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Original Article

Efficiency Analysis of Basic Health Units: A Comparison of Developed and Deprived Regions in Azad Jammu and Kashmir

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Abstract

Background: The current study aims to measure the efficiency of primary health care units completed in health sector of rural Azad Jammu and Kashmir (AJK) and to compare it across developed and deprived regions.

Methods: Operational efficiency and beneficiary efficiency of a total of 32 Basic Health Units (BHUs) were measured through Data Envelopment Analysis (DEA) by using different input and output variables. Independent sample T-test was applied to compare these efficiencies across developed and deprived regions.

Results: The study could find no significant difference of operational efficiency across developed and deprived regions, however a significant difference was found across regions from beneficiary perspective (P= 0.044).

Conclusion: The study concludes that BHUs of deprived region are more efficient from beneficiary perspective, however there is no significant difference of operational efficiency across the regions.

Keywords: Efficiency, Patient satisfaction, Primary health, Azad Jammu and Kashmir

Introduction

Efficiency refers to the success with which an organization utilizes its resources to produce outputs (1, 2). Operational efficiency is the ability of an organization to execute its tactical operational plans while maintaining a healthy balance between cost and productivity measured by examining the amount of output for a given amount of input (3). It is harder to standardize highly heterogeneous inputs and outputs in service sector. Manufacturing sector output is measured by the quantity of units and increased amount of production, however, in service sector output is increased by providing high quality services to the customers and making them satisfied (4). In service sector, outputs produced are intangible and customers have direct interaction with the process of production. In this vein, it is suggested that, if production consists of both tangible and intangible components, efficiency measurement needs to be addressed from intangible perspective as well. So, efficiency from beneficiary perspective refers to the intangible perspective as it had a significant influence on the efficiency of the operational functions (5).

One of the practical approaches in the field of operations research that examine the efficiency of decision-making units is Data Envelopment Analysis (6). Data Envelopment Analysis (DEA) is used to calculate apparent efficiency about the groups observed best practice in the field of health, education, banks, municipalities, and countries (7). Using DEA various researchers i.e. Al-Shammari (8), Zere (9), Bhat et al. (10), Kwakye (11), Pavananunt (12), Chang et al. (13) and Ramathan (14) examined the efficiency of hospitals.

Review of the extant literature shows that the most common variables used were inpatient/outpatient days (although some authors used the same variables with different names as minor and major surgeries), number of medical and paramedical staff, number of beds, and different type of expenditures. However, some studies used unique variables as well like aggregate total recurrent expenditure, and annual payroll. The most of these studies have been conducted in big hospitals that provide multiple health services, but the current study was conducted in Basic Health Units (BHU). It is a medical facility situated in rural Union Council providing primary health care services. Comprehensive primary health care includes health promotion, illness prevention, treatment and care of the sick, community development, advocacy and rehabilitation. It is considered as a peripheral health facility that serves 5,000 to 10,000 people over an area of 15-25 square miles. A BHU is comprised of an office building, residential for the doctor and for staff. (15). Review of the available literature reveals that most of the efficiency analysis studies conducted in health sector did not consider patient satisfaction as an output variable. Surprisingly, various researchers affirmed that patient satisfaction is a key parameter in determining the efficiency of hospitals. Following the studies that declare patients' perceptions as an important tool to determine the success of any health care unit (16-22), the current study measures operational efficiency and efficiency from the beneficiary perspective by taking into account patient satisfaction as an additional output variable.

Hypotheses

Operational efficiency refers to delivering services to customers in a cost effective manner while ensuring high quality (23). The literature reveals that most of the studies to check efficiency in health sector measure efficiency from an operational perspective (24).

H1. Operational efficiency of Basic Health Units is different across developed and deprived regions

Depending on the available literature which supports that, in service sector efficiency should be measured from beneficiary perspectives as well (25-29), a hypothesis was developed to compare efficiency of BHUs from beneficiary perspectives across developed and deprived regions.

H2. Efficiency of Basic Health Units from the beneficiary perspective is different across developed and deprived regions

Materials and Methods

Population and sample

The population of the study comprises of BHUs completed after earthquake 2005 and handed over to the Health Department of Azad Jammu and Kashmir till 2010. So far, 20 BHUs in Muzaffarbad and 19 in Bagh were completed and handed over to the health department. Because of poor road access and availability of logistical support in the area 32 BHUs were selected conveniently by allocating a quota of 16 BHUs from each developed and deprived region.

The regions were identified as developed and deprived according to the socioeconomic development of regions. He argues that deprived regions are less facilitated with public services as compared to developed regions. In this regard, two districts 'Muzaffarabad' and 'Bagh' of Azad Jammu and Kashmir were selected as study area. District Muzaffarabad is the capital of Azad Jammu and Kashmir (AJK) and a suburban area. Bagh was declared as an inde-pendent district in 1987 and is situated 100 km away from Muzaffarabad. Bagh district is slightly deprived than Muzaffarabad, depending on avail-able civic facilities. So, Muzaffarabad district and Bagh district were labeled as developed and dep-rived regions respectively.

Variables

Based upon a critical review of the literature and according to scope of BHUs, input and output variables selected to measure the efficiency of BHUs are given in Table 1.

Analysis

The researchers used the software 'DEA Excel Solver' developed by Zhu (34) to measure efficiency.

Table 1: Variables and their description

Category	Variables	Description
Inputs	Cost	Cost refers to total project cost to reconstruct BHUs and, facilities and equipment delivered to rehabilitate them.
	Area	The area covered by construction is an important input as it consumed huge cost. The area covered do not monetized in this study, because, most of the land area used was government land provided many years before for old BHUs.
	Sanctioned Staff	The sanctioned staff of a BHU comprises of a medical officer, medical assistant or medical technician, lady health visitors and support staff (30).
	Salary	Salary refers to money consumed on staff to deliver services in BHUs.
Outputs	Patient Satisfaction	Patient satisfaction is measured using key quality characteristics assessments for hospitals (KQCAH) scale introduced by sower et al, (31). This scale consists of eight factors, but in the present study only five factors used depending on operational scope of health units. These factors used to measure only one variable i.e. satisfaction
	Services Provided	Owing to the absence of data entry of patients, only services provided considered. Hence, the input 'services provided' refers to a number of different types of services provided in the BHUs. This is an important input, as BHUs facilitated according to services provided discussed in policy documents but unfortunately, not all those services are provided there
	Patients/day	According to health policy documents of SERRA, the average patients per day of BHUs in Muzaffarabad and Bagh district were 17 and 18 respectively. Depending on that data, it was decided to collect at least 10 responses from each BHU. However, during primary data collection it was recognized that patient arrival rate had minimized to 3 to 6 patients per day. The main reason of the reduction in the patient's arrival rate was the absence of provision of medicines in BHU. It is measured as average of patient visits during working hours (8am-2pm) during 7 days.
	Available Staff	In the present study, available staff against the sanctioned staff selected as output variable. This was because of absence of staff in BHUs as reported by (32,33). The study considered average staff available during a week.

The DEA model was used because it could combine multiple inputs and outputs to measure and select most efficient unit into a single summary (35). DEA was first introduced by Charness, Cooper and Rhodes in 1978 (36) and further formalized by Banker, Charness and Cooper in 1984 (37). The technique was first used to study hospital production by Banker, Conral and Strauss 1986 (38) followed by Grosskopf and Valdmanis in 1987 (39). Several recent studies have employed Data Envelopment Analysis (DEA) to measure hospital efficiency (40-45).

Since all the inputs are not controlled completely, so the study used an output oriented model of DEA. After measuring the efficiency for individual BHUs through the DEA, the results were entered into an SPSS sheet. And independent sample t-test was applied to examine the difference of mean efficiencies across developed and deprived regions. Various studies compare efficiencies using different non-parametric tests (46). Banker et al, (47), suggested various non-parametric tests to compare efficiencies and reported that for a large sample group t-test can be used to compare efficiencies. Bayyurt and Duzu (48) used t-test to compare mean efficiencies of the firms of two countries. Vogel (49) employed independent sample t-test to test hypothesis about efficiencies measured by DEA. Said (50) also compared the efficiencies of Western and Islamic banks using independent sample t-test. Following these studies of comparing two sets of DMUs, the present

study also employs independent sample *t*-test to compare efficiencies of two groups of BHUs from developed and deprived regions.

Results

In the present study total 29 items in the questionnaire were used to measure the satisfaction level of the patients in the study area. The reliability statistics of all questions tested together and the Cronbach alpha of all 29 items was 0.918. The value was much higher than Nunnally's reliability criteria of 0.70, hence the data collected for patient satisfaction is reliable. Table 2 shows the descriptive statistics of the data collected for input and output variables.

Table 2: Descriptive statistics for input and output variables of BHUs (n = 32)

Category	Variables	Region	Min	Max	Mean	Std. Dev
Inputs	Cost (Rs. Millions)	Developed	30	40	34.69	2.676
		Deprived	30	38	34.56	2.337
	Area (Sq. ft.)	Developed	6472	10000	8656.56	954.81
		Deprived	6850	9500	8571.88	628.21
	Sanctioned Staff	Developed	7	18	9.69	3.260
		Deprived	3	9	5.63	1.544
	Salaries (Rs. Millions)	Developed	11.00	57.22	23.22	12.071
		Deprived	6.00	18.73	12.53	3.703
Outputs	Satisfaction	Developed	1.61	2.26	1.916	.195
		Deprived	1.62	2.59	2.06	.284
	Services delivered	Developed	2	3	2.44	.512
		Deprived	2	3	2.25	.447
	Patients/day	Developed	3	6	4.25	.856
		Deprived	4	9	6.50	1.461
	Available staff	Developed	2	5	3.06	.854
		Deprived	2	3	2.38	.500

In the input section of table 2, cost (34.69 and 34.56) and area (8656.56 and 8571.88) of BHUs across developed and deprived regions respectively was approximately same, however, the mean sanctioned staff (9.69 and 5.63) is quite different and hence mean salaries (23.22 and 12.53) were also different. In output section, the mean satisfaction (1.91 and 2.06) shows lowered in both regions against five point Likert scale. The mean services provided were approximately same (2.44 and 2.25), mean patients/day (4.25 and 6.50) were slightly higher in deprived region and available staff (3.06 and 2.38) was slightly higher in developed region. Using these inputs and outputs the measured efficiency of each BHUs in developed and deprived region both from operational and beneficiary perspective shown in Table 3. It could be observed that mean efficiencies of deprived region were higher than developed region. In case of operational efficiency the mean efficiency of deprived region was higher due to more patients/day and available staff against sanctions staff. In developed region absenteeism is higher because mean sanctioned staff (9.69) were higher than mean available staff (3.06), however in deprived region mean sanctioned staff (5.63) was against mean available staff (2.38).

Besides having a lower input of sanctioned staff, the patients arrival rate was higher in deprived region as mean patients arrival rate in developed region was (4.25) against deprived region (6.50). The patient arrival rate was higher in deprived region because of few health opportunities available there. Hence overall, the operational efficiency of developed region could be improved by insuring the maximum presence of sanctioned staff. Be-

sides this staff should train enough to deal with advance instruments present in newly reconstructed and well facilitated BHUs. Alternatively it could improve the satisfaction of patients that further improves efficiency from beneficiary perspective. Although the mean satisfaction level of both developed (1.91) and deprived region (2.06) was lower on a five point likert scale, hence there is a need of overall strict monitoring and controlling to insure 100% staff availability and maximum service delivery, to improve patient's arrival rate and their satisfaction.

Operational Efficiency

To test the first hypothesis that is operational efficiency of basic health units is different across developed and deprived regions; independent sample t-test was applied as shown in Table 4.

Table 3: Measured efficiency of developed and deprived regions

BHU	Developed Region		Deprived Region	
	Operational Eff	**Beneficiary Eff**	**Operational Eff**	**Beneficiary Eff**
1	1.000	1.000	0.670	0.820
2	1.000	1.000	0.800	0.900
3	0.880	0.900	0.879	0.920
4	1.000	1.000	0.789	0.892
5	0.375	0.400	0.678	0.780
6	0.450	0.450	0.865	0.865
7	0.500	0.500	0.890	1.000
8	0.333	0.450	0.920	1.000
9	0.880	1.000	0.971	1.000
10	1.000	1.000	0.970	1.000
11	0.750	0.750	1.000	1.000
12	0.444	0.550	0.500	0.670
13	1.000	1.000	0.657	0.841
14	0.690	0.700	1.000	1.000
15	0.580	0.610	0.854	0.950
16	0.670	0.680	1.000	1.000
Mean	0.722	0.749	0.840	0.915

Table 4: Showing t-test results for difference of operational efficiency across developed and deprived regions

Variable	**Region**	**Number**	**Mean**	**Std. Dev.**	***t*-value**	***P*-Value**
Operational Efficiency	Developed	16	.722	.258	-.1.40	.171
	Deprived	16	.840	.217		

The t-test result shows that operational efficiency is not significantly different (t = -1.40, P = .171) across developed and deprived regions. Thus the first hypothesis of the study was not supported.

Efficiency from Beneficiary Perspective

To test the second hypothesis, which states that there is a difference of efficiency from the beneficiary perspective across developed and deprived regions, t-test was applied as shown in Table 5.

T-test result shows a significant difference of efficiency from the beneficiary perspective (t = -2.101, P = .044) across developed and deprived regions. The mean values of efficiency from table 6 show that the efficiency of deprived region (0.91) was higher than developed region (0.74). Thus hypothesis two was supported. The difference in efficiencies becomes significant by adding only one output variable 'patient satisfaction'.

Table 5: Showing t-test results for difference of beneficiary efficiency across developed and deprived regions

Variable	District	Number	Mean	Std. Dev.	*t*-value	*P*-Value
Efficiency from beneficiary perspective	Developed	16	.749	.26304	-2.101	.044
	Deprived	16	.915	.17307		

Discussion

In literature, most of efficiency measurement studies focused on operational perspective. So, the first hypothesis of the study compares the significant difference of operational efficiency of BHUs across deprived and developed regions. The *t*-test result shows no significant difference of operational efficiency across developed and deprived region. According to literature, quality of health projects could be best measured by patient satisfaction (51-56). So, a second hypothesis makes a comparison of mean efficiencies of BHUs from the beneficiary perspective across regions. The result revealed that mean efficiency of the BHUs of deprived region was significantly higher than that of the developed region. Yan et al. (57) achieved similar results for the comparison of patient satisfaction across rural and urban regions. Residents of deprived areas were more satisfied from public services than that of the developed areas (58). The reason for this was lower expectations for public services in deprived areas than in developed areas.

There was no significant difference of operational efficiency across regions but efficiency from a beneficiary perspective was significantly high in deprived region when only one output variable 'patient satisfaction' is added.

Limitations

The main limitation of research was the methods employed to collect primary data for out pout variables. Thus observation method to calculate patients per day and available staff, and self-reported data to measure patient satisfaction and services provided my distort data on which results of the study are based. Another limitation may be the use of the DEA approach to measure efficiency. In fact, this approach calculates relative efficiency. It allocates highest score 'one' to the most efficient DMU and rest of the DMUs will receive a score ranging from zero to one, depending upon their efficiency in relation to the most efficient DMU.

Conclusion

In Data Envelopment Analysis, if a DMU consumes more inputs than outputs it produces, then it becomes less efficient. In the current study, the developed region consumes more inputs in terms of sanctioned staff and salaries, and gives fewer outputs in terms of satisfaction and number of patients. Hence, lower inputs and more outputs make most of BHUs in a deprived region more efficient. It could be observed that by adding only one output variable 'satisfaction' different of efficiencies became significant. Hence, it is suggested that 'patient satisfaction' should be considered as an important output variable to determine the efficiency of health care units.

Ethical considerations

Ethical issues (Including plagiarism, Informed Consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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