Differentiation and the Use of Services, in D. Herbert and R. Johnston (eds.), Spatial Perspectives on Problems and Policies, Vol. II, (London by John Wiley and Sons), 1976.
- Toregas, Constantine and C. Revelle, Optimal Location under Time or Distance Constraints, <u>Regional</u> <u>Science Association</u>, Papers, Vol. 28, pp. 133-143, 1972.
- Vaughn, H., Hospital Emergency Room Utilization Study, Michigan Blue Cross Association, <u>Research and</u> Statistical Division, 1965.
- Weinerman, Richard E., Yale Strides in Ambulatory Medical Care: IV, Out-Patient Clinic Services in Teaching Hospital, New England Journal of Medicine. (1965), Vol. 272, pp. 947-954.
- Weinerman, Richard E., R. Ratner, A. Robbins and M. Lavenhar, Yale Studies in Ambulatory Medical Care: V. Determinants of Use of Hospital Emergency Services, <u>American Journal of Public Health</u>, (1966), Vol. 56, No. 7, pp. 1037-1055.

APPENDIX

ν.

V

# APPENDIX A

## QUESTIONNAIRE

Name of the district:						
Which dispensary do you usually use?						
Age of the respondent:						
Number of persons living in your household:						
What is your occupation?						
How long have you been living in Jeddah?						
Do you own the house you live in? Yes No						
What type of house do you live in?						
l. Villa						
2. Apartment						
3. Traditional house						
4. Shack						
5. Other						
Would you mind telling me your approximate monthly						
income?						
Do you or anyone in your household own a car? Yes No						
What type of transportation do you usually use to get to						
a health care facility?						
l. Walking 5. Taxi						
2. Private car 6. Ambulance vehicle						
3. Friend's car 7. Other						
4. Bus						

Y
-- Usually, what type of medical care do you use?

- 1. Family doctor \_\_\_\_\_ 4. Dispensary \_\_\_\_\_
- 2. Private hospital \_\_\_\_ 5. Other \_\_\_\_\_
- 3. Public hospital

-- How far is the dispensary closest to your home?

\_\_ How long does it take by car to get to the closest dispensary?

-- How would you evaluate the location of this dispensary?

- 1. Very accessible \_\_\_\_\_
- 2. Accessible \_\_\_\_\_
- 3. Inaccessible
- 4. Very inaccessible
- 5. Do not know

-- Why did you choose this dispensary rather than others?

- 1. Because it is close to my residence
- 2. Because it has a good doctor
- 3. Because the service is faster than others
- 4. Other reasons

-- Is the dispensary you go to too crowded? Yes No

- -- What should be the maximum distance from your home to
  - a dispensary? \_\_\_\_\_
- -- What should be the maximum time it takes to reach the dispensary in an emergency?

- -- How would you rate the health care services in the dispensary you use most often?
  - 1. Excellent \_\_\_\_\_ 4. Below average \_\_\_\_\_
  - 2. Above average \_\_\_\_ 5. Do not know \_\_\_\_\_
  - 3. Average
- -- If you or someone in your household has an emergency case, where do you prefer to go?
  - 1. To the public hospital
  - 2. To the dispensary
  - 3. To the private hospital
- -- For which of the following ailments would you go to the dispensary?
  - 1. Minor cuts and bruises \_\_\_\_\_
  - 2. Cold and influenza
  - 3. Minor accident
  - 4. Major accident \_\_\_\_\_
  - 5. Communicable disease \_\_\_\_\_
  - 6. Others

wells, Ponald A

