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Evaluating the Efficiency and Determinants of Efficiency of Rural Health Centers Situated in Punjab, Pakistan

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Abstract

This study calculates the efficiency of Rural Health Centers (RHCs) and investigates the impact of other variables affecting the efficiency of RHCs. The study considers 29 RHCs, 13 of District Faisalabad, 9 of Toba and 7 of Jhang; a survey was conducted to collect data from each RHC for the year 2016. Data Envelopment Analysis (DEA) model was utilized to get the scores for efficiency. Thereafter, after getting the results from DEA Tobit regression was used in the second stage. Out of the 29 Rural Health Centers, only 11 (38%) are working efficiently as compare to others. Distance from the tehsil headquarter, Distance from the road with "0" probability, Distance from private hospital with "0" probability, Behavior of the staff with "0.0064" probability and laboratory equipment's with "0" probability, have an impact on the efficiency scores. Distance from other health facilitators, Staff's behavior, list of medicine and equipment's used at RHCs should be improved to increase the efficiency of RHC's.

1. Introduction

There is a consensus on the importance of health care all over the globe because the healthy population plays a very important role in growing and in the development of an economy [1]. To earn a long lasting return as a prosperity investment in the health sector is very important as a healthy labor force will increase

the productivity, that is why in recent decades' expenditures on health care are grown in most developed and developing countries [2]. The Governments of most of the developing countries are trying to improve the health care facilities; as it will contribute to improve human welfare, life and their increasing participation in economic growth [3] [4]. To improve human welfare, the Governments should increase the share of the health sector in the annual budget [5].

Pakistan is the 6th most populous country in the world with an estimated population of 200.71 million. To get maximum output from that population health of manpower is very important. Like all other sectors, Pakistan has both private and public sectors in the system of health care. The private health sector has developed over time and has spread across the country. While Pakistan's public health sector was devolved to the provinces. To produce active and productive human capital Governments are trying to improve health sector. Pakistan joined the World Health Organization (WHO) ever since its establishment and launched different programs like; Malaria Control Programs, an Expanded Program of Immunization (EPI), family planning program, etc. as per WHO's guidelines [6].

According to the Economic Survey of Pakistan (2016-2017), the public health activities have insistently increased in terms of infrastructure, workforce. The number of doctors, dentist, nurses and LHVs has increased and the availability of doctor, dentist, nurse and one hospital bed versus population has also been improved. Today, the doctor population ratio is 1:997, dentist 1:10,658 and hospital bed 1:1584. While public health infrastructure includes of 1201 hospitals, Basic Health Units 5518, Rural Health Centers 683, 5802 Dispensaries, 731 Maternity & Child Health Centers, 347 TB centers, and the total availability of beds in these health facilities are 123,394. Even though with an extensive health infrastructure, the delivery of health care facilities suffers from some key issues like the very high population growth, uneven distribution of health professionals, poor workforce, insufficient funding and limited access to quality health care services [7].

Rural Health Centers are making health services available very close to people. The main motive of Rural Health Centers is to provide health care facility like medicine and treatment in the rural areas, awareness of basic health education related to antenatal care for women and basic health facilities for child immunization and to launch programs to control various viral diseases like Tuberculosis, Polio, etc. Different hurdles have been observed in the way of attaining better health in Pakistan like Political instability, poverty and hunger, poor public policies and lack of knowledge about health care [8].

Pakistan has a very vast infrastructure of health facilities and the coverage of health facilities in Pakistan have also been improved over the years. The present network of health services consists of a framework of 1201 Hospitals, 5518 Basic Health Units (BHUs), 683 Rural Health Centers (RHCs), 5802 Dispensaries, 733 mother and child health centers and availability of 1,23,396 beds in hospitals,

1,95,896 doctors, 18,333 dentists and 99,228 nurses in the country. To reduce disease burden from society different programs are on the track like Programs for Family Planning (PFP), Expanded Programs of Immunization (EPI), Malaria Control Programs (MCP), HIV/AIDS Control Programs, Child Health and Maternal Health Programs, TB Control Programs, Prime Minister's Programs for Prevention and Control of Hepatitis in Pakistan and Cancer Treatment Program. The total expenditures on health during (July-March) 2014-2015 is estimated Rs. 145.97 billion, which is 0.9 percent more than last year [6]. In Pakistan, Punjab is at 1st position in all the provinces with a population of almost 9.82 million and for this huge population the available health institutions are 1201 Medical Dispensaries, 282 Maternity and Child Health Centers (MCH's), 288 Sub-health Centers, 42 Tuberculosis Centers, 2606 Basic Health Units (BHU's), 337 Rural Health Centers (RHC's), and 340 Civil Hospitals are working. Basic health units are always primarily concerned with the development purposes as with Basic health units you can provide health facilities to doorsteps. Every basic health unit consists of one Medical Officer (Doctor), Medical Technician (PMS), Lady Health Workers (LHW), Midwives (MW) and Other Supporting Staff [7].

As we know the healthy labor force plays a very vital role in the Development of any economy and most of the labor force belongs to rural areas of the country. It is very important for Government to provide proper health facilities to the population in order to increase the efficiency of labor force and to cure the health of the non-participant population of the country. To check whether these facilities are properly provided at rural level or not, this study is trying to estimate the efficiency of Rural Health Centers situated in Faisalabad, Jhang and Toba Tek Singh districts.

2. Data and Methods

2.1. Data Source

Primary data is used in this study. Due to the shortage of time, this study chooses the nearest districts to collect the data for estimating the efficiency of Rural Health Centers. The sample consists of 3 districts and the data about Medical staff, paramedical staff at the RHC's, Medicine stocks, lab equipment's, number of beds, outdoor patient visits, number of family planning visits, number antenatal care visits, no child immunized and no of normal deliveries at RHC is collected for 29 rural health centers, from their concerning Executive District Office of Health (EDO Health) for the year 2014. Therefore, the sampling technique is a convenience sampling technique. In addition, these districts are:

1) Faisalabad;
2) Jhang;
3) Toba Tek Sing.

And the data is collected for 29 rural health centers from their respective Executive District Officer Health's Office (Table 1).

As the study used primary data so a questionnaire was developed to collect the

data before conducting the survey for this study. I got permission from respective EDO of Faisalabad, Jhang and Toba Tek Singh districts but due to the shortage of time, the study chooses the nearest district "Faisalabad" to collect the data for checking those factors which affect the efficiency of Rural Health Centers. So convenience-sampling technique is used and with the help of their permission all, the staff of the Rural Health Center cooperated well and provides me the complete excess to their equipment's and stores which they use for the stock of medicine. The variables, which are used in the study as input and output variables in to find the efficiency score, are given below with their label and description.

To check the factors affecting the efficiency of Rural Health Centers a Questionnaire was developed and data was collected from the respective Rural Health Centers (Table 2).

Questioner was divided into 6 sections: 1) General Information about Rural Health Center. 2) Infrastructure of the Rural Health Center. 3) Services or the Facilities provided at Rural Health Center. 4) Questions related to Recourses which are used at Rural Health Center were asked. 5) Information about stock of medicine and drugs was collected in this section. 6) This section was about Environmental condition of the Rural Health Centers.

In section 1 questions for general information about location of the RHC, distance from District Health Quarter in kilometers, distance from Tehsil Head Quarters in kilometers, and how many kilometers RHC is away from the road were asked, timing of the Rural Health Center, distance from any private hospital in kilometers and address was asked to know the facts. In second section questions related to infrastructure were asked like total area of the RHC in canals, covered area in canals, no of Rooms, water availability, availability of sui gas facility, telephone generator facility and related to ambulance facility were asked, are these facilities available there "0" for no and "1" for yes.

In third section questions related to services provided at RHC. Like indoor patient facility, outdoor patient facility, no of wards, no of available beds, is dental room available there, ophthalmology facility available there, is operation theater available, and operation theater is fully equipped or partially equipped, basic laboratory and separate laboratory room is available or not were asked and dummies were created for them like "0" for no and "1" for yes. Do all the staff including senior medical officer, women's medical officer, dental surgeon and medical officer deal with outdoor patients or not, in which patients with malaria, fever due to other causes, vaccine preventable diseases, skin diseases, hypertension, depression, dental caries, injuries, road accidents, fractures, burns, dog bite, and snake bites, indoor and emergency cases also treated there.

Questions about the availability of equipments like X-ray machine, ultrasound machine, and basic laboratory test equipment's are available "0" for no "1" for yes and the condition of those equipments was observed in the fourth section. The fifth section was about the stock of medicine and drugs are in surplus or in shortage at RHC "0" for shortage if they have medicine stock for less than 3

months and surplus if they have medicine stock for more than 6 months, and how the bulk of medicine a Rural Health Center purchased and used. Last but not the least, questions about environment of the RHC were asked and observed like rooms are kept clean or not so "0" for satisfactory and "1" for excellent condition was used, as through survey it is noticed that no RHC was with bad condition and where the waste of the RHC was thrown. It is also noticed that how is the condition of the buildings, is it satisfactory and well maintained, do people have easy access to RHC's, are RHC's are near to the main road in the area (Table 3).

Table 1. List of Rural Health Centers.

Serial No.	RHC's	Tehsil	District	Serial No.	RHC's	Tehsil	District
1	Chak No. 153/rb	Chak Jhumra	Faisalabad	16	Kot shakir	Jhang	Jhang
2	Chak No. 65/gb	Jaranwala	Faisalabad	17	Mochiwala	Jhang	Jhang
3	Khurrianwala	Jaranwala	Faisalabad	18	Mukhiana	Jhang	Jhang
4	Lundianwala	Jaranwala	Faisalabad	19	Rudo sultan	Jhang	Jhang
5	Satyana	Jaranwala	Faisalabad	20	Shah jewena	Jhang	Jhang
6	Chak No. 229/rb	Jaranwala	Faisalabad	21	Haveli bahadar shah	Shorkot	Jhang
7	Kanjwani	Tahdianwala	Faisalabad	22	Garh. Maharaja	Ahmad Pur Sayal	Jhang
8	Manmun kanjan	Tahdianwala	Faisalabad	23	Chak No. 338/jb nia lahore	Gojra	Toba Tek Singh
9	Pindi sheikh musa	Tahdianwala	Faisalabad	24	Chak No. 740/gb	Kamalia	Toba Tek Singh
10	Chak No. 134/gb	Samundri	Faisalabad	25	Chak No. 316/gb chatiana	Toba Tek Singh	Toba Tek Singh
11	Mureedwala	Samundri	Faisalabad	26	Chak No. 394/jb jaja	Toba Tek Singh	Toba Tek Singh
12	Chak No. 30/jb	Sadar	Faisalabad	27	133072 RHC Rajana	Toba Tek Singh	Toba Tek Singh
13	Dijkot	Sadar	Faisalabad	28	133069 RHC Pir mahal	Pir Mehal	Toba Tek Singh
14	Bagh	Jhang	Jhang	29	133073 RHC Aroti	Pir Mehal	Toba Tek Singh
15	Haveli shiekh rajoo	Jhang	Jhang				

Table 2. Description of variables.

Serial No.	Label	Variable	Description
1	MS	Input	Medical Staff Including Senior Medical Officer, Medical Officer, Woman Medical Officer and Dental Surgeon
2	NS	Input	Nursing Staff Including Midwives, Lady Health Visitor and Nurses
3	PMS	Input	Para Medical Staff Including Dispenser, X-Ray Tech, Dresser Tech, Lab Tech, Theater Assist, Medical Tech, and EPI Vaccinator
4	OS	Input	Other Supporting Staff at RHC Including Naib Qasad, Chowkidar and Sweeper
5	NB	Input	Number of Beds Available at RHC
6	FPV	Output	Number of Family Planning Visits at RHC in a Year
7	ACV	Output	Number Antenatal Care Visits at RHC in a Year
8	OPD	Output	No Out-Door Patient Visits at RHC in a Year
9	CI	Output	No Child Immunized at RHC in a Year
10	ND	Output	No of Normal Deliveries at RHC in a Year

Table 3. List of variables generated from questioner and their description.

Sections	Variables	Description of Variable
1	1) Dist_DHQ	Distance of Rural Health Center from District Health Quarter in Kilometers (Km)
	2) Dist_THQ	Distance of Rural Health Center from Tehsil Health Quarter in Kilometers (Km)
	3) Dist_Road	Distance of Rural Health Center from Main Road in Kilometers (Km)
	4) Dist_Prvt	Distance of Rural Health Center from Private Hospitals in Kilometers (Km)
2	5) Cleanliness	Dummy Was Generated from Hospitals Wastage, Toilet Conditions, Air Pollution, and Environment of Rooms. 1 = Excellent (All Are in a Good Condition), 0 = Satisfactory (All Are in a Normal Condition)
3	6) Beh_Staff	Dummy is Created for Behavior of Staff, 0 = Rude Behavior and 1 = Friendly Behavior
4	7) Avail_Staff	Availability of Medical Staff and Paramedical Staff, 1 = Both Types of Staff Available, 0 = Having Only One Staff
5	8) Lab_Equi	Laboratory Equipment's Like X-Ray Machine, Ultrasound Machine, Basic Laboratory Test Equipment's 1 = Fully Equipped, 0 = Partially Equipped
6	9) Opera_Equi	Operation Equipment's, 1 = Fully Equipped Surgical Instruments, 0 = Partially Equipped
7	10) Med_Stoc	Medicine Stock, 1 = Surplus (Medicines Available for More than 6 Months), 0 = Shortage (Medicines Available for Less than 6 Months)

2.2. Methods

The concept of measuring efficiency has been analyzed since Adam Smith's era and before. There are different methods available to measure the efficiency. Efficiency can be measured by Parametric and Non-parametric techniques. Parametric approach further divided into Deterministic frontier analysis and stochastic frontier analysis, these techniques require functional form and the disturbance term.

Methodology is a very important component of the study. In addition, there are many techniques available, which can be used to estimate the efficiency of any sector like education, Health, Banking sector, etc. From previous studies, it has been noticed that estimation of efficiency is very important for better use and the best allocation of resources.

Data Envelopment Analysis was presented initially by Charnes *et al.* (1978) as the concept they followed had been taken from the work of Farrell 1957. DEA is a non-parametric technique and it gives productive efficiency scores of Decision Making Units. Non-parametric technique does not have any specific shape of the frontier curve, and it does not estimate any relationship between inputs and outputs. However, it can be used to compare the efficiency scores of different units. There are two types of DEA, one is based on the Constant Return to Scale (CRS) and the other one is based on Variable Return to Scale (VRS). Data Envelopment Analysis can be run by both the methods, either cost minimizing method or output maximizing method. In the cost minimizing method, output is fixed and on that output, we try to minimize our cost. Whereas in output maximization method cost kept fixed and tries to maximize the output [9] [10] [11].

Economic Efficiency = Technical Efficiency × Allocative Efficiency

Efficiency of Rural Health Centers have been analyzed by using the Data En-

velopment Analysis technique in the first stage after getting the efficiency scores, Tobit regression is used to find different determinants of the efficiency in the second stage. The concept of measuring efficiency has been analyzed since Adam Smith's era and before. There are different methods available to measure the efficiency. Efficiency can be measured by Parametric and Non-parametric techniques. Parametric approach further divided into Deterministic frontier analysis and stochastic frontier analysis, these techniques require functional form and the disturbance term [12].

Term Data Envelopment Analysis (DEA) was first introduced by Charnes *et al.* (1978) But the concept they followed has been taken from the work of Farrell 1957. Data Envelopment Analysis is a non-parametric technique that gives productive efficiency scores of DMU's [13] [14] [15].

The variables used in the study as input and output in the efficiency analysis through Data Envelopment Analysis are Para Medical staff, nursing staff, Medical staff, Other Supporting Staff and number of beds are the input variables and Number of Family Planning, Number Antenatal Care, Number of Out-door Patient, Number of Child immunized and Number of Normal deliveries used as output variables.

Estimation of Factors Affecting Efficiency

To estimate the factors, which affect the efficiency of Rural Health Centers, this study applies the Tobit regression and the description about variables is given in (Table 4).

Models for Tobit Regression

EFFICIENCY $= \beta_0 + \beta_1$ Dist_THQ $+ \beta_2$ Dist_Road $+ \beta_3$ Dist_Prvt $+ \beta_4$ Cleanliness $+ \beta_5$ Beh_Staff $+ \beta_6$ Avail_Staff $+ \beta_7$ Lab_Equi $+ \beta_8$ Opera_Equi $+ \beta_9$ Med_Stock $+ \beta_{10}$ Dist_DHQ

3. Results and Discussions

The descriptive statistics of output and input variables which are the products or output of Rural Health Centers by using a set of outputs and these outputs are used in calculating efficiency by using Data Envelopment Analysis. As the (Table 5) shows that minimum family planning visits to a Rural Health Center were 102 and maximum were 9184 in 2014. Minimum antenatal care visits were 148 and maximum were 2531. Maximum outdoor patients facilitated from a Rural Health Center in 2014 were 77,494 and minimum visits were 54. 1743 chilled were immunized from Rural Health Center and the minimum amounts of immunized children were 100. The maximum amounts of normal deliveries in a Rural Health Center were 938 in the year 2014 and the minimum amount was 14. The descriptive statistics of input variables which are used in Rural Health Centers to produce outputs in the shape of people facilitated from there. The minimum no of Medical Staff at any of the Rural Health Center is 3 and the total no of Medical Staff allowed to each Rural Health Center is 4 which includes 1 Senior Medical Officer, 1 Women Medical Officer, 1 Medical Officer and 1

Dental Surgeon. These above-mentioned input variables used in Data Envelopment Analysis to calculate the technical efficiency of Rural Health Centers. The minimum and maximum amount of each input variable is shown in the (Table 5).

The frequencies of different variables are shown in (Table 6). In district Faisalabad there are 7 Rural Health Centers are fully equipped with laboratory equipment's that there is all type of machines available for laboratory usage. And out of total 13, Rural Health Centers 6 is those which are not fully equipped that there is lack of machinery. Partially equipped means that there is shortage of machinery which are necessary for laboratory tests. Like blood CP, blood cross matching, blood sugar, pregnancy test, hepatitis b, hepatitis c, TB micro, Stool RE, HIV and Urine RE. Out of total 13 Rural Health Centers of Faisalabad, only 5 Rural Health Centers have complete equipment's for minor surgeries and 8 RHC's are those which do not have complete operational equipment's available there.

Table 4. Variable description.

Short Form	Description of Variable
Dist_DHQ	Distance of Rural Health Center from District Health Quarter in Kilometers (Km).
Dist_THQ	Distance of Rural Health Center from Tehsil Health Quarter in Kilometers (Km).
Dist_Road	Distance of Rural Health Center from Main Road in Kilometers (Km).
Dist_Prvt	Distance of Rural Health Center from Private Hospitals in Kilometers (Km).
Cleanliness	Dummy Was Generated from Hospitals Wastage, Toilet Conditions, Air Pollution, and Environment of Rooms, 1 = Excellent (All Are in a Good Condition), 0 = Satisfactory (All Are in a Normal Condition).
Beh_Staff	Dummy is Created for Behavior of Staff, 0 = Rude Behavior, 1 = Friendly Behavior.
Avail_Staff	Availability of Medical staff And Paramedical Staff, 1 = Both Types of Staff Available, 0 = Having Only One Staff.
Lab_Equi	Laboratory Equipment's Like X-Ray Machine, Ultrasound Machine, Basic Laboratory Test Equipments, 1 = Fully Equipped, 0 = Partially Equipped.
Opera_Equi	Operation Equipment's, 1 = Fully Equipped Surgical Instruments, 0 = Partially Equipped.
Med_Stock	Medicine Stock, 1 = Surplus (Medicines Available for More than 6 Months), 0 = Shortage (Medicines Available for Less than 6 Months).

Table 5. Result of descriptive statistics of output variables and input variables.

Output Variables				Intput Variables			
Variables	N	Minimum	Maximum	Variables	N	Minimum	Maximum
Family Planning Visits	29	102	9184	Medical Staff	29	3	4
Antenatal Care Visits	29	148	2531	Nursing Staff	29	11	12
Outdoor Patient Visits	29	54	77494	Para Medical Staff	29	8	11
Chilled Immunized	29	100	1743	Other Supporting Staff	29	9	11
Normal Deliveries	29	14	938	No. of Beds	29	6	20

Table 6. Frequencies of laboratory equipments, operational equipments, cleanliness and maintenance of the rooms, distance from DHQ, distance from THQ and distance from private hospitals.

Laboratory Equipments			Operational Equipments			Cleanliness and Maintenance of the Rooms		
	Frequency	Valid Percent		Frequency	Valid Percent		Frequency	Valid Percent
Partially Equipped	6	46.2	Partially Equipped	8	61.5	Satisfactory	3	23.1
Complete Equipped	7	53.8	Fully Equipped	5	38.5	Excellent	10	76.9
Total	13	100	Total	13	100	Total	13	100

Distance from DHQ			Distance from THQ			Distance from Private hospital		
	Frequency	Valid Percent		Frequency	Valid Percent		Frequency	Valid Percent
0 - 25 Km	6	46.2	0 - 15 Km	2	15.4	0 - 4 Km	7	53.8
25 - 50 Km	2	15.4	15 - 20 Km	2	15.4	4 - 6 Km	3	23.1
50 - 75 Km	4	30.7	20 - 25 Km	7	53.8	6 - 8 Km	0	0
75 - 100 Km	1	7.7	25 - 35 Km	2	15.4	8 - 10 Km	3	23.1
Total	13	100	Total	13	100	Total	13	100

Table 6 also showed the frequencies that how much rooms are kept clean and maintained the condition of the rooms suitable for patients. Are sweepers done their work properly. A dummy variable is used to observe the condition of rooms and surroundings so "1" is given if rooms are excellently clean and maintained and "0" is given if rooms are satisfactorily clean and maintained. The frequencies show that out of 13, 10 RHC's are excellently clean and 3 have satisfactory condition.

There are 6 Rural Health Centers (RHC) in Faisalabad district which are 0 to 6 Km away from District Head Quarter (DHQ), 2 RHCs are 25 to 50 Km away from the respective DHQ, from 50 to 75 Km there are 4 RHCs and 1 is in between 75 to 100 Km. Then we find the distance of RHCs from the respective Tehsil Head Quarter (THQ), there are 2 RHCs which are 0 to 15 Km away from THQ, 2 are 15 to 20 Km away, 7 RHCs are 20 to 25 Km away and 2 are 25 to 35 Km away from the respective THQ. Distance from Private hospital is also measured in this study so the study finds out that 7 RHCs are 0 to 4 Km away from a private hospital, 3 are 4 to 6 Km away and 3 are 8 to 10 Km away from a private hospital.

The results of outputs and with the help of this information, top Rural Health Centers and lower performance Health Centers can be checked. Mukhiana, Rudo Sultan, Kot Shakir, Bagh, Garh Maharaja, Mochiwala, Shah Jewena, Haveli Bahadar Shah, Haveli Shiekh Rajoo, Satyana, Pindi Sheikh Musa, Chak No. 229/RB, Chak No. 153/RB, Chak No. 30/JB are those Rural Health Centers which have maximum family planning visits from 1000 to 9000 in 2014 and the remaining Chak No. 740/GB, Mureedwala, Lundianwala, Dijkot, Pir Mahal, Chak

No. 65/GB, Rajana, Kanjwani, Chak No. 338/JB Nia Lahore, Chak No. 394/JB JAJA, Manmun Kanjan, Khurrianwala, Chak No. 134 GB, Aroti and Chak No. 316/GB Chatiana are those Rural Health Centers which have minimum family planning visits from 100 to 600 in 2014 (Table 7).

Table 7. Detail of output variables.

				Output Variables				
Serial No.	RHC's	Tehsil	Districts	FPV	ANC	CI	ODP	ND
1	Chak No. 153/RB	Chak Jhumra	Faisalabad	1407	1120	644	43,920	351
2	Chak No. 65/GB	Jaranwala	Faisalabad	477	1635	548	57,601	392
3	Khurrianwala	Jaranwala	Faisalabad	154	910	985	76,759	288
4	Lundianwala	Jaranwala	Faisalabad	519	1172	201	31,869	248
5	Satyana	Jaranwala	Faisalabad	2054	**2531**	794	75,458	444
6	Chak No. 229/RB	Jaranwala	Faisalabad	1617	913	924	56,214	185
7	Kanjwani	Tahdianwala	Faisalabad	405	1015	751	53,138	247
8	Manmun kanjan	Tahdianwala	Faisalabad	203	2048	885	54,512	201
9	Pindi Sheikh Musa	Tahdianwala	Faisalabad	1766	636	732	23,979	196
10	Chak No. 134 GB	Samundri	Faisalabad	151	148	100	14,292	104
11	Mureedwala	Samundri	Faisalabad	548	835	606	31,926	202
12	Chak No. 30/JB	Sadar	Faisalabad	1229	744	526	39,584	142
13	Dijkot	Sadar	Faisalabad	487	1322	943	**77,494**	222
14	Bagh	Jhang	Jhang	8066	1896	821	89	647
15	Haveli Shiekh Rajoo	Jhang	Jhang	2837	981	**1743**	112	566
16	Kot Shakir	Jhang	Jhang	8461	473	960	141	585
17	Mochiwala	Jhang	Jhang	6946	689	888	136	**938**
18	Mukhiana	Jhang	Jhang	**9184**	995	1335	157	107
19	Rudo Sultan	Jhang	Jhang	8550	950	1242	101	99
20	Shah Jewena	Jhang	Jhang	4710	728	742	54	179
21	Haveli Bahadar Shah	Shorkot	Jhang	4348	1338	790	87	372
22	Garh. Maharaja	Ahmad Pur Sayal	Jhang	6974	957	1193	109	178
23	Chak No. 338/JB Nia Lahore	Gojra	Toba Tek Singh	315	1219	798	28,113	194
24	Chak No. 740/GB	Kamalia	Toba Tek Singh	574	328	1430	17,827	106
25	Chak No. 316/GB Chatiana	Toba Tek Singh	Toba Tek Singh	102	902	743	22,067	161
26	Chak No. 394/JB Jaja	Toba Tek Singh	Toba Tek Singh	272	660	647	17,197	150
27	Rajana	Toba Tek Singh	Toba Tek Singh	473	1168	1450	27,489	148
28	Pir Mahal	Pir Mehal	Toba Tek Singh	484	1284	1611	22,321	97
29	Aroti	Pir Mehal	Toba Tek Singh	107	276	450	10,608	14

Rural Health Centers located in Satyana, Mammun Kanjan, Bagh, Chak No. 65/GB, Haveli Bahadar Shah, Dijkot, Pir Mahal, Chak No. 338/JB Nia Lahore, Lundianwala, Rajana, Chak No. 153/RB, Kanjwani are in top 15 with maximum Antenatal Care Visits from 1000 to 2500 and the remaining health centers situated in Mukhiana, Haveli Shiekh Rajoo, Garh Maharaja, Rudo Sultan, Chak No. 229/RB, Khurrianwala, Chak No. 316/GB, Chatiana, Mureedwala, Chak No. 30/JB, Shah Jewena, Mochiwala, Chak No. 394/JB Jaja, Pindi Sheikh Musa, Kot Shakir, Chak No. 740/GB, Aroti, Chak No. 134 GB are with minimum Antenatal Care Visits from 150 to 995.

The above table shows the results of outputs and with the help of this information top Rural Health Centers and lower performance Health Centers can be checked. Mukhiana, Rudo Sultan, Kot Shakir, Bagh, Garh Maharaja, Mochiwala, Shah Jewena, Haveli Bahadar Shah, Haveli Shiekh Rajoo, Satyana, Pindi Sheikh Musa, Chak No. 229/RB, Chak No. 153/RB, Chak No. 30/JB are those Rural Health Centers which have maximum family planning visits from 1000 to 9000 in 2014 and the remaining Chak No. 740/GB, Mureedwala, Lundianwala, Dijkot, Pir Mahal, Chak No. 65/GB, Rajana, Kanjwani, Chak No. 338/JB Nia Lahore, Chak No. 394/JB JAJA, Manmun Kanjan, Khurrianwala, Chak No. 134 GB, Aroti And Chak No. 316/GB Chatiana are those Rural Health Centers which have minimum family planning visits from 100 to 600 in 2014.

Rural Health Centers located in Satyana, Mammun Kanjan, Bagh, Chak No. 65/GB, Haveli Bahadar Shah, Dijkot, Pir Mahal, Chak No. 338/JB Nia Lahore, Lundianwala, Rajana, Chak No. 153/RB, Kanjwani are in top 15 with maximum Antenatal Care Visits from 1000 to 2500 and the ramaining health centers situated in Mukhiana, Haveli Shiekh Rajoo, Garh Maharaja, Rudo Sultan, Chak No. 229/RB, Khurrianwala, Chak No. 316/GB Chatiana, Mureedwala, Chak No. 30/JB, Shah Jewena, Mochiwala, Chak No. 394/JB Jaja, Pindi Sheikh Musa, Kot Shakir, Chak No. 740/GB, Aroti, Chak No. 134 GB are with minimum Antenatal Care Visits from 150 to 995. In the field of outdoor patient treatment Dijkot, Khurianwala, Satyana, 65 Chak awaghat, 229 GB are in top 5 Rural Health Centers and Garh Maharaja, Rudo Sultan, Bagh, Haveli Bahadur Shah and Shah Jewwana are at the lowest place out of 29 Rural Health Centers.

In Child Immunization Haveli sheikh rajoo, Pir mehal, Rajan, Chak 740 GB, Mukhiana are in top 5 RHC's and 65 Chak, 30/JB, Aroti, Lundianwala and 134 GB are at below 25 out of 29 RHC's. Mochiwala, Kot Shakir, Haveli Sheikh Rajoo, Kanjwani, Murid wala, Chak 229 makuana, 30 JB, 740 GB, Rudo Sultan, Pir mehal and Khurianwala have less medical staff as compare to other Rural Health Centers.

Table 8 gives complete information about the Rural Health Centers that how much inputs are used in the form of Medical Staff, Paramedical Staff, Nursing Staff, Other Staff and number of Beds.

Results of DEA Model

Results of DEA are reported in the Table below. Efficiency scores have been cal-

culated by taking Medical Staff including (Senior Medical Officer, Woman Medical Officer, Medical Officer and Dental Surgeon), Nursing Staff, Paramedical Staff and Other Supporting Staff as input variables and Family Planning Visits, Antenatal Care Visits, Outdoor Patient Visits, Child Immunization and Normal Deliveries as output variables.

Results of technical efficiency are described in (Table 8), at the first results of technical efficiency of Faisalabad are described, then results of Jhang and after that results of Toba Tek Singh district are described.

The results of the DEA under constant return to scale, variable return to scale of Rural Health Centers of districts Faisalabad, Jhang and Toba Tek Singh calculations tell that in District Faisalabad there are three Rural Health Centers out of 29 are those working on the production possibility frontiers line; and these are located in Tehsil Khurianwala, Satyana and Dijkot their efficiency score is 100%. There is only one Rural Health Center, which has an efficiency score of 90%, which is close the to 100% efficiency score.

Five are working well above the average efficiency score, with efficiency score to 70% to 80% and they are in Tehsil Jhumra, Jaranwala and Tandlianwala. 23% of the Rural Health Centers are those which are working inefficiently as their efficiency score is quite below the average efficiency score but above 50% as they have an efficiency score between 50% and 60% there is 40% capacity available to increase their productivity. Rural Health Center situated at Chak No. 134 GB showed 20% efficiency score which is very disappointed as that is working totally inefficiently and there is 80% capacity available to increase its productivity to production possibility frontier. According to variable return to scale out of 20 Rural Health Centers 9 are working quite efficiently as their scores are 100% and 4 Rural Health Centers are quite close to 100% with an efficiency score of above 90%.

Out of 9 Rural Health Centers in district Jhang, 6 are working well efficiently as their efficiency scores are 100% and all these are located in Tehsil Jhang. Remaining three Rural Health Centers have an efficiency score of 0.928, 0.864 and 0.718 which are quite above the average efficiency score and they are situated at Havlei Bahadar Shah, Garh Maharaja and Shah Jewana and it is also noticed that there is a capacity available to increase their efficiency and same is the case with Scale efficiency. According to variable return to scale 8 Rural Health Centers have an efficiency score equals to 1 out of 9 Rural Health Centers. Only one Rural Health Center is below 100%, but quite close to 100% with an efficiency score of 0.935.

There are seven Rural Health Centers a located in district Toba Tek Singh out of which only 2 are working efficiently on the production possibility frontier as shown in the above table. One is working at 0.987 which is almost equal to 1. So Rural Health Centers situated in Kamalia, Toba Tek Singh, and Pir Mehal is efficient centers in District Toba Tek Singh. Rural Health Centers of tehsil Gojra and one of the Tehsil Toba Health Centers is at below average as their efficiency

score is 0.681 and 0.567; there is a capacity of increasing their efficiency by 32% and 43% with increasing return to scale. Rural Health Center of Aroti and 394/GB Jaja are the poor in efficiency as their efficiency score is 0.484 and 0.308 there is a lot of space to increase their efficiency by increasing their output because there is no need to increase their inputs as they have enough inputs at theirs. According to variable return to scale 3 Rural Health Centers are working on the production possibility frontier and remaining 4 are above 90% which is close to 100%.

To find out the determinants of the efficiency of Rural Health Centers, the Data Envelopment Analysis technique has been used. Thereafter efficiency scores obtained and regressed by different variables related to Rural Health Centers. Descriptive analysis is presented earlier than the results.

Factors affecting and determinants of Efficiency of Rural Health Centers are examined by using Tobit regression. When the dependent variable is in censored form, we use Tobit regression and as we know efficiency scores showed above are in censored form from 0 to 1 so Tobit regression is used and the results are discussed in (Table 9).

Table 8. Efficiency scores of Rural Health Centers in District Faisalabad, JHANG and Toba Tek Singh.

District Faisalabad				District Jhang				District Toba Tek Singh			
S #	RHC	Tech Eff at CRS	Tech Eff at VRS	S #	RHC	Tech Eff at CRS	Tech Eff At VRS	S #	RHC	Tech Eff at CRS	Tech Eff at VRS
1	Chak No. 153 RB Jhumra	88%	100%	1	Bagh	100%	100%	1	Chak No. 338 JB Nia Lahore	68.10%	95%
2	Chak No. 65 GB Awagat	82.60%	95.70%	2	Haveli Shiekh Rajoo	100%	100%	2	Chak No. 740 GB	98.70%	100%
3	Khurrianwala	100%	100%	3	Kot Shakir	100%	100%	3	Chak No. 316 GB Chatiana	56.70%	93.50%
4	Lundianwala	77%	100%	4	Mochiwala	100%	100%	4	Chak No. 394 JB Jaja	48.40%	92.60%
5	Satyana	100%	100%	5	Mukhiana	100%	100%	5	Rajana	100%	100%
6	Chak No. 229 RB	88.60%	95.50%	6	Rudo Sultan	100%	100%	6	Pir Mahal	100%	100%
7	Kanjwani	74.50%	94.70%	7	Shah Jewena	71.80%	100%	7	Aroti	30.80%	94.40%
8	Manmun Kanjan	90.80%	100%	8	Haveli Bahadar Shah	92.80%	100%				
9	Pindi Sheikh Musa	60.00%	100%	9	Garh. Maharaja	86.40%	93.50%				
10	Chak No. 134 GB	21.30%	100%								
11	Mureedwala	58.30%	100%								
12	Chak No. 30/JB	59.20%	93.80%								
13	Dijkot	100%	100%								

Table 9. Result of tobit regression.

Dependent Variable: Efficiency CRS				
Method: ML-Censored Normal (TOBIT)				
Sample: 1 - 13		Included Observations: 13		
Left Censoring (Value) at Zero				
Convergence Achieved after 8 Iterations				
Coefficient Covariance Computed Using Observed Hessian				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
Distance from Tehsil Head Quarter	0.015	0.003	4.236	0
Distance from Road	−0.194	0.020	−9.582	0
Distance from Private hospital	0.046	0.004	11.575	0
Cleanliness	0.233	0.0293	7.936	0
Behavior of the Staff	0.086	0.031	2.727	0.006
Availability of the Staff	0.037	0.0206	1.777	0.075
Laboratory Equipments	0.150	0.024	6.232	0
Operation Equipments	0.005	0.023	0.222	0.8241
Medicine Stock	−0.0325	0.025	−1.289	0.197
Distance from District Head Quarter	−0.001	0.001	−1.181	0.237
C	0.3655	0.0603	6.063	0

Variable Distance from Tehsil Head Quarter measures how far Rural Health Centers is from Tehsil Head Quarter, the variable is positively significant at 1% level, the coefficient tells that as the distance between THQ and RHC increases the efficiency of RHC will increase by 0.015 and the p-value is "0" which means it is statistically significant. As the distance between THQ and RHC increases people will go to RHC's rather going to THQ's.

Coefficient of Distance from Roads negatively significant at 1% level o as shown in Table 9. This distance is between the main road and Rural Health Centers. In addition, the coefficient indicates that Rural Health Centers, which are located on the main road the efficiency of those Rural Health Centers, are higher than the RHC's far away from the main road. There is a negative relation between Distance from Road and Efficiency as the distance increases the efficiency decreases by 0.19 units and the p-value is "0" which is less than alpha which means it is statistically significant.

There are some private hospitals near the RHC's and the variable Distance from the private hospital show positive and significant effect on efficiency at 1% level of significance. As the distance between private hospitals and Rural Health Centers increases the efficiency of the RHC's will also increase by 0.046 units because people will go to Rural Health Centers than going to private hospitals its p-value is also "0" it means it is statistically significant.

Maintenance and cleanliness of the rooms also affect the efficiency of Rural

Health Centers. Cleanliness is positively significant at 1% level of significance and the coefficient of Cleanliness shows that efficiency of Rural Health Centers with excellent condition will 0.233 units higher than the RHC's with satisfactory condition.

The behavior of the staff also has a positive impact on efficiency. Coefficient of the behavior of the staff is positively significant at 1% level and shows that efficiency is 0.086 units higher of those Rural Health Centers where staff has friendly behavior with their patients than the Rural Health Centers where staff has rude behavior with their patients and the p-value is "0" which means it is statistically significant.

Availability of the Staff is a variable which tells that the presence of the staff affects the efficiency of Rural Health Centers or not. The above table shows that it is positively significant at 10% level and the coefficient shows that the efficiency of the Rural Health Centers is 0.037 units higher where staff is full time available.

Laboratory equipment has a positive and significant impact on the efficiency of RHC's at 1% level of significance. The result indicates that efficiency of those Rural Health Centers is 0.15 units higher which are fully equipped with laboratory equipment than RHC's which are partially equipped. Operation equipment have a positive but insignificant impact on efficiency and the coefficient shows that there is no difference in the efficiency of those Rural Health Centers which have full operation equipment and those which are partially equipped.

Coefficient of Medicine stock shows that medicine stock doesn't have any impact on efficiency as Rural Health Centers where medicine stack is in surplus and where their medicine stack is in shortage have the same efficiency scores and the p-value is "0" which means it is statistically significant. Coefficient of Distance between Rural Health Centers and District Head Quarters shows that there is no effect on the efficiency of this variable as it has an insignificant impact on efficiency score.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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