

RESEARCH ARTICLE

Costing of a State-Wide Population Based Cancer Awareness and Early Detection Campaign in a 2.67 Million Population of Punjab State in Northern India

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Abstract

Background: Punjab state is particularly reporting a rising burden of cancer. A 'door to door cancer awareness and early detection campaign' was therefore launched in the Punjab covering about 2.67 million population, wherein after initial training accredited social health activists (ASHAs) and other health staff conducted a survey for early detection of cancer cases based on a twelve point clinical algorithm. **Objective:** To ascertain unit cost for undertaking a population-based cancer awareness and early detection campaign. **Materials and Methods:** Data were collected using bottom-up costing methods. Full economic costs of implementing the campaign from the health system perspective were calculated. Options to meet the likely demand for project activities were further evaluated to examine their worth from the point of view of long-term sustainability. **Results:** The campaign covered 97% of the state population. A total of 24,659 cases were suspected to have cancer and were referred to health facilities. At the state level, incidence and prevalence of cancer were found to be 90 and 216 per 100,000, respectively. Full economic cost of implementing the campaign in pilot district was USD 117,524. However, the financial cost was approximately USD 6,301. Start-up phase of campaign was more resource intensive (63% of total) than the implementation phase. The economic cost per person contacted and suspected by clinical algorithm was found to be USD 0.20 and USD 40 respectively. Cost per confirmed case under the campaign was 7,043 USD. **Conclusions:** The campaign was able to screen a reasonably large population. High to high economic cost points towards the fact that the opportunity cost of campaign put a significant burden on health system and other programs. However, generating awareness and early detection strategy adopted in this campaign seems promising in light of fact that organized screening is not in place in India and in many developing countries.

Keywords: Cost - campaign - economics - cancer awareness - early detection - screening - Punjab, India

Asian Pac J Cancer Prev, 17 (2), 791-797

Introduction

Global cancer incidence during last 25-30 years was reported higher than the global population growth rate. This rate and trend of epidemiological, demographic transition and ageing is unlikely to change. (Napalkov, 2004). Thus there is an urgent need to accelerate cancer control measures in population at large. (Colditz et al., 2012). In India, new cancer cases are expected to grow from 0.80 million in 2001 to nearly 1.22 million by 2016 as a result of change in size and composition of population. (Murthy et al., 2008). Recently in India, 2011, nearly 1,193,000 new cancer cases were estimated; a higher load among females (603,500) than males (589,800) was reported. (Ferlay et al., 2013).

Significant steps have been taken for cancer control in India. Many hospital based and population based cancer registries are operational for evidence based scientific cancer research and control. Previous experiences of

different states in India on prevention and control of cancer have not been very fruitful. In a review by S Das (2010) lack of political will, human resources and early cancer detection centres have been cited as the probable reasons behind this poor performance of cancer control strategies. (Das and Patro, 2010).

However burden of cancer is not uniform across the country. Among different states, Punjab state is particularly reporting rising burden of cancer (D'Souza et al., 2013). It is one of the most prosperous state in India, predominantly an agrarian economy, and is referred as the 'Granary of India'. Rising burden of cancer is often attributed to increased pesticide use and chemical toxicity in the region. (Thakur et al., 2008). There have been few studies and surveys reporting cancer data from Punjab. Million death study (MDS) reported age standardized cancer mortality rate among women per 100,000 higher for Punjab (113.2) compared to Haryana (73.8) and National averages (95.1). However, age standardized cancer

mortality rate for men per 100,000 was lower for Punjab (80.6) compared to another neighbouring states (120.3) and National averages (97.6). (Dikshit et al., 2012). Within the state, variation was visible as an epidemiological study conducted in one particular region of Punjab, reported age standardized prevalence of cancer, 125.4 per 100,000 compared to 72.5 in another region. (Thakur et al., 2008). With significant increase in prevalence of this disease, population based early detection was attempted wherein a, 'Door to door cancer awareness and early detection campaign' was launched in pilot phase in district Faridkot, Punjab. After a thorough evaluation, program was scaled to cover the entire state. It aimed to create mass awareness and early detection of cancer cases along with providing early registration and management of cases. Economic analysis was attempted at the early stage of project development with the idea to provide a strong basis for choosing between approaches during its development phase only. Based on this economic analysis, the selected option to meet the likely demand for project activities was further evaluated to examine their worth from the point of view of the national economy and long-term sustainability.

Materials and Methods

Campaign was launched statewide after piloting the process in one of the districts of state. Phase one of the program involved intensive information, education and communication (IEC) followed by door to door visits by trained health care staff. This was accompanied by case detection based on list of danger signs for cancer and data recording on cancer cases and deaths in the houses. Knowledge of danger signs and need of early treatment was communicated to the community through pamphlets designed in local language. Phase two of the campaign involved referral and tracking of cases identified as diagnosed and suspects during phase one of the campaign. Health workers ensured visit of the suspects and diagnosed from their respective field practice areas to the nearest public health institution and to the higher centers if required. Patients from the campaign were given a separate referral card and were managed on priority basis in health centers and hospitals. They were exempted from any charges to be paid during investigations or treatment.

Costing methodology

We estimated full economic costs of implementing the campaign from a health-system perspective. Financial costs were obtained from accounting system of both State and District Health Departments. Economic costs were calculated by valuing the opportunity cost of all the resources which were used for planning, implementing and monitoring the campaign. This included the financial costs (explicit) and the opportunity cost of implicit resources such as personnel who spent time out of regular schedule on the training. Each phase of the campaign was elicited under the heads of personnel, space, consumables, non-consumables, refreshment and overheads such as electricity etc. Time costs of the participants and resource persons were additional costs from an economic perspective. Data was collected using bottom-up costing methods. Inputs

were segregated into capital and recurrent costs. Capital inputs included buildings, equipments, furniture and, designing the course. The recurrent resources included resources spent on conducting the campaign i.e. staff salaries of personnel involved in campaign, consumables, refreshment, allowances, electricity, laundry, overheads. Costs were also stratified by phase of implementation i.e. planning phase and implementation phase.

Staff members were interviewed to assess their activities, roles and responsibilities, daily numbers of hours devoted to campaign related work during different phases of project. Man-hours spent by different personnel involved were calculated by dividing daily work hours for campaign related tasks with total work hours in a day and multiplying with number of days for which that particular phase lasted. For estimating economic cost of personnel, we also attributed the time cost of all personnel involved in the campaign related work, either full-time or part-time. We used 'shadow prices' for the salary of the health specialist. The same was done as the actual salaries did not represent true opportunity cost of time of a state health system specialist from a view point of Government as the health specialist was working post retirement on honorary basis. The shadow prices used were the average salaries paid to specialist by Punjab state government.

All buildings used for campaign were those belonging to health department and thus had no financial costs. For estimating economic cost of space, covered area used for campaign related work was multiplied with the prevailing market rental price for this space. For committee rooms and training halls which were used for multiple purposes besides campaign related work, an allocation factor based on the use of this space was applied to attribute the costs. The allocation statistic used for apportioning joint space for campaign was the 'proportion of campaign-days for which the space was used for campaign.

The equipment costs for the campaign included the costs of computers, printers, mobiles projectors used during the trainings. Financial costs were calculated by using purchase price for each line item and attributed as full amount to the year of purchase. For economic costing, cost of equipment assets was annualized using standard assumptions regarding the life of the equipment and discount rates. We used a discount rate of 5% for estimating annualised cost of capital resources. In the case of certain equipments, where no standard was being followed, expert opinion was sought.

Overhead costs for the campaign included the monthly electricity and internet costs for the project coordinator and director's room. Electricity consumption was estimated by multiplying approximate average daily consumption by electrical appliances in the respective rooms by number of days for which the rooms were used. Per day charges of internet connection were estimated from monthly bill by apportioning it into two parts as the internet is used for entering data for another project as well.

Study was undertaken after approval of the State Health Department and due permissions were taken to conduct interviews and collect data from concerned officials and authorities.

Data analysis

Data was analyzed using MS-Excel and sensIt 1.45 software. Total economic cost of implementing the campaign was computed. In order to test for the robustness of our assumptions, we undertook a uni-variate sensitivity analysis by varying the parameters by 20% on either side of base value. Further to improve generalizability in state specific context we included parameters such as equipment prices, salaries, space utilization, time allocated to campaign and population covered etc. to account for variation across different districts of State. Results were presented using a tornado diagram. Unit costs included the salary of human resource, capital space utilization, software utilization, equipment utilization, consumables, overheads and others.

Cost per new confirmed case

For unit cost estimation, total cost of campaign implementation was divided by total cases confirmed at medical college, Faridkot at the campaign completion. Total cost of campaign comprised of cost incurred on

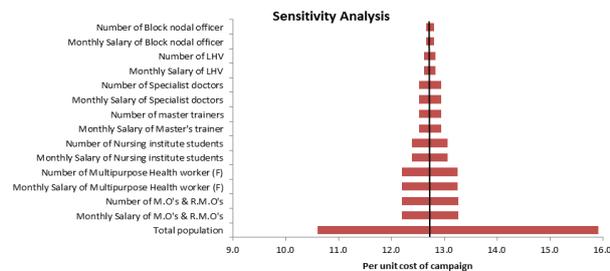


Figure 1. Sensitivity Analysis

campaign & implementation in phase 1 and cost of consultations and diagnosis in phase 2 of the campaign.

Patients covered under costing in Phase 2 belonged to two main categories; a) already diagnosed cancer cases, b) referred suspected cancer cases. Data on resources spent on health service provision was collected from randomly selected health facilities in district Faridkot for the year 2012-13 and unit cost of service delivery was assessed at the level of one block primary health centre, one community health centres, district hospital and medical college. For calculating consultation cost at different health facility levels micro costing approach was used, wherein each component of resource use was estimated and a unit cost was derived for each. For calculating the unit cost “bottom-up” or “ingredient-based” method was used.

Once list of types and quantities of input were drawn, monetary value of each item was determined. Value sought was the current financial price (Cost to provide this particular input in the particular facility). Annual cost of each type of input was calculated by multiplying unit price by number consumed for a given time period. Finally, all calculated costs of input was summed to obtain the total cost of input of different cost centers for the given time period. Estimated total cost of input during a given year was divided by number of output units provided by centre to generate cost per unit of consultation.

For Primary Health Centre (PHC), Community Health Centre (CHC) and District Hospital (DH) it was found that services were restricted to outpatient consultation of suspected patients followed by referral to medical college (MC). Therefore, estimates of per unit outpatient consultation at respective facility level was assumed similar for cost incurred in consultation given to cancer suspects. For medical college, deriving the unit cost of

Table 1. Different Costing Heads and their Data Sources

	Data collected	Data sources
Personnel	Salaries and allowances paid	Pay slips of health officials
		Account details for incentive paid
Capital	Square feet area	Direct Measurement
	Monthly rental price	Assumption based on personal interaction with residents
Equipment	Software's fixed cost	Actual purchase price
	Hardware such as mobile phones desktop, printer, projector etc	
	Average life	Arges GS
Consumables	IEC material, Stationary used in each activity of the campaign	Record review for billed amounts
Overheads	Electricity used in different rooms and internet usage	Approximate units utilised per day based on direct observation.
		Hourly Consumption of energy by different appliances for total hours they were used
		Record review for billed amounts
Others	Refreshments in core committee meetings and trainings	Record review for billed amounts
	Inauguration function spending	

consultation demanded huge resource input in terms of time, manpower and logistics, so we derived these unit cost estimates through literature and record review. (Mulligan et al., 2003) After deriving unit costs for **Table 2. Total Cost of Implementing the Mass Population Awareness and Cancer Screening Campaign in District Faridkot, Punjab 2012**

Cost heads	Different inputs included	Total Fiscal Cost (%)	Total Economic Cost (%)
Personnel	Human resources involved in campaign	60166 (19)	6944204 (94)
Capital space	Health specialist room, Core committee meeting venue, Training venues	-	194667 (3)
Equipment	Software, Laptop, Mobile phones for data entry, Desktop, Printer	-	7014
Consumables	Stationary, Printing of manuals, IEC material for awareness	153768 (47)	153769 (2)
Overheads	Electricity, Internet charges	-	12354 0
Others	Refreshments, Inauguration function spending	110519 (34)	110519 (1)
Total cost (INR)		324454 (100)	7422526 (100)
Total Cost (USD)		5126 (100)	117276 (100)

consultation under OPD services, it was multiplied by number of services given during data collection period to derive full economic cost incurred.

Cost of diagnosis

Estimation of unit cost of services related to early diagnosis of cancer under the campaign was done by assuming that all patients at the medical college were subjected to histopathology tests and biopsy examination for confirmation. Estimate of amount spent by government per patient on these tests was made by market survey of rates for these diagnostic tests. It was found on an average histopathology/ cytopathology examination per specimen is done at a cost of INR 350. Number of suspected cases who reported at medical college was multiplied by per unit cost of diagnostic tests to get the total amount spent by government on these patients.

Scenario analysis for the cancer awareness and early detection campaign

Based on analysis of phase 1 of the campaign, scale up of the campaign to all the districts of the state under two different scenarios were elicited. In scenario 1, total cost per district was estimated by assuming similar pattern of inputs in all the districts. Inputs were kept same keeping in mind that the campaign will be run in all districts of state with a cost function.

Total cost per district = Phase 1+ Phase 2= {(Fixed cost/ total number of districts) + (Unit Recurrent cost per person contacted *Population covered)} + {Per person confirmation* Estimated consultations sought at different levels of health care}

Population covered estimates were the ones reported by implementing agency. The fixed costs which included

Table 3. Total Economic Cost in INR (USD) Borne by Government at Different Facility Levels on Cancer Patients in 2nd Phase of Campaign

	Facility	Unit cost (a)	Number of suspected cancer patients (b)	Total amount spent by government on suspected cases	Number of already diagnosed cancer patients	Total amount spent by government on already diagnosed cases	Total amount spent by Government (x+y)
				x = (a*b)	(c)	y = (a*c)	
OPD consultation	Block PHC	193 (3.04)	543 (8.55)	104799 (1651.03)	86 (1.35)	16598 (261.49)	121397 (1912.5)
	CHC	204 (3.21)	483 (7.61)	98532 (1552.3)	170 (2.68)	34680 (546.36)	133212 (2098.7)
	DH	102 (1.61)	1037 (16.34)	105774 (1666.39)	323 (5.09)	32946 (519.04)	138720 (2185.4)
	MC	113* (1.78*)	414 (6.52)	46782 (737.01)	23 (0.36)	2599 (40.95)	49381 (777.96)
Amount spent on diagnosis	MC	350 (5.51)	414 (6.52)	144900 (2282.79)	0	0	144900 (2282.79)
							587610 (9257.35)

*WHO choice estimate

Table 4. Per unit Costs Incurred Under the Campaign

Variable	Definition	Financial	Economic
		INR (USD)	INR (USD)
Cost per person contacted (till campaign)	Cost of survey/Total population of the district	0.6 (0.1)	12.8 (0.20)
Cost per person suspected by clinical algorithm (INR) (till campaign)	Cost of survey/Persons suspected to have cancer using clinical algorithm	110 (1.73)	2529 (39.78)
Cost per confirmed case under the campaign	(Cost of survey+ cost of consultation and diagnosis)/Total confirmed cases	18025 (284)	447081 (7043)

the cost incurred during the proposal planning, designing the curriculum and resources assessment were one-time cost and so were divided equally into all the districts of state. However recurrent costs which were a function of population of the district were calculated by multiplying unit recurrent cost per person with population to be covered of respective district.

In scenario 2 we assumed that costs can be contained further by decreasing recurrent resources towards the campaign during scale up. For this scenario we performed a many input, one output sensitivity analysis of all the inputs and determined the factors which have maximum effect on per unit cost. Difference in economic and financial costs accounted for opportunity cost of all resources used. The major difference between a simple financial costing and economic costing undertaken by us was the inclusion of the full cost of employed staff (proportion of the salary that

Results

Cancer Incidence and Prevalence was reported to be 90 and 216 per lakh in the State. Campaign covered 97% of Punjab's population. A total of 24659 cases were suspected to have cancer and were referred to health facilities. Participants reported 33 318 cancer deaths in the past 5 years in the state.

Fiscal budgetary cost of running campaign in Faridkot district on pilot basis was approximately four lakh rupees. Inputs included horizontal inputs in the form of infrastructure and manpower from within the health system and vertical inputs like training of the staff for running the campaign. However, full economic cost of implementing the pilot campaign in Faridkot district was INR 74,59,849 (117524.25 USD).

Start-up phase of campaign was more resource intensive (63% of total) than the implementation phase. Implementation phase accounted for INR 27,16,845 (42801.83 USD) (37% of total).

In start-up phase trainings conducted for the health personnel constituted the most important head (55% of total cost of campaign) followed by designing of curriculum for the campaign (4%). During implementation phase conducting the house to house survey which included involvement of health workers in field and payment of incentives to them was the most important cost centre. It consumed 27% of the total project costs and 73% of implementation phase costs. Major constituent of economic cost in descending order were manpower (94%), followed by building (3%) and consumables (2%) and other costs (1% each). Percentage inputs on overheads were very negligible in comparison to other input categories.

Unit cost

The economic cost per person contacted and suspected by clinical algorithm was found to be INR 12.8 (0.20 USD) and INR 2529 (40 USD) respective.

Table 1 shows total cost of implementing the campaign in district Faridkot, Punjab.

Unit cost estimates for OPD consultation were found

to be INR 193(3.04 USD), INR 204 (3.21 USD) and INR 102 (1.61 USD) at PHC, CHC and District Hospital level respectively. During the second phase of campaign, a total of 543, 483 and 1037 suspected patients were given OPD consultation at the above mentioned health care levels. Similarly 86, 170 and 323 already diagnosed patients were also given consultation at these centres. 414 suspected and 23 already diagnosed cases were referred to Medical College where they were given consultation and other diagnostic services. 18 cases were confirmed to be having cancer during data collection period from these referred cases. It was found that during the second phase of campaign government has spent resources worth INR 587610 (9257 USD) in giving consultation and diagnostic services to patients. By combining costs of both the phases of campaign it has been found that INR 8047459 (126781 USD) has been spent by government for getting a total of 18 confirmed cases of cancer in Faridkot district during the campaign. Cost per confirmed case under the campaign has been found to be INR 447081 (7043 USD) from economic perspective.

Since the recurrent costs to be incurred during the campaign were found to be function of population levels so it was found that economic cost of running the campaign across whole state would amount to approximately Rs 33 crore (5198899 USD) in total.

Average cost per person covered under the campaign was found to be between INR 11.67 (0.18 USD) for the state. Overall cost per person under the campaign was found to INR 12-13 (0.19-0.20 USD) per person.

Scenario 2: For within district analysis we changed a set of parameters belonging to phase 1 of campaign belonging to manpower to see their effect on total cost as follows:

Project coordinator who was being paid INR 90000 (1418 USD) for his work on routine immunisation programme was changed with a person hired at 28000 for a period equivalent to project coordinators man hours.

About forty Medical officers involved part time were replaced by twenty supervisors at a monthly salary of INR 20000 (315 USD) per person for man hours equal to those of medical officers thus replacing two important health system personnel from their extra work. It was assumed that the hired personnel will remain moving through- out the campaign so requiring no capital inputs. Equipments were assumed to be provided by government as previously.

Using these assumptions, total economic cost was found to decrease to INR 252205721 (3973309 USD). Cost per participant decreased to 9.7 as compared to 12. However, this would require an increase in fiscal budget of the campaign by INR 1,200,000.

Discussion

The basis of this early detection programme for cancer is public education on cancer, supplemented by provision of professional education. In consonance with the guidelines for such education programme, this campaign focuses on the importance of cancer in the region, its curability when detected early, and the lack of morbidity when modern treatment can be applied at an early stage

detected as a result of heightened awareness and skilled professional examinations. (Khatib and Modjtabei, 2006)

Unit cost estimates of INR cancer awareness campaign of INR 12.7 (0.20 USD) per person contacted and approximately 2516 per person referred are lower than costs in other screening programs. Moreover other screening programs have been screening a particular body part for cancer as opposed to this campaign wherein population is being screened for all types of cancers in general.

In a study on oral cancer screening in Kerala, India, cost of cancer screening program by visual inspection was INR 330 (5.20 USD) per person overall and approximately INR 100 (1.58 USD) per person screened which includes training, recruitment of participants, management, data collection, screening and providing educational messages about oral cancer. (Subramanian et al., 2009). In comparison to our analysis where cost per person contacted is mere INR 12.78 (0.20 USD), One reason for their higher cost can be a randomised controlled setting wherein specific conditions are created for uninterrupted trial progress like hiring of staff, training, purchase of diagnostics etc.

Grazzini G et.al studied cost evaluation in a colorectal cancer screening programme among men of age group between 50-70 years in a district of Florence. In this study the cost per person contacted was INR 1056(16.64 USD) and per person invited was INR 160(2.52 USD) with coverage population of 62,369 whereas in our analysis cost per person contacted was only about INR12.6 (0.20 USD) with covered population of 583105. However the study results are not comparable as our cost analysis does not belong to a specific disease and does not employ any special tests till the first referral level. However cost of inviting a person or contacting a person can be still compared which are too higher than our costs. But breakdown of costs follows an almost similar pattern as found in most of economic evaluations where staff salaries share the highest cost. (Grazzini et al., 2008).

In a study by Mansley et al where the costs of 19 different cancer screening programmes have been modelled. The average costs varied much and they found that much of this variation was due to the size of the programme. The authors concluded that there are economies of scale in this kind of screening programme and that this should be considered when implementing a cancer screening programme.

Though Subramaniam et al have a predominantly horizontal screening programme (i.e. one embedded in the existing health-care system) just like this campaign with vertical inputs in training, programme evaluation and investment in health-care infrastructure to enable screening to be offered at a reasonable cost. Analysis in present context when the campaign has been conducted with health system man power and logistics, complete dependency on health system is expected to decrease the long term sustainability of campaign.

Results of this study hold significance in light of fact that as a nation India lacks organized screening and awareness programs for any of the common cancers in the country. Most cancer centres provide only opportunistic

screening services which are more resource intensive and do not cover even complete effected population. (Dinshaw et al., 2005). Therefore, cost analysis of such a simple campaign that has covered 94% of the population holds its significance from the inputs perspective.

If increase in awareness and early diagnosis by self reporting by visual inspection is to be adopted as a strategy then more research is needed to evaluate the extent to which campaigns lead to cumulative increases in public awareness and year-round behavioural changes. In addition more efforts need to be put into such campaigns to identify which types of awareness campaigns are most successful in achieving various well-defined outcomes, and to examine which segments of the population are most responsive to different types of awareness campaigns.

This simple cost analysis can be a step forward towards cost effectiveness and cost benefit analysis. However, we have limited ourselves to unit cost estimation and sensitivity analysis for this evaluation. A more useful analysis would have been cost effectiveness analysis. But as the project is in its infancy and is continually developing, so unit cost estimates and their sensitivity to changes with different parameters is an equally strong evidence for decision making.

Moreover, despite a high burden of cancer mortality and morbidity, there has been no published evidence of such a primary prevention program, and certainly no cost analysis of such health system based campaigns' cost analysis.

In conclusion, Generating awareness and early diagnosis by the method adopted in this campaign seems promising in light of fact that as a developing nation our health system can-not ensure organized screening for cancer to each and every person of society. Early detection attempt by visual inspection at one point in life is better than no screening at all. Moreover this mode of detection targets apparently healthy people, who need to be about know about the availability of various screening programs, its benefits and risks, in order to make informed decisions about participation. It would be expected that the greater the uptake of campaign, the greater benefit in terms of public health can be achieved.

Benefits of this campaign in longer run will have to be evaluated in terms of reductions in mortality and morbidity through earlier detection of cancer at a more treatable stage. State health officials should try to establish mechanisms to avoid risks of misinterpretations of results conveyed to participants which may include false reassurance that a person is disease free when lesions are missed due to sub-optimal screening sensitivity, and unnecessary anxiety, morbidity and cost if referral on basis of symptoms lead to unnecessary follow-up.

It is agreed upon that designing and benefit valuation of a health sector project is much more complex than in other sectors and cost elicitation becomes even more difficult when a project uses existing health system resources for its operationalization.

However, in light of fact that increasing cancer related morbidity and mortality requires estimation of relative advantage of investing in early detection and awareness campaigns so as to weigh them against other competing

health needs. This increased attention to the extent of cost recovery and the analysis of budgetary implication issues likewise enhance prospects for project impact and sustainability.

Evidence before this study: We did not do a formal systematic review. However, a search of articles published on PubMed using below mentioned search strategy suggested that the literature describing the financial and economic costs of cancer early detection and awareness campaigns is very limited. Only 2 relevant economic evaluations could be found. However they were from developed countries and focussed on effectiveness estimation using decision modelling approaches.

The present study generates evidence on financial as well as economic implications of conducting an cancer awareness and early detection campaign in a developing country or country with low resource settings. Description of costs for awareness and early detection campaign will be helpful in replication of low cost model followed in the state to other low cost settings. These estimates may guide further decision modelling based cost effectiveness analysis. The results will be useful for both programmatic and research purposes. The availability of data on the economic costs of a campaign would allow future comparisons with costs of several other modalities of cancer prevention such as screening or change in life -style in the region. Economic estimates highlight the importance of tapping local resources for making campaigns financially more viable.

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