Chapter-6

Technical Efficiencies of Health Care System in Major States of India

6.1 Introduction:

Healthcare delivery systems have been on demand to enhance performance. It requires both controlling healthcare costs as well as guaranteeing improved outcomes. Twenty years ago, research rarely attempted to estimate the amount and sources of inefficiency for poor performances in healthcare system. Today, that has changed. Several productive efficiency studies have been conducted in countries such as Austria, Finland, Netherlands, Norway, Spain, Sweden, United Kingdom and the United States. These studies have shown a flourishing technical inefficiency in these systems. For example, Roberts *et al.* (2004) have compared the health outcomes of Organisation for Economic Cooperation and Development (OECD) countries and found that more resource allocation is not necessary for better healthcare outcome. This study suggests that some of the countries can substantially reduce its inputs to maintain its present level of health outcomes.

Health sector, in India, is a dispersed responsibility of the central, state governments and local bodies. But in terms of service delivery, the responsibility lies with state governments. The central government is responsible for health services in Union Territories as also for developing and monitoring national standards and regulations. It is also responsible for linking the states with funding agencies and sponsoring numerous schemes to be implemented by state governments. Finally, both the central and state governments have a joint responsibility for programs listed under the Concurrent List. About three-fourth of the expenditure on public health is incurred by state or local governments and the remaining one-fourth by the central government. Hence, it is necessary to estimate efficiency of each state, which would help in identifying the sources of inefficiency of poorly performing states.

Studies on productive efficiency of healthcare system using non-parametric techniques did not attract research in India. Sodani and Madnani (2008) point out the requirements of specialised evaluation technique such as non-parametric technique of DEA to assess the performance of organizations providing health services. They have shown that DEA is a powerful methodology for evaluating performance of health service providers. The primary goal of a health system should be to provide better health in a responsive manner. The outcomes of the health system of a state are reflected by various health indicators. The World Health Organisation (WHO) highlighted the significance of measuring the health system performance in its WHO

Report (2000). Infant mortality rate (IMR) and life expectancy at birth (LEB) are the two important indicators of the health status in any health system. These two indicators have registered considerable improvement over a period of time in India. IMR has decreased from 129 per thousand live births in 1971 to 58 in 2005. LEB has improved from 49.7 years in 1970 to 63.1 years in 2005 at the national level. In spite of these improvements, there is a significant disparity in IMR and LEB across states. For example, in Kerala, a person at birth is expected to live for over 74 years (71.3 for males and 76.3 for females). On the other hand, LEB in Madhya Pradesh is 57.5 (57.2 for male and 57.8 for female). Kerala registered the lowest IMR of 11 per 1000 live births as against highest recorded 83 per 1000 in Orissa. Disparity in the health outcomes among states hinders the progress of the country as a whole. India spent about 6.1 percent of GDP on healthcare in the year 2001-02 (MoH & FW (2005)). This is equivalent to Rs. 997 per capita health expenditure (PCHE). Some of our neighbouring countries, such as China, Sri Lanka, Indonesia, Thailand, and Malaysia are spending 3.2 to 5.8 percent of their GDP. But the health outcomes of these countries measured in terms of IMR and LEB are much better compared to India. In spite of being a high health spending economy, the progress with respect to various health outcomes in India has been sluggish. This is because of disparities in health outcomes among states. This disparity in health outcomes among different states has been persistent for a long time and this gap is not reduced over the years. In our study, we seek to investigate the issue of efficient use of the available resources to maximise output. We also suggest efficient methods of utilisation of resources.

India has set a target to reduce its IMR to 28 by the year 2015 as one of its Millennium Development Goals (MDG) as reported in the MOSPI (2007). Our analysis shows targets for improvement for poor performing health outcomes in comparison with other states to achieve the MDG. The main intention of this chapter is how efficiently different states utilise their resources to achieve health outcomes in the contexts of their socio-economic status. Most of the research work in the area of healthcare efficiency has aimed at measuring organisational level efficiency like health districts, hospitals, nursing homes, primary healthcare etc. Our study offers some guidelines to inefficient states to improve the health outcomes and for optimal utilization of resources. In this study, we consider healthcare system of various states and identify states having higher healthcare efficiency based on outputs IMR and LEB which are the real indicators of health status for given level of inputs. It also shows how inefficient states can efficiently use resources to improve healthcare outcomes. This chapter examines the technical efficiency in healthcare system by comparing health outputs achieved by using the input resources in the major states of India using ADDM of DEA formulation discussed in Chapter-2. Technical efficiency is measured when outputs are maximised and inputs are minimised simultaneously. Applying ADDM of DEA formulation to the health data of major states of India, we study the performance in the health system of different states. The findings of the study could be utilized to make policy implications for resource allocation and fixing the targets for healthcare outcomes with reference to socio-economic status of different states. ADDM of DEA formulation is applied by considering the effect of uncontrollable social environmental inputs on health outputs. The study indicates the resource requirements of states for bringing down infant mortality rate and upgrading life expectancy at birth. The work discussed in this chapter has been accepted for publication (see Shetty and Pakkala (2010b)).

6.2 Application of DEA in healthcare performance:

The application of DEA in health system was initiated by Nunamaker (1983), but the use of DEA in healthcare research gained popularity in 1990. Hollingsworth *et al.* (1999) reviewed 91 studies of DEA applications on healthcare. These studies were carried on measured efficiency of health districts, hospitals, nursing homes, primary healthcare, etc. More recently, Mirmirani *et al.* (2008) applied DEA technique for measuring healthcare efficiencies of translation economies country. In their study, output variables were the average (male and female) LEB and IMR. Inputs were per capita health expenditure, number of inpatient hospital beds/1000 population, number of physicians/1000 population and number of immunization. Bhat *et al.* (2001) conducted the study by analysing the hospital efficiency of district level government and grant-in-aid hospitals in Gujarat, comparing their relative efficiency using DEA approach. It is found that efficiency variations are more significant within government district hospitals than within grant-in-aid hospitals. The overall efficiency levels in the grant-in-aid institutions are relatively more than the government district hospitals. In another study carried out by Dash *et al.* (2007), DEA was applied to determine the efficiency of a set of district hospitals in Tamilnadu. Trends and patterns of public expenditure on health between 1995 and 2006 in India both at the national and state levels were studied by Guruswamy *et al.* (2008). They found that public expenditure on health as a proportion of GDP has remained stagnant over the years.

Roberts *et al.* (2004) have analysed technical efficiency in the production of health outcomes based on IMR and LEB using OECD health data. They selected IMR and LEB as the health status outputs, beds per1000 population, magnetic resonance imager (MRI) units per million population, physicians per 1000 population, expenditure as the controllable inputs and school expectancy, Gini coefficient of income distribution and percentage tobacco consumers as the socio-environment inputs. They solved for an input oriented model and a separate output oriented model for each of the two outputs. They modified the output oriented model for IMR by changing the objective function to minimisation instead of maximising the outputs and reversing the inequality in constraints. Kathuria and Sankar (2005) have studied the efficiency of rural public health in major states of India using stochastic production frontier (SPF) techniques for panel data for the period 1986-97. They considered IMR as the only one output and inputs as numbers of primary health centres, number of doctors, number of paramedical staff and hospital beds. These inputs were standardised to total rural population. They have taken fifth input variable as the percentage of institutional deliveries to the total deliveries. Estimation of efficiency was undertaken in two stages. In the first stage, they generate state-wise efficiency index by applying SPF techniques. In the second stage these efficiencies are compared with the most efficient state to find out the relative efficiency of the states. Poor health outcome state Bihar came at the top in the ladder of efficiency measurement.

Among the various methods of efficiency assessment like stochastic frontier, fixed effects, regression models and simple ratios of health outcomes, non-parametric approach DEA has gained more importance (see Cooper *et al.* 2004). Most of the studies on Indian healthcare have focused on the relative performance of hospital efficiencies and healthcare expenditures. However, less attention has been given to the issue of how operational efficiency of individual states is producing their healthcare outputs. So far, no study has been carried out considering IMR as negative outputs and/or simultaneous consideration of health outcome indicators as outputs. In this chapter, we analyse the healthcare system of major states by applying the ADDM. It finds the efficiency using inputs as PCHE, health centre per million populations

(HCPMP), literacy rate (LR), and percentage of population below poverty line (BPL). Average life expectancy at birth of men and women (LEB) and IMR are the outputs.

6.3 Methodology:

While measuring efficiency in healthcare system through DEA an output such as IMR is undesirable. A state may expect to yield a lower level of its outputs when its input level is increased. In such situations, to measure the efficiency, it is required to minimise desirable inputs as well as undesirable outputs and maximise the desirable outputs and undesirable inputs. Lower level of BPL results in better housing, nutrition and access to healthcare of the states and is taken as negative input in our study. Traditionally, negative data were handled in efficiency applications through some data transformation by adding an arbitrary large number to all values of a given variable to make the negative data positive. Seiford and Zhu (2002) have shown that transformation of the data has impacts on the solution, classification and ranking of the DEA results. Cooper *et al.* (1999), pointed out that need for separately treating input-oriented and output-oriented approaches to efficient measurement is eliminated because additive models affect their evaluations by maximising distance from the efficient frontier and thereby simultaneously maximising outputs and minimising inputs. To overcome these lacunae, we apply the ADDM of DEA formulation to measure the efficiency of healthcare system of different states.

ADDM of DEA formulation is modified to incorporate uncontrollable variables. The objective of this model is to maximise the average inefficiencies of all the variables (both input and output variables). ADDM of DEA formulation allows individual output to increase or input to decrease at different rates. It monotonically decreases for any increase in outputs and/or reduction in inputs or increases monotonically for decrease in outputs and or increase in inputs. This model is translation and unit invariant. By giving equal weights for all the input and output variable, measure of inefficiency is obtained in this model.

Assume that we have a set of 'n' DMUs with '$m+k$' inputs of them 'm' are controllable input variables and 'k' of them are uncontrollable inputs and 's' outputs. Let $(x_j,y_j)= (x_{1j},x_{2j},\ldots,x_{(m+k)j}\ ,\ y_{1j},y_{2j},\ldots,y_{sj}), j=1,2,\ldots,n$. The Pareto-Koopmans technical efficiency of a given DMU_o can be obtained by the ADDM of DEA formulation is as shown below

$$
\left.\begin{aligned}
& I_e(x_o, y_o) = Max \tfrac{1}{m+s}\left(\sum_{r=1}^{s} \beta_{ro}^{+} + \sum_{i=1}^{m} \beta_{io}^{-}\right) \\
\textit{subject to} \quad & \sum_{j=1}^{n} \lambda_j y_{rj} - \beta_{ro}^{+} R_{ro}^{+} \geq y_{ro} \\
& \sum_{j=1}^{n} \lambda_j x_{ij} + \beta_{io}^{-} R_{io}^{-} \leq x_{io} \\
& \sum_{j=1}^{n} \lambda_j x_{tj} \leq x_{to}; t = 1,2,\cdots,k \\
& \sum_{j=1}^{n} \lambda_j = 1, \quad \lambda_j \geq 0, \quad j = 1,2,\cdots,n \\
& \beta_{io}^{-} \text{ and } \beta_{ro}^{+} \text{ unrestricted} \\
& r = 1,2,\cdots,s;\ i = 1,2,\cdots,m
\end{aligned}\right\} \quad \langle \text{M } 6.1 \rangle
$$

Where $R_{io}^{-} = x_{io} - Min\{x_{ij}\}$, $R_{ro}^{+} = Max\{y_{rj}\} - y_{ro}$. In the above model Pareto-Koopmans efficient input-output projection of DMU_0 is

$$x_{io}^{*} = x_{io} - \beta_{io}^{-} R_{io}^{-} = \sum_{j=1}^{n} \lambda_j^{*} x_{ij} \leq x_{io} \quad \text{for } i = 1,2,\cdots,m$$

$$x_{to}^{*} = x_{to} \quad \text{for } t = 1,2,\cdots,k$$

$$y_{ro}^{*} = y_{ro} + \beta_{ro}^{+} R_{ro}^{+} = \sum_{j=1}^{n} \lambda_j^{*} y_{ij} \geq y_{ro} \quad \text{for } r = 1,2,\cdots,s$$

A DMU_0 is Pareto-Koopmans efficient if and only if $\beta_{ro}^{+} = 0$ for each output 'r' and $\beta_{io}^{-} = 0$ for each input 'i' implies $I_e(x_o, y_o) = 0$

The main drawback of this method as in the case of basic formulation of DEA is that substantial number of DMUs comes out to be efficient, particularly when the number of DMUs is less compared to number of inputs and outputs.

In order to discriminate the efficient DMUs, a new model based on Gholam Reza Jahanshaloo *et al.* (2007) is developed, such that a DMU that is efficient by ADDM model is denoted by set E and inefficient DMUs belongs to set N. Applying the re-evaluated inefficiency models as defined in the model $\langle$M 6.2$\rangle$), the original frontier will change if DMU_b belongs to *E* and the new frontier (without DMU_b) gets closer to the inefficient DMUs. Inefficiency may decrease for some of the DMUs or some of the inefficient DMUs may become efficient. When the efficient DMU is excluded from the reference set, all other inefficient DMUs may get closer to the efficient frontier or it may remain same. Inefficiency of all other inefficient DMUs may decrease or remain same as in the model $\langle \text{M } 6.1 \rangle$. The DMUs that influence most on the inefficiency of the other DMUs should be the most efficient DMU. The model to discriminate the efficient DMUs by re-evaluated inefficiency of each inefficient DMU through ADDM of DEA formulation is

$$
\left.
\begin{array}{ll}
 & I_{a,b}^{R} = Max \frac{1}{m+s}\left(\sum_{r=1}^{s} \beta_{ra}^{+} + \sum_{i=1}^{m} \beta_{ia}^{-} \right) \\
subject\ to & \sum_{\substack{j=1 \\ j\neq b}}^{n} \lambda_j y_{rj} - \beta_{ra}^{+} R_{ra}^{+} \leq y_{ra};\ r = 1,2,\cdots,s \\
 & \sum_{\substack{j=1 \\ j\neq b}}^{n} \lambda_j x_{ij} + \beta_{ia}^{-} R_{ia}^{-} \leq x_{ia};\ i = 1,2,\cdots,m \\
 & \sum_{\substack{j=1 \\ j\neq b}}^{n} \lambda_j x_{tj} \leq x_{ta};\ t = 1,2,\cdots,k \\
 & \sum_{\substack{j=1 \\ j\neq b}}^{n} \lambda_j = 1;\ \lambda_j \geq 0,\ j = 1,2,\cdots,n \\
 & \beta_{ia}^{-} \text{ and } \beta_{ra}^{+} \text{ unrestricted}
\end{array}
\right\} \quad \langle M\ 6.2 \rangle
$$

After calculating the re-evaluated inefficiency measure, $I_{a,b}^{R}$ for all inefficient DMUs by excluding efficient DMU_b from the reference set is denoted by

$$
IN_b = \frac{\sum_{a\in N} I_{a,b}^{R}}{\tilde{n}} \qquad (E\ 6.1)
$$

Where, IN_b is the average inefficiency of all inefficient DMUs when efficient DMU_b is excluded from the reference set for efficient DMU_b and $\tilde{n}$ is the number of inefficient DMUs. Then we rank the efficient states based on the score of average re-evaluated inefficiency.

6.4 Data and variables:

In order to measure the efficiency of health systems using ADDM of DEA formulation, two types of variables are essential. First, we need to identify appropriate outcome indicators that represent the output of the health system. Second, it is essential to measure health system resources or inputs that contribute to producing outputs. We have taken two outcomes which represent the health status of the system as a whole. They are three indicators on the health outcome published by the UN

(2003). Health status or output improvement is denoted by decline in infant mortality rate and increase in life expectancy. We compared the efficiency of major states of India. Union Territories and smaller states do not have adequate data pertaining to LEB and therefore these are eliminated from this study. Input variables include resources utilised namely PCHE, HCPMP. Socio-economic characteristics of states such as BPL and LR are also considered for the study. Data considered for this study is shown in the Table-6.1. Higher LR and lower BPL result in better housing, nutrition and access to healthcare and they are found to be most significant factors determining health outcome. As discussed in the Section-6.3, BPL and IMR are undesirable input and output variables respectively. Public and private expenditure on health in states are taken as input variable for the year 2001-02 because of availability of desired input for that year. Private expenditure on health data and LEB are not

Sl. No.	State	Input variables				Output variables	
		Per Capita Health Expenditure (PCHE)	Health Centres Per Million Population (HCPMP)	Percentage of Population Below Poverty Line (BPL)	Literacy Rate (LR)	Infant Mortality Rate (IMR)	Life Expectancy at Birth (LEB)
1	2	3	4	5	6	7	8
1	Andhra Pradesh	1040	187.1	15.77	61.11	59	63.95
2	Assam	569	218.27	36.09	64.28	67	58.65
3	Bihar	779	128.19	42.6	47.53	60	61.05
4	Chhattisgarh	854	255.78	37.43	65.18	70	57.65
5	Gujarat	817	170.12	14.07	69.97	57	63.9
6	Haryana	1571	138.6	8.74	68.57	59	65.8
7	Himachal Pradesh	1305	425.16	7.63	77.13	49	66.7
8	Jharkhand	833	166.62	42.6	54.13	51	61.05
9	Karnataka	712	190.65	20.04	67.04	52	65.15
10	Kerala	1858	191.9	12.72	90.92	11	73.8
11	Madhya Pradesh	865	169.89	37.43	64.11	82	57.65
12	Maharashtra	1011	130.68	25.02	77.27	42	66.95
13	Orissa	583	202.09	47.15	63.61	83	59.2
14	Punjab	1531	142.36	6.16	69.65	49	69.1
15	Rajastan	597	220.28	15.28	61.03	75	61.7
16	Tamilnadu	846	161.83	21.12	73.47	43	65.95
17	Uttar Pradesh	1124	146.19	31.15	57.36	76	59.7
18	Uttarkhand	1218	240.71	31.15	72.28	41	59.7
19	West Bangal	774	144.97	27.02	69.22	46	64.7

Table-6.1: State wise healthcare inputs and outputs for the major states in India.

available separately for the three newly created states of Chhattisgarh, Jharkhand and Uttarkhand. We substitute the value for these variables from their respective erstwhile states Madhya Pradesh, Bihar and Uttarpradesh. Infant mortality rate refers to the number of deaths per thousand live births in the first year of child's life. Life expectancy at birth of an individual at any age is the number of years the person is expected to live given the prevailing age specific rates of population. It is a general measure of mortality that captures prevailing mortality rates of population at different age groups.

Socio-economic factors of the state can change over a period of time and therefore, they are beyond the short term discretionary control of the policy makers and it is not possible to change these inputs. However, these exogenously fixed input variables are included in the analysis because they affect health outcomes. Also, it is not possible to reduce the input variable like HCPMP. Hence this study considers socio-economic input variables like BPL, LR and HCPMP as uncontrollable variables.

6.5 Results and Discussions:

In order to measure the relative efficiency of healthcare systems of different states, ADDM of DEA formulation of model $\langle \text{M } 6.1 \rangle$ is applied and it is run individually for each of the states. A program has been developed to find the efficiency scores for all the DMUs based on CRS or VRS model using the *MATLAB 7.7* and is given in the Appendix, Program-7.

Results show that 11 out of 19 states are on the efficient frontier. Further, to discriminate, the efficient DMUs model $\langle \text{M } 6.2 \rangle$ is applied and based on these results, efficient states are ranked. The order of ranking of efficient states is as follows: Kerala, West Bengal, Bihar, Karnataka, Maharashtra, Jharkhand, Tamilnadu, Rajasthan, Assam, Punjab and Orissa from highest to the lowest. Remaining inefficient DMUs are also ranked according to their efficiency score obtained from the model $\langle \text{M } 6.1 \rangle$. State wise efficiency score is shown in Figure-6.1. The efficiency scores of the different states, inefficiency scores of individual input and output variables and reference DMUs for the inefficient DMUs are given in Table-6.2. A state with efficiency score one suggests that the state is efficient and is on the efficient frontier. An efficiency score of less than one suggests that the state is inefficient and lies below the frontier. In Table-6.2, third and fourth columns show the overall efficiency and inefficiency score respectively from the model $\langle M\ 6.1\rangle$ for each state. Next three columns show the inefficiency of individual output and input variables. For example, inefficiency score of Andhra Pradesh for IMR is 0.0957, LEB is 0 and PCHE is 0.6293. Its reference states are Bihar, Karnataka and Punjab as given in the column-8. The set of efficient states consists of good health outcomes states such as Kerala / Punjab, moderate health outcome states namely Karnataka / Maharashtra / Tamilnadu / West Bengal and poor health outcome states like Assam / Bihar / Jharkand / Orissa / Rajasthan.

Sl. No.	STATE	Efficiency	Inefficiency	Inefficiency			Reference States	Ranks
				IMR	LEB	PCHE		
1	2	3	4	5	6	7	8	9
1	Andhra Pradesh	0.7583	0.2417	0.0957	0	0.6293	3,9,14	14
2	Assam	1	0	0	0	0		9
3	Bihar	1	0	0	0	0		3
4	Chhattisgarh	0.6406	0.3594	0.018	0.066	0.994	2,13	17
5	Gujarat	0.8053	0.1947	0.1673	0.1058	0.311	9,19	12
6	Haryana	0.7213	0.2787	0.3115	0	0.5245	3,10,12,19	16
7	Himachal Pradesh	0.7263	0.2737	0.3769	0.2965	0.1478	9,10	15
8	Jharkhand	1	0	0	0	0		6
9	Karnataka	1	0	0	0	0		4
10	Kerala	1	0	0	0	0		1
11	Madhya Pradesh	0.6289	0.3711	0.2588	0.2525	0.602	2,3,13,19	18
12	Maharashtra	1	0	0	0	0		5
13	Orissa	1	0	0	0	0		11
14	Punjab	1	0	0	0	0		10
15	Rajastan	1	0	0	0	0		8
16	Tamilnadu	1	0	0	0	0		7
17	Uttar Pradesh	0.5985	0.4015	0.3283	0.2258	0.6504	3,9,19	19
18	Uttarkhand	0.778	0.222	0	0.3708	0.2953	8,10,19	13
19	West Bangal	1	0	0	0	0		2

Table-6.2: Technical efficiency, inefficiency scores and ranks among the states.

It is possible for states having poor health outcomes to be on the frontier due to their low PCHE, low HCPMP, low LR and high BPL. It is also found that Bihar was ranked fourth in the study of Kathuria and Sankar (2005) using SPF techniques for panel data for the period 1986-97. However, it is important to note that Bihar comes in third position in spite of poor health outcomes, this is because Bihar consume lowest inputs i.e HCPMP and LR, and BPL is the second lowest input. Orissa is utilising one lowest input (BPL) another second lowest input (PCHE) and

Assam is using one lowest input (PCHE) compared to other states considered in the analysis. These states could have produced good health outcomes if they were provided with good health inputs and socio-economic variables. In other words, if they are provided with more inputs, these states can be expected to have good health outcomes relative to the other states in the data set. DEA formulation of technical efficiency measurements depend heavily on input and output data, the results should be viewed bearing in mind the fact that states differ in their health system inputs, health outcomes and socio-economic status.

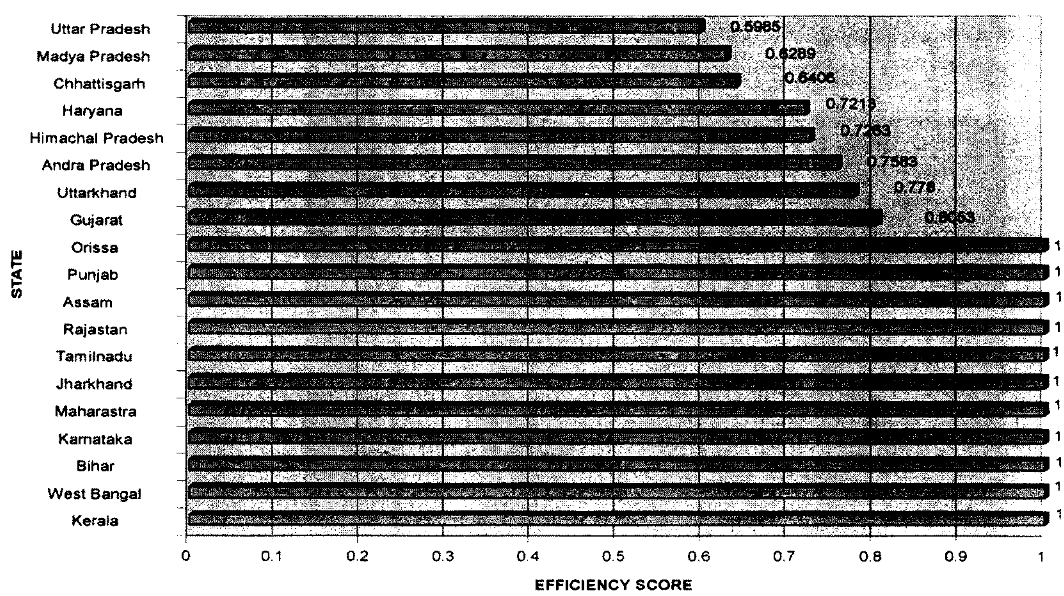

Figure-6.1: Technical efficiency score of healthcare system of major states in India.

The analysis shows that inefficient states include relatively both good health outcomes such as Himachal Pradesh and poor health outcomes such as Uttar Pradesh. It is evident from the studies that current level of health outcomes of the state is not indicative of how it is efficiently utilising its resources to maximise its outcomes. Potential target for different inefficient states and percentage of improvement are given in Table-6.3. For example, the inefficient state Andhra Pradesh should reduce its IMR to 54 (7.74 percent) and PCHE on health to 743.60 (28.50 percent) keeping LEB at the same level to achieve the status of efficiency as shown in Table-6.3. Potential target for inefficient states show achievable target for them if they could work efficiently. If all the states are on the efficient frontier, then it is possible to reduce 6.73 percent of IMR, increase LEB by 1.46 percent with the reduction in 9.54

percent of PCHE among the major states of India keeping the same level of socio-economic condition. Surplus PCHE could be redistributed to poor health outcomes states like Orissa, Bihar, Jharkhand to enhance their health outcomes.

Sl.No.	STATE	Potential target			Percentage of improvements		
		IMR	LEB	PCHE	IMR	LEB	PCHE
1	2	3	4	5	6	7	8
1	Andhra Pradesh	54.41	63.95	743.6	7.79	0	28.5
2	Assam	67	58.65	569	0	0	0
3	Bihar	60	61.05	779	0	0	0
4	Chhattisgarh	68.94	58.72	570.7	1.52	1.85	33.17
5	Gujarat	49.3	64.95	739.9	13.5	1.64	9.44
6	Haryana	44.05	65.8	1045.4	25.34	0	33.46
7	Himachal Pradesh	34.68	68.81	1196.2	29.23	3.16	8.34
8	Jharkhand	51	61.05	833	0	0	0
9	Karnataka	52	65.15	712	0	0	0
10	Kerala	11	73.8	1858	0	0	0
11	Madhya Pradesh	63.63	61.73	686.8	22.41	7.07	20.6
12	Maharashtra	42	66.95	1011	0	0	0
13	Orissa	83	59.2	583	0	0	0
14	Punjab	49	69.1	1531	0	0	0
15	Rajastan	75	61.7	597	0	0	0
16	Tamilnadu	43	65.95	846	0	0	0
17	Uttar Pradesh	54.66	62.88	763	28.08	5.33	32.12
18	Uttarkhand	41	64.93	1026.4	0	8.76	15.73
19	West Bangal	46	64.7	774	0	0	0
Average					**6.73**	**1.46**	**9.54**

Table-6.3: Goal for inefficient states and percentage of improvement.

The inefficient states Andhra Pradesh and Haryana are efficient in their output LEB, inefficient in their input and output IMR. Jharkhand is efficient for IMR and inefficient for other two variables using the model $\langle M\ 6.1 \rangle$. In our study, Kerala, West Bengal, Bihar, Karnataka, Maharashtra are the top five states and Uttar Pradesh, Madhya Pradesh, Chhattisgarh, Haryana and Himachal Pradesh are the last five states in the operational efficiency of health outcomes as shown in Figure-6.1

6.6 Conclusions:

The studies show that present level of health outcomes of states is not necessarily indicative of how efficiently the states utilise their resources to maximise their outcomes. Some of the states are utilising more resources, than those of their efficient counterparts. These resources can be reallocated to those states that are efficient but poor in their health outcomes, in order to improve the health outcome of the nation as a whole. Since resources are limited, the policies of the government need to change in allocating the resources to the states to improve the health outcomes. This study identifies states with health indicators with 'best practices'. More efficient use of resources can also contribute to a better delivery of healthcare in a system. Our results also provide useful information on potential improvement in their outputs for inefficient states. This information can be used to prioritise the efforts of inefficient states to achieve efficiency. Improvements in outcomes of healthcare system can be achieved in a planned manner. For poorly performing states in health outcomes it should help to work in efficient ways. This will also help to increase the resources to improve the health outcomes on par with states having good health outcomes.

Considering India's limited resources and increasing population, there is an urgent need to use these resources efficiently. Reducing waste and inefficiency is one of the ways of improving health outcomes. The study of relative efficiency of different states in the health system suggests ways to improve heath outcomes for the nation. The first step is to enhance the efficiency of inefficient states i.e. bring them on par with efficient states. The second step is to create better health infrastructure and raise the socio economic status of the people having poor health indicators. This results in increased awareness which in turn increases access to healthcare. It also ensures use of the upgraded infrastructure in the most efficient way.

Limitation of this study is that since data for only major states are forthcoming, they tend to give illusion of being efficient. This could be addressed by the taking all the states and Union Territories for analysis. Data constraints particularly related to the output variable LEB have prevented us from studying the efficiency of all the states and Union Territories. Since LEB is computed quinquennially for major states, it forced us to consider only few states for the analysis. Moreover, it is also incorrect to conclude that efficient states have achieved the maximum possible results in their health outcomes. It can be improved further, which will improve the health outcomes of the nation as a whole. In future, more detailed studies could be done, documenting their operating practices to establish as guide to best practice for inefficient states. Efficiency changes over a period of time by change in inputs and outputs can be studied with modification in Malmquist productivity index by building panel data. This study urges to compute health indicators for smaller states and Union Territories so as to monitor and reach the MDG of health outcomes.