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AN ECONOMIC ANALYSIS OF SOME ASPECTS OF MEDICAL SERVICE AVAILABILITY IN NORTHWEST SOUTH DAKOTA

BY

LELAND G. BIERMAN

A thesis submitted
in partial fulfillment of the requirements for the
degree Master of Science, Major in
Economics, South Dakota
State University

1969

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AN ECONOMIC ANALYSIS OF SOME ASPECTS

OF MEDICAL SERVICE AVAILABILITY IN

NORTHWEST SOUTH DAKOTA

This thesis is approved as a creditable and independent investigation by a candidate for the degree, Master of Science, and is acceptable as meeting the thesis requirements for this degree, but without implying that the conclusions reached by the candidate are necessarily the conclusions of the major department.

_____ _____

Thesis Adviser Date

_____ _____

Head, Economics Department Date

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

A community which has its own hospital and doctor is benefited in many ways. First, the people in the community are near medical care in times of emergency. Second, hospital patients from the community are near family and friends when receiving care. Third, a community may be benefited economically by the presence of a hospital facility because additional jobs are provided, and people from the surrounding area are given increased incentive to come to the town in purchasing other goods. Also, adequate medical services are of importance in attracting new industry into a town.

The trend today, however, is away from the concept of the small hospital and one doctor for each town. The modern practice of medicine requires specialization of equipment and personnel to a degree not practical in many small town situations.

Statement of the Problem

Because of rising costs, personnel shortages, and rapidly advancing medical technology, communities throughout the United States are having difficulty providing the types of medical services required today. Average total cost per patient day for the more than

5,000 short-term, non-federal general hospitals belonging to the American Hospital Association (AHA) increased by 113 percent from 1957 to 1967.[1] This was an increase from $26.02 in 1957 to $55.40 in 1967. The personnel shortages are particularly acute in many South Dakota communities. In 1965, for example, there were 39 towns in South Dakota with only one physician. Thirteen of these towns were requesting another physician. In addition, eight non-physician towns were making requests for a doctor.[2]

Rural areas are particularly hard hit by rising costs and medical personnel shortages because they have the additional problem of low population density. These communities often find that the population base of relatively large hospital service areas is not large enough to support a hospital of sufficient size to provide the types of facilities doctors need in treating patients. As a result, communities constructing small hospitals frequently have difficulty holding a physician for any length of time. Dr. Elston, in testimony before the South Dakota Legislative Research Council, points this out when he states, "physicians are 'hospital oriented' and towns with a small hospital or

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[1]American Hospital Association, "Guide Issue," Hospitals, JAHA, Part 2, (August, 1968).

[2]Health Manpower Study Commission, Health Manpower for the Upper Midwest, (St. Paul, Minnesota: Health Manpower Study Commission, 1966), 72.

without a hospital at all do not provide the facilities that a physician needs to practice medicine as he has learned it in medical school."[3] Statistics seem to support Dr. Elston's claim of low quality services in small hospitals. In 1966, for example, only 13 percent of the AHA member hospitals of 25 beds or less had a blood bank, while 86 percent of the hospitals in the 200-299 bed category had such a facility. Similar trends existed with regard to other hospital services.

The effect of the problems faced by small hospitals is also shown in nationwide size trends for AHA member hospitals. From 1957 to 1966 the number of member hospitals of 25 beds or less dropped by 32 percent. The number in the 25-50 bed class increased by only 10 percent, while the number in all other classes increased from 17 to 80 percent.[4]

Because of the problems being faced by rural areas in maintaining hospital facilities, numerous alternatives for providing medical care are being suggested. For example, it has been suggested that medical service technicians should be trained and licensed to provide first aid in those communities that are losing their hospitals or do not have

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[3]State Legislative Research Council, LRC Newsletter and Council Minutes, (Pierre: State Legislative Research Council, July, 1968), 12.

[4]American Hospital Association, "Guide Issue," Hospitals, JAHA, Part 2, August, 1967).

hospitals. These technicians could help in transporting the sick and injured to an accredited hospital that can provide the necessary services.[5] Other suggestions have been made regarding the possibility of utilizing mobile first aid stations and circuit riding physicians.[6] Adoption of any of these suggestions would necessitate an improvement in the method of transporting patients needing hospital care to hospitals that can provide the necessary services.

In summary the situation is as follows. Modern medicine, with its emphasis upon specialization of personnel and equipment, is forcing many small towns to lose both doctor and hospital. In sparsely populated areas where the distance between major trade centers is considerable, this trend away from small town medical facilities often denies many people ready access to medical services. The problem, then, becomes one of providing easy access to medical services for people located in sparsely populated areas in South Dakota.

Studies need to be conducted to determine possible alternatives for providing medical services in these rural communities. Rural community leaders need to be made aware of the alternative methods available for providing medical services and how these methods

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[5]State Legislative Research Council, LRC Newsletter and Council Minutes, (Pierre: State Legislative Research Council, July, 1968), 16.

[6]Ibid., p. 15.

compare in cost and level of coverage. With such information they can better decide how to coordinate the health services within their area so as to provide accessibility to health services at the least possible cost consistent with desired quality standards.

Review of Literature

Studies have been conducted describing some of the problems faced by rural areas in providing hospital and other medical care. These studies have not focused on alternative solutions to the problems.

Kraenzel, in a study of the availability of medical services in sparsely populated areas of Montana, concluded that there is a definite tendency for these areas to provide more hospital beds than necessary in an attempt to make them accessible to everyone.[7]

Kurtz, et al, in a Nebraska study, analyzed factors influencing the efficiency of rural hospitals. He found that one of the most serious problems faced by the smaller unit is retaining the services of medical practitioners. Also, he found that rural people had a

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[7]Carl F. Kraenzel, "Opportunities and Challenges of the Upper Great Plains," (Unpublished paper delivered at, Forum, Inc. of the Great Plains, 1968), 7,8.

definite desire for an immediately accessible facility showing the need of some type of local facility.[8]

Hay and McKain, in studying the interrelationship between health personnel located in rural towns and those located in urban areas, concluded that nearly all of the personnel located in rural areas of Connecticut have working relationships with their counterparts in urban centers. Also, the Connecticut researchers found that 64 rural towns were served by public health and visiting nurse associations, one-fourth of which were covered by associations formed by the banding together of two towns. Similarly, of the 104 rural towns with ambulance services available, two-thirds had linkages with one or more other towns in their service.[9]

These studies point out some of the problems of providing medical care in rural areas and suggest some of the ways rural areas are adapting to these problems. They do not, however, analyze the feasibility of specific alternative methods of providing rural areas access to medical facilities.

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[8]Richard A. Kurtz, Factors Affecting the Efficiency of Rural Hospitals: A Final Progress Report, (Lincoln: University of Nebraska, 1962), 55-58.

[9]Donald G. Hay and Walter C. McKain Jr., Availability of Selected Health Care Resources in Rural Areas of Connecticut, Agriculture Experiment Station, Bulletin 367, (Storrs, Conn.: University of Connecticut, 1961), 34-37.

Delineation of a Study Area

Figure I-1 shows that much of the area within South Dakota was within at least twenty miles of a hospital in 1965. With today's modern transportation vehicles and all weather roads, hospitals in many areas could be eliminated with little loss of accessibility to hospital services.

The Northwest portion of South Dakota is one exception. Figure I-1 shows that a large portion of this area was served primarily by only one twenty-bed hospital. If this hospital should close, as have many hospitals of similar size, portions of Northwest South Dakota would be from 50 to 75 miles or more from the nearest hospital.

The purpose of this detailed analysis of Northwest South Dakota is two-fold: (1) to help Northwest South Dakota to better organize its health resources, and (2) to serve as a guide in planning by other areas in South Dakota and in neighboring states which may be faced with similar situations today or in the future.

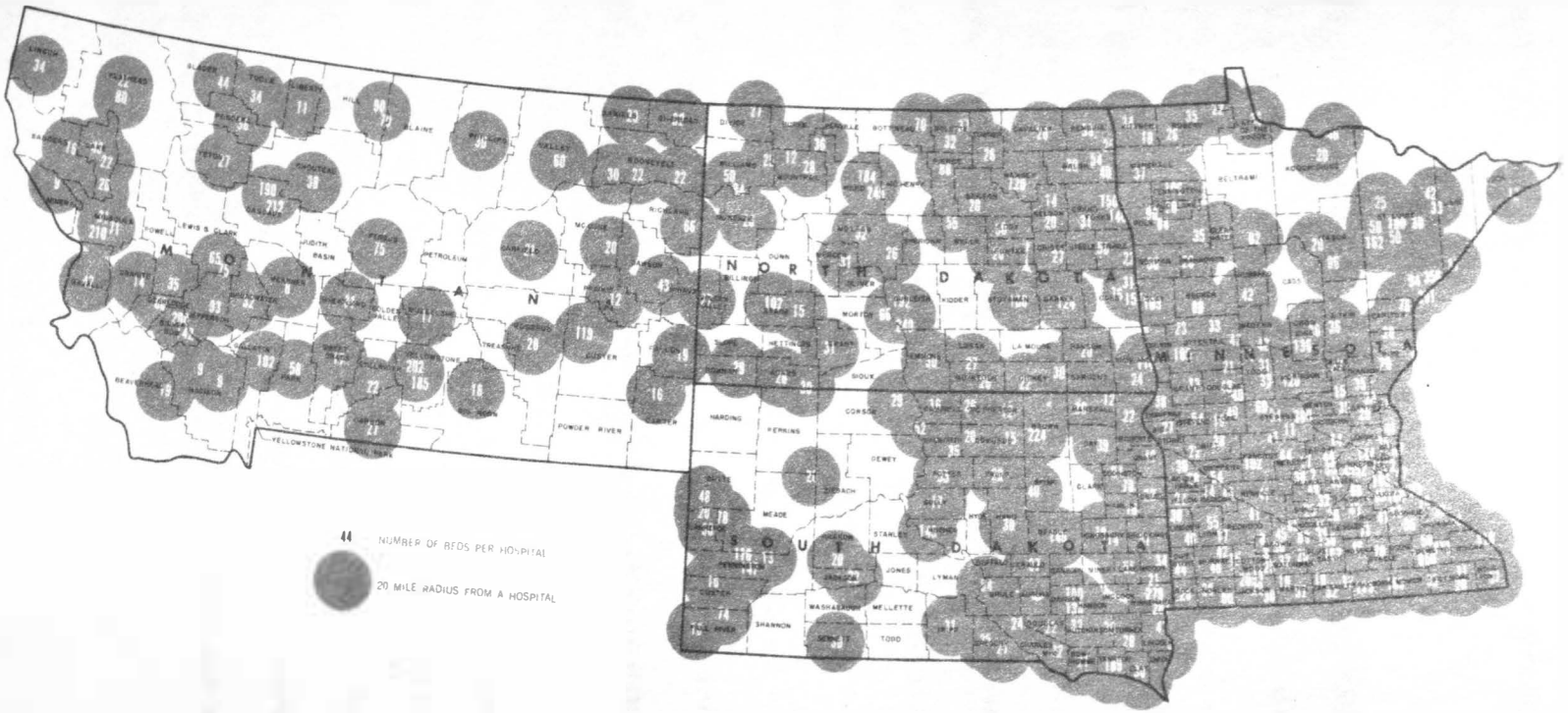
Study Objectives

The objectives of this study were as follows:

1. To determine the current availability of hospitals, doctors, and ambulance services in Northwest South Dakota.
2. To describe and analyze the current pattern of hospital utilization in Northwest South Dakota.

Figure I-1

Location of Hospitals in South Dakota
and the Upper Midwest



To analyze some alternative means of providing ambulance
in Northwest South Dakota.

cedure for Gathering and Analyzing Data Used in this Study

ta used for this study were gathered from a number of sources.
pital license information of the Public Health Service was a
ource of information pertaining to hospitals in the area. In-
on on doctor location and specialties was obtained from the
Board of Medical and Osteopathic Examiners. Ambulance service
n information was obtained from the Public Health Service and
nnaires sent to local governments in the study area. Cost
r the three types of ambulance vehicles considered were ob-
from the United States Department of Transportation, from the
turers of fixed wing air ambulances and from discussions with
from local air services.

e general procedure followed in the study was to indicate the
availability of medical care, then to analyze the pattern of
l utilization. The final step in the analysis was to deter-
e current availability of ambulance services in the area and
are the cost and capability of three ambulance systems which
e used in the area.

Throughout the study the analysis was restricted to non-federal facilities and personnel only. Consequently, the facilities and personnel of the two Public Health Service Hospitals and the Veterans Hospital located in the study area were not included in any data presented.

CHAPTER II

AN ANALYSIS OF THE STUDY AREA

The purpose of this chapter is to give a general description of the area and to indicate the problems the area faces in providing hospital and some other medical services. The area designated as Northwest South Dakota is composed of 16 counties in the Northwest and NorthCentral portions of South Dakota. Included within this area is the second largest trade center in South Dakota, as well as several of the most sparsely populated counties in the state.

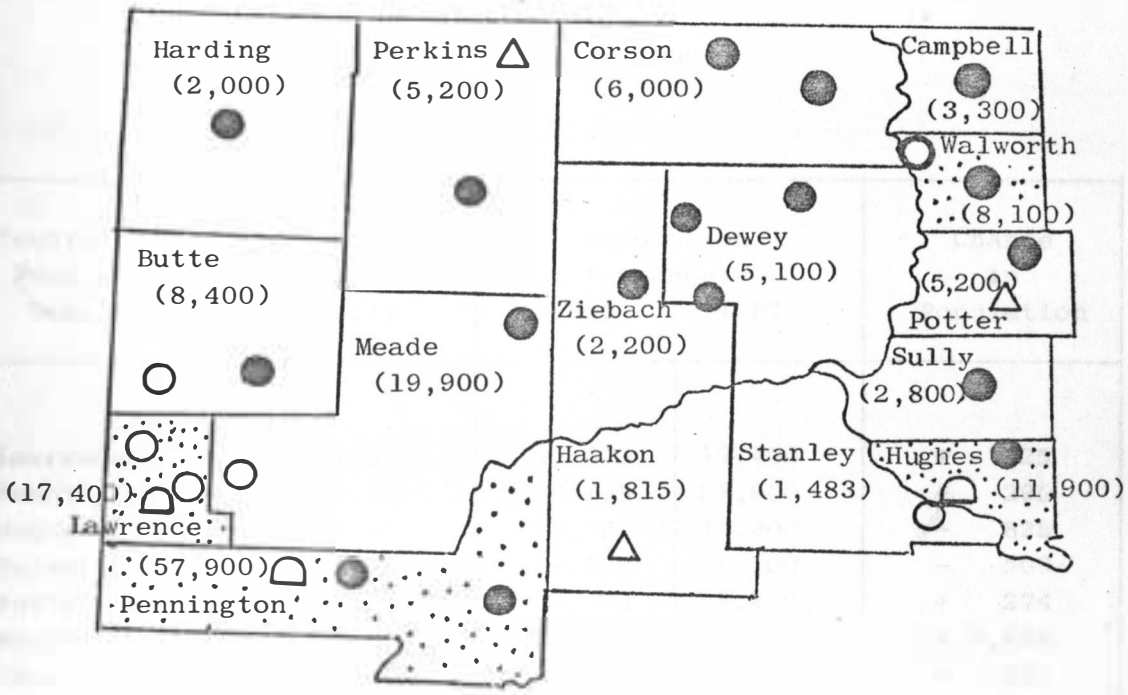
An Economic and Demographic Description of the Study Area

Northwest South Dakota is quite heterogeneous in terms of population density, level of family income and economic base. In 1967 the average population density for Northwest South Dakota was approximately six people per square mile. Counties in the area ranged from an average of 21.8 to 0.7 people per square mile. County population density and total population per county are shown in Figure II-1. The location of major towns greatly influenced population density figures as the Figure shows.

Northwest South Dakota has been increasing in population at a slow rate. The data in Table II-1 show that the area grew in

Figure II-1

Population Density of Counties in Northwest South Dakota, 1967



Key to Figure

Population Size of Towns in Area, 1960

- Town of 400-999 Population
- Town of 1,000-2,499 Population
- Town of 2,500-4,999 Population
- Towns of above 5,000 Population

Population Statistics for Counties in Area, 1967

- 11 People or More Per Square Mile
- 6-10.9 People Per Square Mile
- Less Than 6 People Per Square Mile
- 11 Total Population in County

Table II-1

Population Density for Northwest South Dakota by County

Counties by Population Density	Population Density	Population Per County 1960	Population Per County 1967	Change in Population
Lawrence	21.8	17,075	17,400	+ 325
Pennington	20.9	58,195	57,900	- 295
Hughes	15.9	12,725	11,900	- 825
Walworth	11.0	8,600	8,100	- 500
Potter	5.9	4,926	5,200	+ 274
Meade	5.7	12,044	19,900	+ 7,856
Campbell	4.3	3,531	3,300	- 231
Butte	3.7	8,592	8,400	- 192
Sully	2.7	2,607	2,800	+ 193
Corson	2.4	5,798	6,100	+ 302
Dewey	2.1	5,257	5,100	- 157
Stanley	1.9	4,085	2,800	- 1,285
Perkins	1.8	5,977	5,200	- 777
Haakon	1.5	3,303	2,800	- 503
Ziebach	1.1	2,495	2,200	- 295
Harding	0.7	2,371	2,000	- 371
Area Total	6.5			+ 3,519

Source: South Dakota Department of Health, Annual Statistical Report, Division of Health Statistics, Pierre, South Dakota, 1960, 1967.

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ation by only 3,519 people from 1960 to 1967. Much of this growth
red in Meade County.

Median family income ranged from $10,151 for Hughes County to
6 for Corson County. The percentage of the population with in-
less than $3,000 varied from 15.4 percent for Hughes County to
percent for Corson County. See Appendix Table A-2.

The racial make-up of the area's population affects the demand
edical resources included in this study, because the area's
an population was not likely to utilize these facilities. The
an population was eligible for medical services in two Public
th Service Hospitals located in the study area. Although the
lation of the area was only about 6 percent Indian in 1960, a
e proportion of these people lived on reservations which were
ted in the most sparsely populated portions of the study area.
Appendix Table A-1. For example, Ziebach, Corson, and Dewey
ties all had population densities of less than 2.5 people per
re mile and populations over 30 percent Indian.

The age make-up of the population affects both the total demand
the make-up of demand for hospital and other medical services.
as been found that persons 65 years old or over stay in the hos-
l twice as long as those under 65 and have a bill 80 percent

higher.[10] In 1960 there was a total of 30,491 people above 50 years of age or about 33 percent of the population. See Appendix Table A-1. Nationwide an average of 23.3 percent of the population was above 50 years of age.[11] The fact that a larger percentage of the population in Northwest South Dakota was above 50 years of age suggests a higher per capita level of use might be expected.

The age make-up of the population also affects the area's ability to support hospitals. People in the below 14 year old age group and above 65 age category are characterized by their economic dependence upon the remainder of society. The relationship of the number of people in these categories to the number in the remainder of the population can be shown by the dependency ratio. The dependency ratio for all counties in Northwest South Dakota was at least 16 points above the United States dependency ratio of 67. See Appendix Table A-1. It was found that the most sparsely populated counties were the counties with the highest dependency ratios.

In 1962, local governments in Northwest South Dakota were spending an average of $1.02 per capita for health and hospitals.

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[10]Walter J. McNerney, et. al., Hospital and Medical Economics, Vol. 1, (Chicago: Hospital Research and Educational Trust, 1962), 367.

[11]U. S. Bureau of the Census, Statistical Abstract of the United States: 1967, (Washington: U. S. Department of Commerce, 1967), 10.

This figure, although low compared to the $12.15 spent nationally by similar levels of governments, still overestimates what most counties actually spent on health and hospitals. Sully County had a very high per capita expenditure, thus bringing up the area average. The high average value for Sully County has probably been reduced since 1962, because the hospital located in that county closed in December of 1967.[12]

By 1967 one of the most common areas of local government involvement in health services was the provision of ambulance services. Many of the funeral homes which had been providing these services discontinued providing these services because of minimum wage legislation and quality control measures. Six volunteer ambulance services in the area were being maintained by county and city governments in 1967, and several local governments were considering financial subsidy of ambulance services.[13]

Health Resources Available in the Study Area

Six different types of services and personnel were considered in this section. The types considered were as follows: (1) hospitals,

[12]Division of Comprehensive Health Planning, Hospital License Information, Public Health Service, Pierre, South Dakota.

[13]Information was obtained from questionnaire sent to County and city governments in the study area.

(2) ambulance services, (3) nursing homes, (4) doctors, (5) dentists and (6) optometrists.

A total of 23 of the area's towns had at least one of these six services located in it. When these towns were classified by population size, it was found that no town below 1,000 population had all six services. The most common type of services which these small towns did have were doctors, hospitals, ambulance services, and nursing homes. There were no dentists and only one optometrist located in towns of less than 1,000 people. Nearly all of the towns over 1,000 population had all six services available, as Table II-2 shows.

Figure II-2 shows the distribution of health facilities and personnel within Northwest South Dakota. The services were concentrated in the more densely populated portions of the study area. The county population density was of course greatly influenced by the number and size of the towns located in the county.

Doctors and Hospitals Available in the Area

The medical facilities which were available in the sparsely populated portions of the study area provided only a minimum level of care. Figure II-3 shows that the hospitals which were located in the sparsely populated center portion of the study area were very small in size. Twenty-bed hospitals were located at Faith and Philip,

Table II-2

Location of Medical Services
by Size of Town

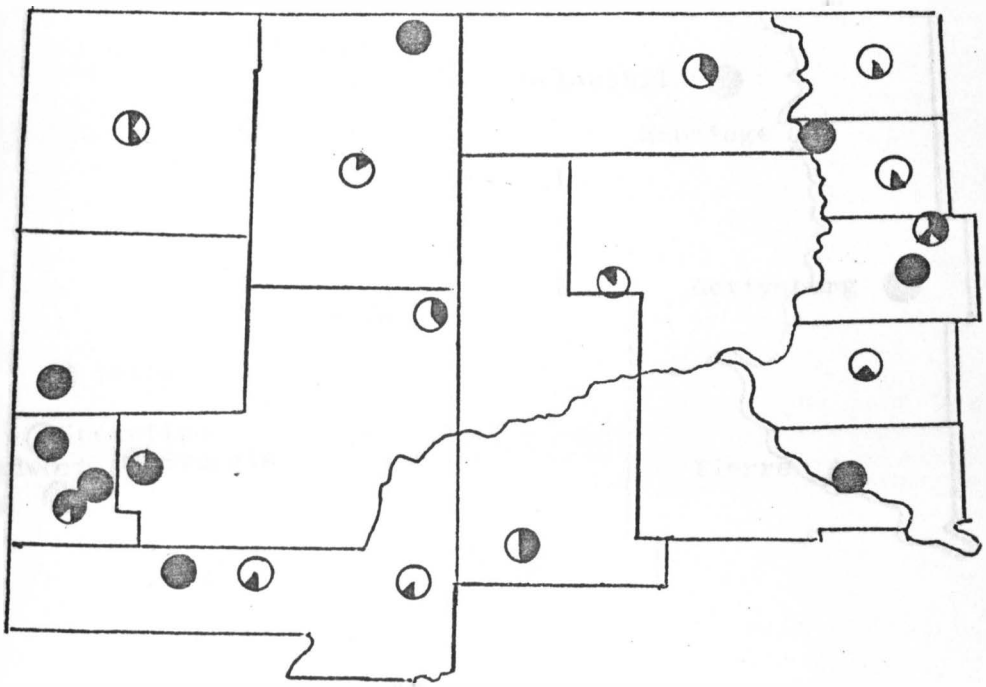
Type of Service[1]	Number of Services in Following Size Classes of Towns				
	Towns with less than 1000 Population	Towns with 1000-2499 Population	Towns with 2500 - 4999 Population	Towns with over 5000 Population	Total for All Centers
Hospital	3	3	5	3	14
Doctors	6	3	5	3	17
Ambulance Service	5	3	5	3	16
Nursing Home	5	2	5	3	15
Optometrist	1	2	5	3	11
Dentist	0	3	4	2	9
Total Services	20	16	29	17	82
Number of Towns with the Above Services	12	3	5	3	23
Number of Services per Town	1.7	5.3	5.8	5.7	3.6

[1]Data for the Veterans Hospital, the Air Force Base Hospital, and the two Public Health Service Hospitals located in the study area were not included in this table.

Source: South Dakota Department of Health, Hospital License Information, 1967, Division of Comprehensive Health Planning and Division of Health Mobilization.

Figure II-2

Medical Resources Located in Northwest South Dakota, 1967



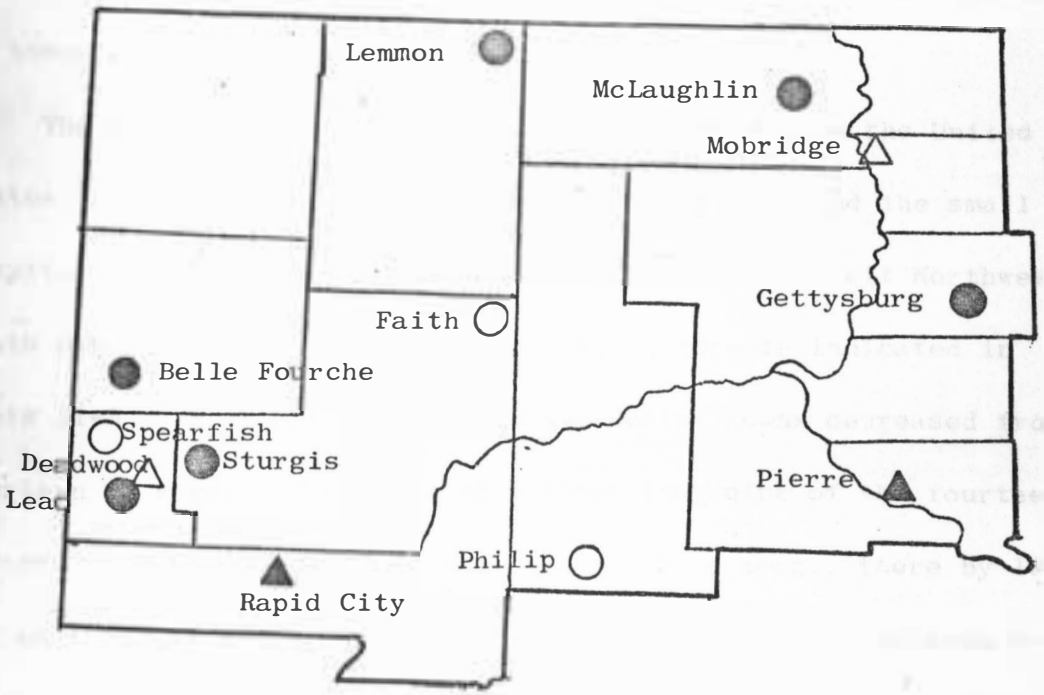
Key to Figure

Types of Medical Services

- Doctor
- Hospital
- Ambulance Service
- Nursing Home
- Optometrists
- Dentist

Figure II-3

The Location of Hospitals in Northwest South Dakota, 1967



Key to Figure

Hospital Size

○ Less Than 25 Beds

● 25-49 Beds

△ 50-99 Beds

▲ 100-200 Beds

while one thirty-bed hospital was located at Lemmon. A total of three doctors of medicine and two doctors of osteopathy were located in these three hospital towns in 1967.

The trend for Northwest South Dakota, as well as the United States, has been away from the one doctor per town and the small hospital concept. The extent to which doctors have left Northwest South Dakota towns with only one or two doctors is indicated in Table II-3. The number of one and two doctor towns decreased from fourteen to eight. The Table also shows that nine of the fourteen doctors located in these towns in 1957 were no longer there by 1967. Six of these nine medical doctors which left were not replaced by medical doctors, although one doctor was replaced by two osteopathic physicians. This high turn-over for rural doctors may discourage the use of small town medical facilities, because patients do not like to establish medical records with a doctor who is not likely to remain in the area.

The centers with over three doctors in them were not experiencing this same loss of physicians. From 1957 to 1967 the number of towns with three to ten doctors and ten or more doctors remained constant. The number of doctors available in towns with three to ten doctors

Table II-3

Medical Doctor Location Changes in Northwest South Dakota, 1957-1967

Number of Doctors in Town[1]	No. of Towns		Doctors Leaving Towns 1957-1967	Doctors Locating in Towns 1957-1967	Number of Doctors in Towns	
	1957	1967			1957	1967
1 - 2	14	8	9	3	16	10
3 - 10	6	6	22	21	32	31
10 or more	2	2	24	37	65	78

[1] Osteopathic physicians were not included in this table.

Source: South Dakota State Board of Medical and Osteopathic Examiners, 1957, 1967.

located in them declined by one. In the case of towns with over ten doctors, the number of available doctors increased by 13 from 1957 to 1967.

The number of years since a doctor was licensed was used to give some indication of the relative age of physicians in different locations. Physicians were grouped into four categories on the basis of the length of time since they were issued a license.

The data in Table II-4 indicate that of the ten medical doctors located in towns served by only one physician only one, or 10 percent, had received his license in the ten years previous to 1967. Over 35

percent of the doctors located in towns with over ten doctors had been licensed during this same ten year period. Thirty percent of the doctors located in towns served by only one or two physicians were found to have been licensed before 1937 or 31 years ago, while only 9 percent of the doctors in towns with over ten doctors located in them were licensed previous to 1937. This information seems to indicate reluctance on the part of younger physicians to locate in the smaller towns in Northwest South Dakota where there was only one other doctor or no other doctor at all.

Table II-4

Time Since License Was Issued to
Northwest South Dakota Medical Doctors

Number of Doctors in Town	Number of Doctors in Towns 1967	Doctors Licensed during Ten Years Previous to 1967	Doctors Licensed during 1937-1956	Doctors Licensed Previous to 1937	Date License Issued Unknown
1 or 2	10	1	6	3	0
3 - 10	31	12	10	7	2
10 or more	78	28	36	7	7

Source: South Dakota State Board of Medical and Osteopathic Examiners, 1957, 1967

The area has also experienced the closing of several hospitals. See Table II-5. The number of hospitals with under 25 beds declined from ten to three from 1957 to 1967. This 7 hospital reduction in the 25 bed or less class was accounted for by the closing of 4 hospitals and the replacement of 3 with larger facilities. It is significant that the four hospitals which closed and were not replaced were all located in towns of under 1,000 people. This suggests that a fairly large "home-town" population is necessary for successful hospital operation.

Table II-5

Hospital Size Trends in Northwest South Dakota, 1957-1967

Bed Size of Hospital	Number of Hospitals[1] 1957	1967	Hospital Beds 1957	1967	Change
Under 25 beds[2]	10	3	171	60	- 111
26-50 beds	6	6	201	211	+ 10
51-100 beds	1	2	76	120	+ 44
101-200 beds	3	3	373	408	+ 35
TOTAL	20	16	821	834	+ 13

[1]Data for the Veterans Hospital, the Air Force Base Hospital and the two Public Health Service Hospitals located in the study area were not included in this table.

[2]Two hospitals which closed in the latter part of 1967 were considered closed in 1967.

Source: Division of Comprehensive Health Planning, Hospital License Information, Public Health Service, Pierre, South Dakota.

Chapter Summary

The present chapter has shown that the counties located in Northwest South Dakota vary greatly in population density. Population growth trends for the area indicate that an even greater inter-county gap in density may be in store for the future.

Besides the problem of low population density, the sparsely populated counties tended to have the highest dependency ratios. A further problem faced by these counties is the fact that quite a high proportion of the population are Indians, who are eligible for care at the Public Health Service Hospitals in Rapid City and Eagle Butte.

Statistics from 1962 indicate little local government financial support for health and hospitals in Northwest South Dakota. By 1968, however, several county and city governments were involved in providing ambulance services.

The small towns have the greatest difficulty keeping medical facilities and personnel. From 1957 to 1967 the number of hospitals serving the area declined from 20 to 14. Those which closed tended to be below 25 beds in size and located in a town of population less than 1,000.

A higher proportion of doctors left towns with only one or two doctors than was true for towns with three or more doctors

located in them. Two-thirds of the doctors which left were not replaced by another doctor. It was also found that the newly licensed doctors tended to be located in the area's larger centers.

If this trend away from small town medical facilities continues, the population living or traveling through some portions of Northwest South Dakota is going to be denied easy access to hospital facilities. Ready access to adequate hospital facilities is particularly crucial in times of emergencies.

CHAPTER III

AN ANALYSIS OF THE AVAILABILITY OF HOSPITAL PERSONNEL IN NORTHWEST SOUTH DAKOTA HOSPITALS, 1967

The purpose of this chapter is to determine the relationship between the availability of hospital personnel and hospital size, and also to determine the relationship between doctor and hospital availability.

The Location and Availability of Hospital Personnel

Hospital personnel were grouped into four classes on the basis of level and type of service performed. The classifications were: (1) registered nurses, (2) licensed practical nurses, (3) hospital aides, and (4) specialized personnel. Included in the specialized personnel group were medical records personnel, dietitians, physical therapists, x-ray technicians, laboratory technicians, pharmacists, radiologists, and pathologists.

The most numerous type of personnel found in Northwest South Dakota hospitals was the hospital aide. It is shown in Table III-1 that hospital aides made up nearly 50 percent of the total personnel

Table III-1

NUMBER OF PERSONNEL EMPLOYED IN NORTHWEST SOUTH DAKOTA HOSPITALS

Size Classes of Hospitals	Registered Nurses		Licensed Practical Nurses		Hospital Aides		Specialized Personnel		Total Personnel	
	Full-Time	Part-Time	Full-Time	Part-Time	Full-Time	Part-Time	Full-Time	Part-Time	Full-Time	Part-Time
100 beds & above	99	46	24	12	147	37	37	7	307	102
50-99 beds	16	5	3	2	48	18	8	19	75	44
25-49 beds	35	29	7	6	55	26	21	20	118	81
25 beds & below	14	11	4	3	18	19	9	5	45	38
TOTAL	164	91	38	23	268	100	75	51	545	265

Source: Division of Comprehensive Health Planning, Hospital License Information, Public Health Service, Pierre, South Dakota.

employed for patient care by Northwest South Dakota Hospitals. The least commonly employed personnel were licensed practical nurses.

Relationship of Personnel Availability to Hospital Size

In order to determine if a relationship existed between the availability of hospital personnel and hospital size, the Spearman rank correlation test was used. The rank correlation test is a non-parametric test for which a statistic rho (r_s) is computed. Rho (r_s) is a measure of association between two variables. It requires that these variables be measurable only on an ordinal scale.[14] If the computed r_s is of sufficient size, the null hypothesis, that of statistical independence is rejected and the alternative hypothesis, statistical dependence, accepted. In the application of the rank correlation test in this study a 5 percent level of significance was used.

The results of the test are shown in Table III-2. The number of full-time aides per patient and the total number of part-time personnel per patient were the only cases in which number of personnel available was significantly related to hospital size at the 5 percent level of significance. The number of full-time aides per patient was found to be directly related to size, while the total number of part-time personnel per patient was inversely related to size.

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[14]Sidney Siegal, Nonparametric Statistics for the Behavioral Sciences (New York: McGraw-Hill Book Company, 1956), 202.

Table III-2

Results of Rank Correlation Test for Relationship between Hospital Size and Personnel Available Per Patient, 1967

Type of Personnel	Rank Correlation Coefficient	Predicted Direction of Relationship
Total Personnel	.0023	Direct
Total Registered Nurses	.0073	Direct
Total Licensed Practical Nurses	.0234	Direct
Total Hospital Aides	.1590	Direct
Total Specialized Personnel	.1301	Direct
Total Full-time Personnel	.1672	Direct
Full-time Registered Nurses	.0552	Direct
Full-time Licensed Practical Nurses	.0861	Direct
Full-time Hospital Aides	.5511*	Direct
Full-time Specialized Personnel	-.1181	Direct
Total Part-time Personnel	.4453*	Inverse
Part-time Registered Nurses	.2111	Inverse
Part-time Licensed Practical Nurses	.3014	Inverse
Part-time Aides	.3038	Inverse
Part-time Specialized Personnel	-.3383	Inverse

Range of rejection: $.425 < r_s$ at 5 percent LOS.

*Significant at 5 percent level of significance.

The analysis of specialized personnel availability only in terms of number per patient did not give a true picture of the availability of specialized services. Therefore, it was necessary to analyze the number of different types of specialties which were available per hospital. The data presented in Table III-3 indicate that although small hospitals may have just as many specialized personnel per patient as a larger facility, fewer types of specialized personnel were available per hospital. In the 6 hospitals of less than 25 beds in size, there was an average of only 1.8 different types of specialized full-time personnel available per hospital and 0.2 available on a part-time basis. The predominant type of personnel was medical records personnel. For hospitals of 25 to 49 beds in size there was an average of 2.6 different types of specialized personnel available full-time per hospital and 1.1 available part-time. The most common type of personnel in this case were x-ray technicians, lab technicians, and medical records personnel. There was an average of three different types of specialized personnel available full-time in 50- to 99- bed hospitals and 0.5 available on a part-time basis. For the three hospitals 100 to 199 beds in size there was an average of 5.6 different types of specialized personnel employed full-time per hospital and 0.3 employed part-time.

Table III-3

THE AVAILABILITY OF SPECIALIZED PERSONNEL IN FOUR SIZE CLASSES OF HOSPITALS

Specialty of Personnel	Number of Hospitals in each Size Class with the Specialized Services Listed							
	Hospitals with Less Than 25 Beds		Hospitals with 25-49 Beds		Hospitals with 50-99 Beds		Hospitals with 100-199 Beds	
	Full-Time	Part-Time	Full-Time	Part-Time	Full-Time	Part-Time	Full-Time	Part-Time
Medical Records	5	0	5	1	1	0	3	0
Dietitian	0	1	2	0	0	0	3	0
Physical Therapy	0	0	0	0	0	0	0	1
X-ray Technician	2	0	6	0	2	0	3	0
Laboratory Technician	2	0	5	0	2	0	2	0
Pharmacists	0	0	0	2	1	0	3	0
Radiologist	0	1	0	3	0	1	2	0
Pathologist	0	0	0	2	0	0	1	0
Number of Hospitals	5		7		2		3	
Number of Specialized Services Per Hospital	1.8	0.2	2.6	1.1	3.0	0.5	5.7	0.3

Source: Division of Comprehensive Health Planning, Hospital License Information, Public Health Service, Pierre, South Dakota.

Area's Dependence upon Part-Time Personnel

Although the Spearman rank correlation test indicates a significant relationship between hospital size and part-time personnel per 100 patients, no indication of the number of part-time personnel relative to the total number employed is given. Data in Table III-4 indicate that 45 percent of the personnel employed in hospitals of less than twenty-five beds in size were part-time, while only 24.9 percent of the personnel in 100-199 bed hospitals were employed on a part-time basis. A similar relationship existed for each specific type of personnel such as registered nurses. It appears that this high ratio of part-time to full-time personnel in small hospitals was not caused by the substitution of part-time personnel for full-time personnel, but rather, it was caused by the employment of more personnel per 100 patients in small hospitals. The data in Table III-5 show that small hospitals employed nearly three times as many part-time personnel per 100 patients as did large hospitals, yet these small hospitals employed about the same number of full-time personnel per patient. The employment of extra personnel per patient in small hospitals may be necessary to provide 24 hour availability of personnel and may also be caused by a lack of labor saving equipment. It seems then, that the lack of a complete complement of specialized

Table III-4

Percent of Personnel Employed Part-Time in Four Size Classes of Hospitals

Size Classes of Hospitals	Percent of the Following Personnel Employed Part-Time				
	Registered Nurses	Licensed Practical Nurses	Hospital Aides	Specialized Personnel	Total Personnel
100 beds & larger	31.7%	33.3%	20.1%	15.9%	24.9%
50-99 beds	23.8	40.0	27.3	70.4	37.0
25-49 beds	45.3	46.2	32.1	48.8	40.7
24 beds & below	44.0	42.9	51.4	35.7	45.8

Source: Division of Comprehensive Health Planning, Hospital License Information, Public Health Service, Pierre, South Dakota.

Table III-5

Number of Hospital Personnel Employed Per 100 Patients
in Four Size Classes of Hospitals

Size Classes of Hospitals	Number of the Following Personnel Employed Full-Time and Part-Time per 100 Patients									
	Registered Nurses		Licensed Practical Nurses		Hospital Aides		Specialized Personnel		Total Personnel	
	Full-Time	Part-Time	Full-Time	Part-Time	Full-Time	Part-Time	Full-Time	Part-Time	Full-Time	Part-Time
100 beds & larger	34.5	16.0	8.4	4.2	51.3	12.9	12.9	2.4	107.1	35.6
50-99 beds	23.6	7.4	4.4	2.9	70.8	26.6	11.7	28.0	110.5	64.9
25-49 beds	27.6	22.9	5.5	4.7	43.4	20.5	16.6	15.8	93.5	63.9
24 beds & below	39.1	30.7	11.2	8.4	50.3	53.1	25.1	14.0	125.7	106.2
Area Average	31.7	17.6	7.4	4.5	51.8	19.3	14.5	9.9	105.4	51.2

Source: Division of Comprehensive Planning, Hospital License Information, Public Health Service, Pierre, South Dakota.

personnel, plus reliance upon part-time personnel, would greatly hinder the provision of high quality care in small hospitals.

Physician Availability in Northwest South Dakota

The availability of physicians is an important factor in hospital operation. It is shown in Table III-6 that there was a total of 130 physicians located in Northwest South Dakota in 1967. Of these physicians, 119 were medical doctors, while the remaining eleven were doctors of osteopathy.

Table III-6

Number and Location of Physicians in Northwest South Dakota, 1967

Population Size Classes of Towns	Number of Towns	Physicians Available		
		Total Number	Doctors of Medicine	Doctors of Osteopathy
250-499	19	1	0	1
500-990	14	8	5	3
1,000-2,499	3	5	5	0
2,500-4,999	5	29	25	4
Over 5,000	3	87	84	3
TOTAL	44	130	119	11

Source: South Dakota State Board of Medical and Osteopathic Examiners, 1967

Although the medical doctors were the most numerous in nearly l size classes of towns, they were most commonly found in the larger nters. The doctors of osteopathy tended to be located in the small wns not served by a medical doctor. Eight of the 11 doctors of teopathy were located in towns of less than 5,000 people, while ly 35 of the 119 medical doctors were located in towns of this ze class. Without the doctors of osteopathy, three of the ten wns with only one doctor would have had no physicians in 1967. By rtue of their location, the doctors of osteopathy become important providing health care in Northwest South Dakota.

e Relationship between Physician and Hospital Location

Most of the doctors located in Northwest South Dakota in 1967 sided in towns with hospitals. Only three towns in the area had doctor, but not a hospital. In two of these cases the physician s a doctor of osteopathy.

When hospital towns were grouped on the basis of number of doc-rs located in them, it was found that those towns with the fewer nber of doctors had the highest number of hospital beds, hospital rsonnel, and hospital patients per doctor. The data in Table III-7 w that the towns with only 1 or 2 doctors located in them had on average 18.6 hospital beds per doctor, while those towns with

3 to 9 doctors had 7.3 general hospital beds per doctor. The two towns with over ten doctors had on the average five hospital beds per doctor.

Table III-7

The Relationship between Doctor and Hospital Facility Availability, 1967

Number of Doctors in the Town	Hospital Personnel Per Doctor	Hospital Beds Per Doctor	Hospital Patients Per Doctor
1-2 Doctors	9.9	18.6	7.9
3-9 Doctors	5.5	7.3	4.3
10 Doctors or More	4.4	5.0	3.5

The statistics also show that the number of hospital personnel per doctor in towns with only one or two doctors was much greater than for towns with over three doctors. There was an average of 9.9 hospital personnel per doctor in the one and two doctor towns, while there was only an average of 4.4 hospital personnel per doctor in towns with over ten doctors.

The average daily census of hospital patients per doctor was also higher in towns with fewer doctors. The number of hospital

patients per doctor averaged 7.9 in the 1 and 2 doctor towns, while the number of patients per doctor averaged 4.3 in 3 to 9 doctor towns and 2.9 in the hospital towns with over 10 doctors located in them.

In spite of the larger number of hospital patients per doctor, the one and two doctor towns still were found to have an average 10.7 empty hospital beds per doctor. This large number of empty beds indicates that hospital facilities would have been available for the patients of from one to two additional doctors. The results of this analysis support the conclusion that rural doctors are over-worked, which then makes it difficult for rural communities to keep the number of medical doctors which they need.

Location of Medical Doctors by Specialty

Up to this point no distinction has been made between doctors on the basis of the specialty in which they are qualified. It is shown in Table III-8 that the specialists tended to be concentrated in the major centers.

A total of sixty-five medical doctors with fifteen different specialties resided in Rapid City in 1967. Only 9 of these 65 physicians or 13.8 percent were engaged in full-time general practice and only 4 were engaged in part-time general practice. The remaining fifty-two were in various other specialties, the most common being surgery and internal medicine as the data in Table III-8 show.

LOCATION OF MEDICAL DOCTORS IN NORTHWEST SOUTH DAKOTA, BY SPECIALTY, 1967

Specialty	Rapid City (Pop. 49,000)		Pierre (Pop. 11,200)		Other Hospital Towns		Total for All Towns in Area	
	Full-Time	Part-Time[1]	Full-Time	Part-Time[1]	Full-Time	Part-Time[1]	Full-Time	Part-Time[1]
General Practice[2]	9	4	8	2	26	13	45	2
Internal Medicine	8	0	0	0	1	2	9	3
Obstetrics & Gynecology	3	3	0	1	0	1	3	5
Roentgenology Radiology	4	0	1	0	0	2	5	2
Surgery	9	1	1	1	1	7	11	9
Other Specialty	28	0	1	0	0	1	25	3
Total	61	8	11	4	28	26	98	42

[1]Part-Time means that the specialty to the left was listed in addition to some other specialty.

[2]For purposes of this study, general practice was considered a type of specialty.

Source: South Dakota State Board of Medical and Osteopathic Examiners, 1967.

Of the thirteen physicians located in Pierre only five had a specialty other than general practice listed. Two of these five had general practice listed along with some other specialty.

There was a total of 41 medical doctors located in the remaining Northwest South Dakota towns. Of these 41, 63 percent were engaged in general practice and 13 were engaged in general practice in addition to some other specialty. Consequently, a total of over 90 percent of the physicians located in towns other than Rapid City or Pierre were in some way involved in a general practice.

Chapter Summary

The small hospitals in the area employed more personnel per patient than the larger hospitals did, but nearly all of these additional employees were part-time personnel. The small hospitals also lacked many of the specialized personnel, such as x-ray and lab technicians, which would tend to lower the level of care available.

The physicians located in small towns were nearly always engaged in general practice. If a physician in the area's small towns did have a specialty, it was usually in addition to general practice. A shortage of doctors in towns with only one or two doctors was indicated by the large number of hospital patients admitted per doctor and the number of unoccupied hospital beds available per doctor.

The information presented in this chapter indicated that few types of specialized personnel or doctors with specialties were available in the area's small towns. It seems unlikely that this situation will improve in the future. In fact, a continued decline in rural population numbers will likely bring about increased concentration of medical personnel and facilities in the large centers.

CHAPTER IV

CHANGES IN THE UTILIZATION OF NORTHWEST SOUTH DAKOTA HOSPITALS 1957 AND 1967

The purpose of chapter four is to indicate the amount and type of hospital care given in Northwest South Dakota hospitals in 1957 and 1967.

Amount of Care Provided by Northwest South Dakota Hospitals

Admissions into hospitals in Northwest South Dakota increased in both total and per capita terms from 1957 to 1967. The total number of inpatients treated increased by 9 percent from 26,669 in 1957 to 29,065 in 1967. Likewise, the number of admissions per 100 people increased from 169.2 to 171.5 during this same period as the data in Table IV-1 show. Admissions per 100 people in Northwest South Dakota was above the United States level of 117.1 per 100 people in 1957 and 136.5 for each 100 people in the population in 1967. This higher per capita utilization was probably caused in part by the larger proportion of the Northwest South Dakota's population in the higher age groups. In relative terms, however, admissions per 100 people increased by 16.6 percent nationwide and only 1.4 percent in Northwest South Dakota.

Table IV-1

Selected Data for United States and Northwest South Dakota Hospitals, 1967

	Northwest[a] South Dakota 1957	1967	Percent Change	United States[b] 1957	1967	Percent Change
TOTAL ADMISSIONS	26,669.0	29,065.0	+ 9.0%			+28.1%
Admissions/1000 Population	169.2	171.5	+ 1.4	117.1	136.5	+16.6
Total Patient Days	162,796.0	194,525.0	+19.5			+34.2
Patient Days/1000 Population	1,033.1	1,147.6	+11.1	891.0	1.088.0	+22.1
Average Length of Stay	6.1	6.7	+ 9.8	7.6	7.9	+ 3.9
Percent of Available Beds Occupied	59.0	60.8	--	73.7	76.5	--

Sources: [a]Division of Comprehensive Health Planning, Hospital License Information, 1967, Public Health Service, Pierre, South Dakota.

[b]American Hospital Association, Guide Issue, J.A.H.A., August, 1968.

The increase in admissions into Northwest South Dakota Hospitals was not a complete indicator of the amount of hospital care provided because the average length of time patients stayed in the hospital per admission was not uniform. Calculation showed that 15,000 of the 30,000 day increase in care provided resulted from patients staying in the hospital 0.6 days longer per admission in 1967 than in 1957. The remaining 15,000 days of care provided were the result of the increase in number of patients treated.

The increase in amount of care given was not evenly distributed among Northwest South Dakota hospitals. The data in Table IV-2 show that from 1957 to 1967 eleven of the area's hospitals experienced increases in number of patient days of care given ranging from 11,000 to 78 patient days. Six hospitals provided fewer patient days of care in 1967 than in 1957. The data in Table IV-2 indicate that the observed changes in patient days of care given were caused by changes in length of stay or by changes in number of patients treated.

Utilization Rate of Available Hospitals

Even though total and per capita utilization of Northwest South Dakota hospitals was higher in 1967 than 1957, the proportion of available hospital beds which were occupied was below the United States average and the United States Public Health Department goal in both years. The statistics in Table IV-3 show that on the average

Table IV-2

Change in Patient Days of Care Given in Northwest South Dakota Hospitals, 1957-1967

HOSPITALS	Patient Days of Care Given (1957)	Patient Days of Care Given (1967)	Change 1957-1967	Change in Patient Days Caused by: Change in Length of Stay	Change in Patient Days Caused by: Change in Admissions
Rapid City (St. John's)[1]	28,754	39,898	+11,144	+4,020	+7,124
Sturgis	7,364	12,732	+ 5,368	+3,352	+2,016
Pierre	28,104	33,403	+ 5,299	+8,819	-3,520
Rapid City (Bennett)[1]	26,560	31,413	+ 4,853	+2,210	+2,643
Spearfish	612	3,817	+ 3,205	+ 124	+3,081
Gettysburg	6,214	9,273	+ 3,059	- 664	+3,721
Mobridge[2]	8,681	10,079	+ 1,398	- 639	+2,037
Onida	1,184	2,309	+ 1,125	+2,664	-1,539
Philip	3,224	3,899	+ 675	+1,177	- 502
Belle Fourche	8,070	8,251	+ 181	+1,454	-1,274
Lemmon	3,744	3,822	+ 78	+2,025	-1,947
Lead	6,106	5,766	- 340	- 58	- 281
Faith	3,753	3,029	- 724	+1,064	-1,841
McLaughlin	4,964	3,676	- 1,288	- 604	- 684
Hoven	4,334	2,771	- 1,563	- 917	- 645
Deadwood	21,128	14,694	- 6,434	-1,989	-4,447

[1]Both Bennett and St. John's hospitals were located in Rapid City.

[2]This represents total for two hospitals located in Mobridge in 1957.

Source: Division of Comprehensive Planning, Hospital License Information, 1967, Public Health Service, Pierre, South Dakota.

Table IV-3

Occupancy Rate of Northwest South Dakota and United States Hospitals by Size Classes, 1967

HOSPITAL SIZE	Average Occupancy[1]				Peak Occupancy	
	Northwest South Dakota[a]		United States		Northwest South Dakota[a]	
	1957	1967	1957	1967	1957	1967
0-24 beds	48.1%	46.5%	53.7%	55.2%	85.0%	90.9%
25-49 beds	48.0	51.5	58.5	63.1	92.4	82.5
50-99 beds	78.2	56.5	66.0	69.0	98.7	95.8
100-199 beds	65.7	70.3	73.8	74.5	87.4	91.9
200-299 beds	0.0	0.0	77.0	79.8	--	--
300-499 beds	0.0	0.0	80.3	80.8	--	--
500 beds & over	0.0	0.0	79.8	81.7	--	--
TOTAL	59.0	60.8	73.7	76.5		

Source: [a]Division of Comprehensive Planning, Hospital License Information, Public Health Service, Pierre, South Dakota.

[b]American Hospital Association, Guide Issue, J.A.H.A., August, 1968.

only 59 out of every 100 hospital beds available were utilized in 1957 and only 61 out of every 100 in 1967. In both 1957 and 1967 the hospitals in all size classes but one had from 4.5 to 12.5 more unoccupied beds per 100 available beds than was true for hospitals of similar size in the remainder of the United States. The level of utilization was even farther below the 80 percent utilization figure set as a national goal by the United States Public Health Service and the 90 percent level thought reasonable by some experts in the field.[15]

Information on level of peak occupancy was available for only Northwest South Dakota hospitals. The average peak occupancy was above 80 percent for all size classes of hospitals in both 1957 and 1967. There were four hospitals which had peak occupancy above 100 percent in 1957 and three in 1967. Since it is highly unlikely that peak occupancies would occur in two or more hospitals at the same time, some type of arrangement for moving patients between hospitals might be suggested by the high peak occupancy statistics.

The Importance of Outpatient Facilities

Hospitals serve the health needs of communities both through the services rendered to patients admitted into the hospital and those treated only in the outpatient department of the hospital.

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[15]Herman Somers and Anne Somers, Medicare and the Hospitals, (Washington: The Brookings Institution, 1967), 58.

The number of patients treated as outpatients in Northwest South Dakota hospitals increased by 13,000 from the 1957 level of 23,453 to 36,582 by 1967.[16] This represented a 55 percent increase. Nationally the number of outpatients treated increased from 67 million in 1957 to 106 million in 1967 or by 58 percent.[17]

The increase in the ratio of outpatients to inpatients from 1.01 to 1.46 from 1957 to 1967 indicates that the number of patients treated in outpatient departments of Northwest South Dakota hospitals increased faster than the number of inpatients treated. This was true for hospitals less than 25 beds in size and hospitals between 100 and 200 beds in size. The ratio decreased for those 25-99 beds in size. See Table IV-4. Nation-wide the ratio of outpatients to inpatients was 3.1 in 1957 and 3.9 in 1967. This higher national ratio indicates that the amount of use made of outpatients departments relative to inpatient departments was less for Northwest South Dakota than for the remainder of the United States in 1967. This lower rate of outpatient facility utilization may also be a factor

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[16] Data for both 1957 and 1967 were available for only thirteen Northwest South Dakota hospitals, thus only data from these hospitals were used in making comparisons between increases in outpatients and inpatients treated.

[17] American Hospital Association, "Guide Issue," Hospitals, JAHA, Part II, (August, 1968).

Table IV-4

Utilization of Thirteen Hospital Outpatient Departments in Northwest South Dakota, 1957, 1967

Hospital Size	Number of Hospitals[1] 1957	1967	Average Number of Outpatients Treated per Hospital 1957	1967	Percent Change	Ratio of Outpatients to Inpatients Treated 1957	1967
0-24 Beds	6	4	440	798	+81.0%	.80	1.93
25-99 Beds	4	6	1,696	1,276	-24.8	1.20	.93
100-200 Beds	3	3	4,676	8,579	+83.4	.98	1.69
TOTAL	13	13	23,453	36,582	+56.0	1.01	1.46

[1]Two of the thirteen hospitals increased in size between 1957 and 1967.

Source: Division of Comprehensive Health Planning, Hospital License Information, Public Health Service, Pierre, South Dakota.

contributing to the somewhat higher per capita inpatient admittance rate for Northwest South Dakota.

Departmental Breakdown of Hospital Care Given in Northwest South Dakota Hospitals

Data were not available on the type of hospital services given the outpatients treated in Northwest South Dakota, but information was available on the category of care provided the inpatients served. Hospital care has traditionally been departmentalized on the basis

of services rendered (surgery, psychiatry, medicine, etc.) and age of the patient (pediatrics and geriatrics).[18] The departmental breakdown used in this study was medical, surgery, obstetrics, psychiatry, orthopedics, pediatrics, and geriatrics.

The data in Table IV-5 show that the most commonly used department was the medical department. The treatment most commonly given to medical patients included rest, control of diet, medication, and atmospheric control. In the medical department, time is often necessary to diagnose what is wrong with the patient and to find which drugs or other treatment will be effective in treating his ailment.[19] The total number of patient days of care given to medical patients increased by slightly over 10,000 days from 1957 to 1967. All of this increase was caused by increased admission because average length of stay was 7.3 days in both 1957 and 1967.

Another commonly used department was the surgery department. The same group of laboratory and x-ray tests given patients admitted into medical departments is sometimes necessary here also, but usually the diagnosis establishing the disorder is made before the

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[18] E. Todd Wheeler, Hospital Design and Function, (New York: McGraw-Hill Book Co., 1964), 10.

[19] Ibid., p. 57.

Table IV-5

Change in Days of Care Given in Each of Seven Hospital Departments, 1967

Type of Care	Patient Days Provided		Average Length of Stay		Number of Patients Treated		Change in Patient Days of Care Because of Change in	
	Number in 1957	Change 1957-1967	1957	Change 1957-1967	1957	Change 1957-1967	Length of Stay	Number Admitted
Medicine	72,622	+11,168	7.3	0	9,952	+1,548	0	+11,300
Surgery	29,525	+27,378	6.3	+1.3	4,701	+2,776	+6,111	+21,098
Obstetrics	22,614	-12,041	5.8	-2.1	3,897	-1,037	-8,184	- 3,837
Pediatrics	23,914	- 3,026	4.3	-1.1	5,546	+ 840	-6,101	+ 2,688
Geriatrics	--	+20,165	-	29.8	-	+ 676	--	--
Extended Care	35,379	--	15.7	-	2,250	-	--	--
Orthopedic	--	+ 6,049	-	8.7	-	+ 698	--	--
Psychiatric	--	+ 729	-	5.4	-	+ 136	--	--

Source: Division of Comprehensive Health Planning, Hospital License Information, 1967, Public Health Service, Pierre, South Dakota.

patient entered the hospital. A 27,300 patient day increase in surgical care is indicated by the data in Table IV-5. Average length of stay increased from 6.3 to 7.6 days accounting for 6,111 days of the increase in care, while an increase of 2,776 patients treated accounted for the remaining 21,098 patient day increase in days of care given.

Expectant mothers admitted for childbirth enter the obstetrics department. It is shown in Table IV-5 that the number of patient days of care given in the obstetrics departments of Northwest South Dakota Hospitals decreased by 12,000 days from 1957 to 1967. Much of this decrease was caused by a decrease in the average number of days obstetrics patients spent in the hospital. Had length of stay remained constant at 5.8 days, the reduction in days of care given would have been only 3,837 days caused by a 1,000 patient decline in number of obstetric patients treated. This decline in obstetrics patients was probably caused in part by the migration of many of the younger people from the area before they reach the child-bearing age.

The number of days of pediatrics care given decreased by 3,000 patient days from 1957 to 1967. All of this decrease was caused by a decrease in average length of stay. The number of patients admitted into pediatrics departments increased by 840 between 1957 and 1967.

Thirty-five thousand patient days of extended care were given by Northwest South Dakota hospitals in 1957. Data for this category of care were not available for 1967. Statistics for geriatrics care, a similar type of care, were available, however. Geriatrics care is a type of care which emphasizes treating the problems and diseases of the aging, while extended care also involves the treatment of many aged people. Over 20,000 patient days of geriatrics care was provided in 1967, which is 15,000 patient days less than the number of days of extended care given in 1957. A possible reason for this decline in this type of care was the growth of nursing homes.

Only two hospitals offered orthopedic care in 1967. These two hospitals gave only 5,000 patient days of orthopedic care in 1967. Six hundred seventy-one patients were treated, however. Data were not available for 1957.

Available statistics show that only three hospitals in the area treated psychiatric patients in 1967. A total of 700 patient days of psychiatric care were given by these three hospitals in 1967. A total of 126 patients were treated. Data were not available in 1957.

Differences in Type of Care Given by Four Size Classes of Hospitals

The data in Table IV-6 show that 55 percent of the total patient days of care given by Northwest South Dakota Hospitals was given in the three largest hospitals in the area. These hospitals did not

Table IV-6

Proportion of Total Days of Care Given by Each of Four Size Classes of Hospitals, 1967

Type of Care	Proportion of Care Given by Hospitals in each Size Class			
	Under 25 Beds	25-49 Beds	50-99 Beds	100-199 Beds
Medicine	15.0%	25.8%	13.2%	46.0%
Geriatrics	12.5	34.4	26.1	27.0
Pediatrics:				
Medical	13.5	30.0	9.9	46.6
Surgical	1.4	14.8	7.8	75.9
Surgery	4.8	14.7	6.7	73.9
Orthopedic	1.1	17.8	--	81.1
Psychiatric	0.0	0.0	0.0	100.0
Obstetrics:				
Delivered	7.6	21.9	14.3	56.3
Not Delivered	1.2	41.6	14.3	42.7
Total Care	10.0	23.0	11.9	55.1

Source: Division of Comprehensive Health Planning, Hospital License Information, Public Health Service, Pierre, South Dakota.

provide 55 percent of all types of care, however. It is shown in Table IV-6 that only 46 percent of the medical days, and 27 percent of the geriatric days were provided by these hospitals, while over 70 percent of the total patient days of care in the surgery, orthopedic and psychiatric departments were provided by these same three hospitals.

To test the statistical significance of these relationships, the Spearman rank correlation test was used. The test results shown in Table IV-7 indicate that the proportion of patient days of care given to medical patients was significantly inversely related to hospital size at the 5 percent level of significance. The proportion of patient days of care given to surgical and surgical pediatrics patients was found directly related to hospital size. In this case the relationship was significant at both the five and one percent level of significance. The availability of psychiatric and orthopedic care were also related to hospital size, because only the large hospitals provided these types of care. The proportion of care given in the other departments was not found significantly dependent upon hospital size.

Chapter Summary

The demand for hospital care has increased during the 1957-1967 period as was indicated by increased admissions and patient

Table IV-7

Results of Rank Correlation Test for Relationship between Hospital Size and Personnel Available Per Patient, 1967

Type of Care	Rank Correlation Coefficient	Direction of Relationship
Medicine	.555*	Inverse
Surgery	.7669**	Direct
Pediatrics	.2198	--
Medical Pediatrics	.2224	--
Surgical Pediatrics	.7225	Direct
Obstetrics	.3068	--
Geriatrics	.0316	--
Orthopedics[1]	--	--
Psychiatric[1]	--	--

[1]Insufficient number of hospitals offering this type of care to apply test.

*Significant at 5 percent level of significance.

**Significant at 1 percent level of significance.

days of care given. It was found that the number of outpatients treated increased at a faster rate than did the number of inpatients treated.

Although the demand for care increased, the supply of hospital beds still exceeded demand for them. In 1967, for example, an average of 40 out of every 100 beds available were unoccupied. Many of these unoccupied beds were located in small hospitals situated in the area's small towns. The peak occupancy, however, for many of these hospitals was found to be considerably above this figure and in some instances above 100 percent. Since it is unlikely that the peak in occupancy would occur at the same time in all hospitals, some type of transportation system might be helpful in transporting patients from hospitals which may, for a short time, be filled beyond capacity.

When the total patient days of care given were broken down by departments, the days of care given in medicine and surgery far outnumbered the days given in any of the other departments. The greatest increase in care given between 1957 and 1967 occurred in surgery departments and the greatest decrease occurred in obstetrics departments.

Information on type of care given by different sized hospitals showed that small hospitals tended to provide large portions of their

total patient days of care in medical departments, while the larger hospitals provided higher percentages of care in more specialized categories such as surgery. A possible explanation for this situation may be that the smaller hospitals act as kind of first aid stations which are not fully equipped to perform many types of surgery, but often serve as a clinic where initial diagnoses are made before patients are routed to a medical specialist and hospital located in a larger center.

The following chapter will show the extent to which patients are currently traveling to the larger hospitals for care and the distance traveled. Particularly in emergencies, the time involved in covering the distance to these hospitals becomes of life and death importance.

CHAPTER V

DISTANCE TRAVELED BY PATIENTS ADMITTED INTO NORTHWEST SOUTH DAKOTA HOSPITALS, 1967

Hard surfaced all weather roads and modern automobiles have made it possible for people living in rural communities to travel long distances for the type of medical care desired. In this situation if a particular type or quality of care is not available in a community's hospital, the likely result will be the utilization of a more distant hospital. The purpose of Chapter V is to show where and how far the population of Northwest South Dakota traveled for hospital care in 1967.

The first section of this chapter indicates how the study area was divided into hospital service areas and points out the extent to which people left their service area for hospital care. The second section indicates the distance which residents of different service areas traveled for hospital care. The last section deals with the geographic source of patients to individual Northwest South Dakota hospitals and includes not only Northwest South Dakota patients but also patients from the remainder of South Dakota and neighboring states.

Analysis of Patient Movement in Northwest South Dakota

For this analysis, Northwest South Dakota was divided into fifteen hospital service areas. Each town in the area was assumed to be part of the hospital service area of the hospital nearest to it in terms of road miles. Hospital A, for example, would have a service area composed of all towns closer to it than they were to any other hospital. Service areas for other hospitals were arrived at in a similar manner. The delineated service areas and the study area's road network are shown in Figure V-1.

The data presented in Figure V-2 show the number of hospital admissions of people living in each service area and indicate the proportion of these admissions that were into hospitals outside that service area.[21] The proportion of admissions into hospitals outside the service area is shown to vary from less than 5 percent to as high as 80 percent. The following Figures indicate which hospitals were utilized by residents leaving their service area for care. Of course, by definition, anyone leaving his service area for care would not be using the closest hospital.

The statistics presented in Figure V-3 indicate the hospitals used by residents of the Faith and Onida Hospital service areas.

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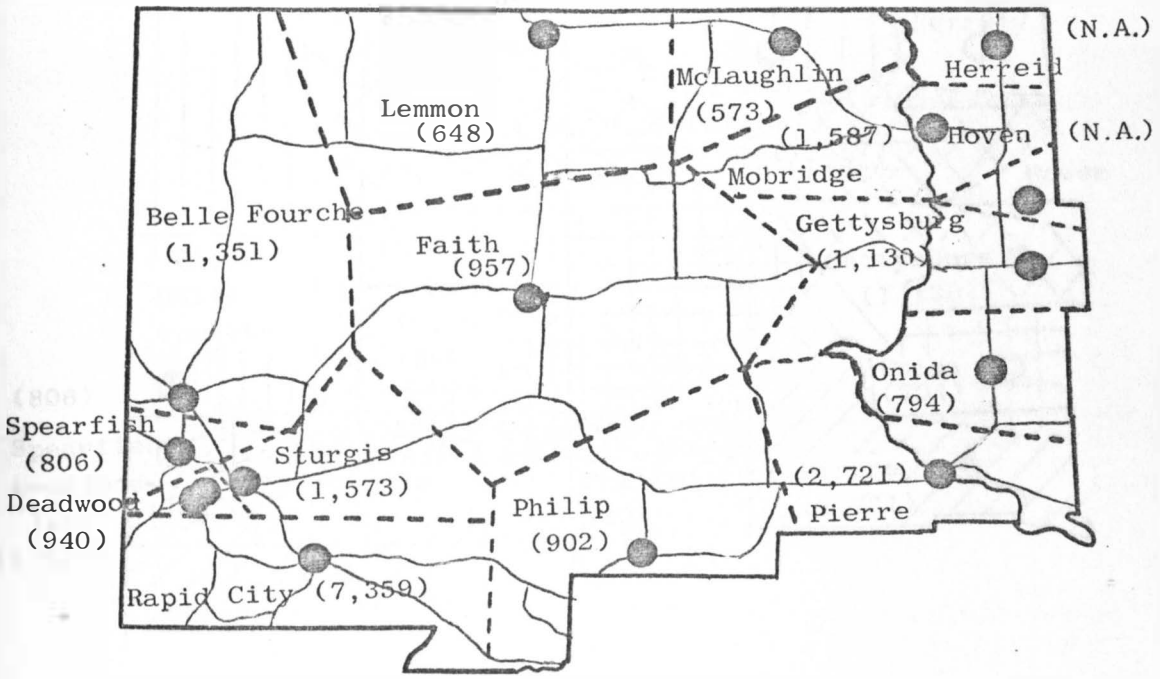
[21] This analysis includes only admissions into Northwest South Dakota Hospitals.

Figure V-1

Delineation of Hospital Service Areas in Northwest South Dakota



Key to Figure

Service Area Boundary

( ) Number of Patients from Area Admitted into a Hospital

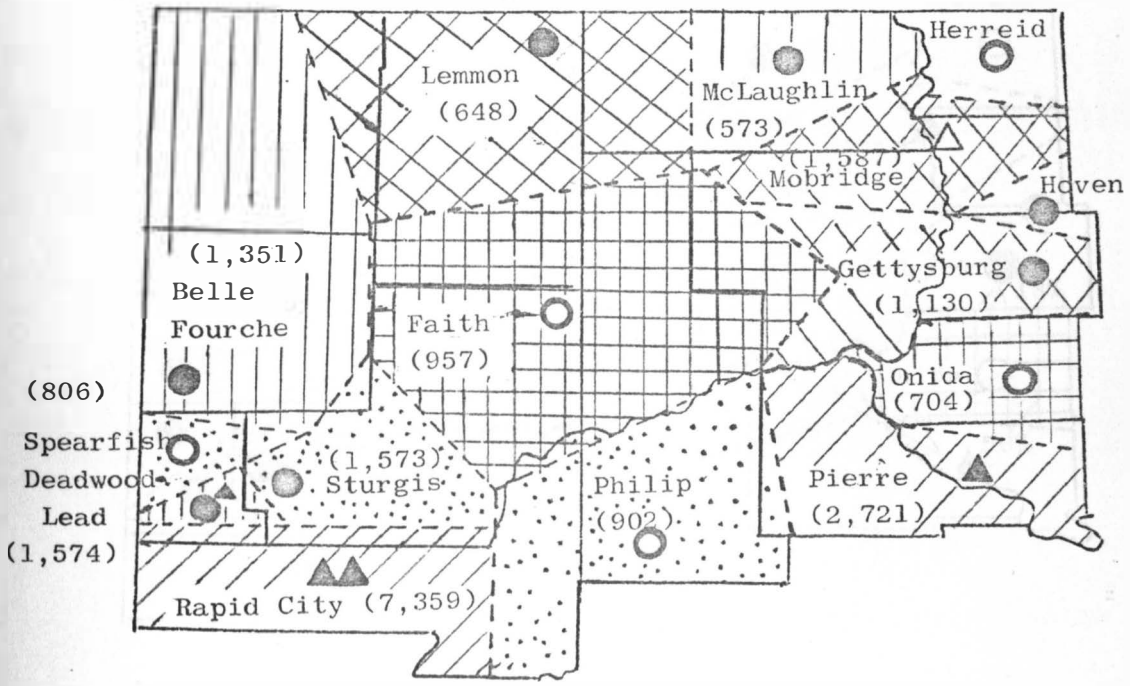
Road

Hospital

N.A. Data Not Available

Figure V-2

Proportion of Patients Leaving Service Area for Hospital Care, 1967



Key to Figure

Hospital Service Area Boundary

( ) Number of Hospital Admissions of Service Area Residents

Percent of Hospital Admissions which Were into Hospitals outside Service Area

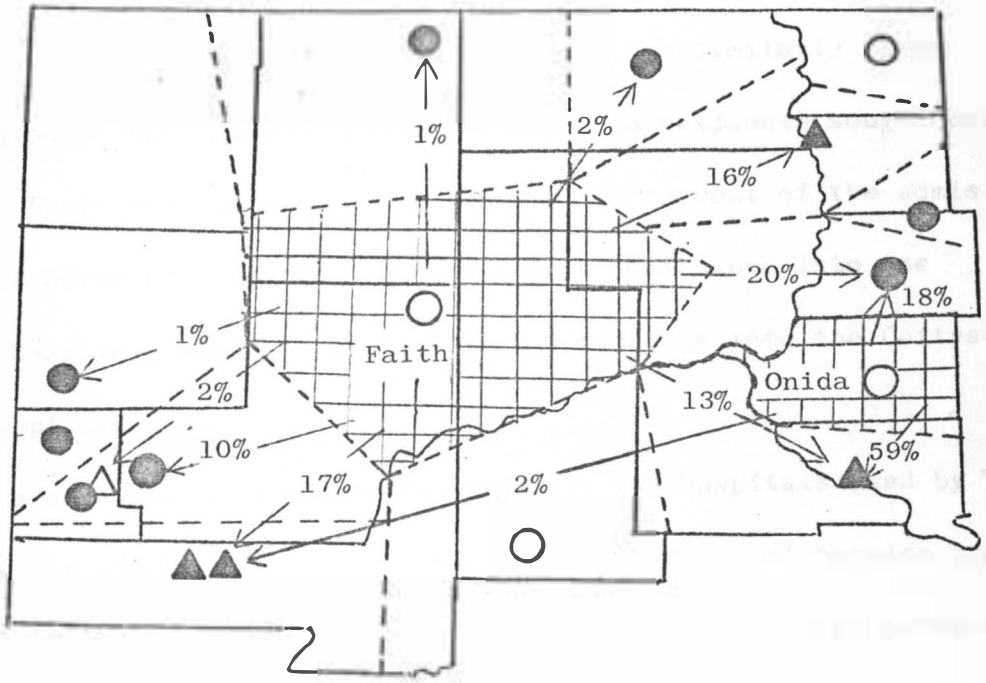
- 0-5% outside Area
- 6-20% outside Area
- 21-40% outside Area
- 41-60% outside Area
- 61-80% outside Area
- Data Were Not Available

Size of Hospital in Service Area

- Less Than 25 Beds
- 25-49 Beds
- 50-99 Beds
- 100-199 Beds

Figure V-3

Destination Patients Leaving the Faith and Onida Hospital Service Areas for Hospital Care



Key to Figure

% Percent of the Area's Total Admissions which Were into the Hospital Designated

Hospital Size Classification

- ○ Less Than 25 Beds
- ● 25-49 Beds
- △ 50-99 Beds
- ▲ 100-199 Beds

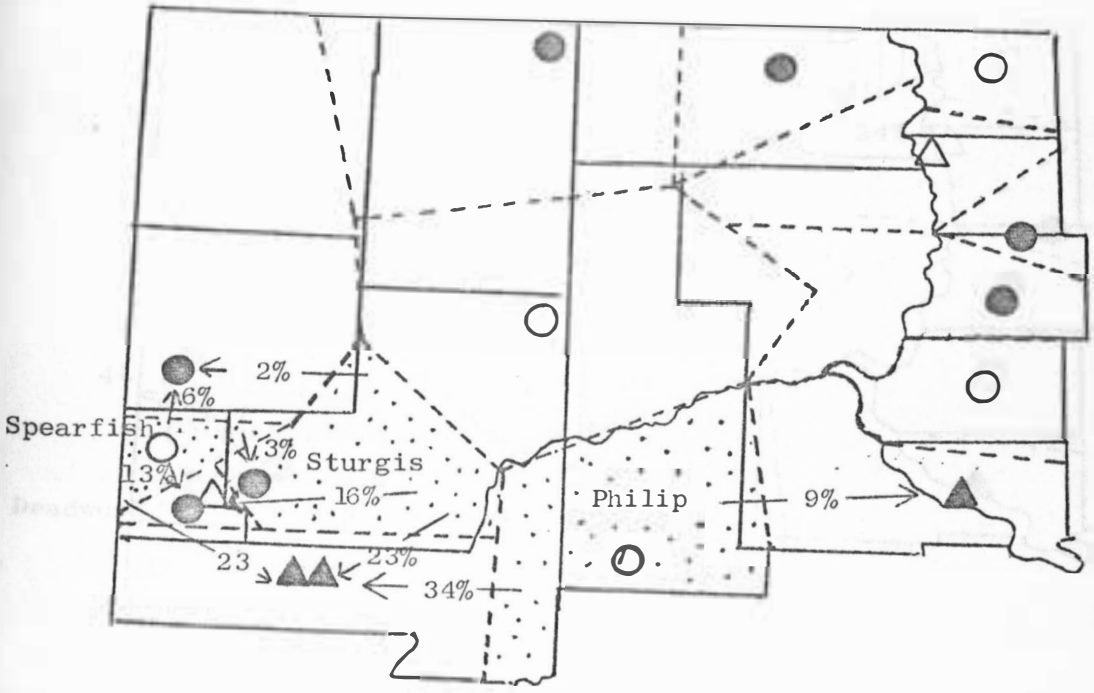
This figure shows that 10, 17, 13 and 16 percent of the admissions of Faith area people were admissions into the Sturgis, Rapid City, Pierre, and Mobridge Hospitals respectively. A similarly large proportion of the Onida Hospital service area residents sought care outside their service area. For example, 59 percent of the admissions of Onida service area residents were admissions into the Pierre Hospital, while 18 percent were admissions into the Gettysburg Hospital.

The data shown in Figure V-4 indicate the hospitals used by people from the Sturgis, Philip and Spearfish Hospital service areas. A total of 43 percent of the hospital admissions of Philip service area residents were admissions into hospitals outside the Philip service area. Nine percent of the admissions of Philip area residents were into the Pierre Hospital, while 34 percent were admissions into the two hospitals located in Rapid City. The data in Figure V-4 indicate that residents of the Spearfish and Sturgis service areas frequently utilized the Deadwood and the Rapid City Hospitals.

The data presented in Figure V-5 indicate that 20 percent of the admissions of Belle Fourche service area residents were admissions into the Rapid City hospitals. A similar proportion of the admissions of McLaughlin area residents was into the Mobridge

Figure V-4

Destinations of Patients Leaving the Spearfish, Sturgis, and Philip Hospital Service Areas for Hospital Care



Key to Figure

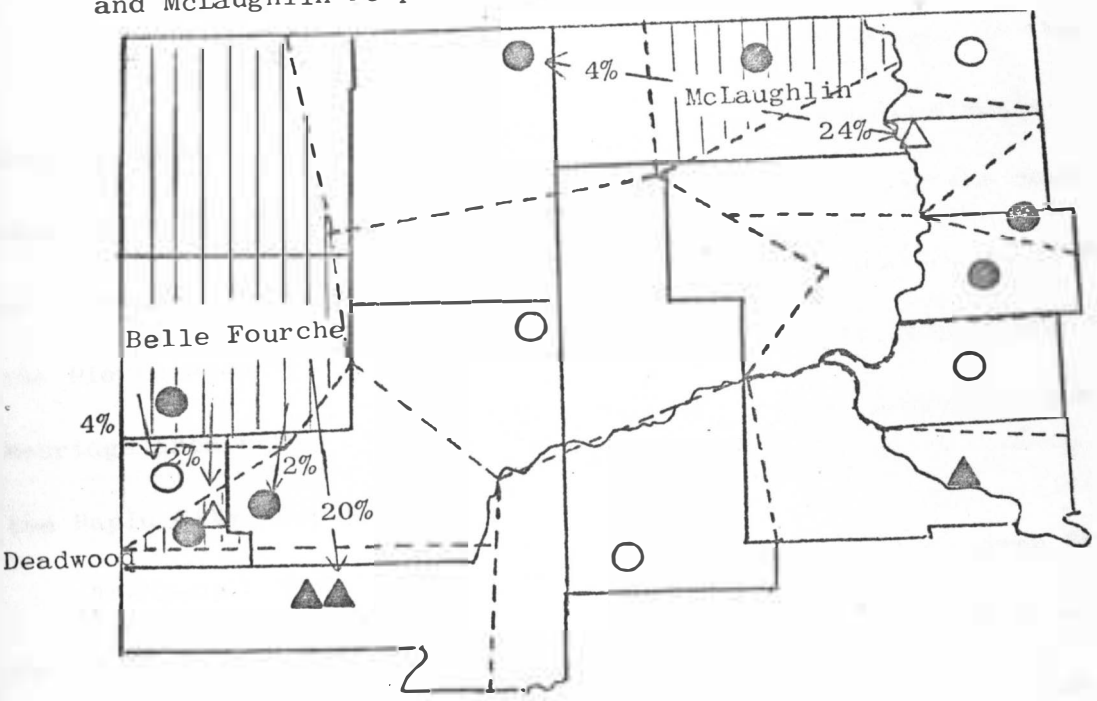
% Percent of the Area's Total Admissions Which Were into the Hospital Designated

Hospital Size Classification

- ○ Less Than 25 Beds
- ● 25-49 Beds
- △ 50-99 Beds
- ▲ 100-199 Beds

Figure V-5

Destinations of Patients Leaving the Belle Fourche, Deadwood, and McLaughlin Hospital Service Areas for Hospital Care



Key to Figure

Percent of the Area's Total Admissions which Were into the Hospital Designated

Hospital Size Classification

○ Less Than 25 Beds

● 25-49 Beds

△ 50-99 Beds

▲ 100-199 Beds

Hospital. Deadwood service area residents were shown to utilize several nearby hospitals in addition to the Deadwood Hospital.

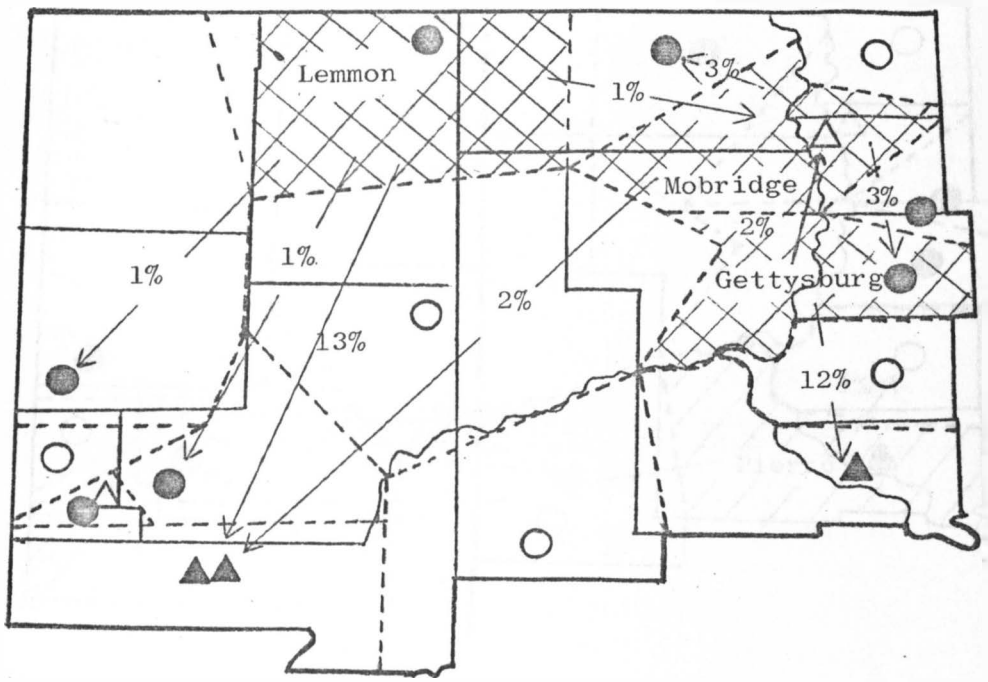
The data presented in Figure V-6 show that 13 percent of the hospital admissions of Lemmon service area residents were admissions into the Rapid City Hospitals, while 12 percent of the hospital admissions of Gettysburg area residents were admissions into the Pierre Hospital. A small proportion of the total admissions of Mobridge area residents was admissions into nearby hospitals and the Rapid City Hospitals.

The people found least likely to leave their service area to obtain hospital care from other Northwest South Dakota hospitals were those located in the Pierre and Rapid City Hospital service area. This is to be expected since the three largest hospitals in the study area were located in these service areas. When people from these areas did utilize a hospital outside their area, it was usually a nearby facility as is shown in Figure V-7.

The data in Table V-1 indicate that those patients not utilizing the closest hospitals tended to travel to a hospital larger in size. Of the 4,546 patients not utilizing the closest hospital, only 644 went to a smaller hospital, while 3,902 went to a larger hospital. Furthermore, nearly one-half of the patients who did not utilize the

Figure V-6

Destinations of Patients Leaving the Lemmon, Mobridge, and Gettysburg Hospital Service Areas for Hospital Care



Key to Figure

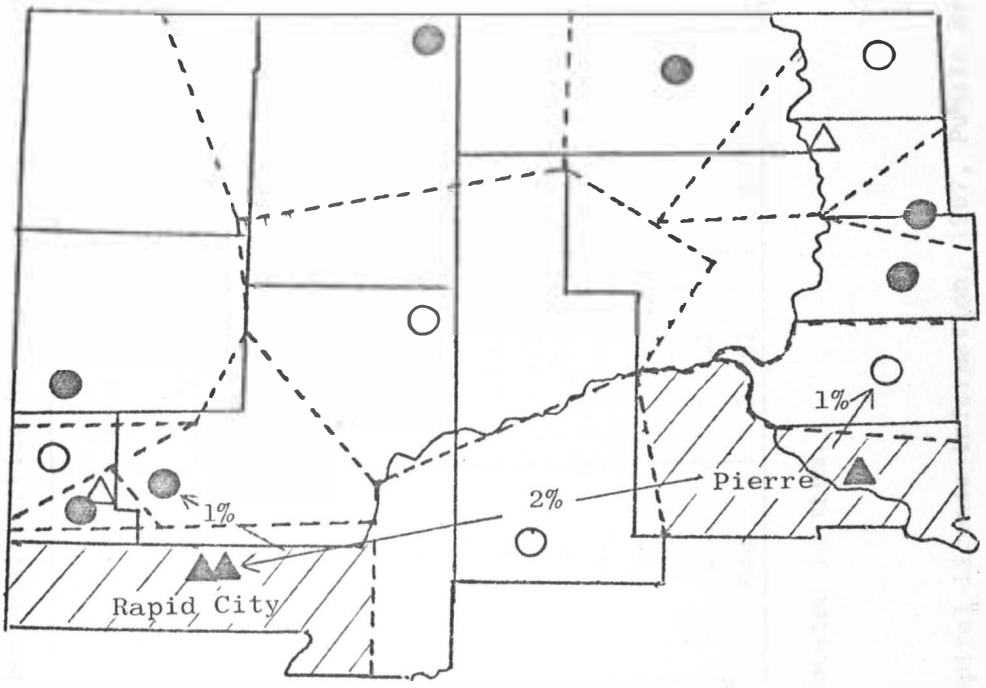
% Percent of the Area's Total Admissions Which Were into the Hospital Designated

Hospital Size Classification

- ○ Less Than 25 Beds
- ● 25-49 Beds
- △ 50-99 Beds
- ▲ 100-199 Beds

Figure V-7

Destinations of Patients Leaving the Rapid City, and Pierre Hospital Service Areas for Hospital Care



Key to Figure

% Percent of the Area's Total Admissions Which Were into the Hospital Designated

Hospital Size Classification

- ○ Less Than 25 Beds
- ● 25-49 Beds
- △ 50-99 Beds
- ▲ 100-199 Beds

Table V-1

The Extent to Which Closest Hospital Was Used by Residents of Fifteen Hospital Service Areas

Hospital[1] Service Area	Total Admissions into a Hospital by Area Residents	Proportion Leaving Service Area	Number to Smaller Hospital	Number to Larger Hospital	Number to Rapid City Hospitals	Number to Pierre Hospital
Rapid City	7,359	2.0%	137	9	--	9
Pierre	2,721	3.0	16	65	65	--
Deadwood-Lead	1,992	21.0	189	229	227	2
Mobridge	1,587	13.3	156	40	25	15
Belle Fourche	1,351	28.6	83	303	274	2
Sturgis	573	54.9	45	661	358	3
Gettysburg	1,130	14.9	5	163	4	131
Lemmon	648	17.3	6	106	82	1
McLaughlin	573	29.1	3	164	2	0
Faith	958	80.4	4	766	159	118
Philip	902	43.3	--	391	306	80
Spearfish	806	44.9	--	362	181	1
Onida	794	80.3	--	643	18	472
Herreid[2]	N.A.	--	--	--	--	--
Hoven	N.A.	--	--	--	--	--
TOTAL	21,394	21.2	644	3,092	1,701	834

[1]Service areas are arranged by size of hospital located in them.

[2]Data were not available for this hospital.

Source: Division of Comprehensive Planning, Hospital License Information, 1967, Public Health Service, Pierre, South Dakota.

closest hospital were admitted into the Pierre and Rapid City Hospitals, the largest hospitals in Northwest South Dakota.

When the number of patients leaving a hospital service area for hospital care was calculated, no distinction was made between patients from the hospital town and patients from thearea's non-hospital towns. When a distinction was made, it was found that for nearly every area the proportion of patients seeking care outside their service area was higher among patients from non-hospital towns than was true for the patients from the area's hospital town. See Table V-2. Area-wide, all but 13.3 percent of the patients from hospital towns were admitted into the hospital in their area, while 46.4 percent of the patients from non-hospital towns were not admitted into their area's hospital. This difference in utilization may in part be explained by the fact that the distance to a hospital outside the service area would nearly always be less for a non-hospital town resident than a resident from a hospital town. A second explanation may be that once on the road en route to a hospital, the added distance for care from a hospital outside the area would not seem important. A third factor may be that people from a hospital town feel an obligation to patronize their town's

Table V-2

The Extent to Which Closest Hospital Was Used by Residents
of Hospital and Non-Hospital Towns in Fifteen Hospital Service Areas

Hospital[1] Service Area	Total Number of Admissions of:		Percentage not Admitted into Service Area's Hospital, of:	
	Hospital-Town Residents	Non-Hospital Town Residents	Hospital-Town Residents	Non-Hospital Town Residents
Rapid City	6,746	613	1.6%	6.7%
Pierre	2,622	99	3.1	1.0
Deadwood-Lead	1,854	139	21.2	18.7
Mobridge	309	778	5.6	19.4
Belle Fourche	949	402	20.0	48.8
Sturgis	1,238	335	43.3	50.8
Gettysburg	944	186	13.7	21.0
Lemmon	382	310	7.9	40.7
McLaughlin	376	197	23.4	40.1
Faith	203	752	52.7	88.6
Philip	447	455	24.4	62.0
Spearfish	766	40	43.5	72.5
Onida	356	429	69.1	92.5
Herreid[2]	N.A.	--	--	--
Hoven[2]	N.A.	--	--	--
TOTAL	17,692	4,735	13.3	46.4

[1] Service areas are arranged by size of hospital located in them.

[2] Data were not available for this hospital.

Source: Division of Comprehensive Planning, Hospital License Information, 1967, Public Health Service, Pierre, South Dakota.

hospital; also, they may have greater confidence in a local facility staffed by people whom they know personally.

Distance Traveled for Out-of-Town Care

Because of the location of hospitals and the sparse population in much of Northwest South Dakota, many people traveled considerable distance from their home-town, i.e., town of address, to obtain hospital care. For purposes of this study, distance traveled was measured from the patient's town of address to the hospital utilized. Distances traveled by patients who utilized hospitals in the same town as their post office address were assumed to be zero. The data in Table V-3 indicate that patients leaving their home town for care traveled 325,560 miles or an average of 56 miles per patient.

It should be pointed out that both the average distance, and proportion of patients involved in computing the average distance, differed between areas. For example 90 percent of the people from the Faith Hospital service area left their town for hospital care and traveled an average of 91 miles from their town of address for the care they received. The remaining 10 percent were assumed to travel zero distance because their home address was Faith and they were admitted into the Faith Hospital. In the case of Gettysburg, however, 28 percent of the service area residents traveled an average of 44

Table V-3

Distance Traveled for Hospital Care in Northwest South Dakota, 1967

Hospital[1] Service Area	Number of Admissions into a Hospital	Percent of Those Admitted Who Left Their Town for Care	Miles Traveled by Those Seeking Out-of-Town Care	
			Total Distance (Miles)	Average Distance (Miles)
Faith	958	90%	77,748	90.2
Onida	794	85	21,867	32.4
Philip	902	63	34,503	61.2
Sturgis	1,573	55	20,181	23.2
Mobridge	1,585	52	32,586	39.6
McLaughlin	573	50	10,218	35.9
Spearfish	806	46	11,271	30.2
Lemmon	648	46	22,575	76.3
Belle Fourche	1,351	44	29,051	49.0
Gettysburg	1,130	28	13,714	43.5
Deadwood-Lead	1,990	27	17,931	33.8
Rapid City	7,350	10	19,022	26.5
Pierre	2,711	7	14,931	83.4
Herreid[2]	N.A.	--	--	--
Hoven[2]	N.A.	--	--	--
TOTAL	22,394	25.4	325,562	56.0

[1]Service areas are arranged by size of hospital located in them.

[2]Data were not available for this hospital.

Source: Division of Comprehensive Planning, Hospital License Information, 1967, Department of Health, Pierre, South Dakota.

miles, while the remaining 72 percent were Gettysburg residents admitted into their home-town hospital and assumed to travel zero distance.

Geographic Location from Which Each Hospital Drew Patients

All of the hospitals in Northwest South Dakota drew patients from an area considerably larger than the service areas outlined in this chapter. To determine the size of the geographic area which served as a source of patients for the study area's hospitals, patients were first divided into two categories: home town and out-of-town, i.e., those from the town of hospital location and those who were not. See Table V-4. The proportion of out-of-town patients coming from within various road distances was then computed. The computations in Table V-5 indicate that in the case of 9 of the study area's hospitals, 75 percent of the out-of-town patients who were admitted were from within 50 miles of the hospital. In all but 4 cases, 90 percent of the out-of-town patients came from within 100 road miles of the hospital. The proportion of out-of-town patients from over 100 miles who utilized these hospitals varied from 33.1 percent for Bennett Hospital in Rapid City to 15 percent for the Sturgis Hospital.

Table V-4

The Number of Out-of-Town Patients Admitted into Northwest South Dakota Hospitals, 1967

Location of Hospital	Number of Patients for Whom Address Was Available	Percent of Patients from Out-of-Town
Rapid City (Bennett)[1]	4,871	31.7%
Rapid City (St. John's)[1]	5,998	29.4
Spearfish	623	27.0
Pierre	4,042	48.4
Mobridge	2,023	61.8
Gettysburg	1,523	40.2
Belle Fourche	1,514	49.1
Sturgis	1,196	37.9
Lemmon	525	29.8
McLaughlin	673	56.9
Faith	211	51.0
Philip	545	34.2
Onida	167	28.1
Deadwood	1,574	56.7
Lead	518	33.5
Hoven[2]	N.A.	--
Herreid[2]	N.A.	--
TOTAL	25,976	41.7

[1]Service areas are arranged by size of hospital located in them.

[2]Data were not available for this hospital.

Source: Division of Comprehensive Planning, Hospital License Information, 1967, Department of Health, Pierre, South Dakota.

Table V-5

Proportion of Patients Coming Various Road Distances for Hospital Care, 1967

Location of Hospital	Number of Out-of-Town Patients	Percent of Out-of-Town Patients Who Came from within the Following Road Distances				
		0-25 miles	0-49 miles	0-75 miles	0-99 miles	100 miles & over
Rapid City (Bennett)[1]	1,588	14%	45%	53%	67%	33%
Rapid City (St. John's)[1]	1,788	30	53	70	79	21
Spearfish	179	55	61	76	83	17
Pierre	2,056	33	63	88	94	6
Mobridge	1,239	27	76	92	96	4
Gettysburg	680	33	78	87	97	3
Belle Fourche	731	31	79	89	96	4
Sturgis	469	45	70	82	85	15
Lemmon	173	44	85	95	97	3
McLaughlin	376	31	93	96	98	2
Faith	107	37	81	86	98	2
Philip	191	17	91	96	97	3
Onida	48	54	100	--	--	--
Deadwood	938	88	93	95	96	4
Lead	178	100	--	--	--	--
Hoven[2]	N.A.	--	--	--	--	--
Herreid[2]	N.A.	--	--	--	--	--

[1]Rapid City was served by both Bennett and St. John's hospitals.

[2]Data were not available for this hospital.

Source: Division of Comprehensive Planning, Hospital License Information, 1967, Department of Health, Pierre, South Dakota.

Table V-6

Distance Traveled by Out-of-Town Patients Admitted into Northwest South Dakota Hospitals, 1967

Location of Hospital	Average Miles Traveled	Total Miles Traveled	Number of Out-of-Town Patients
Rapid City (Bennett)[1]	80.1	134,703	1,588
Rapid City (St. John's)[1]	71.2	125,138	1,788
Spearfish	52.6	9,356	179
Pierre	25.4	79,200	2,056
Mobridge	24.1	48,897	1,239
Gettysburg	55.8	38,031	680
Belle Fourche	44.6	31,767	731
Sturgis	42.8	20,060	469
Lemmon	35.3	5,931	173
McLaughlin	31.7	2,382	376
Faith	41.6	4,132	107
Philip	24.7	4,727	191
Onida	21.0	1,009	48
Deadwood	21.2	19,937	938
Lead	11.5	2,048	178
Hoven[2]	N.A.	--	--
Herreid[2]	N.A.	--	--
TOTAL	48.7	527,318	10,741

[1]Rapid City was served by both Bennett and St. John's hospitals.

[2]Data were not available for this hospital.

Source: Division of Comprehensive Planning, Hospital License Information, 1967, Department of Health, Pierre, South Dakota.

Faith area would have utilized a 30-bed hospital at an average of 75 percent of capacity. In 1967 the 20-bed Faith Hospital was utilized an average of less than 50 percent of capacity.

The exact reason for this lack of small hospital utilization was not found in this study, but the study did point out that when the closest hospital was by-passed, a larger hospital was usually utilized. A possible reason for utilization of the hospitals in larger towns might be the greater variety of physicians available, and better equipped hospitals with more specialized personnel than small hospitals employed. The analysis also showed that people from a hospital town were less likely to by-pass their hospital and go to another hospital than were people from other towns in the service area of that same hospital, which suggests a loyalty influence.

The data indicates that a major source of patients for hospitals of all sizes are people from the town in which the hospital is located. The distance traveled by out-of-town patients was not in general related to hospital size. The average distance traveled by out-of-town patients admitted into the Rapid City hospitals, which were among the largest hospitals in the study area, was far greater than was true for any other hospitals in the area. However, the average distance traveled by out-of-town patients admitted into the Pierre Hospital, the largest hospital in the study area, was among

the shortest for any hospital in the area. One major reason for this difference may be the fact that Pierre had far fewer physicians and particularly physicians with specialties than did Rapid City. Consequently, doctors in the study area would be more likely to refer patients to Rapid City doctors.

Up to this point this study has been concerned with a descriptive analysis of the medical services and facilities available in Northwest South Dakota. This sets the stage for specific analysis of the costs and capabilities of alternative methods of providing access to these services. Part of this latter problem involves the location, number and quality of ambulance services in Northwest South Dakota. The next chapter deals with the problems of ambulance services in Northwest South Dakota and analyzes some alternative organizations of ambulance services for providing improved access to medical services in the area.

CHAPTER VI

COST AND CAPABILITIES OF THREE TYPE OF AMBULANCE VEHICLES SUITABLE FOR USE IN NORTHWEST SOUTH DAKOTA

Part of the problem of providing medical services and accessibility to them involves the quality of ambulance service available to residents of an area. Ambulance service is closely related to hospital care because in emergencies the quality of the care given at the scene and en route to a hospital is often more important to patient welfare than the care eventually given at the hospital. Availability of quality ambulance service is particularly vital in sparsely populated areas where it is likely that patients will need to be transported long distances before reaching an adequate hospital. The purpose of Chapter VI is to point out the characteristics of existing ambulance services and analyze the cost and capabilities of three alternative ambulance systems suitable for use in Northwest South Dakota.

Ambulance Services Located in Northwest South Dakota, 1968

Northwest South Dakota is currently served by both auto ambulances and fixed wing air ambulances. Information on the location of auto ambulance services in Northwest South Dakota was obtained from both the State Department of Public Health and questionnaires

sent to local governments in the study area. The Department of Health data was from a survey of state licensed ambulances, which in the study area included all but volunteer services. A questionnaire was sent to city and county treasurers in the study area to find the number of volunteer services licensed or maintained by local governments. Air taxi services in the area were also sent questionnaires to find out the extent to which they were involved in providing air ambulance service.

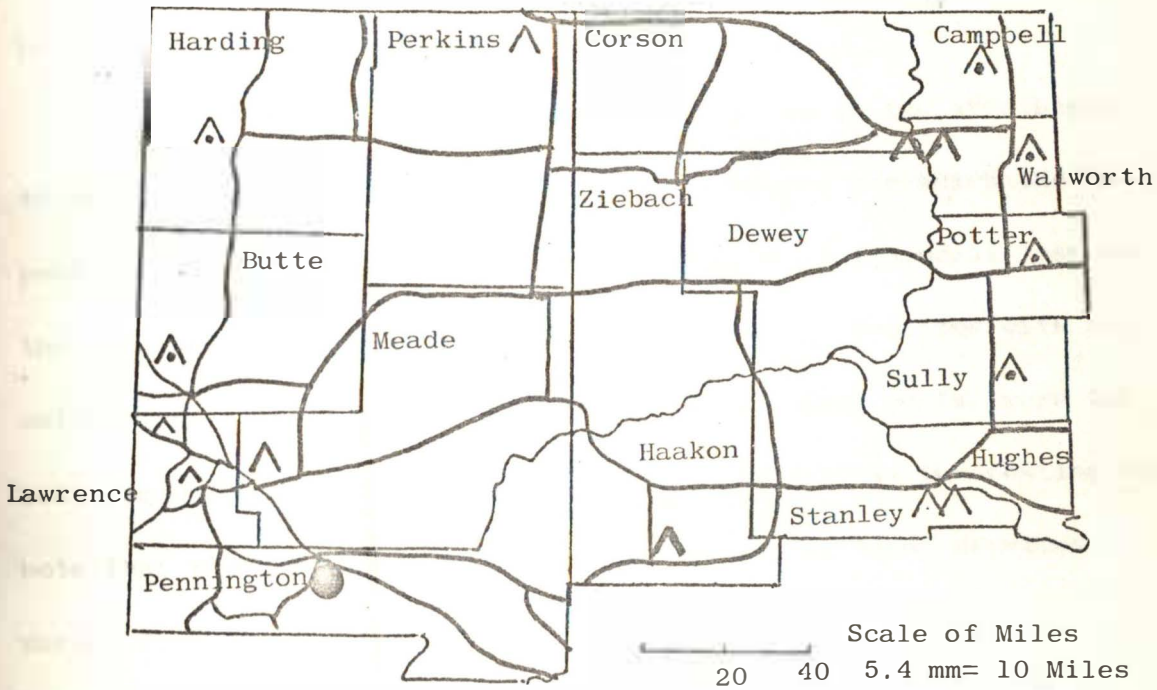
The location of auto ambulance services in Northwest South Dakota is shown in Figure VI-1. It appears that an adequate number of services were available in all parts of the study area except the center portion around Ziebach County. This portion of the study area was dependent upon the ambulance services located in surrounding towns, which were quite distant.[22]

Data available from the Department of Health showed that many of the ambulance services in the study area were unsure about future operations. Of the nine services for which the Department of Health data were available, four indicated they planned on discontinuing their ambulance service, and one was undecided about future operations.

[22]A Public Health Service ambulance was located in Eagle Butte which is near the center of the area, but its services are limited mainly to the Indian population in the area.

Figure VI-1

Ambulance Services Located in Northwest South Dakota, 1968



Key to Figure

Type of Ambulance Services

Funeral Home Services

Volunteer Services

Commercial Services

Other Symbols

Paved Road

Of those proposing to discontinue their service, at least one has since been granted a subsidy by its county government and one has been replaced by a volunteer service.

The major problem facing ambulance services in the area seems to be of a financial nature. All of the services for which the Department of Health data were available reported a financial loss on the ambulance service portion of their business. Problems with non-collection, as well as high equipment and personnel costs, were the most commonly indicated reasons for this loss. It is interesting to note that the percentage of fees collected by different services varied from 30 to 90 percent.

Probably most important for quality ambulance services is the availability of well-trained ambulance attendants with adequate equipment at their disposal. Of the services for which Department of Health data were available, six of the nine indicated they always carried both driver and attendant, two indicated they carried both sometimes, and one indicated it never carried both. The most common type of training given attendants was Red Cross training, although medical self-help and military training were also indicated. The most common type of vehicle used was the hearse type ambulance. Only one service used a station wagon as anything other than a back-up vehicle. All but one of the vehicles were equipped with two-way radio equipment.

Nearly all of the services carried oxygen or resusitation equipment.

Eleven of the 18 air taxi services located in the area were providing a significant amount of patient transportation in 1968. A total of 203 flights were made for this purpose in 1968. Most of the flights were made in transporting patients to or from hospitals outside the area, such as to the University of Minnesota Hospital.

The air services providing air ambulance services were not specially equipped for this purpose. Only one service reported it had a specific air ambulance plane. None of the planes used carried radio equipment other than that which is standard for a plane of its size. All of the services were also dependent upon local auto ambulance services and hospitals for furnishing an attendant and much of the medical equipment carried.

Need for Improvement in Area's Ambulance Services

Probably the most important medical resource which small towns can maintain are ambulance services, because they improve access to the medical facilities of neighboring towns. In 1967 some parts of the study area did not have an ambulance service reasonably available. Services in other towns were planning to discontinue. In all towns primary reliance was placed on auto ambulances, which may be sufficient for patient transportation to the local hospital, but lack

the speed desired for transporting patients to distant facilities. Because of its speed and flexibility, increased interest has been focused on the use of helicopter ambulances for patient transportation. To understand what role various types of ambulance vehicles might perform in satisfying the future health needs of Northwest South Dakota, three types of vehicles were analyzed.

Differences in Cost and Capabilities of Three Ambulance Vehicles

Data for this section were obtained from three sources. Information pertaining to auto and helicopter ambulances was obtained from a study done for the United States Department of Transportation. Fixed wing air ambulance data were obtained from the Piper and the Cessna Aircraft Companies and through discussions with people from local air services.

Auto Ambulances

The auto ambulance has been found to be an important link to adequate emergency care even in areas served by an air ambulance. The investment necessary for an auto ambulance varies a good deal depending upon the type of vehicle chosen. The data in Table VI-1 show the estimated price ranges and capacities of various body style of ambulances. Price ranged from $3,600 for the cheapest converted station

wagon to $18,000 for the most expensive limousine. Of course, cost to a specific community could be reduced by purchasing a suitable second-hand vehicle.

Table VI-1

Basic Body Styles for Auto Ambulances

Ambulance Body Type	Patient Carrying Capacity (Supine only)	Head Room (Patient Department)	Price Range
Limousine	1 - 2	50 in.	$12,000 - 18,000
Converted Stationwagon	1	41 in.	3,600 - 8,000
Custom Van Truck	1 - 3	77 in.	10,000 - 12,000
Converted Panel Truck	1 - 2	51 in.	8,000 - 9,000
Detachable Cab Truck Chassis	2	50 in.	6,000 - 8,000

Source: Dunlap and Associates, Economics of Highway Emergency Ambulance Services, Vol. 1. Prepared for U. S. Department of Transportation, (Darien, Conn.: Dunlap & Associates).

The quality of service possible with higher priced vehicles does not seem to increase commensurate with price. Much of the price differences between types of vehicles seems to be caused by the inclusion of unnecessary frills and status symbol type luxuries. The more

expensive vehicles differ from the lower cost models because of superior styling, higher performance engines, more luxurious interior furnishings, and better suspension systems.[23] Two important variables, patient carrying capacity and amount of headroom, did not vary greatly between price ranges. An adequate amount of headroom is particularily important when a patient must be given first aid en route to a hospital.

In addition to vehicle cost, the cost of necessary equipment must also be considered. The expected capital outlay for medical equipment is about $1,900 per vehicle. The estimated cost of furnishing a suitable ambulance installation was estimated at $1,700 with the largest single cost item being radio equipment. See Appendix Tables D-1 and D-2.

Probably even more important than initial investment are the operating costs involved in providing ambulance services. The cost figures in Table VI-2 show the expected annual fixed costs involved in operating three different types of auto ambulance services. The major difference in these three services is the costs per manpower. The commercial service operating complementary business can utilize ambulance personnel when they are not out on a call; consequently,

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[23]Dunlap and Associates, Economics of Highway Emergency Ambulance Services, Study for the United States Department of Transportation, (Washington, D. C.: Department of Transportation, 1968).

Table VI-2

Estimated Annual Fixed Cost for Ambulance Service Using One Auto Ambulance

Fixed Cost Elements	Total Annual Fixed Costs with Each of the Following:		
	Private Firm	Private Firm Also Operating Complementary Business[1]	Volunteer Service
Driver Attendant Wages[2]	$23,489	$11,745	--
Support Personnel Wages[2]	11,745	5,873	--
Employee Benefits[3]	2,784	1,392	--
Vehicle Depreciation[4]	964	964	964
Equipment Depreciation[4]	275	275	275
Facilities Rental[5]	5,600	2,800	1,400
Utilities	2,000	2,000	2,000
Insurance	714	714	714
Other Fixed Costs	600	600	600
TOTAL	48,171	26,363	5,953

[1]This category would include funeral homes which provide ambulance service.

[2]Driver, attendant, and support personnel assumed available 24 hours a day.

[3]Employee benefits were assumed to be 7.9 percent of total wages - 4.4 percent was for Social Security and 3.5 percent for workman's compensation.

[4]It was assumed that all of the services used a $9,000 vehicle depreciated over 7 years with 25 percent residual. Equipment was depreciated over 10 year period with no residual assumed.

[5]Facility rental was assumed to be lower with volunteer service and private firm operating a complementary business, because these services usually serve smaller towns where property values are lower.

Source: Dunlap and Associates, Inc., Economics of Highway Emergency Ambulance Services, Volume I, U. S. Department of Commerce, July, 1968.

labor costs can be reduced. The volunteer service generally has no paid personnel thus no allowance needs to be made for manpower. Costs of some other sources were assumed to be lower for the volunteer services and private firm operating a complementary business because these services are usually located in smaller towns where property values are lower and calls are received less frequently. An average variable cost of $6.00 per trip was assumed for all three types of services.

Helicopter Ambulances

The helicopter is unsurpassed for rapidly transporting the sick or injured to medical care. Presently, helicopters are most frequently used in urban areas to avoid traffic congestion in transporting auto accident victims to hospital care; however, many of the benefits from the urban use of helicopters are also possible in low population density rural areas. These areas are characterized by poor roads, often only indirectly leading to a hospital of sufficient size to provide the type of medical care needed.

The aircraft chosen for use as a helicopter ambulance should have payload capacity to carry two litter patients in addition to a pilot and a medical attendant. The aircraft also ought to have sufficient fuel capacity to permit at least three hours flying time without the

need for refueling or the addition of reserve tanks which reduce carrying capacity.

The medical attendant used on a helicopter needs to be more highly trained in some ways than the usual ambulance attendant. In addition to a high degree of skill in general first aid and trauma treatment, he must be aware of the possible complications which may occur during flight because of changing air pressure, patient anxiety, etc.

One of the most important capabilities of the helicopter is its ability to land almost anywhere. A helicopter can land on any clear, flat space with a diameter of 100 feet. Many newer hospitals are currently being built with heliports and nearly all hospitals located in rural areas such as Northwest South Dakota provide sufficient space on lawns or parking lots for helicopter landings.

Weather conditions such as fog, icing, or severe turbulance may prohibit the use of helicopters at some times. Helicopters are, however, able to fly at low altitudes under conditions which would ground fixed-wing aircraft. This is especially true in relatively flat terrains with few natural or man-made obstacles. Experience in Northern cities have shown that a helicopter ambulance could fly approximately 88 percent of the time.[24]

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[24] Ibid., p. 95.

Some type of indoor storage of the aircraft will be necessary if it is going to be ready to respond to emergencies in all types of weather. Heliport facilities should include a landing zone, hanger facilities, office space, and communications equipment. Maintenance facilities for daily and 100 hour maintenance inspection and minor engine and airframe maintenance is also necessary. Major overhauls on the airframe every 1,200 hours and on the engine every 900 hours will likely need to be done at a maintenance and overhaul depot outside of the service area. If a helicopter ambulance were to be used in Northwest South Dakota, perhaps some agreement could be made for use of the facilities and personnel available at the Ellsworth Air Force Base in Rapid City.

Efficient use of a helicopter requires a capability for continuous air-to-ground communications. The helicopter typically should have an airborne transceiver capable of contacting air traffic control, an ambulance dispatcher, and law enforcement agencies. Medical facilities can normally be contacted by telephone.

Fixed Wing Air Ambulance

Most of the characteristics desired in a helicopter would also be needed in a fixed wing air ambulance, that is: (1) capacity for carrying two litter patients plus one attendant, (2) sufficient fuel capacity, (3) appropriate radio equipment, (4) cruising speed of at

least 100 MPH, (5) landing area with aircraft storage and some maintenance equipment available.

The capability of the fixed wing air ambulance is different from the helicopter ambulance, because of its need for some type of prepared landing strip for taking off and landing. The typical air ambulance plane operating in the elevation characteristic of Northwest South Dakota requires a runway of at least 2,000 feet for normal take-off. The runway may be of either hard surface or sod construction. This need for an appropriate landing strip implies that all patients carried in a fixed wing ambulance need to be transported to an airport by auto ambulance.

Cost Comparison between Helicopter and Fixed Wing Air Ambulance

A number of different models of helicopters and fixed wing aircraft would be suitable for air ambulance work. See Appendix Table D-3. However, the Bell Ranger and the Cessna Skywagon 206 were chosen for the analysis in this chapter.

The data in Table VI-3 show that the initial investment in a helicopter ambulance was considerably higher than the investment in a suitable fixed wing air ambulance. The major contributor to this inequality was differences in cost of the basic aircraft. The allowance used for medical equipment and radio equipment was the same for both types of air ambulances.

Table VI-3

Comparison of Initial Investment for Helicopter Ambulance and Fixed Wing Air Ambulance

Item of Equipment	Investment	
	Helicopter[a]	Fixed Wing Plane[b]
Basic Aircraft		
Purchase Price	$95,000	$25,275
Registration Fee (3%)	2,850	758
Communications and Avionics		
Channelized Transceiver with Intercom	1,895	1,895
Ambulance Dispatch Transceiver	500	500
DF, Omni and Transponder	5,620	5,620
Switch panels & cabin speakers	550	550
Utility Equipment		
Heater	3,250	
Heavy Duty Battery	925	
Fire Extinguishers	40	40
Night and Flood Lights	1,050	
Rotor Brake	1,195	
Medical Equipment[1]	1,150	1,150
TOTAL	114,025	35,788

[1]Both aircraft were assumed equipped with radio equipment of same price and type.

[2]Medical equipment included here was the same as that used with the auto ambulance. See Appendix Table D-2.

Sources: [a]Dunlap and Associates, Economics of Highway Emergency Ambulance Services, Volume I, U. S. Department of Commerce, July, 1968.

[b]"Aircraft and Accessory Price List," Cessna Aircraft Company, Wichita, Kansas, February, 1969.

The cost figures shown in Table VI-4 indicate that the annual fixed costs were considerably higher for the helicopter ambulance than was true for the fixed wing plane. This difference in fixed cost was caused mainly by the higher investment necessary with the helicopter ambulance. Cost of extra equipment items such as flood lights contribute to the added capabilities of the helicopter, however.

The variable costs per hour were also found to be nearly twice as high for the helicopter ambulance as was true for the fixed wing plane. The difference was caused by the higher allowance for maintenance and overhaul necessary with the helicopter, and a slightly higher oil and gas cost per hour flown.

Helicopter and Fixed Wing Ambulance Costs at Various Levels of Use

The data in Table VI-5 show the total hourly costs of both the fixed wing and helicopter ambulance at various hours of use. The hourly costs decrease with increased aircraft use, because it is possible to spread fixed costs over more hours of flight time.

Since total cost per hour decreases with increases in total hours of use, it was necessary to estimate the number of flight hours which an air ambulance would be used. In making this estimation a number of assumptions were made. First, it was assumed that the air ambulance would be used mainly in the most sparsely populated portions of Northwest South Dakota. All of Northwest South Dakota was included in this

Table VI-4

Comparison of Annual Costs of Helicopter Ambulance and Fixed Wing Air Ambulance

Cost Items	Costs for Helicopter Ambulance[a]	Costs for Fixed Wing Air Ambulance[b]
Annual Fixed Cost		
Depreciation (5 years, 30% residual)[1]	$15,964	$ 5,010
Interest[2]	3,421	1,074
Hull & Liability Insurance	12,000	6,400
License Fee (based on weight)	25	35
Miscellaneous - Hanger Expense etc.	2,000	2,000
Two Full-Time Pilots[3]	24,000	14,400
Two Full-Time Attendants	12,600	12,600
Support Personnel	12,600	12,600
TOTAL FIXED COSTS	82,610	54,295
Variable Costs Per Flight Hour[4]		
Fuel and Oil	9	7.81
Reserve for Airframe Maintenance	2	
Reserve for Engine Maintenance	1	2.15
Reserve for Spare Parts	3	
Reserve for Retirement Life Items	7	
Reserve for Engine Overhaul	9	2.00
Pilot		6.00
TOTAL VARIABLE COST	31	17.96

[1]Cost of equipment and 3 percent initial registration fee are included in aircraft cost used in calculating annual depreciation.

[2]Includes 6 percent interest on one-half initial investment in aircraft and equipment.

[3]Wage of $1,000 per month assume with helicopter and $600 per month plus $6 per flight hour assumed with fixed wing plane.

[4]All maintenance calculations on helicopter were based on $8 per hour for FAA licensed mechanics. Overhaul is necessary every 1200 flight hours and on engine every 900 flight hours.

Sources: [a]Dunlap and Associates, Economics and Highway Emergency Ambulance Services, Volume I, U. S. Department of Commerce, July, 1968.

[b]"Aircraft and Accessory Price List," Cessna Aircraft Company, Wichita, Kansas, February, 1969.

Table VI-5

Total Annual Hourly Cost of Helicopter and Fixed Wing Air Ambulances at Various Hours of Use

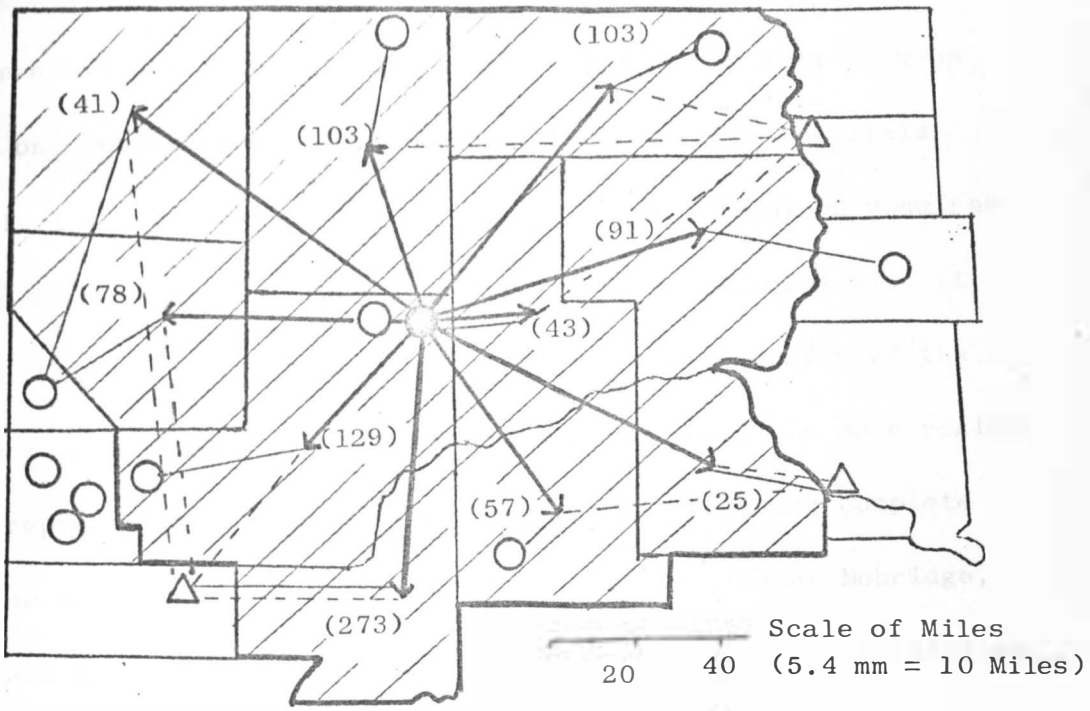
Annual Number of Flight Hours	Helicopter Cost per Hour	Fixed Wing Ambulance Cost per Hour
300	$306	$199
600	169	109
800	134	86
1,000	114	72
1,400	90	57
2,000	72	45

category except Lawrence, Campbell, Walworth, Potter, and Sully Counties. The towns of Belle Fourche, Mobridge, Pierre, Fort Pierre, Sturgis, and Rapid City, although located in counties considered to be sparsely populated, were also excluded from air ambulance coverage. See Figure VI-2.

The air ambulance service installation was assumed to be located near the center of the area to be served by the air ambulance. Flight time was estimated assuming an average speed of 135 MPH for the helicopter and 164 MPH for the fixed wing plane. Flight time per trip was broken down into three parts: (1) flight time from ambulance location to patient location, (2) flight time from patient pick-up site to hospital, and (3) flight time from hospital back to airport. Flight time between the installation housing the ambulance and the geographic center of each county assumed served by an air ambulance was used as an estimate of flight time to patient location. See Figure VI-2. Flight time between the center of each county and the hospital utilized was used as an estimate of the time necessary to bring the patient to a hospital. Flight time between the hospital to which the patient was brought and the air ambulance storage location made up the remainder of flight time per trip. Flight time per trip to each county was then multiplied by the expected number of trips to each county in order to find total expected

Figure VI-2

Area to be Served by Air Ambulance



Key to Figure

Area Assumed Served by Air Ambulance

( ) Ambulance Utilization Per County

Distance from Air Ambulance Installation to Patient Location

Distance to Closest Hospital

Distance to Large Hospital

Air Ambulance Installation

Small Hospital

Large Hospital

flight time for the entire area served.[25] Total expected flight time was first estimated assuming that three-fourths of the patients transported were brought to the hospital closest to the patient pick-up site and one fourth were brought to one of three large hospitals located in the study area. Because patient condition often requires the level of care available only in relatively large hospitals, it was felt that the use of the closest hospital three-fourths of the time and a large hospital one-fourth of the time would be more realistically representing the present situation than to assume complete dependence on the closest hospital. Hospitals located at Mobridge, Pierre, and Rapid City were assumed to be the large hospitals utilized. These hospitals were chosen because they were the largest in their respective portions of Northwest South Dakota.

Total expected flight time was estimated a second time. In this case the assumption was that all patients from the portion of the study area served by air ambulance would be brought to the closest of any one of three large hospitals in the study area. See Figure VI-2. Because of the trend away from small town medical facilities, it was

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[25] The following relationship was found in the Dunlap Study for a sample of ambulance services serving populations of less than 10,000 people.

$Y = 17.3X$ Where Y is number of emergency calls per year and X is the population of the area served divided by 1,000.

felt that transporting all patients to three large hospitals would realistically represent what might be expected in the future.

The total estimated flight times for both helicopter and fixed wing planes are shown in Table VI-6. The data in columns one and three of this Table were compiled assuming that the closest hospital was used three-fourths of the time and a large hospital one-fourth. The relatively small number of flight hours shown for the fixed wing plane results because an auto ambulance was necessary to bring patients to an airport and this airport was usually located in the town with the closest hospital. The flight times shown in columns two and four of the Table were computed assuming all patients to be brought to the closest of any one of three large hospitals in the area.

Using the flight hour data shown in Table VI-6 as a guide, the helicopter ambulance would be flown approximately 1,250 hours per year if three-fourths of the patients transported were brought to the closest hospital and one-fourth were brought to a large hospital in the area. If all patients were brought to a large hospital, total flight time would be 1,425 hours. Total annual cost would be $121,360 at 1,250 hours of use and $126,785 at 1,425 hours of use. Cost per hour at the two levels of use would be $97 and $89 per flight hour.

Total annual cost for the fixed wing air ambulance would be $59,539 if three-fourths of all patients were assumed to be brought to the closest hospital and one-fourth were assumed brought to one of

Table VI-6

Expected Flight Times Using Helicopter and Fixed Wing Air Ambulance

	Helicopter		Fixed Wing Air Ambulance	
	Flight Time Using Closest Hospital[1] (Hours)	Flight Time Using Large Hospital (Hours)	Flight Time Using Closest Hospital[1,2] (Hours)	Flight Time Using Large Hospital (Hours)
Flight Time to Location of Patient	439	439	90	361
Flight Time for Transportation of Patient to Hospital	271	368	75	303
Flight Time for Return to Storage Location	541	618	127	509
Total Flight Time	1,251	1,425	292	1,173

[1] Seventy-five percent of the trips were assumed to be to the closest hospitals and 25 percent to one of the previously designated large hospitals.

[2] Little use would be made of the fixed wing plane in transporting patients to closest hospital because it was often located in the same town as the closest airport.

three large hospitals. If all patients were assumed brought to a large hospital, total annual costs increased to $75,362. Cost per hour at these two levels of use would be $188 and $60 per flight hour, respectively. It is interesting to note that with major dependence on the small hospitals in the area, the hourly cost for the fixed wing air ambulance was over twice that of the helicopter ambulance. It is also significant that total expected costs for the helicopter ambulance increased by only $5,000 when all patients were assumed to be delivered to one of the three large hospitals in the area.

Estimating Service Times and Total Costs Associated with Three Alternative Ambulance Systems

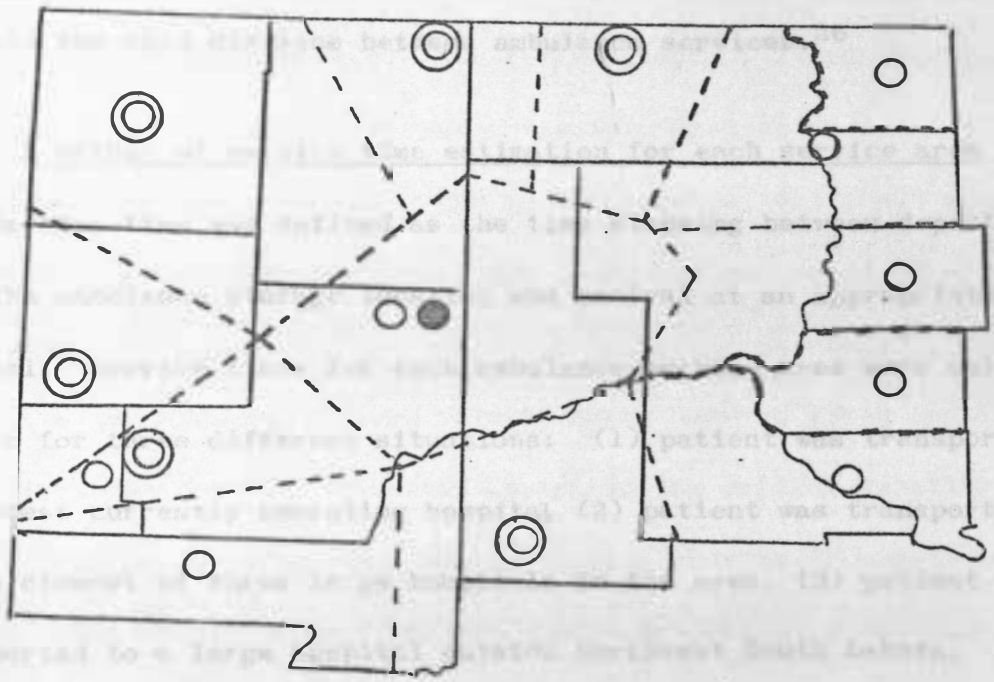
The three systems considered were: (1) auto ambulance, (2) joint use of helicopter ambulance and auto ambulance, and (3) joint use of fixed wing air ambulance and auto ambulance. The location of the services are shown in Figure VI-3. The average service times possible with each system were first calculated, after which the cost of each system was presented.

Approximating auto ambulance service areas

The assumed number and location of auto ambulance installations necessary to provide ambulance service within reasonable distance of all parts of Northwest South Dakota are shown in Figure VI-3. To

Figure VI-3

Assumed Location of Ambulance Services in Northwest South Dakota with Each of Three Ambulance Systems



Key to Figure

- Auto Ambulance Installation
- Auto Ambulance Installation Assumed Eliminated with Use of Helicopter Ambulance
- Air Ambulance Installation
- Auto Ambulance Service Area Boundaries

better understand the size of the area which would be dependent upon each auto ambulance installation, service area boundaries were drawn one-half the road distance between ambulance services.[26]

A method of service time estimation for each service area

Service time was defined as the time elapsing between departure from the ambulance storage location and arrival at an appropriate hospital. Service times for each ambulance service area were calculated for three different situations: (1) patient was transported to closest currently operating hospital, (2) patient was transported to the closest of three large hospitals in the area, (3) patient was transported to a large hospital outside Northwest South Dakota. In order to provide a comparison between the service times possible using different ambulance vehicles in each of the above situations, service time was calculated three times: first, assuming exclusive use of the auto ambulance; second, exclusive use of the helicopter ambulance; and third, exclusive use of a fixed wing air ambulance-auto ambulance combination.

The assumptions made in computing service time reflect differences in vehicle capacities. The air ambulances were each assumed to be located in one centralized location, while one auto ambulance was

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[26]The decision as to type of service was made mainly on the basis of what currently exists in the town.

assumed located in each ambulance service area. See Figure VI-3. The average speeds possible with the three vehicles were assumed to be 135 MPH, 164 MPH, and 60 MPH for the helicopter, fixed wing air ambulance, and auto ambulance, respectively. Road miles were used in calculating service times using the auto ambulance, while air miles were used in calculating service times using the two types of air ambulances.

The major problem involved in estimating service times for each of the ambulance service areas was approximating patient location. Because much of the demand for ambulance care results from auto accidents, road midpoints were used as approximations of where ambulance care would be needed. Road midpoints were defined as a point one-half the road distance between the service area's auto ambulance installation and the border of the service area. Average service time for a service area was computed by first calculating service time for each road mid-point in the area and then finding the average of these service times. The service time for a midpoint would be the time necessary for getting to a midpoint with an ambulance and taking a patient from that point to a designated hospital. The same basic model was used for estimating the service time possible using each type of vehicle.

It was first assumed that patients were brought to the closest hospital. The computations in Table VI-7 show that in the case of four of the ambulance service areas a helicopter located at a centralized installation could fly to the area and bring patients to the local hospital in less time than it would take using a locally stationed auto ambulance. Because an auto ambulance is necessary for bringing patients to an airport before boarding a fixed wing plane, the use of the fixed wing plane was assumed not applicable for bringing patients to the closest hospital.

Service time necessary for bringing patients to a large hospital was next computed. The hospitals included in this category were located in Rapid City, Pierre, and Mobridge. The data in Table VI-7 show that patients from eight service areas could be brought to a large hospital in less time with a helicopter ambulance or fixed wing air ambulance than with the auto ambulance; also the difference in service time is quite large in most cases. The fixed wing air ambulance has a service time similar to the helicopter for most service areas.

The third possible patient transportation need is the transportation of patients to a hospital outside Northwest South Dakota, such as to the University of Minnesota Hospital. It was assumed that on the average the distance would be 350 miles from the point of

Table VI-7

Service Times Possible Using Auto Ambulance, Helicopter Ambulance, or Fixed Wing Air Ambulance in Northwest South Dakota

Ambulance Service Areas	Service Time to Closest Hospital			Service Time to Large Hospital in Area			Service Time to Large Hospital out of Area		
	Auto Amb. (Min.)	Helicopter Amb. (Min.)	Fixed Wing Air Amb.	Auto Amb. (Min.)	Helicopter Amb. (Min.)	Fixed Wing Air Amb. (Min.)	Auto Amb.	Helicopter Amb. (Min.)	Fixed Wing Air Amb. (Min.)
Lemmon	28*	31	--	123	64	62	--	179	156*
Faith	58	24*	--	125	45*	90	--	169*	186
Philip	49	37*	--	93	55*	74	--	183	169*
McIntosh	45	37*	--	78	51*	64	--	185	158*
Mobridge	36*	48	--	35*	48	--	--	195	160*
Herreid	46*	64	--	46*	64	56	--	206	169*
Gettysburg	35*	50	--	74	61	50*	--	199	165*
Pierre	36*	53	--	36*	53	--	--	199	164*
Rapid City	34*	47	--	34*	47	--	--	194	162*
Sturgis	26	42	--	53	49	43*	--	192	159*
Belle Fourche	33*	44	--	75	60	59*	--	193	162*
Buffalo	92	55*	--	175	79*	134	--	187	172*

*Shortest service time possible with any of the three vehicles.

[1]Service time was defined as the time between leaving the ambulance installation and arriving at a hospital with the patient.

[2]The Deadwood service area was so small in geographic area that the analysis of service time for the area was not considered applicable.

patient pick-up. In this situation the fixed wing air ambulance could provide faster service for nearly every service area than was possible with the helicopter ambulance. In the one service area where it did not, patients had to be transported considerable distance to an airport before boarding the air ambulance.

The initial investment and operating costs associated with each of the three ambulance systems analyzed are shown in Table VI-8. The use of the auto ambulance alone was shown to require the lowest initial investment and annual operating cost. The helicopter ambulance with some support from a auto ambulance had a lower annual operating cost than the system using the fixed wing air ambulance. This lower cost resulted because the helicopter could replace several auto ambulance installations which would have been needed with the other two systems.

Table VI-8

Initial Investment and Total Annual Operating Costs for Three Alternative Ambulance Systems

Type of System	Initial Investment	Annual Operating Cost
Auto Ambulance Only	$176,400	$282,962
Auto Ambulance and Fixed Wing Air Ambulance	215,788	342,501
Helicopter and Auto Ambulance	231,025	307,328

Financing Ambulance Services

Historically most ambulance services have been financed through the use of fees charged to the patients served. Because of rising costs, caused in part by federal legislation aimed at increasing quality, the fee financing of services is beginning to prove more and more impractical. One of the major problems with fee financing is non-collection. The small size of the fee makes it easily forgotten. The small amount involved makes legal action against non-paying customers nearly impossible. Furthermore, the life and death nature of ambulance care nearly always assures repeated service to those not paying for previous services.

One alternative to complete reliance upon fee financing is subsidization by some level of government. If local control is desired, primary reliance for financial support will probably need to come from local town or county government units. However, since the use of an ambulance service is not restricted to those living in an area, state and federal financial help also seems justified.

The Federal Government's concern for the adequacy of ambulance services is shown by its passage of the Highway Safety Act of 1966. (P.L. 89-564). This act authorized the Secretary of Transportation to issue standard No. 11, Emergency Medical Services. Under this standard, states are expected to identify deficiencies in their

emergency medical services and establish remedial priorities in order to apply for Federal Highway Safety funds to assist in alleviating deficiencies. If funds available under this act prove insufficient in South Dakota, perhaps resources could be reallocated from highway construction, because one important reason of highway construction is to provide rural areas with access to medical care and other public services, a function which a helicopter ambulance also performs.

A second alternative to complete reliance upon fee financing is the establishment of volunteer services. With such services the expenditures for labor are greatly reduced. Volunteer services do have some unique problems, such as reduction in ambulance service availability when volunteers are at their jobs, and keeping a sufficient number of trained volunteers.

Chapter Summary

Some portions of Northwest South Dakota do not have ambulance services readily available at the present time. In all parts of the study area, auto ambulances were relied upon almost completely for emergency transportation to hospitals; some air services were providing patient transportation to distant hospitals outside the area.

The least costly type of ambulance service per installation was found to be the auto ambulance. The auto ambulance was also found to

be the most restricted in terms of area it can serve and distance it can transport patients within acceptable time periods.

Both the helicopter and fixed wing air ambulances are capable of providing ambulance service to a larger geographic area than the auto ambulance. This capability results from the fact that they are not bound to roads and are able to travel at relatively high speeds. The fixed wing air ambulance is, however, limited primarily to picking up patients at airports.

When cost of the two types of air ambulances were compared, it was found that the helicopter ambulance required a higher initial investment and had both higher fixed and variable costs than did the fixed wing aircraft. However, when the costs of alternative ambulance systems were analyzed, it was found that the system utilizing a helicopter ambulance in conjunction with an auto ambulance provided service at a lower total annual cost than the system utilizing a fixed wing ambulance. This lower level of cost was possible because the helicopter could replace several auto ambulance installations. Furthermore, with the helicopter system serving the sparsely populated counties the service time between these areas and large hospitals in the study area was greatly reduced from what it was using auto

ambulances only. The long service time necessary with the auto ambulance would be a serious limitation to the quality of the service which these ambulances could provide, even when well staffed and equipped.

CHAPTER VII

CONCLUSIONS, RECOMMENDATIONS, AND NEED FOR FURTHER RESEARCH

The purpose of this study was to investigate some of the problems which Northwest South Dakota communities face in providing medical services, as well as suggest some alternative solutions for the area. The study focused on three main areas: (1) hospital location and services available, (2) doctor location, and (3) ambulance services.

Study Conclusions

Hospitals and physicians appeared to be available in all parts of Northwest South Dakota. However, a considerable rural-urban difference in the level of care available did seem to exist. The hospitals located in low density portions of the area were small in size and lacked many of the specialized personnel found in larger hospitals. The occupancy rate of these small hospitals was generally quite low, caused in part by the frequency with which people living near these hospitals sought hospital care at larger, better equipped hospitals. These larger hospitals were located in towns served by more doctors with a greater variety of specialties.

During the past ten years many of the small towns located in sparsely populated portions of Northwest South Dakota have lost the

medical resources which they had. Towns with one or two doctors often could not replace doctors which left, and the turn-over of doctors in these small towns seems to have been more rapid than for larger towns. Also, a number of the hospitals located in the small isolated towns have closed, often caused by loss of the town doctor.

Northwest South Dakota was primarily dependent upon auto ambulance services for patient transportation. Such services were not presently available in all parts of Northwest South Dakota and some currently available services were also considering discontinuing their operations.

Of three alternative ambulance systems analyzed, a system utilizing a helicopter ambulance appeared capable of providing the best quality in terms of getting patients to a hospital in the shortest time. A helicopter could pick up patients from most parts of Northwest South Dakota and bring them to a local hospital in about the same length of time as it would take a locally stationed auto ambulance, and a patient could be brought to a large hospital in the area much faster with a helicopter ambulance than would be possible using an auto ambulance.

When patients required transportation long distances, the fixed wing air ambulance was faster than the helicopter ambulance. The fixed wing aircraft was of little use in transporting patients to

their local hospital, however. The ambulance system utilizing the fixed wing ambulance was also shown to be more expensive than the system utilizing the helicopter, because the fixed wing plane could not replace any auto ambulance services as the helicopter ambulances probably could.

Improving the Level of Medical Care Available in Northwest South Dakota

The low population density of rural areas in Northwest South Dakota makes it nearly impossible for communities located there to provide anything but a minimal level of medical service. One of the most promising long run opportunity for increasing the level of care in these areas is by establishing a good ambulance system to improve access to the specialized care available in large centers, and by establishing extended care units and clinics for local treatment of routine health problems. However, it is doubtful if the area could finance an adequate ambulance system for this purpose without some help from an outside source. Therefore, it is recommended that the state give consideration to partially financing an area-wide ambulance service utilizing a helicopter ambulance. Use of the helicopter seems necessary because the present auto ambulance services are having difficulty functioning and the analysis in this study indicates that this would probably be only slightly more costly than

complete dependence upon auto ambulances. The analysis of this study also indicated that use of a helicopter ambulance would greatly improve access to the medical facilities of the area's larger towns. It is also recommended that local communities give consideration to the construction of clinics as an alternative to small hospitals. Such clinics could be served by para-medical personnel on a full-time basis and a physician on a part-time basis.

Limitations of the Study and Need for Further Research

This study pointed out where the area's medical resources were located, indicated the geographic location from which hospitals in the area drew their patients, and provided information on the number and type of personnel employed by various sized hospitals. This information will provide important background material for further studies analyzing the cost of operating various sizes and types of medical facilities, such as hospitals, clinics, and nursing homes.

Although the study focused on where people from the study area went for hospital care, little could be deduced from the study as to why people utilized the hospital they did. Other important questions not answered by the study are: would people from the area's small towns utilize local clinic type facilities staffed by personnel with less training than a medical doctor, and how would study area residents

react to the establishment of an air ambulance service in the area, particularly if it meant the loss of their local ambulance service installation.

The study covered an area containing only about one-fourth the land area of South Dakota and about the same proportion of the population. A similar state-wide study needs to be conducted periodically, perhaps every five or ten years. Such a study would provide current information on changes in the pattern of patient movement to hospitals and information on the levels of care available in different size classes of hospitals. This information would be useful in planning future hospital construction in the state.

Although the study compared the cost and capabilities of various ambulance systems, the study does not cover their organization. A study needs to be done on how an area wide ambulance system might be organized, including ways in which local governments could share costs with the federal and state governments. A method for organizing area ambulance systems into a statewide system also ought to be considered.

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APPENDICES

Appendix Table A-1

Age and Racial Make-up of the Northwest South Dakota Population, 1960

County	Population Age Make-Up, 1960[a]		Dependency[b]	Racial Make-up[a]	
	Number below 14	Number above 50	Ratio 1960	Number Non-white	Percent Non-white
Pennington	21,014	8,832	84.2	2,590	4.5%
Meade	3,787	2,973	91.5	257	2.1
Lawrence	5,808	4,031	92.7	124	0.7
Hughes	4,657	2,399	95.1	641	5.0
Walworth	2,796	1,900	94.7	199	2.5
Potter	1,725	1,116	97.6	50	1.6
Campbell	1,255	758	95.0	2	0.0
Butte	2,893	2,082	98.6	52	0.6
Sully	938	586	99.9	20	0.8
Corson	2,329	1,054	115.5	1,674	28.9
Dewey	2,063	1,014	108.4	2,005	38.1
Stanley	1,724	535	104.7	133	3.3
Haakon	1,204	774	108.4	41	1.2
Perkins	2,063	1,506	98.5	37	0.6
Ziebach	1,035	411	111.6	998	40.0
Harding	854	520	97.9	4	0.0
TOTAL	56,155	30,491	--	--	5.6

Sources: [a]U. S. Bureau of the Census, U. S. Census of Population: 1960. General Social and Economic Characteristics, South Dakota, Final Report PC (1)-43C, U. S. Government Printing Office, Washington, D. C., 1961.

[b]Marvin P. Riley, South Dakota Population and Farm Census Facts, Circular Number 151, Rural Sociology Department, South Dakota State University, Brookings, South Dakota, 1962.

Appendix Table A-2

Economic Characteristics of the
Northwest South Dakota Population

County	Median Incomes[a]		Percent of Families below $3,000[a]		Local Government Expenditures for Health and Hospitals[b]	
	1960	1966	1960	1966	Total 1962	Per Capita 1962
Pennington	5,501	9,589	17.1%	15.4%	$77,000	$ 1.33
Meade	4,490	8,947	27.8	21.3	7,000	0.59
Lawrence	5,226	8,439	18.3	18.5	--	--
Hughes	6,360	10,151	13.3	16.9	1,000	0.05
Walworth	4,771	7,924	27.4	25.1	--	--
Potter	4,289	6,891	33.9	28.3	--	--
Campbell	3,691	5,981	36.8	33.0	1,000	0.26
Butte	5,062	8,541	21.1	20.9	--	--
Sully	4,109	7,717	35.0	27.2	66,000	25.50
Corson	2,914	5,986	51.3	41.3	--	--
Dewey	3,364	6,116	44.2	37.4	--	--
Stanley	5,758	9,156	9.7	14.8	7,000	0.39
Haakon	4,660	8,534	29.3	24.3	--	--
Perkins	4,471	7,629	30.1	27.1	1,000	0.09
Ziebach	3,988	7,752	35.6	27.5	--	--
Harding	4,710	9,140	31.0	25.5	--	--
AREA	--	--	22.7	20.3	160,000	1.02

Sources: [a]"Survey of Buying Power," Sales Management, The Marketing Magazine, June 10, 1967.

[b]U. S. Bureau of the Census, Census of Governments: 1962, Vol. IV, No. 4, Compendium of Government Finances, U. S. Government Printing Office, Washington, D. C., 1964.

Appendix Table A-3

Live Births in Northwest South Dakota,
by County of Mother's Residence, 1957 - 1967

County	Live Births Per County						Change
	1957	1959	1961	1963	1965	1967	1957-1967
Pennington	2,069	2,285	2,130	2,358	1,593	1,329	-740
Meade	264	282	283	355	250	225	- 39
Lawrence	434	451	467	472	357	300	-134
Hughes	359	379	431	327	240	209	-150
Walworth	206	224	221	166	179	117	- 89
Potter	164	169	159	133	107	103	- 61
Campbell	80	87	87	79	65	42	- 38
Butte	207	212	202	214	164	116	- 91
Sully	71	67	82	66	53	37	- 34
Corson	177	169	174	185	177	157	- 20
Dewey	179	218	187	160	153	121	- 57
Stanley	129	107	157	95	66	65	- 64
Haakon	103	92	80	78	53	54	- 49
Perkins	153	144	125	108	90	70	- 83
Ziebach	66	98	89	69	77	54	- 12
Harding	60	61	63	51	36	29	- 31
TOTAL	4,721	5,045	4,937	4,916	3,660	3,028	-1,693

Source: Division of Public Health Statistics, Annual Statistical Report, South Dakota Department of Health, Pierre, South Dakota, 1957, 1959, 1961, 1963, 1965, 1967.

Appendix Table A-4

Infant Death Rate Among White and Non-White Populations in Northwest South Dakota

Year	Infant[1] Death Rate Per 1,000 Live Births					
	Northwest[a] South Dakota		South Dakota[a]		United States[b]	
	White	Non-White	White	Non-White	White	Non-White
1960	26.7	75.0	26.0	79.1	26.0	43.2
1962	20.4	71.9	25.3	52.7	25.3	40.7
1965	25.3	42.5	24.7	50.3	24.7	40.3
1967	20.0	28.3	22.1	34.9	22.1	--

[1]Includes deaths of all babies under one year of age.

Sources: [a]Division of Public Health Statistics, South Dakota Public Health Statistics, Annual Statistical Report, South Dakota Department of Health, Pierre, South Dakota.

[b]U. S. Bureau of the Census, Statistical Abstract of the United States: 1967. (88 edition.) Washington, D. C., 1967.

Appendix Table A-5

Infant Deaths Per 1,000 Live Births in Northwest South Dakota, by Counties

Counties by Infant Death Rate	Infant Death Rate per 1,000 Live Births, 1960-1966 Average		
	All Races	White	Non-White
Corson	37.8	21.4	57.3
Sully	37.5	37.5	--
Hughes	32.1	27.9	71.1
Meade	29.5	28.2	66.7
Pennington	28.1	26.6	54.5
Lawrence	27.3	26.9	54.1
Campbell	25.9	25.9	--
Ziebach	26.6	4.6	44.4
Haakon	22.8	22.8	--
Butte	22.7	21.0	33.3
Stanley	21.9	22.1	21.3
Walworth	18.8	14.9	64.5
Dewey	17.1	14.6	18.7
Potter	16.9	16.9	--
Perkins	15.1	15.1	--
Harding	14.8	14.8	--
AREA	26.8	24.9	44.9

Source: Division of Public Health Statistics, Annual Statistical Report, South Dakota Department of Health, Pierre, South Dakota, 1960-1966.

Appendix Table B-1

Number of Patients Admitted, Days of Care Given, and Percent of Beds Occupied in Northwest South Dakota Hospitals, 1957-1967

Hospitals	Size of Hospital		Patients Admitted		Patient Days of Care Given		Percent of Beds Occupied	
	1957	1967	1957	1967	1957	1967	1957	1967
Belle Fourche	44	48	1,720	1,490	8,070	8,251	50.0	47.0
Deadwood	76	68	2,156	1,655	21,128	14,691	89.0	59.1
Faith	20	20	334	210	3,753	3,029	51.5	41.5
Gettysburg	26	35	1,016	1,692	6,214	9,273	82.0	72.6
Herreid[2]	N.A.	--	--	--	--	--	--	--
Hoven	35	35	736	597	4,334	2,771	33.0	21.7
Lead	29	30	558	532	6,106	5,766	59.3	52.7
Lemmon	24	30	877	581	3,744	3,822	43.0	34.9
McLaughlin	31	29	784	661	4,964	3,676	44.7	34.7
Mobridge[1]	50	52	1,631	2,044	8,681	10,079	47.6	53.1
Onida[2]	18	20	285	171	1,184	--	22.2	32.0
Philip	20	20	631	559	3,224	3,899	44.2	53.4
Pierre	102	145	4,699	4,251	34,310	33,398	92.0	63.1
Rapid City (B)	125	116	4,582	5,003	26,560	31,413	71.0	74.1
Rapid City (S)	150	147	4,997	6,083	28,754	39,898	58.5	74.4
Spearfish	8	20	128	664	612	3,817	35.0	52.3
Sturgis	24	39	1,042	1,238	7,364	12,732	84.1	89.4
New Underwood[2]	N.A.	--	--	--	2,478	--	56.4	--
Quinn[2]	8	--	185	--	1,686	--	64.5	--

[1]Data for two hospitals located in Mobridge were summed to get 1957 figure.

[2]The New Underwood, Quinn, and Herreid Hospitals closed previous to 1967.

Source: Division of Comprehensive Health Planning, Hospital License Information, 1967, State Department of Health, Pierre, South Dakota.

Appendix Table B-2

Location of Physicians In Northwest South Dakota, 1967

Towns	Total Number of Doctors	Number of Doctors of Medicine	Number of Doctors of Osteopathy	Number of Doctors with Specialties[1]
Rapid City	67	65	2	56
Pierre	14	13	1	5
Mobridge	7	7	-	2
Lead	6	6	-	2
Belle Fourche	5	5	-	3
Deadwood	5	5	-	3
Spearfish	6	5	1	1
Sturgis	6	3	3	1
Lemmon	2	2	0	2
Faith	2	0	2	0
Newell	1	1	-	0
Gettysburg	2	2	-	0
Hoven	1	1	-	0
McLaughlin	1	1	-	0
Wall	1	1	-	0
Philip	1	1	-	0
Bison	1	0	1	0
Buffalo	1	0	1	0
TOTAL	130	119	11	75

[1]Doctors with a specialty other than general practice.

Source: South Dakota State Board of Medical and Osteopathic Examiners, 1967.

Appendix Table B-3

Type of Care Given by Four Size Classes of Hospitals, 1967

Departments Offering Care	Proportion of Total Days of Care Given In Eight Departments, by Hospital of Size: Less than 25 beds	25-49 beds	50-99 beds	100-199 beds
Medicine	61.6%	47.2%	47.1%	35.3%
Geriatrics	12.3	15.1	22.5	5.0
Medical Pediatrics	9.7	9.5	6.2	6.2
Surgical Pediatrics	0.5	2.0	2.1	4.4
Surgery	13.5	18.4	15.7	38.5
Orthopedic	0.3	2.4	--	4.5
Psychiatric	--	--	--	0.7
Obstetrics	3.5	5.4	6.5	5.4
TOTAL	10.2	23.0	11.7	54.9

Source: Division of Comprehensive Health Planning, Hospital License Information, State Department of Health, Pierre, South Dakota.

Appendix Table B-4

Number of Selected Health Services and Personnel Located in Northwest South Dakota

Location of Services	Ambulance Services[a,b]	Nursing Home Beds	Dentists[1,d]	Optometrists
Wall	--	--	--	--
Hoven	--	--	--	1
McIntosh	--	--	--	--
Faith	--	--	--	--
Herreid	1	--	--	--
Newell	--	4	--	--
Onida	1	17	--	--
Selby	1	64	--	--
McLaughlin	--	--	--	--
New Underwood	--	18	--	--
Quinn	--	9	--	--
Bison	--	--	--	--
Buffalo	1	--	--	--
Philip	1	--	X	--
Gettysburg	1	59	X	1
Lemmon	1	31	X	1
Spearfish	1	191	X	1
Belle Fourche	1	104	X	2
Mobridge	2	27	X	2
Sturgis	2	71	--	1
Deadwood	1	9	X	1
Lead	1	--	X	1
Pierre-Ft. Pierre	2	119	X	2
Rapid City	1	234	X	9

[1]The Location of Dentists are Shown by X.

Sources: [a]Division of Health Mobilization, State Department of Health, Pierre, South Dakota.

[b]Questionnaire sent to county and city governments in Northwest South Dakota.

[c]Division of Comprehensive Health Planning, Hospital License Information, State Department of Health, Pierre, South Dakota.

[d]Health Manpower Study Commission, Health Manpower for the Upper Midwest, St. Paul, Minnesota, 1966.

[e]Dr. Bert C. Corwin, President, Optometrists of South Dakota.

Appendix Table C-1

Number of Out-of-Town Patients Coming Various Road Distances for Hospital Care, 1967

Hospitals Ordered by Size	Number of Out-of-Town Patients	Number of Out-of-Town Patients who Came from within the Following Distances: 0-24 miles	25-49 miles	50-74 miles	75-99 miles	100 miles & over
Rapid City (St. John's)	1,788	531	419	296	169	380
Pierre	2,056	681	607	511	129	128
Rapid City (Bennett)	1,588	248	517	138	247	568
Mobridge	1,239	337	603	194	54	51
Deadwood	938	822	46	20	10	40
Belle Fourche	731	225	352	71	55	28
Sturgis	469	210	119	57	15	68
Gettysburg	680	226	304	63	63	24
Lead	178	178	--	--	--	--
Lemmon	173	75	72	17	4	5
McLaughlin	376	118	230	14	7	7
Faith	107	40	47	5	2	13
Philip	191	33	141	9	2	6
Spearfish	179	98	12	26	13	30
Onida	48	26	22	--	--	--
Herreid[1]	N.A.	--	--	--	--	--
Hoven[1]	N.A.	--	--	--	--	--
AREA	10,741	3,692	3,517	1,421	763	1,348

[1]Data were not available for this hospital.

Appendix Table C-2

Number of Out-of-Town Patients by Size of Town of Home Address, 1967

Hospitals Ordered by Size	Number of Out-of-Town Patients	Percent of Out-of-Town Patients who Were Residents of Each of the Following Size Classes of Towns:			
		50-499	500-2,499	2,500-9,999	10,000 & over
Rapid City (St. John's)[1]	1,788	38.6%	31.5%	27.3%	2.6%
Pierre	2,056	45.7	51.1	1.4	1.8
Rapid City (Bennett)[1]	1,588	38.4	28.6	25.4	7.6
Mobridge	1,239	55.7	43.6	0.3	0.5
Deadwood	938	16.3	4.3	78.5	0.7
Belle Fourche	731	52.5	21.3	23.9	2.0
Sturgis	469	59.5	15.1	13.4	12.0
Gettysburg	680	54.4	43.3	0.9	1.4
Lead	178	13.5	--	86.5	--
Lemmon	173	79.8	18.5	1.7	--
McLaughlin	376	52.8	45.4	1.6	--
Faith	107	51.0	46.0	3.0	--
Philip	191	72.3	25.7	0.5	1.5
Spearfish	179	51.7	15.7	29.2	3.4
Onida	48	35.4	35.5	--	29.1
Herreid	N.A.	--	--	--	--
Hoven	N.A.	--	--	--	--
AREA		45.3	31.5	20.1	3.1

Appendix Table C-3

Number of Patients Admitted into Northwest South Dakota Hospitals from Towns Located in Fifteen Hospital Service Areas

Towns Grouped by Service Areas	Number of Admissions of Residents of Each Town	Admissions into Hospital in Service Area	Admissions into Other Northwest South Dakota Hospitals
Rapid City Hospital Service Area			
Black Hawk	56	55	1
Caputa	20	20	--
Farmingdale	13	13	--
Hill City	83	80	3
Keystone	55	55	--
New Underwood	164	149	--
Piedmont	94	74	20
Rapid City	6,746	6,641	105
Rockerville	1	1	--
Scenic	16	16	--
Wasta	36	36	--
BoxElder	57	55	2
Owanka	18	18	--
TOTAL	7,359	7,213	146
Pierre Hospital Service Area			
Canning	6	6	--
Ft. Pierre	529	518	9
Hayes	79	79	--
Pierre	2,093	2,024	69
Kirley	14	13	1
TOTAL	2,721	2,642	79
Deadwood-Lead Hospital Service Area			
Deadwood	853	662	191
Central City	50	44	6

Appendix Table C-3 (Continued)

Towns Grouped by Service Areas	Number of Admissions of Residents of Each Town	Admissions into Hospital in Service Area	Admissions into Other Northwest South Dakota Hospitals
Rochford	14	5	9
Terraville	17	17	0
Pluma	1	1	0
Silver City	5	0	5
Lead	1,001	799	202
Galema	1	1	0
TOTAL	1,942	1,529	413
Mobridge Hospital Service Area			
Glencross	23	23	0
Firsteel	30	24	6
Java	121	116	11
Mahta	1	1	0
Mobridge	809	764	45
Selby	288	231	57
Wakpala	19	14	5
Whitehorse	19	11	8
Akaska	25	17	8
Trail City	39	32	7
Timber Lake	213	164	49
TOTAL	1,587	1,391	196
Belle Fourche Hospital Service Area			
Belle Fourche	949	759	190
Camp Cook	31	17	14
Castle Rock	7	5	2
Fruitdale	32	23	9
Hoover	5	1	4
Newell	173	87	86
Nisland	64	45	19
Redig	5	5	0

Appendix Table C-3 (Continued)

Towns Grouped by Service Areas	Number of Admissions of Residents of Each Town	Admissions into Hospital in Service Area	Admissions into Other Northwest South Dakota Hospitals
Zerona	7	0	7
Buffalo	76	21	55
Ludlow	4	1	3
Ladner	6	1	5
TOTAL	1,359	965	394
Sturgis Hospital Service Area			
Elm Springs	12	1	11
Enning	24	18	6
Fairpoint	5	3	2
Hereford	4	2	2
Sturgis	1,238	702	536
Union Center	26	15	11
Vale	63	48	15
Whitewood	146	66	80
Fort Meade	31	12	19
TOTAL	1,549	867	682
Gettysburg Hospital Service Area			
Gettysburg	944	815	129
Laplant	8	3	5
Lebonon	100	90	10
Lowry	33	17	16
Tolstoy	23	23	0
Ridgeview	23	14	9
TOTAL	1,131	962	169
Lemmon Hospital Service Area			
Bison	29	6	23
Glad Valley	3	--	3

Appendix Table C-3 (Continued)

Towns Grouped by Service Area	Number of Admissions of Residents of Each Town	Admissions into Hospital in Service Area	Admissions into Other Northwest South Dakota Hospitals
Lemmon	382	352	30
Lodgepool	1	1	0
Meadow	40	24	16
Morristown	64	53	11
Prairie City	15	4	11
Ralph	3	--	3
Reva	10	--	10
Shade Hill	14	9	5
Watanga	46	21	25
Keldron	17	13	4
Morristown	63	53	10
Sorum	5	--	5
TOTAL	692	536	156
McLaughlin Hospital Service Area			
Bullhead	9	8	1
Kenel	6	2	4
Little Eagle	21	12	9
McIntosh	160	95	65
McLaughlin	376	288	88
Walker	1	1	0
Cherry Creek	10	1	9
Dupree	168	40	128
Eagle Butte	307	12	295
Faith	203	96	107
Howes	3	--	3
Isabel	132	12	120
Longry	29	9	20
Marcus	9	1	8
Marine	7	2	5
Mud Butte	16	--	16
Opal	6	1	5
Plainview	10	2	8

Appendix Table C-3 (Continued)

Towns Grouped by Service Area	Number of Admissions of Residents of Each Town	Admissions into Hospital in Service Area	Admissions into Other Northwest South Dakota Hospitals
Red Owl	20	5	15
Stoneville	15	--	15
White Owl	12	1	11
Zerona	7	--	7
Bridger	1	--	1
Parade	3	--	3
TOTAL	958	182	776
Philip Hospital Service Area:			
Creighton	22	8	14
Milesville	77	40	37
Ottumwa	11	8	3
Philip	447	338	109
Quinn	48	21	27
Wall	153	39	114
Midland	116	30	86
Cottonwood	40	27	13
TOTAL	914	511	403
Spearfish Hospital Service Area			
Spearfish	766	433	333
St. Onge	40	11	29
TOTAL	806	444	362
Onida Hospital Service Area			
Agar	131	9	122
Blunt	180	15	165
Harrold	118	8	110
Onida	365	119	246
TOTAL	794	151	643

Appendix Table C-3 (Continued)

Source: Division of Comprehensive Health Planning, Hospital License Information, 1967, State Department of Health, Pierre, South Dakota.

Appendix Table D-1

Investment in Equipment for Each Installation

Equipment	Cost
Office	
Desk and Chair	$ 100
Two Lounge Chairs	50
File Cabinet	40
Typewriter	200
Adding Machine	80
Office Supplies	75
Communications	
Base Station Installation	1,000
Personnel	
Bunk Beds	100
Garment Rack	10
Utility Cabinet	25
Miscellaneous	20
TOTAL COST	1,700

Source: Dunlap and Associates, Economics of Highway Emergency Ambulance Services, U. S. Department of Transportation, Washington, D. C.

Appendix Table D-2

Investment in Equipment for each Ambulance

Equipment	Cost
Communications	
Mobile Transceiver	$ 750
Medical	
Resuscitator-Inhalator-Aspirator	400
Wheel Stretcher (incl. Mattress)	230
Chair Stretcher	100
Litter	30
Orthopedic Stretcher	125
Bag-Mask Resuscitator	45
Portable Suction Apparatus	50
Splints (2 sets arm and leg)	40
Orpharyngeal Airways	5
First Aid Kit	50
Miscellaneous	
Sand Bags	15
Pillows and Blankets	25
Fire Extinguisher (1 qt.)	25
Flashlights and Flares	10
TOTAL COST	1,900

Source: Dunlap and Associates, Economics of Highway Emergency Ambulance Services, U. S. Department of Transportation, Washington, D. C.

Appendix Table D-3

Some Models of Fixed Wing and Helicopter Aircraft
Suitable for Use in Air Ambulance Work

Model	Initial Cost	Direct Operating Cost Per Hour[1]	Cruising Speed	Range (at Maximum Payload without Reserve or Refueling)
Fixed Wing Aircraft				
Piper Cherokee, Six B[a]	$24,900	$11.00	168MPH	570 miles
Cessna Skywagon 206[b]	25,275	11.95	164	650
Helicopter Aircraft				
Jet Ranger[c]	95,000	31.00	135	400
FH-1100[c]	94,500	32.00	142	396
47J-2A[c]	25-50,000	29-33.00	91	200

[1]Includes maintenance and reserve for overhaul on engine and airframe.

Sources: [a]Piper Aircraft Corporation, Lock Haven, Pennsylvania.

[b]Cessna Aircraft Company, Wichita, Kansas.

[c]Dunlap and Associates, Economics of Highway Emergency Ambulance Services, U. S. Department of Transportation, Washington, D. C.

Appendix Table D-4

Expected Ambulance Utilization for Counties Assumed Served by Air Ambulance

Counties Assumed Served by Air Ambulance	Population Served in Counties[1]	Expected Ambulance Utilization
Harding	2,371	41
Butte[2]	4,505	78
Perkins	5,977	103
Corson	5,798	100
Campbell	3,531	61
Dewey	5,257	91
Stanley[2]	1,436	25
Ziebach	2,435	43
Haakon	3,303	57
Meade	7,405	129
Pennington[2]	15,796	273
TOTAL	57,874	940

[1] 1960 population figures were used.

[2] 1960 population of the county minus the 1960 population of the largest town in this county comprised the population served from this county.

Appendix Table D-5

Expected Flight Miles Using Helicopter and Fixed Wing Air Ambulance[1]

Breakdown of Flight Distance	Total Distance with Helicopter Using: Closest Hospital	Large Hospital	Total Distance Flown with Fixed Wing Air Ambulance Using: Closest Hospital	Large Hospital
Flight Distance to Patient Location	59,212	59,212	14,803	59,212
Flight Distance to Hospital with Patient	36,563	49,731	12,335	49,731
Flight Distance for Returning to Storage Installation	73,061	83,404	20,851	83,404
Total Flight Distance	168,836	192,347	47,989	192,347

[1]When flight distance shown in this table is divided by 135 in the case of the helicopter ambulance and 164 in the case of the fixed wing air ambulance the result is flight time as shown in Table VI-6.

Appendix Table D-6

Type and Location of Ambulance Services Used in the Three Ambulance Systems Analyzed[1]

Location of Services	Type of[2] Service	Services[3] Utilized with Plan A	Services[3] Utilized with Plan B	Services[3] Utilized with Plan C
Rapid City	PF	X	X	X
Faith	PFCB	X	X	X
Mobridge	PFCB	X	X	X
Pierre	PFCB	X	X	X
Deadwood	PFCB	X	X	X
Lemmon	PFCB	X	X	-
Sturgis	PFCB	X	X	-
Philip	PFCB	X	X	-
Belle Fourche	V	X	X	X
Herreid	V	X	X	X
Onida	V	X	X	X
Gettysburg	V	X	X	X
Buffalo	V	X	X	-
McIntosh	V	X	X	-
Faith	H	-	-	X
Faith	FWA	-	X	-

[1]The three systems analyzed were: Plan A, auto ambulance only; Plan B, auto ambulance and fixed wing air ambulance; and Plan C, auto ambulance and helicopter ambulance.

[2]PF means private firm, PFCB means private firm operating a complimentary business, V means volunteer service, H means a helicopter ambulance, and FWA means Fixed Wing Air Ambulance.

[3]An X means that with this Plan an ambulance of the type designated was assumed located in the town listed to the left.