Research Article

A prospective audit of costs of intensive care in cancer patients in India

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Abstract

Background: The costs of healthcare are increasing. Intensive care poses largest burden on the hospital budget, even in developed countries. We attempted to find out the costs of intensive care in an Indian cancer hospital. **Materials and Methods:** Cost data was prospectively collected for patient-related and non-patient-related activities in a mixed surgical, medical cancer ICU. Demographic data, source, reason, and length of ICU stay were recorded. Total per day costs, costs for patients admitted from wards and operating rooms, and effective cost per survivor (ECPS) were calculated. **Results:** Data was collected for 101 consecutive ICU patients. Fifty-five patients were admitted after surgery (total patient hours 3485 i.e., 145.21 patient days). The mean (SD) intensive care unit length of stay (ICU LOS) was 64.84 (58.47) hrs. (8.25 to 552). Fifty-three patients survived to discharge. Forty-six patients were admitted from wards (hematooncology) or casualty and stayed 3980.25 patient hrs (165.84 patient days). The mean (SD, range) ICU LOS was 106.84 (64.05, 1-336) hrs. Of these, 26 patients survived to discharge. The effective cost per survivor (ECPS) was significantly higher for patients admitted from wards. [Rs. 83,558 = 00 (USD 1856.84) vs. Rs. 15,049 = 00 (USD 334.42)]. **Conclusion:** The costs of ICU place much higher burden on the patients as the Indian GDP and per capita income is much lower. Better selection process is needed for hemato-oncology patients for ICU admission for better utilization of scarce resources. Such data as ours can be used to inform families and physicians about anticipated costs.

Keywords: Cost analysis, costs, effective cost per survivor, health economics, intensive care, length of stay

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Introduction

A large part of healthcare costs is spent on intensive care units in the developed countries.[1] Intensive care units offer care that is resource-intensive both in terms of equipment and manpower.[2] ICU costs have been reported to be between three to six times the costs of treatment in a general hospital ward,[1] and in the USA, intensive care medicine uses up 30% of total hospital resource allocation.[2,3] The high cost of intensive care therapy is attributed to the need for specially trained and experienced staff, the cost of equipment, and the increased use of diagnostic tests, drugs, and therapeutic interventions.[4] The outcome benefits in economic terms remain unproven. Calculating costs of intensive care is helpful in assessing intensity of interventions and analyzing patient characteristics while identification of cost drivers leads to optimum utilization of resources.[3] Critical care for cancer patients is of special interest in this regard, as the high costs of intensive care are coupled with poorer outcomes.[4]

The cost per year of life gained for patients with hematological cancers ($189,339) was found to be much higher than those with solid tumors ($82,845).[5] However, over the years, intensive care outcomes of cancer patients have improved due to better patient selection, better understanding of pathophysiology of complications of cancer treatment, and improved

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intensive care management strategies. Aggressive intensive care is advocated for selected patients with cancer.[6]

India is a developing country, and the gross national income (GNI) per capita for India was 820 US $. This is extremely low when compared to figures for the US (44970 US $) and the UK (40180 US $) for the same year. Using the purchasing power parity (PPP) method, the GNI per capita for India rises to 3800 international dollars (ID), compared to 44,260 ID for the USA and 35,580 ID for the UK.[7] In addition to the low incomes, Indian government funding of the public health system is low. There is no nationalized health scheme in India, and government contribution to health care is negligible. Most of this expenditure is on public health measures like awareness campaigns and vaccination. According to the WHO data in 2004,[7] only 5% of the gross domestic product of the government of India was spent on health care as compared to 8% and 15%, respectively, for the UK and the USA. The per capita government spending on health was 15.8 I$, a meager amount, as compared to US expenditure of 2724.7 I$. Health care facilities in India are either privately-run institutions or public-funded. Government-sponsored institutes deliver care free of cost to patients. These constitute about 10% of the critical care facilities in India. Only a small section of the population, predominantly those in urban centers, has opted for private health insurance coverage. Of the total expenditure on health care in India, 83% was private expenditure and only 17% of expenditure was borne by the government. More than 92% of private healthcare financing was through unplanned for, non-contributory spending. However, costs of ICU care in India appear to be much lower than those in the developed nations. In a study from a public hospital, Karnad and colleagues reported that the cost per patient per day was Rs. 1,973 (U.S. $57) while the cost per survivor was Rs. 17,029 (U.S. $487).[8] In this unique setting of patients with a low income per capita, but lower costs of intensive care, based on the limited data available, it is essential to undertake a detailed cost-effectiveness analysis of intensive care in India. This is even more imperative when critical care for cancer patients is considered. Our hospital is a tertiary referral center for cancer in India. We conducted a prospective study to calculate the costs of intensive care in cancer patients. We aimed at finding out the cost differences for intensive care for post-surgical patients and those admitted from wards. We also calculated the effective cost per survivor and money loss per patient in our patients.

Materials and Methods

This study was conducted at the intensive care unit (ICU) of a partially government-funded, 550 bed, tertiary referral cancer center. The need for informed consent was waived off by the Institutional Review Board. We cater to private as well as public patients. Professional fees are not charged to public patients, and other hospital charges are considerably subsidized. The costs of care of public patients are cross-subsidized partly by the revenue generated from the private patient and in part from government funding. The ICU has nine intensive care beds, which are equipped for advanced hemodynamic monitoring, ventilatory support, and continuous renal replacement therapy (CRRT); and an adjoining 14-bedded recovery room. The ICU receives patients from the operating rooms (OR) as well as from the emergency room and medical wards. The case mix thus consists of high-risk post-surgical patients, hematological malignancy patients, and an occasional patient from the radiotherapy unit. It is a semi-closed unit staffed by two intensivists during daytime and two qualified residents (Anesthesiology) and two postgraduate students round the clock. We have 46 nurses with varying experience (6-12 yrs) who work in three shifts with nurse to patient ratios ranging from 1:2 to 1:4. Various specialists are available for consultation when required. Laboratory, imaging and transfusion medicine services are available round the clock.

We used a combination of bottom-up approach and cost block method.[9] For patient-related costs, a specially designed form, which was kept in the patient's case record file till death or discharge, was used. Data was collected for 101 consecutive patients admitted to the ICU after 8th November 2005. Demographic data and source of ICU admission, ICU admission diagnosis, and ICU outcomes were recorded. The ampoules, vials of drugs, and consumables used for a patient were collected in a cardboard box kept at the foot end of the bed in the cubicle. At the end of every 24 hrs till the time of discharge, the items and their quantity used was noted. Blood and blood products transfused, investigations ordered, outside consultations obtained, and procedures performed were also noted every day. The costs of the drugs and consumables were obtained from the dispensary.

Non-patient-related costs for intensive care were collected from various departments involved. The manpower costs were obtained from the accounts department. Of the 11 consultants in anesthesiology department, we assumed that one consultant is working full time in the ICU per week and thus calculated salary

for four consultants working for four weeks. Similarly of the 24 residents and 12 postgraduate students in our department, of whom eight residents are on duty in the ICU every month in two shifts of four each the salary was calculated. For salary calculation, we assumed the ICU to have eight residents of varying seniority. We obtained the costs for land and building from the current municipal rental value. We have used the depreciated costs of the equipment. The electricity costs for running various pieces of equipment were obtained from the specifications given in the service manuals of that piece of equipment. No patient needed CRRT during the period of the data collection, thus the variable costs do not include those costs. CRRT is not very commonly performed, and this should not present problems in the calculation of variable costs. The electricity costs for the air conditioning were obtained from the AC section of the engineering department. The ICU has an independent air conditioning system. Costs for water consumption were obtained from appropriate apportioning between various areas. Costs of linen, laundry, and sterilization of instrument packs were obtained from daily supply. Costs of sterilization of instruments, which are quite old, were obtained from CSSD. ICU overheads for various departments such as administration, engineering, stores, purchase, maintenance and verification cell, accounts, security, etc., were calculated as a proportion of the general management costs as per the floor area of the ICU.

Results

Data was collected for 101 consecutive patients admitted to the ICU from the OR after elective or emergency surgeries (55 patients) and from the ward (hemato-oncology) or emergency room (46 patients) from 8th November – 29th December 2005. There were 59 males, and the mean age (SD) was 42.94 (17.54) yrs. Fifty-three of 55 patients admitted from OR and 26 of 46 patients admitted from ward survived to discharge. The patients admitted from ward stayed longer than patients admitted from the OR; however, this difference was not statistically significant Table 1. The overall patient-related costs can be seen in Table 2. Maximum costs were incurred for drugs, investigations, fluids and blood, and blood products Table 3. The patient-related costs were significantly higher in the patients admitted from the ward or casualty. The largest component of non-patient-related costs was medical and support staff salaries Table 4. The patient-related effective cost per survivor Table 5 was Rs. 83,558.30 (US$ 2088.95) for a patient admitted from the ward, significantly higher than the costs for patients admitted from the OR Rs. 15,049.14 (US$ 376.29). Similarly, the money loss per patient (expenditure for patients who died/total number of patients) was higher [Rs. 15,795.50 (US$ 394.89) vs. Rs. 7,538.8 (US$ 188.46)] for patients admitted from wards.

Table 1: Patients, source of admission, and ICU LOS

Source	No. of pts	Survivors (%)	Total pt hours	Total pt days	Mean LOS hours (SD)	*P* value#
All	101	79 (78.22)	7465.25	311.05	73.91 (62.3)	
Ward	46	20 (43.48)	3980.25	165.84	74.51 (63.59)	0.145
OR	55	53 (96.36)	3485.00	145.21	64.54 (58.47)	

#Calculated using Students' *t* test, ICU: Intensive care unit; LOS: Length of stay; OR: Operating room

Table 2: Overall patient-related costs

Admission source	Total cost (IR) all patients	USD	Total patient days	Per day cost (IR)	USD
All pts	2468770.21	61719.26	311.05	7936.89	198.42
Ward	1671166.01	41779.15	165.84	10076.98	251.92
OR	797604.20	19940.11	145.21	5492.76	137.32
P value#	0.001799		0.0000330	0.00267	

#Calculated using Students' *t* test, USD: US dollars; IR: Indian rupees; OR: Operating room

Table 3: Components of patient-related costs

Component	All pts mean (SD)		Ward pts mean (SD)		OR pts mean (SD)		*P* value#
	IR	USD	IR	USD	IR	USD	
RS	1426 (1242)	35.65 (31.05)	1728 (1525)	43.2 (38.12)	1163 (966)	29.08 (24.15)	0.114
CVS	1570 (1775)	39.25 (44.38)	2532 (2144)	63.3 (53.6)	732 (1048)	18.3 (26.2)	0.00064*
Consumables	576 (481)	14.4 (12.03)	723 (522)	18.08 (13.05)	449 (396)	11.25 (9.9)	0.035*
Fluids, blood	6210 (7950)	155.25 (198.25)	10994 (13234)	274.85 (330.85)	2048 (2215)	51.2 (55.38)	0.035*
Drugs	6416 (7840)	160.4 (196)	9912 (10547)	247.8 (263.68)	3375 (4148)	84.375 (103.7)	0.0021*
Investigations	7480 (5910)	187 (147.75)	8488 (6195)	212.2 (154.88)	6603 (5299)	165.075 (132.48)	0.17
Imaging	772 (943)	19.3 (23.58)	1180 (1304)	29.5 (32.6)	409 (478)	10.225 (11.95)	0.012*
Total cost	24443 (24098)	661.08 (602.45)	35557 (30669)	888.93 (766.73)	14771 (14172)	369.28 (354.3)	0.0017*

#Calculated using Students' *t* test, * Statistically significant difference, USD: US dollars; IR: Indian rupees; OR: Operating room

Discussion

In an Indian cancer hospital ICU, we found that the patient-related cost of intensive care was much higher in patients admitted from the ward than those admitted from the operating rooms. This may be because the patients admitted from operating rooms were relatively stable and stayed in the ICU for a shorter duration of time. Also, we did not include the costs of endotracheal tubes, central lines or arterial lines, and pressure transducers while calculating the costs as the patient would have been charged for these items during anesthesia. In contrast, the patients admitted from the wards were sicker, more unstable as reflected by a longer ICU stay and poorer ICU outcomes. Most patients admitted from wards to our ICU are hemato-oncology patients, the most common admission diagnoses being febrile neutropenia, sepsis, and septic shock, needing high intensity of critical care. These patients need-advanced hemodynamic monitoring, broad-spectrum antibiotics, and multiple transfusions with blood and blood products. Thus, patients admitted from ward spent significantly higher amounts on drugs, fluids and blood, and on hemodynamic monitoring consumables as compared to their postoperative counterparts. Courtney and colleagues evaluated costs of managing patients with febrile neutropenia in emergency department (ED).[10] For a median stay of 3.3 hours (IQR 2.3-4 hrs), the costs of care in the ED was $1,455 (IQR, $1,300-$1,579). During this short stay in ED, maximum resources were spent on routine and critical care nursing, laboratory and imaging, and blood and blood product transfusion. A retrospective cohort study used therapeutic intervention scoring system points to compare resource utilization in hemato-oncological patients and those without malignancy.[11] The resource use of hemato-oncological patients was higher (median (IQR), 214 (102 to 642) versus 95 (54 to 224), $P < 0.0001$); but the outcomes were similar for the same severity of illness.

Edbrooke and colleagues reported that the costs of treating sepsis and early sepsis to be higher than treating non-sepsis patients.[12] A large retrospective cohort study compared hospital length of stay and costs of hospitalization in severe sepsis patients with and without cancer.[13] The length of hospital stay and costs were three times higher in cancer patients with severe sepsis. A multicenter Italian study reported the costs of intensive care in various diagnostic groups.[14] They found the costs for trauma patients to be 4076 Euros, much higher than for elective coronary surgery patients, at 380 Euros. The maximum expenditure was for infusions, laboratory tests and imaging, and drugs in patients with polytrauma, whereas in coronary artery bypass patients, laboratory tests consumed the most resources. The costs of intensive care vary according to admission diagnosis, intensity of interventions required, and whether admission was elective or emergency. The costs of intensive care thus vary with various diagnostic categories and nature of admission *viz*. emergency or elective. Costs of staffing, variously termed nursing shifts and ward rounds (44% of total costs), staff (53.6% to 54.9%), staff costs (56%) have consistently been shown to be the main component of non-patient-related costs.[15-17] In our study also, staffing costs were the highest component (nearly 67%) of non-patient-related costs.

It is difficult to obtain costs in Indian ICUs. There is wide variation in organizational structures of Indian ICUs. Intensive care units are often under administrative control of some larger department, for instance, our ICU is part of department of anesthesia, with no separate budget. This precludes accurate calculation of overheads of other departments as well as staff salary due to common staffing. In India, several brands of the same medication are available at varying prices and the prescribing practices vary, making for difficulties in computing the costs of the medications. In public

Table 4: Non-patient-related costs

Head	Annual cost		
	IR	% of all costs	USD
Land and building	144000.00	0.94	3600
Equipment	956742.68	6.26	23918.57
Salaries doctors	5156629.00	33.74	128915.7
Salaries support staff	5698213.00	37.28	142455.3
Electricity consumption	1382072.21	9.04	34551.81
General consumables	444976.50	2.91	11124.41
Linen and sterilization	388750.00	2.54	9718.75
Medical gases	309913.00	2.03	7747.83
ICU overheads	243678.65	1.59	6091.97
Water consumption	550519.20	3.60	13762.98
Waste management	9586.36	0.06	239.66
Total annual costs	15285080.60	100	382127
Avg admissions to ICU/yr	650.00		
Indirect costs/per pt	23515.51		587.89

ICU: Intensive care unit; IR: Indian rupees; USD: US dollars

Table 5: Effective cost per survivor*

Category	No. of pts	Survivors	Total cost (IR)	Total cost (USD)	ECPS (IR)	ECPS (USD)
All pts	101	79	2468770	61719.26	31250.26	781.26
Ward	46	20	1671166	41779.15	83558.3	2088.95
OT	55	53	797604	19940.11	15049.14	376.29

*Includes only patient-related costs, ECPS: Effective cost per survivor; USD: US dollars; IR: Indian rupees

institutes, in particular; and sometimes also in private institutes, all medications and consumables may not be available in the dispensaries and patients are expected to buy these from outside chemists. As patients are paying out of pocket, these costs may be overlooked while working out patient-related costs.

We made several assumptions. 1. In our hospital, patients can choose categories of care, according to what they can afford. They are often downgraded when ICU stay is prolonged to lower charge category to limit their expenses. To keep the costs uniform, we assumed all patients to belong to semi-private category. 2. The data collection period was short and, therefore, may not represent the full case-mix or interventions done in our ICU. For instance, during the data collection, no patient required CRRT, so our costs do not include patient-related costs of CRRT. This may be offset however, by the fact that our use of CRRT is often hampered by lack of affordability as most patients are paying out of pocket. 3. We have assumed 100% occupancy while calculating the costs, which may not be the case always. Often, when ICU is full, we are forced to ventilate critically ill patients in the recovery room. 4. In a government-funded hospital, no depreciation is followed and assets purchased are written off the same year. We have, however, followed standard practice and calculated 10% linear depreciated cost of the ICU equipment.

A limitation of our study is that in spite of ICU admission criteria being in place for admission to our ICU, patients with advanced malignancies in unstable condition may be admitted during late hours. Subsequently, decisions regarding the limitation of care or withdrawal of care are made during working hours next day. In the ideal world, intensivists will prefer that such patients not be admitted to the ICU by adhering to ICU admission protocol, however, that is unlikely to happen due to extraneous factors such as insistence by primary physician, insistence by family, and lack of clarity in final diagnosis of malignancy. This is likely to happen in any ICU dealing with malignancy patients. Inclusion of such patients will alter cost incurred in the ICU. Since this was an observational study, in an effort to being pragmatic, we did not exclude such patients and included all consecutively admitted patients in the study. Another limitation is that we do not have severity of illness scores for these patients and we have assumed that ICU length of stay, interventions and mortality reflect the severity of illness of these patients.

The ICU outcomes of patients of hematological malignancies are known to be poor. The cost per year of life gained for patients with hematological cancers was $189,339, much higher than those with solid tumors ($82,845) in a study published[5] in early 1990. Effective cost per survivor (ECPS) and money loss per patient are useful measures of cost performance. The ECPS rises considerably at higher probability of death when more resources are spent for non-survivors. In cancer patients, we found that it is more cost-effective to treat post-surgical patients than patients admitted from the ward. The cost efficacy can be improved in this group of patients by triage of patients before ICU admission and setting limits of care in patients likely to have poor outcomes.

Should we offer intensive care to patients with hematological malignancies who have suffered a complication of chemotherapy? This decision needs to be taken in the light of cost of treatment of primary malignancy. The cost of 1 cycle of rituximab, vincristine, adriamycin, cyclophosphamide, and prednisolone chemotherapy for Non-Hodgkin's Lymphoma is Rs. 1,50,000.00 (US$3750) for the medications alone, and 6 such cycles are usually given. Thus, the cost per patient is Rs. 9,00,000.00 (US$22,500). Assuming a 70% 5-year survival, the cost per survivor is Rs. 12,86,000 (US$32,143). This does not include cost of hospitalization, professional charges, and supportive care (growth factors, blood and blood products, antibiotics). Thus, although intensive care is expensive in cancer patients, it is far less expensive than treatment of non-Hodgkin's lymphoma.

Rationing of intensive care is increasingly being discussed. The decision of rationing intensive care may be based on presence of external constraints, a reference to clinical guidelines and lastly based on clinical judgment alone.[18] The per capita income of the average Indian was Rs. 29786 (744.65$) per annum in 2007 i.e., Rs. 81 per day[19] and the costs per day must be looked at bearing this gross disparity in income and the costs of ICU. In other words the daily cost of ICU care is approximately 100 times the per capita income of an Indian. In developing countries, where the patient is paying out of pocket, ICU cost is one of the major external constraints, in the decision of whether to offer intensive care to the patient or not. The data such as ours can be used to inform the referring physicians and patients families about anticipated costs of intensive care.

Conclusions

The costs of intensive care were much higher and outcomes poorer for hemato-oncology patients as compared to patients with solid tumors undergoing resection, resulting in higher ECPS. Though the costs

of intensive care seem to be lower as compared to the western ICUs, a greater burden is placed on Indian patients due to much lower per capita incomes. A better selection process is needed for hemato-oncology patients for ICU admission for better utilization of scarce resources. Data such as ours can be used to inform families and referring physicians about anticipated costs.

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