Can Health schemes ensure Completion of treatment for Cancer patients? A Study in the context of South Assam

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Abstract: The study tries to address a pertinent question as to why the stipulated course of treatments of cancer (especially oral cancer- the most prevalent type) are not completed for a significant proportion of cancer patients in a backward area of Assam. In this context, the study tries to understand the role of Government funded health schemes'- Pradhan Mantri Jan Arogya Yojana (PM-JAY) and Atal Amrit Abhiyan's (AAA) implementation in South Assam. It is observed that the probability of completion of treatment has improved significantly to 63.9 percent from 17.9 percent after the implementation of these health schemes. This however does not explain fully the apparent puzzle of non-completion of the treatment. While fund flow dynamics involved with the schemes (essentially positioned as Economic reason) improves the scenario, the analysis of available data suggests that interaction effect of demographic factor (age in particular) and medical factor (pertaining to treatment techniques) provides a possible explanation for such non-completion of treatment even in the post intervention period. The study has been first of its kind in Assam and is expected to have several policy implications.

Keywords: Atal Amrit Abhiyan, Cancer, Demography, Government, Pradhan Mantri Jan Arogya Yojana, Public Health.

Introduction

Cancer has been emerging as a major public health concern in India and other parts of the world due to ongoing demographic and epidemiological transition (Rajpal et al., 2018). Looking at the global scenario and studying the cancer incidence related spatial data, it is found that the incidence of oral cancer patients is more compared to others (Gupta et al., 2017). It has been observed that 3,69,200 new cases of oral cancer were reported worldwide very recently with two-thirds diagnosed in developing countries (Ghantous et al., 2017). Oral cancer is expected to comprise 30 percent of total cancer burden by 2020 in Assam; and the same is expected to comprise 50 percent of total cases in the southern region of Assam (Sharma et al., 2014). The research theme has thus been finalised with a focus on south Assam keeping the broad canvass in mind.

Understanding from the treatment perspective, it was observed that most of the patients in South Assam like other parts of India have not been able to afford the expensive treatments commonly available at the treatment centres (hospitals in particular). Under this backdrop, Cachar Cancer Hospital and Research Centre was established in south Assam with a ray of hope popularising the vision "that no patient is denied appropriate cancer treatment for want of resources, and that no family suffers treatment induced poverty and grief". It has been the only exhaustive cancer care centre with the provisions of treatment, education and research on cancer

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in south Assam (*https://cacharcancerhospital.org*). As per the hospital register, 516, 506 and 631 oral cancer patients were admitted in the hospital for the years 2017, 2018 and 2019 respectively.

Questions normally arise: how the funding for the treatment of cancer has been managed so far? Does fund flow ensure completion of treatment of cancer? The government health schemes, especially for economically backward sections as is well known, is expected to support the treatment of cancer (Keshri et al., 2020). Major health schemes implemented in Assam since 2016 have been Pradhan Mantri Jan Arogya Yojana (PM-JAY) and Atal Amrit Abhiyan (AAA). The objectives of both the schemes were to support the treatments of cancer for economically vulnerable patients in Assam. Present study tries to understand the impact of these two health schemes on treatment of oral cancer patients of south Assam. Going little further, it is interesting to observe that treatment of cancer has often not been completed even after the fund flow ensured through the schemes. The study tries to provide an explanation for this apparent puzzle. Analysis of available data suggests that the interaction of demographic and medical factors restricts the continuation of treatment. Thus, the broader research question addresses the issue how successful the national health schemes have been as regards to the treatment of cancer (oral cancer in particular). The policy implication of this study in the context of Assam might be well perceived.

Review of literature

Cancer is considered as a major public health concern not only due the suffering of individual patients but for the significant impact it creates on the society as a whole (Chu et al., 2008). As mentioned earlier, the incidence of oral cancer has been more severe as compared to other types (Agarwal et al., 2017). Since treatment of cancer has been quite expensive, health schemes rolled out were expected to provide some relief to the patient parties concerned. (Angell et al., 2019). The implementation of health schemes in India like *Pradhan Mantri Jan Arogya Yojana (PMJAY), Ayushman Bharat* in letter and spirit (meaning thereby the appropriate implementation by the agency/organisation for a desired result) was expected to be a game changer. Various views expressed on this including the design issues relating to implementation (Keshri et al., 2020, Lahariya, 2018, Yadawar, 2020). Studies mention that awareness campaigns to disseminate the importance of the schemes has been the key to success (Agarwal et al., 2017). Some studies also highlighted the financial inclusion aspect brought about through introduction of health schemes like PMJAY scheme (Ravindra et al., 2020).

However, limited research has been undertaken to focus on the impact of the health schemes in the case of treatment of dreaded diseases (like cancer) especially in the context of backward areas. Such areas in our country have under- developed medical infrastructure and level of living of the people are lower compared to developed regions. In particular, no evidence in the available literature has been found to answer a robust question as to whether health schemes have encouraged continuation of treatment of cancer patients (especially suffering from oral cancer). Neither, the existing literature in the context of India tries to identify the pitfalls behind the non-continuation of treatment by a small proportion of cancer patients in spite of the implementation of health schemes. Current study under the limited domain of South Assam tries to fill up the gap in the literature available so far.

Objective of the study

The paper tries to separate out the economic and non-economic factors carefully as possible explanation behind the continuation of treatment of oral cancer patients in South Assam. In particular, the impact of the health schemes has been measured bringing in the interactive effects of various factors. The counterfactual as to why treatments are discontinued even after the implementation of health schemes have also been explained to some extent with the aid of demographic and medical parameters.

The paper in a nutshell is designed keeping in view the following objectives:

- To understand the importance of economic and selective non-economic factors (as referred to by medical professionals) explaining the completion of treatment of cancer prior to the implementation of the health schemes.
- To understand the importance of economic and selective non-economic factors (as referred to by medical professionals) explaining the completion of treatment of cancer in the post-implementation period of the health schemes.
- The study also tries to provide a possible explanation of non-completion of treatment even after the implementation of health schemes (often interpreted through public perception as the failure of health schemes by mistake due to the lack of solid evidence).

Materials and Methods

The Study is based on the secondary data provided by the Cachar Cancer Hospital and Research Centre, Silchar, Assam covering a time period 2014 to 2019 The hospital endeavors to provide best possible treatment to all the patients by keeping the cost of all services as low as possible without compromising on quality. It is observed that 80 percent of patients are daily wage earners and 50 percent earning meagre wages (*https://cacharcancerhospital.org*).

Out of a total of 2604 patients suffering from different types of cancer, we have selected 1652 oral cancer patients considering the dominance of this type of cancer in the area. We have also collected the data on the implementation of Government funded health schemes. We have segregated the data into pre-intervention and post intervention period. Further, looking at the profile of the patients, they have been categorized as Below Poverty Line (BPL) and Above Poverty line (APL) beneficiaries. It is observed that there has been a spurt of BPL patients' admission just after the implementation of the health schemes in 2016. This exactly coincides with the introduction of health schemes in the area (see **Table 1**). One may immediately question the efficacy of the schemes as all the patients do not complete the treatment even after the support received from the health schemes. Domain information was gathered in consultation with medical professionals (doctors in particular). Doctors opine that demographic variable (like age) and medical factors (like size of the tumour, size of the node, blood sugar level and different treatment techniques or therapies) should be considered as other explanatory factors for non-completion of treatment. Our analysis basically tries to capture all these. The following table provides the details for pre and post intervention period.

II. alth Calcana	Periods -	Above Po	verty Line	Below Poverty Line		
Health Schemes		Complete	Incomplete	Complete	Incomplete	
Before PMJAY/AAA	2014	61 (52%)	57 (48%)	13 (10%)	113 (90%)	
	2015	56 (39%)	89 (61%)	20 (14%)	119 (86%)	
	2016	77 (75%)	25 (25%)	28 (15%)	156 (85%)	
After PMJAY/AAA	2017	98 (85%)	17 (15%)	117 (91%)	11 (9%)	
	2018	114 (93%)	9 (7%)	142 (95%)	8 (5%)	
	2019	119 (79%)	31 (21%)	140 (81%)	32 (19%)	

Table 1: Completion and Incompletion of treatment before and after implementation of health

 schemes

Chi square test for independent of attributes have been undertaken to compare both the poverty line in terms of completion and incompletion of treatment separately. The null hypothesis to be tested is

 H_0 : There is no association between the poverty lines in terms of the completion and incompletion of the treatments among the patients.

against the alternative hypothesis,

 H_1 : There is association between the poverty lines in terms of the completion and incompletion of the treatments among the patients.

Binary logistic regression model is applied to analyze the probability of completion of treatment before and after implementation of these two health schemes. Various factors explaining the continuation of treatment has also been included in the analysis. The model stated below.

$$p = \frac{e^{\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6}}{1 + e^{\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6}}$$

where p = Probability of completion of the treatment

 X_1 = Economic Status (Above Poverty Line / Below Poverty Line)

Medical factors:

 x_2 = Tumor size (> 2 Centimeter / < 2 Centimeter)

 x_3 = Node size (> 1 Centimeter / < 1 Centimeter)

 X_4 = Blood Sugar Level (> 140 mg/dL / < 140 mg/dL)

 $X_5 = Age (in years)$

 X_6 = Treatment techniques/Therapies (Chemotherapy / Radiotherapy)

Note that, the factor 'Economic Status', 'Tumour size', 'Node size', 'Blood Sugar Level', 'Treatment' is considered as categorical variables and 'Age' is considered as continuous variable. Following (Nair et al., 2014) and considering the treatment of cancer to be expensive, economic burden is considered as an important variable. This is expected to impact the continuation of treatment among cancer patients.

Can Health schemes ensure Completion of treatment for Cancer patients? A Study in the context of South Assam

'Tumour size', on the other hand, is considered to be the best measure of tumour behaviour in cancer. Patients with a primary tumour size of less than 1 cm mostly exhibit 10 percent to 20 percent for nodal metastasis. This directly follows from available studies on the subject(Carter et al., 1989). This in turn implies a 10-year disease-free survival rate (about 90 percent). It is worth seeing how continuation of treatment is affected by the tumor size.

Axillary 'lymph node size' has been described as the second most important prognostic factor in relation to disease-free survival, as well as overall survival in cancer. 70 percent of node-positive patients are likely to develop recurrence compared to only 20-30 percent of node-negative patients (Veronesi et al., 1993). We want to explore the relation between Lymph node size and continuation of treatment.

One research reveals that treatment through Chemotherapy in high blood sugar cancer patients act as painful outcome causing harmful damage in several other parts of the body as compared to the normal cancer patents (Baskar et al., 2012). Thus, blood sugar level is an important factor and can be included as a factor/covariate in the study. Treatment procedures specific to a case might thus have interesting implications in the context of continuation of treatment.

Most of the studies on cancer mentions age as one of the crucial factors. Some studies also mention the incidence of most cancers increases with age (White et al., 2014). It is also well known that 'Treatment' at early stage of cancer can relieve the pain as well prevent the metastasis (Sun et al., 2017). We aim to explore how continuity of treatment is affected due to age factor of the patient.

In a nutshell, we try to identify economic, medical and demographic factors in place which might have influenced continuity of treatment in case of oral cancer.

Results

As mentioned earlier, we are trying to explain the huge jump that has occurred in terms of completion of treatment of cancer patients belonging to BPL families just after 2016 (see **Figure 1**). Interestingly, this coincides with the inception of health schemes (PMJAY/AAA in particular). We suspect that economic factor in terms of financial support provided through the schemes have brought about this drastic change. Question normally arises as to why 100% completion of treatment was not ensured for all the BPL families. With seemingly no financial constraint, why 100% completion was never observed for APL families too? This persuades us to explore more and find out reasons beyond economic reasons. Through interaction with cancer specialist of the hospital and elsewhere, it was understood that beyond financial reasoning, other factors (like demographic including age and medical factors like size of the tumor and suitability of specific medical techniques) played a significant role to explain the non-completion of treatment. The statistical analysis takes care of all these mentioned.

Figure 1: Percentages of completion of treatment before and after intervention of the health schemes



Now, we apply chi square test for independent of attributes to compare both the poverty line in terms of completion and incompletion of treatment separately and thus construct the following table.

Table 2: Result of Chi square test for comparison of both the poverty line in terms of completion						
and incompletion of treatment						

Periods	APL (No. of Patients Complete the Treatment)	BPL (No. of Patients Complete the Treatment)	p value	APL (No. of Patients Incomplete the Treatment)	BPL (No. of Patients Incomplete the Treatment)	p value
2014	61	13		57	113	
2015	56	20		89	119	
2016	77	28	0.001	25	156	0.002
2017	98	117	0.001	17	11	0.002
2018	114	142		9	8	
2019	119	140		31	32	

We obtain from the above table (Table 2) that there are associations between the poverty lines in terms of completion and incompletion of treatment as *p*-values are less than 0.05.

In addition to this, we construct the following table to observe the association of all the selective factors (Economic Status, Tumour Size, Node Size, Blood Sugar Level, Age and Treatment techniques) with completion and incompletion of treatment among oral cancer patients along with chi square test for better understanding of the study and results.

Can Health schemes ensure Completion of treatment for Cancer patients? A Study in the context of South Assam

Festers	Status of T			
Factors	Complete	Incomplete	p value	
Age groups				
Less than 30	79 (10.76%)	95 (10.35%)		
30-34	90 (12.26%)	92 (10.02%)		
35-39	88 (11.99%)	90 (9.80%)		
40-44	89 (12.13%)	96 (10.46%)		
45-49	90 (12.26%)	95 (10.35%)	0.025	
50-54	55 (7.49%)	94 (10.24%)		
55-59	46 (6.27%)	90 (9.80%)		
60-64	54 (7.36%)	84 (9.15%)		
65-69	78 (10.63%)	86 (9.37%)		
70 and above	65 (8.86%)	96 (10.46%)		
Tumour Size	Complete	Incomplete		
> 2 cm	288 (43.96%)	485 (48.64%)	0.062	
< 2 cm	367 56.03%)	512 (51.34%)		
Node Size	Complete	Incomplete		
> 1 cm	285 (43.51%)	481 (48.24%)	0.141	
< 1 cm	361 (55.11%)	525 (52.65%)		
Economic Status	Complete	Incomplete		
Above Poverty Line	525 (80.15%)	228 (22.86%)	0.001	
Below Poverty Line	460 (70.22%)	439 (44.03%)		
Blood Sugar Level	Complete	Incomplete		
>140 mg/dL	401 (61.22%)	505 (50.65%)	0.093	
< 140 mg/dL	361 (55.11%)	385 (38.61%)		
Treatment Technique	Complete	Incomplete		
Chemotherapy	301 (45.95%)	505 (50.65%)	0.027	
Radiotherapy	361 (55.11%)	485 (48.64%)		

Table 3: Association of different factors with completion and incompletion of treatment among oral cancer patients

It is obtained from Table 3 that there are associations between completion and incompletion of treatment among oral cancer patients in terms of the factors 'Age', 'Economic Status' and the 'Treatment Technique' as *p*-value are less than 0.05 corresponding to these factors. Binary logistic regression model has been constructed accommodating all the factors in question concerning oral cancer (demographic factors like age and medical factors like 'Tumor size', 'Node size', 'Blood sugar level', 'Treatment' technique).

We check the goodness of fit of the models which provide some idea about the closeness between the observed and expected data. We thus understand subsequently whether the relevant data fits in the models. The null hypothesis to be tested is that the data fits the model against the alternative that the data does not fit the model. Hosmer-Lemeshow test is applied to check the goodness of fit for the models of oral cancer; separately in case of pre-implantation, post-implementation and combination of pre and post implementation of health schemes. Thus, from Table 4, we interpret that the quality of fit for both the models are good as *p*-values are quite greater

than 0.05 (Peng et al., 2002). Thus, we accept our null hypotheses that data fit in the models specified.

 Table 4: Results of Goodness of fit test for the binary logistic models for oral cancer patients

 (Before, After and Combination of Before and After implementation of health schemes)

Before Implementation of Health Schemes						
Site of cancer	Chi-square	Sig.				
Oral cancer	4.588	.710				
A	After Implementation of Health Schemes					
Site of cancer	Chi-square	Sig.				
Oral cancer	4.661	.793				
Implem	Implementation of Health Schemes (Before + After)					
Site of cancer	Chi-square	Sig.				
Oral Cancer	4.705	.801				

Table 5: Major findings of binary logistic regression model before, after and pooled (before + after) implementation of health schemes

	Before Implementation of Health Schemes		After Implementation of Health Schemes		Pooled (Before+ After) Implementation of Health Schemes	
Factors						
	p value	Odds Ratio	p value	Odds Ratio	p value	Odds Ratio
Economic Status						
Below Poverty Line	.001	.821	.004	1.639	.002	1.628
Above Poverty Line ®						
Tumour Size						
> 2 cm	.421	.832	.131	.872	.125	.881
< 2 cm ®						
Node Size						
> 1 cm	.541	.866	.147	.891	.152	.888
< 1 cm ®						
Blood Sugar Level						
>140 mg/dL	.078	.895	.177	.876	.181	.869
< 140 mg/dL ®						
Age	.002	1.537	.045	1.552	.035	1.543
Treatment						
Radiotherapy	.032	1.587	.040	1.601	.015	1.596
Chemotherapy ®						
Constant	.007	1.523	.003	1.215	.006	1.325

Note:
[®] Denotes reference category.

Table 5 reveals that the probability of completion of treatment is 17.9 percent less in case of patients living below poverty line category (BPL) as compared to those above the poverty line category (APL) patients before the implementation of health schemes. On the other hand, the chance of completion of treatment is increased by 53.7 percent with increase of age of the patients.

Can Health schemes ensure Completion of treatment for Cancer patients? A Study in the context of South Assam

Interestingly, 'treatment types imply that chance of completion is increased by 58.7 percent if the patients are treated through Radiotherapy as compared to Chemotherapy. The other factors like 'Tumour size', 'Node size' and 'Blood Sugar level' do not show any significant result explaining the completion of treatment for oral cancer before implementation of health schemes.

Further, "Economic Status" reveal the noteworthy result that the probability of completion of treatment increases by 63.9 percent after the implementation the health schemes for below poverty line category as compared to above poverty line category for oral cancer patients. The chance of completion of treatment is increased by 55.2 percent with increase of age of the patients. As earlier, the 'treatment' factor shows that the chance of completion of treatment increases by 60.1 percent if the patients are treated through Radiotherapy as compared to Chemotherapy. Other factors do not show any significant results concerning completion of treatment for oral cancer after implementation of the health schemes.

When before and after implementation of health schemes data are pooled together; we observe that probability of completion of treatment increases by 62.8 percent for below poverty line category as compared to above poverty line category for oral cancer patients. On the other hand, the chance of completion of treatment is increased by 54.3 percent with increase of age of the patients. The factor 'treatment' shows that the chance of completion of treatment increases by 59.6 percent if the patients are treated through Radiotherapy as compared to Chemotherapy. The other factors do not show any significant difference concerning completion of treatment for oral cancer.

Conclusion

The present study is first of its kind concerning oral cancer patients of south Assam with the primary focus on the impact of two available health schemes viz. Pradhan Mantri Jan Arogya Yojana (PM-JAY) and Atal Amrit Abhiyan (AAA). The study attempts to establish that both the schemes have been successful especially in South Assam in enhancing the probability of completion of cancer treatment. In other words, the earmarked economic factor has been found to have significant impact on the completion of treatment of oral cancer. Thus, it provides a good piece of evidence of health financing by the state for promotion of health care for the poor. In addition, the study has attempted to provide a suitable reply to the puzzling question why in spite of the implementation of the health schemes, some patients (especially in BPL categories) are not able to complete the stipulated treatment. Previous study shows that the younger patients, who have been treated applying chemotherapy have the fear of pain during the treatment process and are often not in the favour of completing the course of the treatment (White et al., 2014). It is argued that such a population group often do not take the treatment process seriously. The same is evident as the combination of demographic factors and medical factors points out at the noncompletion of treatment. All these paves the way for more advanced research on the effectiveness of available medical technologies on individual oral cancer patients.

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