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An Evaluation of Role of the Sub Centres in the Healthcare System in India towards Increasing Health Awareness with Special Reference to Delivery Care

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Abstract

Sub Centre under the publicly funded primary healthcare system in India is a health facility, which is manned by few paramedical staff and voluntary health workers. It is the first contact point between public healthcare system and the village community. The tasks of it are relating to interpersonal communication in order to bring about behavioural change and provide services in relation to maternal and child health, family welfare, nutrition, immunisation, and control of communicable and infectious diseases. In order to evaluate the functioning of such health facilities we have studied whether they have been too successful to promote institutional delivery care among rural mass. We have considered three categories of input, such as manpower, plant and equipment and intermediate goods and services. The output is nothing but the proportion of intuitional delivery within the jurisdiction of an SC. We have seen that the second and third categories of input work in the positive direction to influence the output. The manpower category gives somewhat negative signal. It implies that an SC with adequate manpower could not establish good relationship with the village community and spread its messages on promotive care. However, we observed that there are some States or Union Territories (such as Puducherry, Tamil Nadu and Karnataka), which attained or nearly attained success. Others should follow such success stories to adopt appropriate strategies for better outcome. The study utilises data from the Facility Survey – 4, which was conducted during 2012-2013 and published in 2015.

Keywords: Institutional delivery care, National Rural Health Mission, Primary Healthcare, Public Healthcare system, Sub-Health Centre

1. Introduction

The primary healthcare system in India has been developed to provide preventive and curative healthcare services to the vast majority of rural people. It comprises

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three types of healthcare institutions: Sub Centre (SC), Primary Health Centre (PHC) and Community Health Centre (CHC). The SC is the most peripheral and first contact point between the primary health caresystem and the village community. They are assigned tasks relating to interpersonal communication in order to bring about behavioural change and provide services in relation to maternal and child health, family welfare, nutrition, immunisation, and control of communicable and infectious diseases (GOI, 2015). According to the national norms of population coverage there should be one SC for 5000 population in plain area and 3000 in hilly / tribal area. An SC is run by two paramedical staff and one voluntary worker. Paramedical staff may include one Health Worker (Female) /Auxiliary Nurse Midwife (ANM) and one Health Worker (Male). Under NRHM (National Rural Health Mission), there is a provision for one additional second ANM on contract basis. It implies that an SC may be manned by as many as four personnel to fulfil its objectives as stated above.

In order to ensure that SCs rightly promote access to improved healthcare at household level, NRHM, as a part of its supplementary strategies, recommended one additional female Accredited Social Health Activist (ASHA) for every village (or large habitation). ASHA workers are chosen by and accountable to the panchayat – to act as the interface between the community and the public healthcare system (GOI, 2015).

According to Rural Health Statistics 2016-2017 (GOI, 2017), as on 31st March 2017, there were 156231 Sub Centres (SCs) in the Country. Manpower statistics, particularly the number of Auxiliary Nurse Midwives (ANMs) in position at the peripheral units, are not available directly. The above-mentioned report displays data on ANM in a combined manner for SCs and Primary Health Centres (PHCs). For example, as on 31st March 2017, there were 25650 PHCs in the Country and there were 220707 AMNs in position in both the healthcare institutions. In order for strengthening of infrastructure of SCs, each Centre has an Untied Fund of Rs. 10,000 per annum for local action. This Fund is meant for supply of allopathic and indigenous medicines and provision of an additional ANM. An annual maintenance grant of Rs. 10,000 is also made available to every SC to undertake and supervise improvement and maintenance of the facility. Number of SCs in the States and Union Territories in India is shown in table 1 below.

Table 1. Availability of Sub Centres in States and Union Territories in India

State/Union Territories	Number of Sub Centres (as on March 2017)	%
Andhra Pradesh	7458	4.77
Arunachal Pradesh	312	0.20
Assam	4621	2.96
Bihar	9949	6.37
Chhattisgarh	5186	3.32
Goa	214	0.14
Gujarat	9082	5.81
Haryana	2589	1.66
Himachal Pradesh	2083	1.33
Jammu & Kashmir	2967	1.90
Jharkhand	3848	2.46
Karnataka	9381	6.00
Kerala	5380	3.44
Madhya Pradesh	9192	5.88
Maharashtra	10580	6.77
Manipur	421	0.27
Meghalaya	436	0.28
Mizoram	370	0.24
Nagaland	396	0.25
Odisha	6688	4.28
Punjab	2950	1.89
Rajasthan	14406	9.22

Sikkim	147	0.09
Tamil Nadu	8712	5.58
Telangana	4797	3.07
Tripura	987	0.63
Uttarakhand	1847	1.18
Uttar Pradesh	20521	13.14
West Bengal	10369	6.64
A & N Islands	123	0.08
Chandigarh	17	0.01
D & N Haveli	71	0.05
Daman & Diu	26	0.02
Delhi	10	0.01
Lakshadweep	14	0.01
Puducherry	81	0.05
India (Total)	156231	100

Source: Rural Health Statistics 2016-2017

Given the infrastructure and strategies, as above, this paper tries to evaluate the role of the Sub Centres to increase health awareness in rural parts of the Country. As the activities of SCs round about preventive and promotive cares, this paper examines whether the SCs have been too successful to fulfil their objectives particularly, in promoting institutional delivery care among the eligible rural mass.

2. Data and method

The study utilises data from the Facility Survey – 4, which was conducted during 2012-2013 and published in 2015 by the International Institute for Population Sciences, Mumbai and which was sponsored by the Ministry of health and Family Welfare, Government of India.

The survey covered 18367 SCs in 30 States and Union Territories in India. It provides information on input used by the system and some output related data.

Such an input-output specification was done by Fuchs (1966) considering an healthcare system as one healthcare industry. For example, for each SC, it provides information on: (i) manpower, (ii) plant and equipment, and (iii) intermediate goods and services. On the other hand, in regard to output (among other), it provides information on number of home delivery (when available) as well as total number of deliveries (when available) within the jurisdiction of an SC. Information on these two enable us to compute proportion of institutional delivery within the jurisdiction of an SC. Here, institutional delivery does not imply deliveries performed in primary or public healthcare system only. It may comprise institutional delivery of any type including those in private healthcare institutions too. If we assume that creating awareness on institutional delivery is the prime objective of SCs, we may judge success or failure of the system by looking at the proportion of institutional delivery.

Table 2 below shows about how we process data on input used and output produced by the system. With manpower, other components of input are chosen in such a way, so that we can judge whether an SC is functioning well in all possible directions. When an SC functions well, it will be easier for it to establish good relationship with the village community. For example, we have considered a variable – whether IFA tablets are available or not. When IFA tablets are available, those will be distributed to pregnant mothers and obviously there will be some communication or discussion between the patients and care providers on institutional delivery. Based on the specifications mentioned in table 2, we present State level average data in table 3 and district level average data for West Bengal in table 4 respectively. It is to be kept in mind that although there are 18367 cases, some are filtered out for incomplete information leading to 17111 cases available for analysis.

Table 2. Variable description: input used & output produced by the system

Type	Variable name*	Components	Specifications	Value
Input variables	Manpower: X_1 (Contractual & regular)	Auxiliary Nurse Midwife (ANM) available	Yes: 1 No: 0	Aggregate of the four
		Male health worker available	Yes: 1 No: 0	

		Additional ANM available	Yes: 1 No: 0	
		Voluntary health worker available	Yes: 1 No: 0	
	Plant and equipment: X_2 (Condition of the building)	Condition of the building	Good: 1 Satisfactory: 0.67 Needs repair: 0.33	Aggregate of the two
		Toilet facility	Yes: 1 No: 0	
	Intermediate goods and services: X_3 (Drugs etc.)	Iron Folic Tablets (IFA) available	Yes: 1 No: 0	Aggregate of the three
		Vitamin A tablets available	Yes: 1 No: 0	
		Oral Rehydration Solution (ORS) available	Yes: 1 No: 0	
Output	Proportion of institutional delivery: Y	Number of home delivery– HD (within the reference period)	Actual number	(TD – HD) ÷ TD
		Number of total deliveries – TD (within the reference period)	Actual number	

Other relevant variables	ASHA worker	ASHA worker available under one SC	Actual number	Actual number
	Population coverage	Population covered by an SC	Actual number	Actual number

Source: Self-elaboration

We also try to explore the relationship between input and output at various levels (such as, SC, district and State levels) by drawing scatter plots. Except for State level, we did not find any specific relationship with individual SC level or district level data. Finally, we estimate Cobb-Douglas type production function for the SCs utilising the relationship between input and output at State level.

Estimation of Cobb-Douglas type production function is not new in health economics literature. Feldstein (1967) estimated Cobb-Douglas type production function of hospitals for the first time for the British National Health Service. Such a framework was found to be very useful for planning purposes and numerous studies have replicated it.

Mathematically, a Cobb-Douglas production function takes the following form:

$$y = \alpha + \sum_{i=1}^{n} \beta_i x + \varepsilon, \qquad (1)$$

where, y and x stand for the natural logarithms of the output (Y) and inputs (X_i) respectively; β is coefficient of input and α is the intercept, which are to be estimated through OLS; ε is the error term, and i = 1, 2, …, n. When estimated:

$$\hat{y} = \alpha + \sum_{i=1}^{n} \beta_i x. \qquad (2)$$

Specification of the variables is shown in table 2.

3. Results

3.1. Descriptive statistics

We see from table 3 that in terms of manpower, Maharashtra scores the highest with a value of 0.663 followed by Manipur (0.660), Mizoram (0.655) and Assam (0.618); and Tamil Nadu scores the lowest with a value of 0.285. Uttar Pradesh (0.288), Bihar (0.345) and Karnataka (0.358) precede Tamil Nadu in the scale. West Bengal occupies the seventh position with a score of 0.570.

The score under the category of plant does not vary much. It ranges from 0.805 (Manipur) to 0.960 (Kerala). It implies that building condition of the SCs does not differ much across States.

The third category of input (availability of drugs etc.) appears to be very important, as score varies from 0.423 (Uttrakhand) to 0.973 (Andhra Pradesh). Sikkim (0.970), Andaman & Nicobar Islands (0.963), Haryana (0.960) and others succeed Andhra Pradesh in the same scale in terms of score value. The poorly equipped States under this category are Manipur (0.503), Arunachal Pradesh (0.500) and Meghalaya (0.470).

When we look at the output measured in terms of proportion of institutional delivery, Puducherry stands first with a score value of 1.000 followed by Tamil Nadu (0.989), Karnataka (0.968), Maharashtra (0.960) and others. In terms of output, Manipur scores the lowest with a value of 0.089. It implies that nearly 9 per cent of the deliveries are institutional in Manipur. The score is second lowest in Bihar, where 10 per cent of the deliveries only are institutional.

Although we have seen that Tamil Nadu remains at the bottom in terms of utilising manpower, it has a very good score in terms of output – nearly 99 per cent of the deliveries are institutional. So, mere comparison of the average level figures may not reveal the true picture of the relationship between inputs and output. We explore functional relationship (if any) between inputs and output in the next section.

If we look at table 4, we see that in West Bengal under the category of manpower, Cooch Behar has the highest score (0.695) and Hugli has the lowest (0.428). In case of plant, all the districts have good scores, which vary from 0.835 (South 24 Parganas) to 0.970 (Dakshan Dinajpur). For the third input (drugs), score varies sharply across districts. Haora has the highest score (1.000) and Birbhum has the lowest (0.543). When we look at the output, Darjeeling comes first with an institutional delivery of 96.1 per cent. Other well-performed districts are: Bardhaman (0.830) and Paschim Medinipur (0.803). The score of institutional delivery is the lowest in Maldah (0.219). The same is significantly low in some other districts, such as Bankura (0.242) and Uttar Dinajpur (0.270).

3.2. Relationship between inputs and output

In order to explore the relationship between manpower and proportion of institutional delivery, we go for a scatter plot between the variables and try to draw a regression line summarising the relationship. The plot is shown below. In all the present and subsequent exercises, we utilise State level data from table 3.

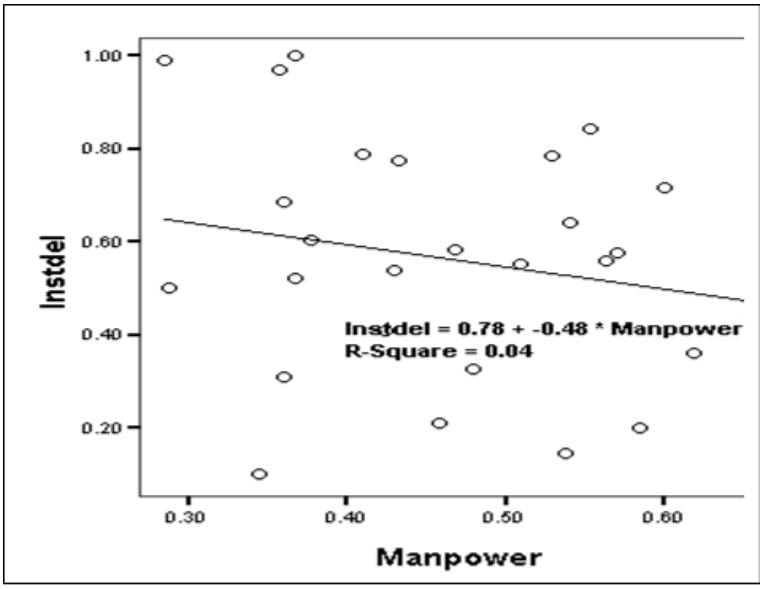

Figure 1. Relationship between manpower and institutional delivery

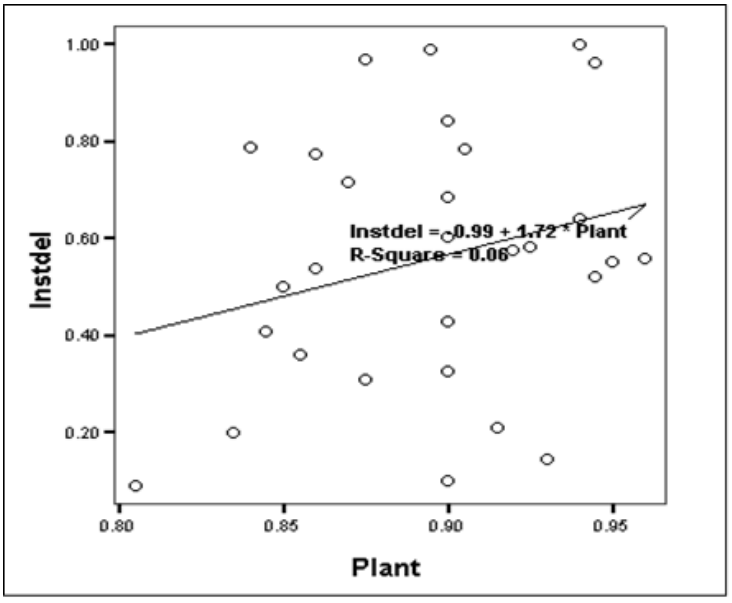

Figure 2. Relationship between building condition and institutional delivery

Table 3. Input used and output produced by the system in major States and Union Territories in India

States / Union Territories	Manpower*	Plant*	Drugs*	ASHA**	Population coverage**	Institutional delivery*	n	%
A & N Islands	0.433	0.860	0.963	2.67	1629	0.773	54	0.0
Andhra Pradesh	0.553	0.900	0.973	4.51	5042	0.841	459	3.0
Arunachal Pradesh	0.458	0.915	0.500	4.58	1693	0.209	109	1.0
Assam	0.618	0.855	0.890	5.53	5422	0.361	826	5.0
Bihar	0.345	0.900	0.753	7.71	9223	0.100	1808	11.0
Chandigarh	0.510	0.950	0.943	0.17	10722	0.551	23	0.0
Chhattisgarh	0.425	0.845	0.953	13.38	4671	0.408	798	5.0
Goa	0.523	0.890	0.887	0	5791	.	47	0.0
Haryana	0.600	0.870	0.960	6.59	7788	0.715	664	4.0
Himachal Pradesh	0.378	0.900	0.943	0.17	3350	0.602	255	2.0
Jharkhand	0.468	0.925	0.563	9.96	7686	0.581	678	4.0
Karnataka	0.358	0.875	0.780	3.62	5176	0.968	1018	6.0
Kerala	0.563	0.960	0.847	3.28	7384	0.558	145	1.0
Madhya Pradesh	0.410	0.840	0.953	6.40	6191	0.788	1394	8.0
Maharashtra	0.663	0.945	0.947	4.78	6116	0.960	977	6.0
Manipur	0.660	0.805	0.503	6.92	4635	0.089	144	1.0
Meghalaya	0.538	0.930	0.470	8.28	6880	0.144	165	1.0
Mizoram	0.655	0.900	0.857	2.42	2591	0.429	134	1.0
Nagaland	0.585	0.835	0.830	1.87	2128	0.200	143	1.0

Odisha	0.430	0.860	0.953	6.67	6242	0.538	1420	8.0
Puduchery	0.368	0.940	0.860	0	3906	1.000	19	0.0
Punjab	0.480	0.900	0.670	5.63	6434	0.326	637	4.0
Rajasthan	0.360	0.900	0.837	2.91	3941	0.685	984	6.0
Sikkim	0.540	0.940	0.970	3.16	2151	0.640	74	0.0
Tamil Nadu	0.285	0.895	0.860	0.09	6073	0.989	223	1.0
Telangana	0.530	0.905	0.933	4.55	5205	0.785	255	2.0
Tripura	0.368	0.945	0.710	8.27	4249	0.519	101	1.0
Uttar Pradesh	0.288	0.850	0.727	5.84	8075	0.499	2510	15.0
Uttarakhand	0.360	0.875	0.423	5.06	3883	0.307	555	3.0
West Bengal	0.570	0.920	0.710	4.34	7468	0.576	492	3.0
India	0.477	0.894	0.806	4.65	5392	0.557	17111	100

[*] In (0-1) point scale; [**] Average figures;

Source: Self-elaboration of Facility Survey – 4 data

Table 4. Input used and output produced by the system in major districts in West Bengal

Districts	Manpower*	Plant*	Drugs*	ASHA**	Population coverage**	institutional delivery*	n	%
Bankura	0.573	0.880	0.610	4.38	7134	0.242	24	4.9
Barddhaman	0.478	0.925	0.553	4.75	9240	0.830	32	6.5
Birbhum	0.533	0.940	0.543	4.50	7244	0.520	24	4.9
Cooch Behar	0.695	0.925	0.643	5.15	6447	0.734	27	5.5
DakshinDinajpur	0.570	0.970	0.880	4.40	6532	0.725	25	5.1
Darjiling	0.638	0.905	0.817	3.33	7248	0.961	33	6.7
Haora	0.523	0.950	1.000	2.41	7967	0.494	22	4.5
Hugli	0.428	0.870	0.623	4.84	6665	0.780	31	6.3
Jalpaiguri	0.608	0.940	0.710	3.00	7081	0.717	30	6.1
Maldah	0.500	0.945	0.653	5.62	7904	0.219	26	5.3
Murshidabad	0.590	0.875	0.690	5.29	8045	0.785	28	5.7
Nadia	0.640	0.915	0.597	4.94	10029	0.464	34	6.9
North 24 Parganas	0.475	0.970	0.633	4.19	7023	0.402	31	6.3
PaschimMedinipur	0.590	0.885	0.840	4.08	6555	0.803	25	5.1
PurbaMednipur	0.683	0.925	0.897	5.69	6779	0.421	26	5.3
Puruliya	0.620	0.945	0.883	3.35	6086	0.678	23	4.7
South 24 Parganas	0.595	0.835	0.680	3.62	7195	0.707	26	5.3
Uttar Dinajpur	0.560	0.945	0.680	4.12	8233	0.270	25	5.1
West Bengal	0.570	0.920	0.710	4.34	7468	0.576	492	100

* In (0-1) point scale; ** Average figures;

Source: Self-elaboration of Facility Survey – 4 data

The relationship appears to be somewhat negative. However, it does not mean that in order to increase intuitional delivery one should reduce manpower. Usually, we think that when an SC is fully equipped with manpower, it functions well. However, the relationship gives a negative signal. It means that SCs with full manpower did not able to motivate the rural community well. This is the reason that the States, which performed well in terms of output, remains at the bottom in terms of scores under the manpower category.

As above, we repeat the exercise for the second input – plant. The relationship is shown below. In this case, we have found some sort of positive relationship. It implies that condition of the building has positive impact on its current or potential users.

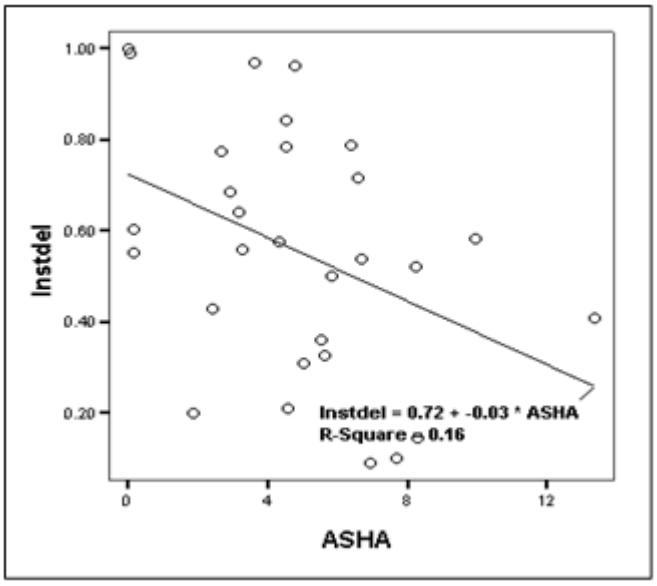

Figure 3. Relationship between drugs availability and institutional delivery

We present the relationship between institutional delivery and drugs in figure 3 above, which is found to be a significant one. We see that the single variable – availability of drugs is able to explain 36 per cent of the variation in output. Two other relevant variables were also considered: number of ASHA worker under an SC and population covered by an SC. We plot the relationship of the two variables with output in figures 4 and 5. The relationship between number of ASHA worker under an SC and institutional delivery is negative. As per NRHM objectives, ASHA would act as a bridge between the ANM and the village. However, the negative relationship raises a question whether they have been too successful to fulfil their objectives. The final variable of population coverage of an SC has no relationship with institutional delivery.

After exploring the individual relationship of the input and other variables with the output respectively, we will now go for estimating a Cobb-Douglas type production function for the Sub Centres considering the three input variables and the output.

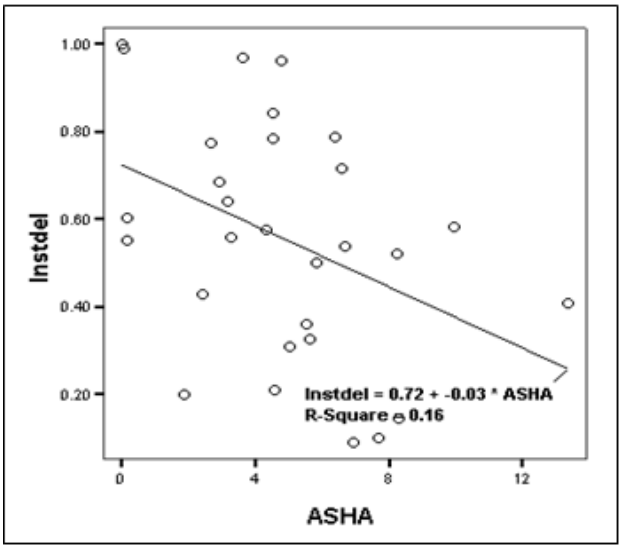

Figure 4. Relationship between availability of ASHA worker and institutional delivery

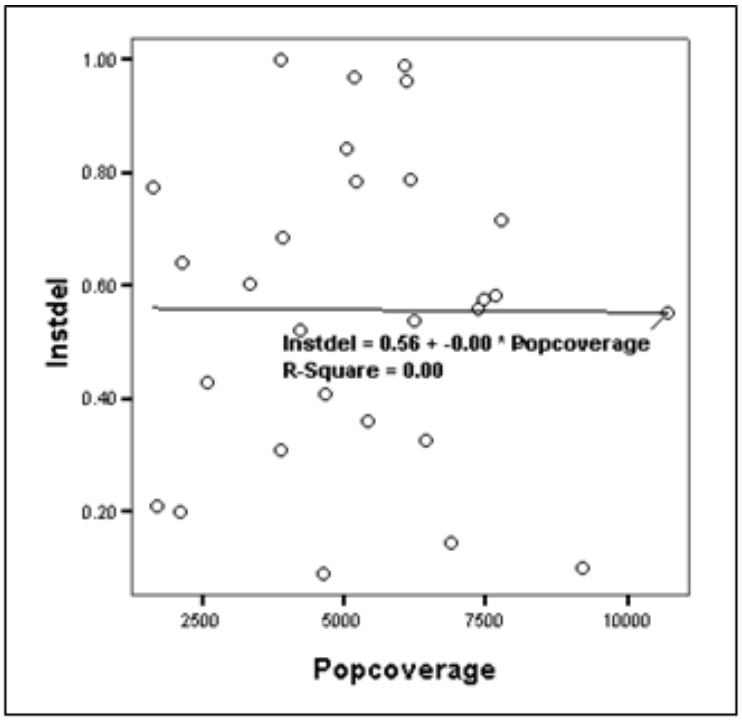

Figure 5. Relationship between population coverage and institutional delivery

3.3. Cobb-Douglas type production function for the Sub Centres

Results of multivariate analysis are shown in table 5. It is to be remembered that estimation of Cobb-Douglas type production function for health facilities using input variables belong to the supply-side economics of healthcare. Factors in the demand-side, such as socio-economic and demographic characteristics of the subjects are not considered in the model. Consideration of such factors is beyond the scope of this study, as Facility Survey does not provide such compatible information. However, we see that supply-side factors have been able to explain nearly 50 per cent of the variation in output (as reflected from R square value).

Table 5. The Summary and goodness of fit statistics of the Cobb-Douglas type production function

Statistic	Value	Standard error	F or t♣	Sig.	Tolerance	VIF
R square	0.529	0.481	9.354	0.000	-	-
Constant	-4.309	1.218	-3.538	0.002	-	-
Manpower (X_1)	-0.649	0.371	-1.749	0.093	0.993	1.007
Plant(X_2)	4.278	2.016	2.122	0.044	0.997	1.003
Drugs (X_3)	1.727	0.373	4.635	0.000	0.996	1.004

Dependent variable: Proportion of institutional delivery; All variables are transformed taking natural logarithm

♣ F for adjusted R square, t for the constant and the coefficients

Source: Self-elaboration

The independent variables are free from the problem of multicollinearity. For example, tolerance limit of the variable, manpower is 0.993. It implies that when manpower is considered as a dependent variable and plant and drugs as independent ones respectively, the latter explains a very small amount of variation in the former (R square = 1- 0.993 = 0.007). VIF of manpower is 1.007, which is nothing but 1 ÷ tolerance (VIF = 1 ÷ 0.993 = 1.007). When VIF exceeds 5 (meaning R square is more than 0.800), it is considered significant indicating multicollinearity.

As mentioned in the previous section (and as shown in figure 1), we know that there exists a negative relationship between manpower used in the system and output produced. Here, when the effects of plant and drugs are controlled, the elasticity coefficient of manpower became -0.649. It tells that one per cent increase in the index of manpower will lead to a decline in proportion of institutional delivery by 0.649 per cent. This is not anticipated. It implies that the workability and consequent appeal of the category of manpower somewhat goes to the opposite direction of the objective of the system. In general, under the current situation, an SC equipped with full manpower motivates the village community about institutional delivery care less than an SC does with insufficient staff. The issue is to be addressed in a proper manner.

The elasticity coefficient of plant appears to be 4.278. The variable shows the relationship between building condition (and availability of toilet facility) and output. It implies that when effects of other variables are controlled, one per cent increase in the score of this variable will lead to more than 4 per cent increase in the output. When building condition of one health facility is good (with other

basic amenities, such as toilet etc.), more patients are likely to visit the facility and consequently there are more chances of dissemination of the objectives of the system among common mass.

The third coefficient shows the relationship between availability of essential drugs etc. with output. The elasticity coefficient is 1.727. It tells that for one per cent increase in the index of availability of drugs etc., output increases by 1.727 per cent. This factor also works in the positive direction as mentioned above.

4. Conclusion

Sub Centre under the publicly funded primary healthcare system in India is a health facility, which is manned by few paramedical staff and voluntary health workers. It is the first contact point between public healthcare system and the village community. It is assigned tasks relating to interpersonal communication in order to bring about behavioural change and provide services in relation to maternal and child health, family welfare, nutrition, immunisation, and control of communicable and infectious diseases. In order to evaluate the functioning of such health facilities we have studied whether they have been too successful to promote institutional delivery care among rural mass. By institutional delivery we tried to mean the cases where the deliveries are performed in any public or private health facilities. From methodological perspective, we have considered the healthcare system as an healthcare industry, which uses different inputs, such as manpower, plant and equipment (building condition, availability of toilet etc.) and intermediate goods and services (availability of essential drugs etc.) and produces output. The technical objective of the study has been to assess the relationship between the inputs and output. As the prime objective of the Sub Centres rounds about preventive and promotive care, output of such a system can be viewed in terms of changing behaviour or preferences among rural community in regard to a certain health issue. For example, we have considered proportion of institutional delivery in an area under the jurisdiction of an SC as an output. It will help us to judge whether an SC has been able to motivate people under its jurisdiction on the subject matter. We have considered three categories of input, and out of these the second and third categories work in the desired direction. The manpower category gives somewhat negative signal. It shows that when manpower increases, output tends to decline. It implies that an SC with adequate manpower could not establish good relationship with village community and spread its messages on promotive care. We have seen that the National Rural Health Mission (NRHM), under one of its main strategies, made a provision of one more additional (contractual) ANM for each of the SCs. Further, as a part of supplementary strategy, the NRHM made a provision of one more voluntary worker (outside the healthcare system, who will be accountable to the panchayat)

namely, Accredited Social Health Activist (ASHA) for each village or locality. The primary role of ASHA is to strengthen the functioning of an SC by bridging the gap between the village community and public healthcare system. In general, fruits of such initiatives are yet to be observed. If having adequate manpower is considered as a necessary condition, the sufficient condition is to establish good relationship with the village community. However, on the good side, we have observed that there are some States or Union Territories (such as Puducherry, Tamil Nadu and Karnataka), which attained or nearly attained success. Others should follow such success stories to adopt appropriate strategies for better outcome.

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