

# ANALYZING COST OF OUT-PATIENT CANCER CHEMOTHERAPY IN A RESOURCE-POOR SETUP

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## ABSTRACT:

**Background:** The incidence of cancer is increasing globally and the greatest burden of this increase will fall on low and medium resource populations. Cost becomes the greatest barrier in availing cancer treatment in low income societies as insurance policies exist infrequently. Cancer chemotherapy is usually administered on out-patient basis due to increase in cost and patient numbers. Family and community support systems thus get increasingly involved in patient care. Therefore, hospital administrators should devise cost-effective measures to be put in place in weaker economies for better affordability of treatments. It is obligatory to be cost conscious for optimum utilization of facilities and available resources.

**Objective:** To perform the cost analysis of out-patient cancer chemotherapy at regional cancer centre SKIMS.

**Methods:** A prospective study for a period of six months duration was carried out in day care ward of SKIMS to study the cost of out-patient cancer chemotherapy. Direct costs that include cost of material, labor and laboratory investigations, along with indirect costs incurred on electricity, water, construction and miscellaneous charges on admission, travel, sanitation, Lenin and stationary were calculated and data analyzed to compute the unit cost of treatment per patient per visit.

**Results:** The major cost components of out-patient cancer chemotherapy are drugs (74.15 %) and labour (19.11 %). The average unit cost per patient per visit for out-patient chemotherapy is rupees 4249.18 (\$84.09) low at rupees 1475.94 (\$29.20) per visit, a difference of 26% when compared with in-patient chemotherapy of same protocol. Out of average unit cost, the estimated provider cost was rupees 1051.67=\$20.81 (24.75 %) and out of pocket expenditure was rupees 3197.50=\$63.27 (75.25 %) per patient per visit.

**Conclusion:** Cancer Chemotherapy should be given on an out-patient basis as far as possible to patients with cancer as it reduces the overall cost.

**Key words:** cost analysis, cancer, chemotherapy, out-patient, low economy, chemotherapy protocol.

**Introduction:**

Chemotherapy has had an expanding role in the treatment of cancer in humans over the past four decades. Chemotherapy provides therapeutic benefits ranging from palliation to long-term remission or cure. The refinement of combination chemotherapy has increased both the effectiveness of drug treatment of malignant tumors and the price paid for treatment.<sup>(1)</sup>

Outpatient chemotherapy is becoming more common as the patient, family and community support systems become increasingly involved in patient care. Besides, the number of cases and cost is increasing and the emergence of medical oncologist has given impetus to evaluating new treatment protocols. One centre in Britain estimated that 90% of all chemotherapy was given on an out-patient basis.<sup>(2)</sup>

The incidence of cancer is increasing globally and the greatest effect of this increase will fall on low and medium resource countries. Cost becomes the greatest barrier in availing cancer treatment in low income countries as insurance policies exist infrequently.<sup>(3)</sup>

Cancer remains a major health problem in all communities world wide. Cancers in all forms are causing 9% of deaths throughout the world. One in every four deaths in USA is related to cancer.<sup>(4)</sup> It is estimated that there are approximately 2 - 2.5 million cases of cancer in India at any given point of time, with around 7-9 lac new cases being detected each year.<sup>(5)</sup>

This disease engulfs a major portion of health budget each year. The fact that the health care costs are rising fast, coupled with high expenses associated with treating advanced cancer do present a significant challenge for

the economy. Ways and methods to control such expenses are needed.<sup>(6)</sup>

The annual number of new cancer cases is expected to double in the next two decades. By 2020, up to 70% of the 20 million new cases annually are predicted to occur in the developing countries. The inability to cope up with the growing economic and societal burden of cancer is emblematic of the tremendous global health disparities in which developing countries only have 5% of the resources spent on cancer globally. There exist several well recognized and persistent obstacles to adequate health care in developing countries, many of which affect patient outcomes as the cancer burden continues to rise. There is a lack of adequate health care coverage available to many people living in less developed countries and when available, it is often inequitable and not affordable. It is clear from the above data that cancer will become an increasingly important challenge to health services of developing countries in coming decades.<sup>(7)</sup> Recognizing cancer as a public health problem hospital managers have to bring certain rationality in financing of health and hospital services, and control of these expenditures besides maintaining quality of service.

We have already examined the cost of in-patient cancer chemotherapy in medical oncology and here **as a secondary objective** we will compare it with out-patient chemotherapy administered in a day care ward of Regional Cancer Centre (RCC) affiliated with Sheri-i-Kashmir Institute of Medical Sciences (SKIMS), Srinagar, Kashmir.

**Methods:**

Chemotherapy is administered at both in-patient and out-patient levels in the SKIMS-RCC, Kashmir. However same protocol is

followed in in-patients and out-patients. Out-patient chemotherapy is administered in a special area called day-care ward. There are 9 chemotherapy nurses including a senior supervisor nurse and two doctors working full time in day care unit. A senior doctor takes round of the area daily.

A prospective study for a period of six months duration was carried out with effect from Oct. 1, 2011 to March. 31, 2012 in day care ward. The same methodology was applied as in in-patient study of cost estimation of cancer treatment to contrast in-patient and out-patient treatment cost. A questionnaire was used for collection of data for unit cost analysis. The data was collected daily from patient records attending for cancer chemotherapy in day care ward. The unit cost analysis was done using the technique of average costing with a top down approach in estimating the costs incurred by the hospital for providing the service. Top-down costing starts at the top with total expenditures and then divides these by a measure of total throughput (patient visits, days, or admission) to give an average cost per patient per visit, day or admission.<sup>(8)</sup> The out of pocket expenditure for purchase of drugs by patient himself and travel cost was also included in computing the unit cost. The average unit cost of treatment was calculated after adding following costs.

#### **Direct Costs:**

**Material Cost:** Materials included drugs, disposables and other consumables provided by the hospital as well as purchased by patient himself.

**Labour cost:** The day care unit is staffed by two doctors, nine nurses and one nursing attendant. In addition, a consultant visits day care daily for about half an hour which is 5% of total consultant time. On average, 25 to 30

patients are dated daily for out-patient chemotherapy in day care.

The labour cost was calculated on the basis of actual staff employed in day care ward which runs in two shifts, morning and evening. Full time was considered for nurses and class-IV employees. Salaries of two junior doctors posted permanently in daycare ward and 5% of one consultant time are apportioned accordingly while calculating labour cost.

#### **Cost of Laboratory investigations:**

Hematological investigations are done either before or on same day on which chemotherapy is instituted. The cost of these investigations was taken as same as is being charged for out-patients. As a matter of policy of institute these investigations are done free to cancer patients.

#### **Indirect Costs:**

Indirect costs included expenditure on electricity, water, construction, cost depreciation of the building and other miscellaneous costs like admission charges, travelling charges, cost of sanitation, Lenin and stationary.

**Cost of Electricity:** As there is no metered supply of electricity for the individual departments at SKIMS, the cost of electricity was calculated on the basis of actual electric load of the electrical gadgets as specified by the manufacturers. As such, existing electricity tariff issued by Power Development Department of the State Government in 2011 at rupees 700.0 for first Kw consumed and rupees 900.0 thereafter including 22% electricity duty and 0.5 added as diversity factor, has been utilized for calculating cost of electricity. The total electricity was calculated per month which was accordingly apportioned among number of patients. This was calculated with the help of Electrical Engineering Department of SKIMS.

**Cost of Water Supply:** The cost of water consumption was calculated on the basis of average quantity consumed per hour in day care ward. Total number of water taps and water discharge per tap per hour was taken to calculate daily water consumption. The prevailing cost fixed by Public Health Engineering Department (PHE) of State Govt. as per 2011 rates was used to derive the cost component of water with the help of Civil Engineering Department of SKIMS.

**Building Cost:** The area occupied by day care ward was physically measured. The capital value on account of building and its fixed assets (plumbing and electrification) was calculated with the help of Civil Engineering Department of SKIMS. Assuming the life of building to be 100 years, the depreciation of the capital value at the annual rate of 1% was calculated. Depreciation of fixtures was calculated as 5% of the capital cost per annum. The maintenance cost of building and fixtures was calculated on the basis of actual verified from Civil Engineering Department of SKIMS. These costs were apportioned to each patient. Miscellaneous costs were calculated on the basis of actual consumption of each item (sanitation, stationary, linen, admission charges and travel charges) and their price per unit was obtained from the respective departments and by interviewing patients respectively. The cost of these items was calculated for whole study period and then apportioned accordingly among number of patients. The cost of central heating, telephone calls, security and other office furniture costs were not taken into consideration. Finally the data was analyzed to compute the unit cost of treatment.

**Results:**

Over the six month period, 1766 patients made 2412 visits for chemotherapy treatment. The major cost components of out-patient cancer chemotherapy are costs of drugs and labour cost. They are 74.15% and 19.11% respectively. Rupees 4249.18 (\$ 84.09) transpired to be the average unit cost per patient per visit for out-patient chemotherapy (Tables I and II).

Out of average unit cost, the estimated provider cost per patient per visit was rupees 1051.67=\$20.81 (24.75 %) and out of pocket expenditure was rupees 3197.50=\$63.27 (75.25 %).

Most commonly used chemotherapeutic agents included cisplatin, vincristine, vinblastine, 5 FU, calcium leucovorin, adriamycin, taxol, doxytaxol, zolendronic acid, bortizimab, epirubicin, gemcitabine, carboplatin, decarbazine, oxyplatin, retuximab and premetrexed. Besides chemotherapy drugs, other drugs included antiemetic, analgesics and antibiotics.

Solid malignancies like stomach, lungs, GE junction, breast, NHL, ovary, colon, prostate, and rectal cancers were most commonly treated tumors on out-patient basis.

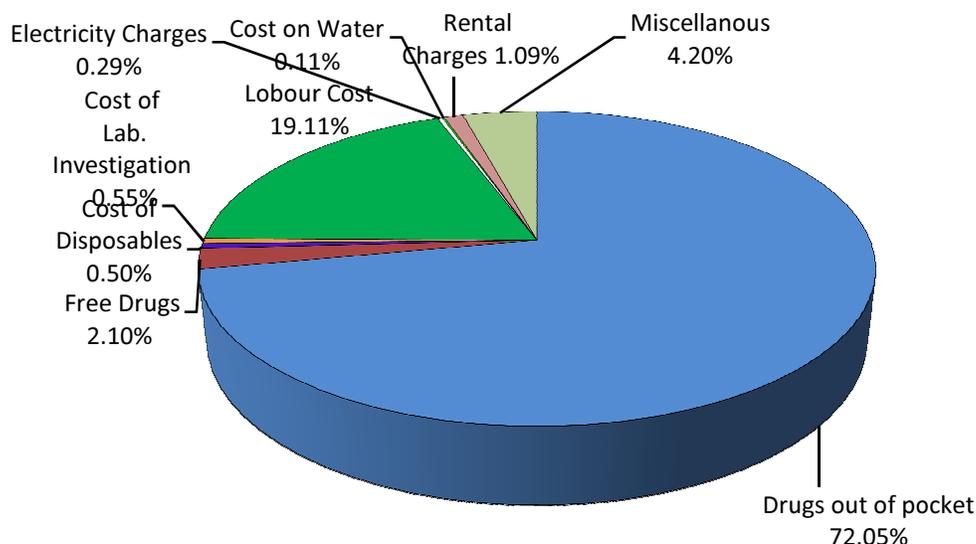
The cost of six completed courses, (spanning six months) was calculated for gastro intestinal, (colon, stomach, GE junction, rectum, Ca. esophagus and anal canal) and gynecological (Ca. ovary) malignancies. The cost of six courses was between rupees 152970.48 and rupees 314018.00 (\$3027.32 & \$6214.48) i.e. an average of rupees 203960.64 (\$4036.42) for gastro intestinal and rupees 52295.05 and rupees 152970.48 (\$1034.93 & \$3027.32) i.e. rupees 71947.52 (\$1423.85) for gynecological malignancies on an average.

**Table 1: Showing different cost particulars.**

| <b>Cost category</b>                            | <b>Total expenditure<br/>Rupees (USD)</b> | <b>Average monthly<br/>cost Rupees<br/>(USD)</b> | <b>Unit cost/visit<br/>Rupees (USD)</b> | <b>%</b>    |
|---|---|--|---|-------------|
| Cost of drugs<br>(out of pocket<br>expenditure) | 7384410.36(\$146139.13)                   | 1230735.06<br>(\$24356.52)                       | 3061.53 (\$60.58)                       | 72.05       |
| Cost of free drugs<br>provided by hospital      | 215229.67 (\$4259.44)                     | 35871.61 (\$709.90)                              | 89.23 (\$1.76)                          | 2.10        |
| Cost of disposables                             | 51245.15 (\$1014.15)                      | 8540.85 (\$169.02)                               | 21.24 (\$0.42)                          | 0.50        |
| Cost of lab.<br>Investigations                  | 56369.67 (\$1115.56)                      | 9394.94 (\$185.92)                               | 23.37 (\$0.46)                          | 0.55        |
| Labour cost                                     | 1958588.13 (\$38760.89)                   | 326431.35<br>(\$6460.14)                         | 812.01 (\$16.06)                        | 19.11       |
| Cost on electricity<br>consumption              | 9722.19 (\$588.20)                        | 4953.69 (\$98.03)                                | 12.32 (\$0.24)                          | 0.29        |
| Cost on water<br>consumption                    | 11273.93 (\$223.11)                       | 1878.98 (\$37.18)                                | 4.67 (\$0.09)                           | 0.11        |
| Building cost (Rental<br>value)                 | 111714.44 (\$2210.85)                     | 18619.07 (\$368.47)                              | 46.31 (\$0.91)                          | 1.09        |
| Miscellaneous costs                             | 430459.34 (\$8518.88)                     | 71743.22<br>(\$1419.81)                          | 178.46 (\$3.53)                         | 4.20        |
| <b>Total</b>                                    | <b>10249031.96<br/>(\$202830.63)</b>      | <b>1708171.99<br/>(\$33805.10)</b>               | <b>4249.18<br/>(\$84.09)</b>            | <b>100%</b> |

**Table 2: Distribution of Direct and Indirect Costs.**

| Cost category          | Cost<br>Rupees (USD)         | Average monthly cost<br>Rupees (USD) | Unit cost/visit<br>Rupees (USD) | %     |
|------------------------|------------------------------|--------------------------------------|---------------------------------|-------|
| <b>Direct Cost:</b>    |                              |                                      |                                 |       |
| Material Cost          | 7650885.18<br>(\$151412.72)  | 1275147.53<br>(\$25235.45)           | 3172.00<br>(\$62.77)            |       |
| Labour Cost            | 1958588.13<br>(\$38760.89)   | 326431.35<br>(\$6460.14)             | 812.01<br>(\$16.06)             | 94.31 |
| Cost of Lab.<br>Tests  | 56369.67<br>(\$1115.56)      | 9349.49<br>(\$185.02)                | 23.37<br>(\$0.46)               |       |
| <b>Indirect Cost:</b>  |                              |                                      |                                 |       |
| Electricity Cost       | 29722.19<br>(\$588.20)       | 4953.69<br>(\$98.03)                 | 12.32<br>(\$0.24)               |       |
| Water Cost             | 11273.93<br>(\$223.11)       | 1878.98<br>(\$37.18)                 | 4.67<br>(\$0.09)                | 5.69  |
| Building Cost          | 111714.44<br>(\$2210.85)     | 18619.07<br>(\$368.47)               | 46.31<br>(\$0.91)               |       |
| Miscellaneous<br>Costs | 430459.34<br>(\$8518.88)     | 71743.22<br>(\$1419.81)              | 178.46<br>(\$3.53)              |       |
| Total                  | 10249031.96<br>(\$202830.63) | 1708171.99<br>(\$33805.10)           | 4249.18<br>(\$84.09)            | 100%  |



**Fig.1: Contribution of Different Cost Components.**

#### Discussion:

The study revealed that 1766 patients were administered chemotherapy over a six month period in 2412 visits. The major cost components of out-patient cancer chemotherapy are costs of drugs and labour cost. They are 74.15 % and 19.11 % respectively. The average unit cost per patient per visit for out-patient chemotherapy is rupees 4249.18 (\$84.09). Out of average unit cost, the estimated provider cost was rupees 1051.67=\$20.81(24.75 %) and out of pocket expenditure was rupees 3197.50=\$63.27 (75.25 %) per patient per visit.

In a study in Toronto Bayview Regional Cancer Centre, the cost of chemotherapy administered in an out-patient basis over 4 to 6 months ranged from \$260 to \$5374 (mean \$2224). The total cost of out-patient administration was estimated to be \$152.53 per dose, compared with \$185.39 for in-patient administration of the same protocol, at a difference of 22%.<sup>(1)</sup> The results are

comparable and indicate that out-patient administration reduces the overall cost of chemotherapy.

Outpatient chemotherapy is becoming more common. One centre in Britain estimated that 90% of all chemotherapy was given on an out-patient basis.<sup>(2)</sup> Our study also revealed that more patients i.e. 85% were administered chemotherapy on out-patient basis for the same period.

The drug cost of rupees 3150.76=\$62.35 per visit was the highest cost component in our study at 74.15 % of total cost 72% of which i.e. rupees. 3061.53 (\$60.58) was paid by the patients themselves. It reveals that much of the financial burden is on patient himself in a 3<sup>rd</sup> world country like India where health insurance is almost non-existent as yet. While in many developed countries over 70% of pharmaceuticals are publicly funded through reimbursement plans and other mechanisms, in developing countries 50-90% of drugs are paid for by the patients themselves. Medicines

are the major out of pocket health expenses for poor patients in most developing countries.

<sup>(9)</sup> Researchers at RAND, a nonprofit research organization, studied the effect of out of pocket expenses on some chronic diseases and showed that out of pocket costs reduce patient's willingness to start treatment for their chronic illnesses.<sup>(10)</sup>

Results of another study showed that the mean cost to patients and their families for treatment weeks was \$72.81, and for non-treatment weeks it was \$45.88. Approximately 45% of these costs were out of pocket expenses, and 55% were wages lost. Transportation and food were the largest out of pocket expenses. Patients living at greater distance from treatment had higher out of pocket costs, and younger patients reported more loss of wage. Fourteen percent of the patients were estimated to be spending more than 50% of their weekly incomes on nonmedical expenses, and these patients were found largely in the lower-income categories.<sup>(11)</sup>

The average labour cost per visit for outpatient chemotherapy treatment was calculated to be rupees 812.00 (\$16.06) i.e. 19.11%. For in-patient chemotherapy, this was the single highest cost component i.e. 48.45% of total cost (rupees 2773.95= \$ 56.80). This shows that in public sector out-patient chemotherapy is cost-effective for the provider of care than in-patient treatment. The overall hospital overhead charges are also low than in-patient treatment as far as provider's perspective is concerned. It is pertinent to mention here that travel charges were considered under indirect cost head as it was an important cost component from patient's perspective especially for patients who had to travel long distances to reach to the hospital. While as food cost, though important, could not be

ascertained as most patients and their attendants gave erratic response to this question perhaps being busy with their patients chemotherapy administration had no time to take their meals in a busy day schedule.

Comparing the cost details of in-patient *verses* out-patient chemotherapy treatment for the cancer patients at SKIMS, it is clearly seen that out-patient chemotherapy is low at around rupees 1475.94 (\$29.20) per visit, a difference of 26 %. The average unit cost of out-patient chemotherapy administration, Rs 4249.18 (\$84.09), is 26% lower than that of in-patient administration of same protocol.

In contrast, 275 patients were admitted in medical oncology for the same period for chemotherapy whose length of stay was spread over 1585 in-patient days with an average length of stay of 5.76 days. The major cost components of in-patient cancer chemotherapy are costs of drugs and labor cost. They are 46.39% and 48.45% respectively. The average unit cost per patient per day for in-patient chemotherapy is rupees 5725.12 (\$117.22). The total costs of out-patient and in-patient administration of chemotherapy are shown in Table 3.

Comparisons between various providers of similar services to more or less homogenous types of patients have attracted increased interest in healthcare service research in recent years, such comparisons are the most appropriate means of assessing the performance of individual providers, and they are often used for purpose of benchmarking.<sup>(12)</sup>

Jack Zwanziger, Geoffrey Anderson et al compared hospital costs in California, New York and Canada. This study compares hospital spending in two U.S states with

spending in two Canadian provinces, to gain better understanding of the recurring differences in hospital spending reported by the two countries. In 1987 hospital costs per person were about one-third higher in the United States than in Canada. Results suggest that the higher U.S costs are due primarily to higher unit costs rather than to differences in output.

It was concluded that studies of the two systems may prove even more valuable when the two systems are viewed as one large-scale natural experiment. Rather than proving the superiority of one entire system over another, a more modest and possibly more productive view is that international comparisons provide an opportunity to evaluate different patient care strategies. <sup>(13)</sup>

**Table 3- Comparison of total cost of out-patient and in-patient chemotherapy at SKIMS, Srinagar.**

| <u>Variable</u>                   | <u>Average unit cost</u> |                   |
|-----------------------------------|--------------------------|-------------------|
|                                   | <u>Rupees (USD)</u>      | <u>In-patient</u> |
| Drugs<br>2655.98(\$54.38)         |                          | 3150.76(\$62.35)  |
| Labour<br>2773.95(\$56.79)        |                          | 812.00(\$16.06)   |
| Investigations<br>(\$0.71)        | 23.37 (\$0.46)           | 34.70             |
| Other materials<br>(\$0.57)       | 21.24 (\$0.42)           | 28.10             |
| Overhead costs<br>(\$4.75)        | 241.76 (\$4.78)          | 232.36            |
| <b>Total</b><br>5725.12(\$117.22) |                          | 4249.18(\$84.09)  |

### **Conclusion:**

The study concludes that, out-patient cancer chemotherapy is more cost effective than in-patient and should be preferred to reduce the cost burden in poor resource setup/population. Besides, hospitals are able to treat more patients at out-patient level and patient is intact with the home environment with his/her support group and psychological disturbance of hospital admission is avoided. The number of patients needing such treatment is

increasing day by day, the possibility of using district hospitals for cancer chemotherapy should be considered. Cost information can also be used for reimbursement plans by insurance companies and other agencies.

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**Author Contribution:**

**Tabish SA:** the conception and design of the study, final approval of the version to be published.

**Wani MA:** acquisition of data, or analysis and interpretation of data, acquisition of data, or analysis and interpretation of data

**Wafai ZA:** analysis and interpretation, revising it for important content

**Yattoo GH:** Administrative, technical, or material support

**Pandita KK:** acquisition of data

**Haroon Rashid:** Revising the manuscript

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