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LOCATION AND PLANNING OF HEALTH CARE DELIVERY SYSTEM AT THE DISTRICT LEVEL

JAYASREE DE, ROLEE KANCHAN & NILADRI RANJAN DASH, Vadodara.

ABSTRACT: The planning of health care services is assuming increasing importance in India due to the economic and social significance of tackling the problems of human health. In order to make our health care services more effective, it is necessary to asses the adequacy of the existing services at the microlevel. A comprehensive study of the adequacy of health care services would involve extensive field investigations which would be both time-consuming and expensive. Hence, an alternative approach to assess the situation, by the use of secondary data, needs to be adopted. The present study has therefore attempted to analyse the adequacy of the existing health care facilities in the rural areas of one district in Gujarat, namely, Vadodara, as a test case.

Introduction :

The planning of health care and welfare services is assuming increasing importance due to the social and economic significance of tackling the problems of human health. However, the spatial aspect of this planning is still a neglected segment of our Indian Plans. This fact has been emphasized in most studies related to health care distribution in India. According to Akhtar and Izhar (1985). "although considerable growth in health facilities is recorded, the uneven distribution has resulted in the disparities in their availability.

In order to make our health care services more effective, it is necessary to assess the adequacy of the existing services at the micro level. This adequacy can be measured in terms of (1) the specific types of services required by various groups of people and in different areas; (2) the number of services available in relation to the number of persons to be served; and (3) the accessibility of the services which is an effect of the geographical location as well as the cost of the available facility.

The types of services required would involve an assessment of the prevailing disease patterns. The numerical adequacy of the services can be gauged by evaluating the number of persons served by a given facility and comparing the same wtith the norms set out by our planners Physical accessibility can be measured in terms of travel distance, or travel time, or travel cost, while accessibility in terms of expenditure on use of health services can be judged by correlating the cost with the economic status of the users.

A comprehensive study of the adequacy of health care services would thus involve extensive, time-consuming and expensive field investigations.

In a vast country like India, such extensive field studies at the micro level would itself involve a long-term plan project. It is therefore necessary to look for alternative techniques by which the required results may be derived more easily, yet effectively. The use of secondary data, alone, can allow for speedy analysis. An attempt has therefore been made through this study to show how the available secondary data may be utilised for obtaining an overview of the existing position regarding the health care services at a micro level. If the entire country can be studied in this manner, the results will provide the framework for planning the spatial distribution of health care services.

Research in the optimisation of health service centres and determining hierarchical order has been pursued by geographers particularly through the concept of Central Place Theory. In Sweden, such studies have been actually applied in health service planning (Learmonth, 1976). A simple method of determining the service areas of health care centres has been adopted in this study. The efficiency of the service is then judged by the number of persons covered within the service area and the average distance that one has to travel within the service area to avail of the facility.

Objectives:

The Government of Gujarat, in accordance with the policies of the Government of India, has been aiming at intensifying the health services, laying particular emphasis on backward and tribal areas. The vital role of the primary health centres in this respect, has been recognised. During the Perspective Plan Period (1974-84), the targets of one primary health centre per every 70,000 persons, and one primary health subcentre per every 10,000 persons, were therefore set. These were to form the first tier in the state health services. Currently, in accordance with the objective of Health for All by 2000 A.D., enunciated in the Alma Ata Declaration in 1977, the Government of Gujarat has revised the norms to one primary health centre for 50,000 population, and one primary health subcentre for 5,000 persons.

Keeping in view the policy recommendations of the perspective plan, the present study is an attempt to assess the achievements of the planning programme and the locational efficacy of the health care delivery system. Since the study is based on 1981 census data, it endeavours to understand the situation in the light of the norms prevailing at that time, viz., one primary health centre for 70,000 persons and one primary health subcentre for 10,000 persons. This paper thus attempts to:-

1. Study the spatial distribution of health care facilities in the district of Vadodara in Gujarat, and estimate the adequacy of the existing primary health care facilities in terms of population and area served; and

2. Devise a method to help in identifying centres of location of health services which will allow for a more equitable distribution of the facilities.

Data Base :

This study is based entirely on secondary data published in the District Census Handbook of Vadodara District for 1981. The unit of study is the village for which necessary information regarding area, population, and various facilities available, have been compiled.

Distribution of Health Care Services in Vadodara District :

Vadodara district is situated in the central part of the plains of Gujarat and has an area of approximately 7794 sq. km. out of which 7515 sq. km. is rural. The total population of the district is 2,558,092 (1981) of which 1,607,565 comprises the rural population. For administrative purposes, the district is divided into 12 talukas encompassing 1655 villages.

The distribution of health care facilities in the district (excluding the urban areas) reveals a rather unbalanced pattern (Table 1). The number of services available in each taluka, the percentage of villages with facilities, the area covered by the facilities, the population served by these facilities, show considerable variations between the talukas. In each case, Vadodara taluka ranks the highest and Nasvadi occupies the lowest position. The superior situation in Vadodara taluka may be due to the proximity and consequent influence of the urban area of Vadodara.

The degree of concentration of health care services in the talukas, studied with the help of the location quotient, reveals a distinctive pattern. The location quotient was worked out by the following formula:

$$L.\ Q. = \frac{\text{Population of villages with facilities in the taluka as percentage of population of villages with facilities in the district}}{\text{Total rural population of taluka as percentage of total rural population of district}}$$

The results obtained were as follows:-

Taluka	Location Quotient
1. Vadodara	1.76
2. Padra	1.20
3. Sinor	1.16
4. Karjan	1.13
5. Savli	1.13
6. Dabhoi	1.13
7. Vaghodia	1.02
8. Tilakwada	0.95
9. Sankheda	0.71
10. Chhota Udaipur	0.56
11. Jetpur Pavi	0.51
12. Nasvadi	0.50

It is apparent that the first seven talukas, mentioned above, have a greater concentration of medical services, while the remaining five talukas are less well served. The high location quotient of Vadodara taluka is notable.

The overall picture regarding availability of health care facilities shows that talukas adjacent to Vadodara, enjoy a better position. The district may thus be divided longitudinally into two halves, with the western half, including the talukas of Savli, Vadodara, Padra, Karjan, Sinor Dabhoi and Vaghodia showing better development of medical facilities, while the remaining five talukas further east, which are predominantly tribal areas, show lesser development. (Fig. 1).

Adequacy of Health Care Facilities:

The overall picture studied so far at the taluka level does not give a precise

Table 1: Basic statistics and distribution of health care facilities in Vadodara District

Talukas	Rural area in sq. km.	Number of villages	Total rural population	Number of health care services available	Villages with health care services		Area covered by villages with health care services		Population served directly by health care services	
					No.	% of total villages of the taluka	Area in sq. km.	% of taluka area	No.	% of total rural population of taluka
1. Vadodara	538.51	102	202,022	139	39	38.23	320.21	59.46	1,45,740	72.14
2. Karjan	586.16	93	121,867	76	26	27.96	238.66	40.71	56,584	46.43
3. Padra	521.30	82	170,908	65	24	29.27	234.01	44.89	84,344	49.35
4. Savli	791.99	137	193,613	73	26	18.98	286.58	36.18	90,029	46.50
5. Vaghodia	549.43	95*	95,614	55	22	23.15	209.54	38.14	39,995	41.83
6. Dabhoi	607.77	118*	120,040	76	26	21.19	240.46	39.56	55,719	46.42
7. Sankheda	695.94	184*	126,157	61	21	11.96	151.29	21.74	36,752	29.13
8. Jatpur Pavi	800.75	212*	162,275	61	21	10.38	121.24	15.14	34,284	21.13
9. Chhota Udaipur	1367.16	276	216,718	81	41	14.85	248.52	18.18	50,285	23.20
10. Nasvadi	535.18	219*	89,263	34	14	6.85	55.53	10.38	18,388	20.60
11. Tilakwada	244.52	97	48,661	36	16	16.49	75.32	30.80	18,983	39.01
12. Sinor	276.31	40	60,427	39	12	30.00	106.14	38.41	28,821	47.05
District Total	7515.02	1655	1,607,565	796	288	17.58	2287.50	30.44	659,924	41.05

* 1 village uninhabited.

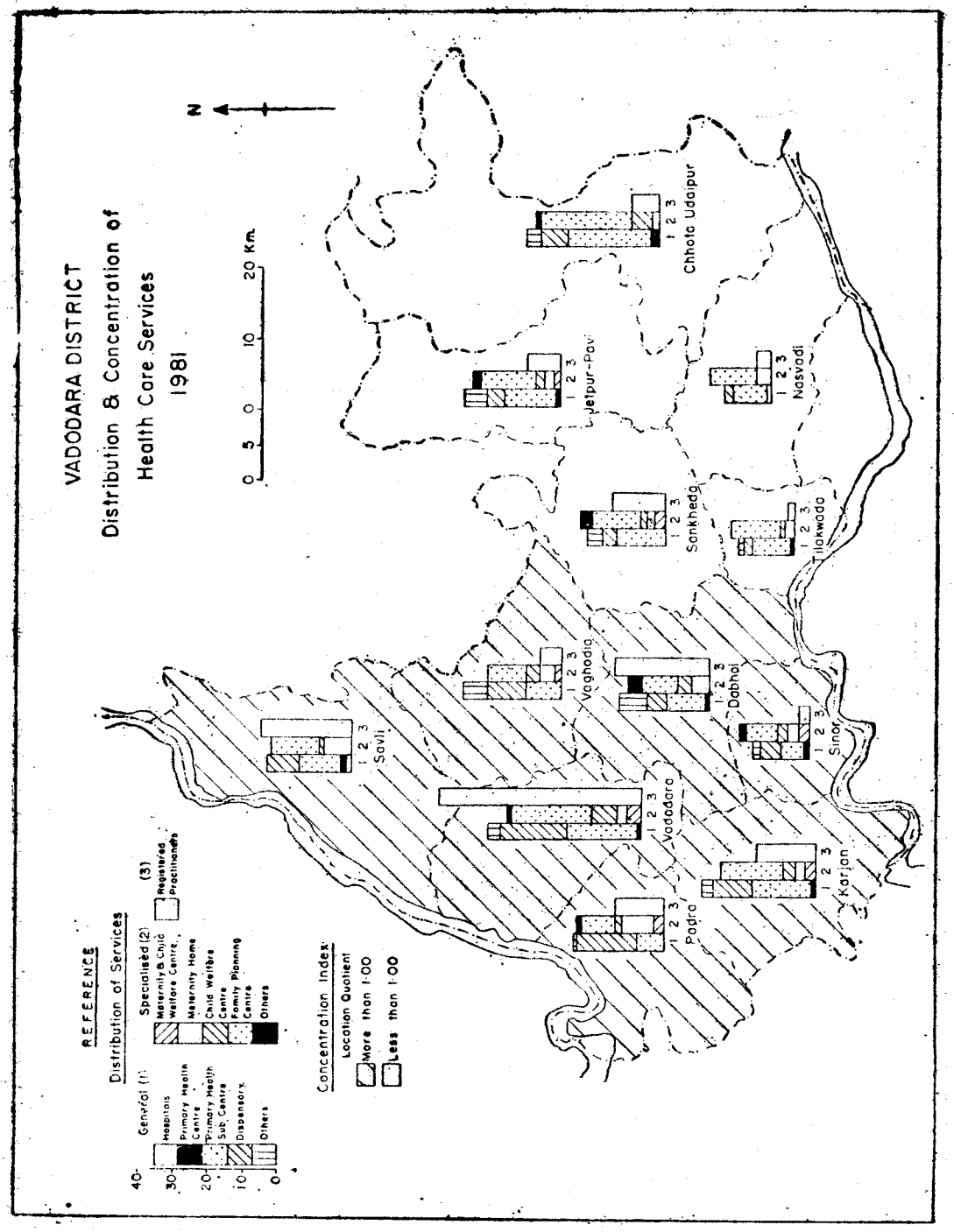
VADODARA DISTRICT
Distribution & Concentration of
Health Care Services
1981
N
0 5 0 10 20 Km.
Chhota Udaipur
Jetpur-Pavi
Nasvadi
Sankheda
Tilakwada
Vaghodia
Dabhoi
Savli
Vadodara
Sinor
Padra
Karjan
1 2 3
REFERENCE
Distribution of Services
General (1)
Hospitals
Primary Health Centre
Primary Health Sub Centre
Dispensary
Others
Specialised (2)
Maternity & Child Welfare Centre
Maternity Home
Child Welfare Centre
Family Planning Centre
Others
(3)
Registered Practitioners
Concentration Index
Location Quotient
More than 1·00
Less than 1·00

Fig. 1

picture regarding the adequacy of health care service which can be judged only through an investigation into the number of people who have access to a given service. Since field investigations to determine this fact was not possible, it was decided to make a hypothetical analysis on the basis of established theories of locational analysis. This exercise has therefore been attempted at the micro level by taking into account the locations of individual health care services and the population of the villages which constitute the target areas to be served. Since government health programmes lay emphasis on primary health care and since the norms for their establishment have been clearly stated in the plan documents, this exercise has been confined to the determination of the adequacy of primary health centres and primary health subcentres.

It is not feasible to locate a dispensary or a health centre in every village as the small size of the population and the area that some of them may serve, will not make them economically viable under existing levels of economic development in India. Hence, adjacent villages will have to be grouped in order to provide a medical facility between them. This has to be done by taking into consideration both the population and distance factors to derive an optimum location.

In order to judge the adequacy of health care centres, it was decided to theoretically demarcate the areas served by these centres. The method adopted for this purpose has been the construction of proximal regions for obtaining Thiessen polygons (Taylor, 1977) for each of the primary health centres (Fig. 2) and primary health subcentres (Fig.. 3) Where the regional boundary was found to cut across a village, the centre of the village, as marked on the census map of 1981, has been considered for allocating the village to a region. The area and population for each village has then been calculated by adding the respective figures for the villages falling within a region. The service efficiency index was calculated by multiplying the population by area. The regions have then been categorised by grouping the indices by the standard deviation method, a lower index indicating a better situation.

Primary Health Centres: There were nine primary health centres (PHC) in Vadodara district in 1981. Out of the twelve talukas, Padra, Nasvadi, Vaghodia and Sankheda did not have any such centre. Chhota Udaipur had two, and the remaining talukas had one each. In the district as a whole a PHC catered to 178,618 persons on an average, which was much above the prescribed norm of 70,000. The only PHC which served a population smaller than the stipulated norm, was the one at Sinor. The population it covered was 58,354. The centre at Karjan and one at Chhota Udaipur served a population closer to the norm, in spite of being above it. All other centres served a very large number of persons, the PHC in Vadodara taluka covering at least 358,850 people (Table 2). It may be noted that in the context of the revised norms of 50,000, all the existing centres served a much larger population, and a considerable increase in the number of PHCs is an imperative.

The service efficiency indices worked out for the PHCs reveal a pattern which is in contrast to the overall picture of health care services studied at the taluka level. This is a clear indication of the need for detailed micro level studies for

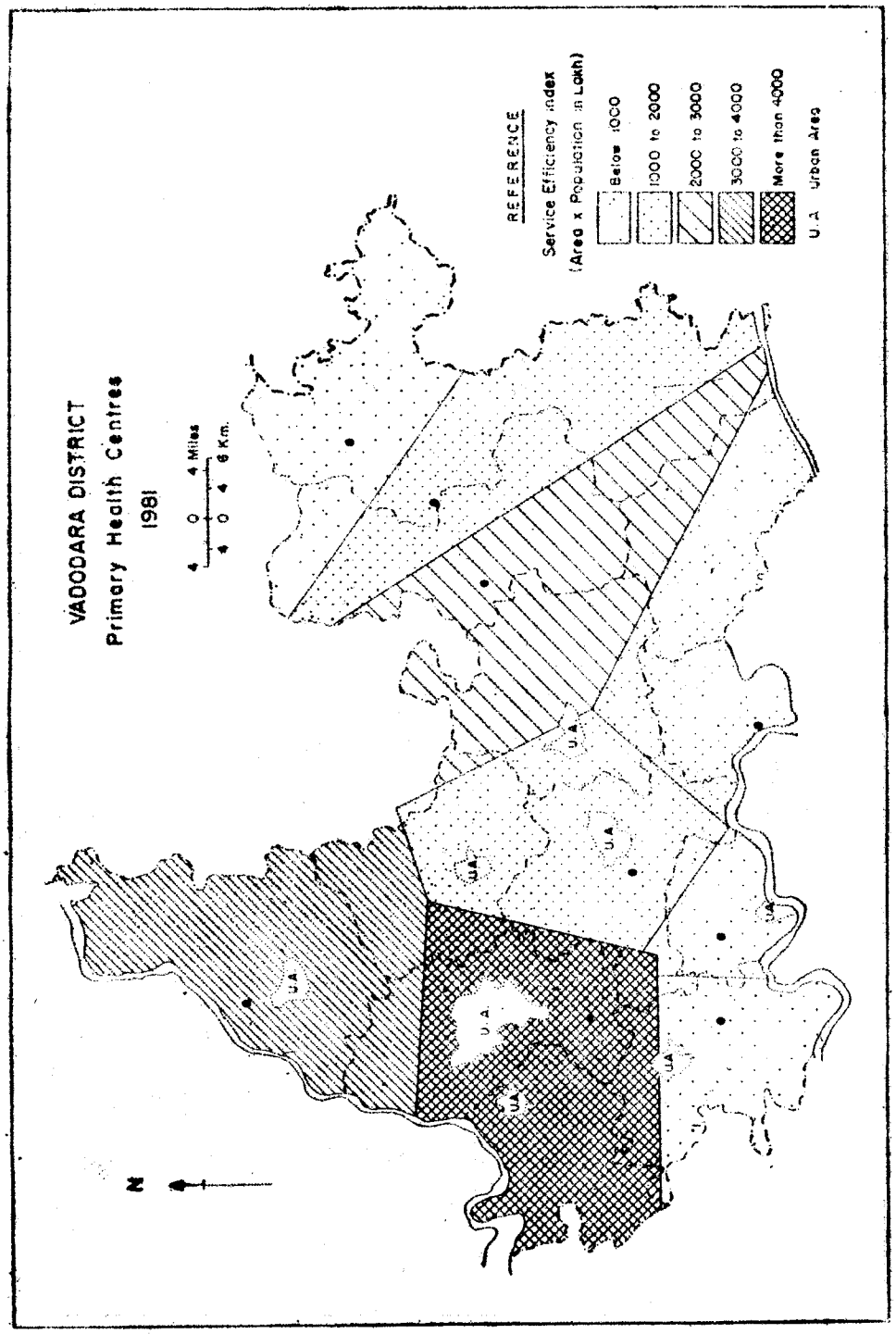
VADODARA DISTRICT
Primary Health Centres
1981
4 0 4 Miles
4 0 4 6 Km.
N
REFERENCE
Service Efficiency Index
(Area x Population in Lakh)
Below 1000
1000 to 2000
2000 to 3000
3000 to 4000
More than 4000
U.A Urban Area
U.A

Fig. 2

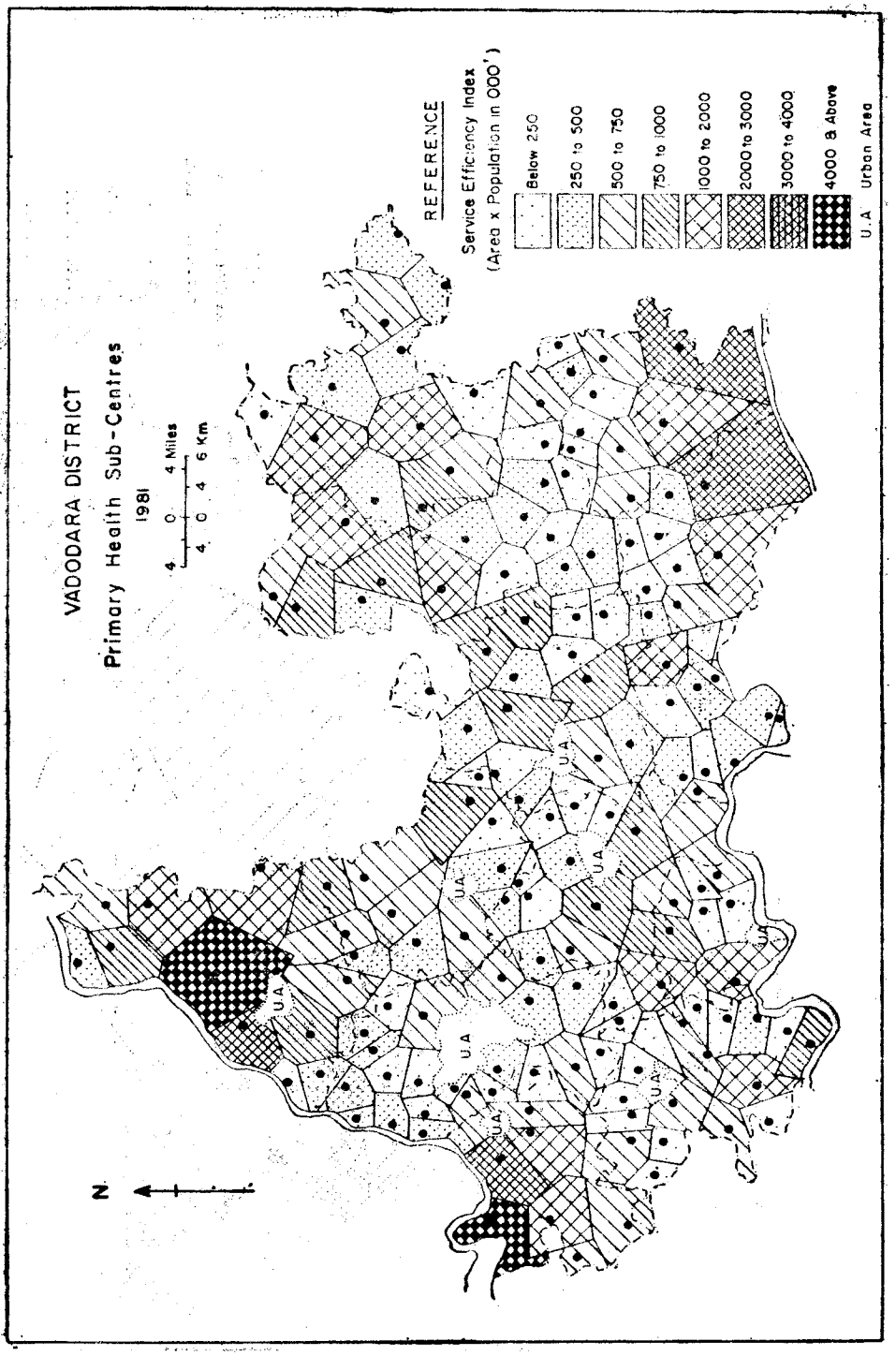
VADODARA DISTRICT
Primary Health Sub-Centres
1981
4 0 4 Miles
4 0 4 6 Km
REFERENCE
Service Efficiency Index
(Area x Population in 000')
Below 250
250 to 500
500 to 750
750 to 1000
1000 to 2000
2000 to 3000
3000 to 4000
4000 & Above
U.A Urban Area
N
U.A

Fig. 3

Table 2 : Areas Served by Primary Health Centres in Vadodara District.

Sr. No.	Centres with village code of taluka	Area in sq. km.	Population served	Service efficiency index (Area x Population in Lakhs)
1.	Savli 81	1136.95	305,101	3469
2.	Vadodara 90	1196.19	353,850	4233
3.	Karjan 43	450.67	97,083	438
4.	Sinor 21	264.35	58,354	154
5.	Dabhoi 67	890.49	159,451	1420
6.	Tilakwada 65	768.66	136,152	1047
7.	Jetpur Pavi 129	1179.66	223,250	2634
8.	Chhota Udaipur 34	683.46	97,612	668
9.	Chhota Udaipur 115	945.77	176,632	1671

individual services. The high indices at Vadodara and Savli talukas reveal the inadequacy of PHC services in these talukas. Their overall situation was, however, a favourable one, as described earlier. This anomaly may perhaps be due to the availability of other services such as hospitals, dispensaries, maternity homes, child welfare centres, registered practitioners and various other specialised medical care available in Vadodara and Savli.

Primary Health Subcentres:

There were 161 primary health subcentres (PHS) in the entire district. Therefore, statistically, the number of persons served by a centre is approximately 9985, which was within the prescribed norm of 10,000, although it was above the newly targeted norm of 5,000. However, when studying the regions served by individual health care centres, it has been found that nearly 65 percent of the PHS centres served a population which was much smaller than the norm, while the remaining 35 percent, located mostly in the talukas of Padra, Savli, Dabhoi, Nasvadi and Chhota Udaipur, catered to a much larger than the required number of persons. This anomaly probably arose out of the fact that in some places the PHS were very closely spaced, being located in contiguous villages; whereas, elsewhere, they may be very widely spaced. Hence, it appears, that while setting up the PHS, emphasis has been more on meeting the targets of numbers rather than an equitable spatial distribution. The result has been a haphazard distribution pattern with possibly a less effective utility.

For the purpose of regional health care planning, the distance factor should be taken into consideration because travel time and cost may prove a deterrent to the utilisation of facilities. This fact has not been taken care of in our planning programmes. In the present study, an attempt has been made to determine the average distance travelled within a region. This was obtained by drawing circles of 2, 4, 8, and 12 km. radii around each of the existing centres. The number of persons covered within a given radius was noted and the man-km for each distance range was calculated. For each centre, the man-km. indices were than added and the total was divided by the number of persons served by a centre to obtain the average travel distance involved within a service are. According to a study conducted by Vasanthkumaran and Jaypal (1981) through field investigations in the neighbourhood of Madras, 2 to 3 km. has been found to be the optimum travel distance for patients. Since the present study is confined to the rural areas, the optimum travel distance is being assumed here to extend upto 4 km. The results of the present analysis (Table 3) reveals that the percentage of centres where the average travel distance is less than 2 km., is insignificant. However, about 60 percent of the service areas have an average travel distance upto 4 km. It is only in the remaining 40 percent of the areas that the average travel distance exceeds the optimum.

Proposed Sites for New Primary Health Subcentres:

It is evident that a considerable number of PHS served larger than the required number of persons, and also covered extensive areas within which the travel distance to these centres exceeded desirable limits. A few new sites for PHS have therefore been suggested within the existing framework which would prove more effective in those areas which are at present less adequately served. Although the suggested pattern may not be an ideal one, since it has been framed without altering the location of the existing centres, nor changing the population norms it is definitely an improvement over the

Table 3 : Classification of service areas of primary health subcentres in Vadodara district according to average distance travelled within the region.

Average Distance Range in km.	Number of P H S			
	Existing situation		Proposed situation	
	Number	Percentage	Number	Percentage
Less than 2	3	2	5	3
2 to 4	93	58	108	61
4 to 6	56	35	55	31
6 to 8	9	5	10	5

prevailing situation (Table 3). It may also be noted, that the suggested pattern has again been based on the earlier norm of one PHS for 10,000 persons to judge how far the situation fell short of the then prevailing requirements.

The procedure adopted for siting additional centres in the district involves reducing the service efficiency index of those areas having very high indices. As already stated, the regions served by PHS have been grouped into five categories according to their service efficiency indices. Those regions coming within the highest categories were selected for further bifurcation. Where a PHC or a hospital existed in the higher category the regions were left undisturbed. On the basis of the number of persons served by a centre, the number of new centres required was determined keeping in view again the norms regarding coverage prevailing at that time. The linear distance of each of the villages of a region from the centre was measured from the map, and the population-linear distance index was obtained by multiplying population by distance. For each of the selected PHS, the villages were grouped according to this index by the standard deviation method. Villages falling within the highest category were considered for the location of new centres. Where more than the required number of villages were found in the highest category, the availability of transport facilities as well as population size as obtained from the census, were considered for selection of the new centres. Proximal regions were once again drawn incorporating the selected centres. Finally, 17 centres, which satisfied the prescribed norm in terms of coverage of population, were selected. Among these new centres, 8 are located in Padra, 5 in Savli, 2 in Dabhoi, and 2 in Chhota Udaipur talukas (Fig. 4).

The average area covered by a PHS in the prevailing situation was 46.68 sq. km. With the newly allocated centres, this would reduce to 42.23 sq. km. and the average population covered would change from 9985 to 9031 with the standard deviation declining from 5859 to 4159. The reduced area served by each of the PHS would inevitably help to cut down the travel distance within the region, and thereby increase the utility of the health care facility. Once again, the average travel distance within the new and reorganised service areas was derived.

Recent trends in health care planning :

As already noted, the norms for the setting up of a PHC and a PHS have already been revised. A number of PHS are now being provided, with greater facilities and upgraded to PHC as part of the new planning strategy. The individual centres such as those of family planing, child welfare etc. are now being integrated with the PHC and PHS and multipurpose centres are developing. However, investigations have revealed that most of these upgraded centres are yet to acquire the necessary infrastructure to perform their enhanced services. Besides, the allocation of the functional status of a centre is again being done on the basis of numbers, without taking cognizance of the distance factor.

Conclusions:

Primary health care centres (PHC) in Vadodara district were found to be hopelessly inadequate upto 1981. The number of PHS, however, satisfied the norms regarding the average number of persons

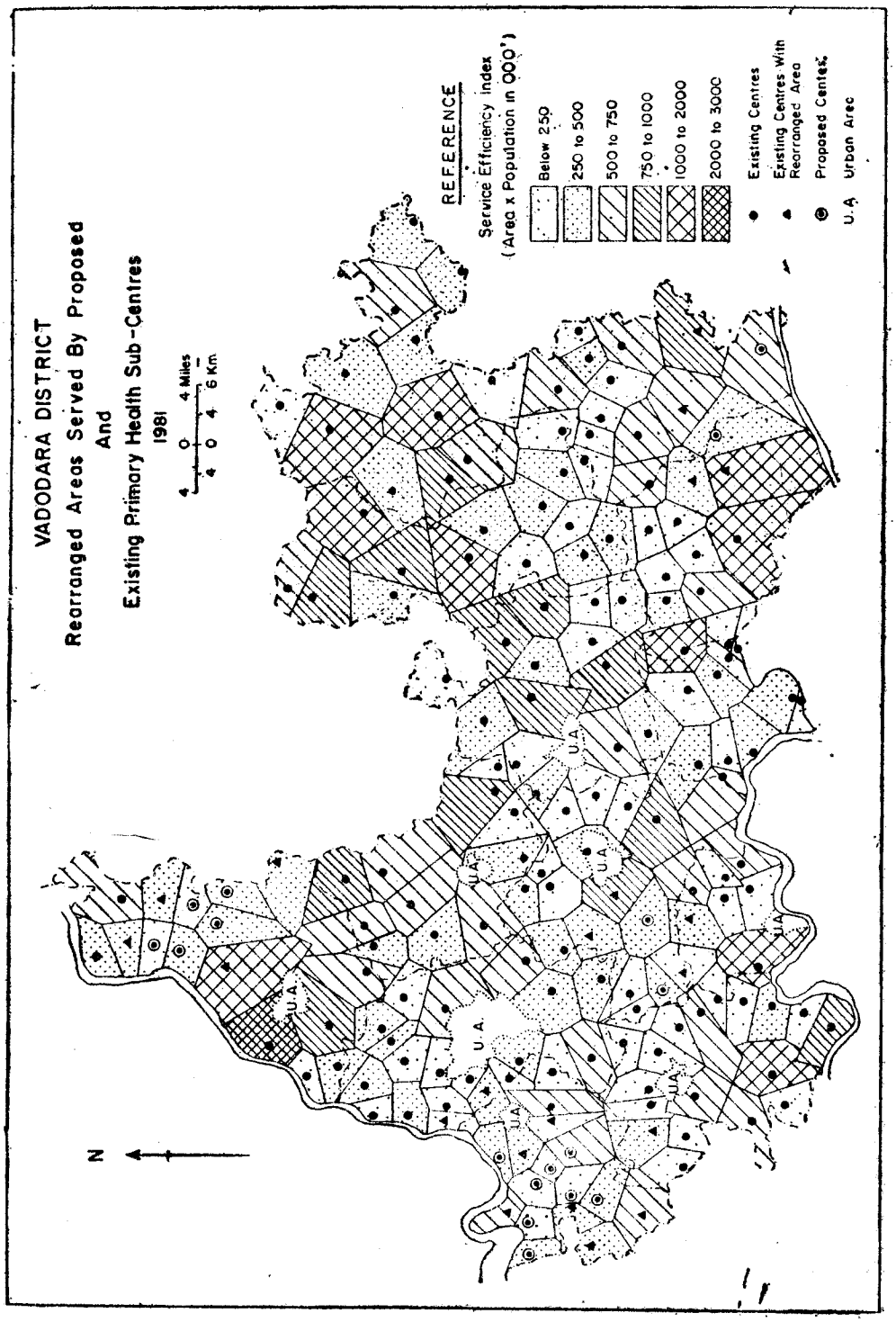
VADODARA DISTRICT
Rearranged Areas Served By Proposed
And
Existing Primary Health Sub-Centres
1981
4 Miles
0
4 0 4 6 Km
N
REFERENCE
Service Efficiency Index
(Area x Population in 000's)
Below 250
250 to 500
500 to 750
750 to 1000
1000 to 2000
2000 to 3000
Existing Centres
Existing Centres With Rearranged Area
Proposed Centers
U.A Urban Area
U.A

Fig. 4

served although there were considerable variations in the actual population served by individual centres. But, the distribution of these centres appears to have been unplanned and without any consideration of the spatial dimension of health care delivery system. Therefore, it is imperative that while setting up new PHCs and PHSs conforming to the revised norms, the factors of area covered by a centre and average distance travelled therein, be incorporated in the planning. While doing so, imbalances in the distribution of health care facilities can be evened out by a concerted plan of closing down some of the centres which serve minimal number of population, and by opening new centres in areas of scarcity. However, this exercise may not be feasible considering the political repercussion of closing down a centre in any area. Neverthless, if the suggested method is utilised for planning the location of health care centres in the future, the less viable existing centres may be relocated at more appropriate sites. However, it is necessary to assess the requirements of individual services in order to gauge the adequacy of the health care facilities. The application of the suggested method for a choice of centres of location of medical services may help to achieve a more balanced pattern in the distribution of at least the basic services.

In a vast country like India, where it is difficult to gather first hand information regarding accessibility and utilisation of health care facilities, the dependence on secondary sources of data is inevitable for any analysis. Health care planning on a regional basis can be effective when an analysis of the existing conditions of utilisation and access are available. The present line of study can readily be applied to all districts of the country and could thus provide the basic framework for preparing policies and programmes for health care planning on a regional basis

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