

# Study of Unit Cost of Medical Intensive Care Unit at Tertiary Care Hospital in Government Set up in New Delhi

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## ABSTRACT

**Aim:** The cost incurred on delivery of Medical Intensive Care Service to the patient varies from type of Intensive Care Unit (ICU). The present study was conducted to assess the cost of per patient per day in Medical Intensive Care Unit (MICU).

**Materials and methods:** It was a prospective study which was carried out at tertiary care hospital, in Government setup, Delhi from 01st January 2014 to 31st January 2014. All the Adult patients admitted in Medical ICU were taken for study. Various costs like fixed, variable, Direct and Indirect were calculate for the study period by step down approach. The unit cost was calculated.

**Results:** Total 32 patients were admitted in Medical ICU during the study period. The average days of admissions calculated to 171 days. The average length of stay was estimated at 5.343. The salary component amounts to 42.44% of the total cost. The equipment cost amounts to 37.00% of the total cost. The total fixed cost amounts to 81.62% and variable cost amounts to 18.38%. Out of variable cost the investigation radiology amounts to 6.35% followed by medicine 4.81% and Investigation 3.83%. The unit cost calculated amounts to ₹ 1133.29.

**Conclusion:** The fixed cost is a major share of the total cost incurred in Medical ICU. Out of which equipment cost stands first. The unit cost amounts to ₹ 1133.29 which is relatively less than the other studies probably due to close type of ICU and patients admitted in Medical ICU are coming from outside.

**Keywords:** Medical ICU, Unit cost, Tertiary care hospital.

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## INTRODUCTION

India is a very diverse country having geographical, political, linguistic predominance. The health need defer from region to region and as such healthcare delivery with facilities as per requirement of the people. Various cost studies are being conducted in India for different levels of healthcare services and providers. They may be specific to a particular disease (e.g. typhoid) or based on a specialty (e.g. pediatric care) or service provider (e.g. primary health center). Anand et al (1993)<sup>1</sup> estimated the cost incurred by a primary health care center in Northern India during 1991-92, Krishnan et al (2005)<sup>2</sup> tried to estimate the cost of outpatient and inpatient pediatric health services provided by the All India Institute of Medical Sciences. Treatment cost of typhoid fever at two hospitals in Kolkata was estimated by Sur et al (2009).<sup>3</sup> Mathur et al (2010)<sup>4</sup> had determined the unit cost of curative care provided at primary healthcare centers in Ahmadabad. The ICU patients across the country show peculiar and distinct trends. During monsoon, 70 to 80% of patients are of infectious diseases (tropical febrile emergencies, e.g. malaria, leptospirosis, dengue). Lifestyle related metabolic diseases and consequent critical situations are on the rise, e.g. diabetes, cirrhosis, uremia. Consistent with the general demographic trends, 30 to 40% of patients in ICU are elderly, with inherent features of difficult weaning, prolonged stay and refractoriness to standard line of treatment. Nosocomial infections due to multiple vascular accesses and tubings, catheterizations are clinical entities of concern, as are fungal infections in immune compromised hosts, such as those with HIV/AIDS, uncontrolled diabetes mellitus further accentuated by usage of potent antimicrobials.

This is not surprising as critical care medicine is relatively a new field though it has evolved significantly over the past decade. In order to understand the cost, it is important to understand the current organization of critical care services in India and its inherent diversity.<sup>5</sup> There are only very few studies looking into cost of intensive care in India, hence this study is carried out.

## MATERIALS AND METHODS

It is prospective study. All sick patients admitted in Medical Intensive Care Unit (MICU) for the month of January 2014

at Government Tertiary Care Hospital, New Delhi, were included in the study.

The cost of eight bedded Medical Intensive Care Unit (MICU) for 1 month (31 days of January) is calculated by step down method of costing taking into consideration of fixed cost (direct and indirect) and variable cost (direct and indirect). The numbers of patients admitted were counted and total days of admission were ascertained. The average length of stay was also calculated. The unit cost was calculated later on as per standard formula of cost per patient per day.

Fixed cost is of two types direct and indirect. The Variable cost also consists of two components, i.e. direct and indirect. fixed direct cost included the salary of Staff, Equipment cost with depreciation, building maintenance cost. Respective maintenance cost was obtained from equipment maintenance department as per Annual Maintenance Charges norms and then computed for monthly basis for the said study period. Building depreciation and maintenance of the premises were arrived at by guidelines for valuation of immovable properties by A Chattopadhyaya; Chief Engineer Valuation Income Tax Department, New Delhi, 1996.

Fixed Indirect cost included Electricity consumption (was arrived at by taking note of type and number of fixture, equipment's and its consumption of electricity by individual patient and collective use by the premises in watts counted. Total consumption was arrived at and cost assessed by applying the charges @ ₹ 5.50 per unit.), Water consumption (500 liters per patient per day as per standard WHO guidelines and prevalent charges (₹ 10 per KL) as applicable were applied), Running cost of closed circuit TV (CCTV) was calculated by adding the cost of installation, its depreciation, AMC charges, and the salary of human resource required to run it. The cost per bed was calculated and then multiplied by the MICU capacity, i.e. 8 in number). Furniture maintenance (done on apportionment method), telephone and internet cost (was computed by apportionment method by dividing the monthly bill of telephone and internet by the number of beds and then computing for eight bedded MICU) and Generator cost for 8 bedded MICU.

The Variable Direct cost included Cost of Medicines, (rates of all pharmaceutical agents used in the MICU were obtained from the purchase department of the hospital and its individual consumption was assessed and costing per month is calculated). Cost of consumables (was compiled as per three monthly consumption, on which basis monthly consumption determined and its costing assessed), Central Sterile Supply Department (CSSD) (costing was done by compiling the equipment price and its depreciation, calculating the equipment maintenance, salary of human resources. divided by total no. of items sterilized in 1 month and multiplied by no. of items supplied in MICU), cost of lab services (Government approved rate/ CGHS rates were

applied for cost assessment for each lab/procedure/ surgery / radiology services on individual basis and costing arrived at on monthly basis) and radiological cost was calculated (the similar methodology of lab services was applied). Oxygen cost (only the running cost of oxygen therapy was calculated on the monthly consumption pattern of liquid oxygen, supply of oxygen cylinders in the manifold, running cost of plant, its maintenance cost, salary of technicians). Variable indirect cost included cost of stationery, pest control services. The Stationery cost was calculated on monthly consumption. Pest control services was calculated by the method of apportionment. Totaling of each cost was done and unit cost is calculated.

## EXCLUSIONS

1. The land rates were not included in for paucity of data.
2. Data on laundry, waste disposal, blood product was not available hence excluded.
3. Dietetic services were not included as majority of Patients were on Ryle's Tube feeds/ IV fluids and very few were given normal feed short duration.

## RESULTS

This study was conducted in 8 bedded Tertiary Care Government Hospital in New Delhi in the month of January 2014. The data incorporated 'fixed direct cost', e.g. salary of the staff including medical, nonmedical as well as supporting staff, equipment procurement as well as maintenance cost, building depreciation and maintenance costs and 'Fixed Indirect costs', e.g. generator backup, water and electricity charges, provision of telephone and internet, installation of CCTVs as well as furniture maintenance. 'Variable Direct cost', e.g. like investigations, medicine, radiology, consumables, oxygen, and 'variable indirect cost', e.g. stationery, pest control cost, etc. were calculated.

Costs incurred for MICU services in 1 month under various heads were calculated and analysis was carried out.

### Fixed Cost

The total fixed cost was calculated as 81.62%. The Direct fixed cost was calculated as 79.44%. Out of direct fixed cost salary component has major share (42.44%) and equipment component was amounting to 37.00%. Only 2.18% cost was shared by other services like charges of electricity, equipment and building maintenance, etc. (Table 1).

### Cost of Salary

It was observed that the salary component accounts to 42.44% of total cost of MICU, during the study month. Out of which 21.31% belongs to doctor's salary which included

both faculty and resident doctors. The salary of the faculty amounts to 8.87% and resident doctors to 12.44%. The salary of the nursing personnel calculated was 15.39%. The cost of supervisory component of nursing personnel amounts to 9.17% of the cost of salary of nurses. The salary of ECG technicians takes the share of 2.68% of the total cost (Table 2).

**Cost of Equipment**

Various life saving equipment were used in the MICU, like ventilator, defibrillator, monitors, bipap, ultrasound, X-ray, ECG, infusion pumps, etc. The total cost of equipment amounts to 37.00%. Out of this, cost ventilator consume 11.13%, central station monitor 8.95%, and X-ray amount to 6.90%. Monitors 2.18%, defibrillators 2.90% 2D Echo 1.94% respectively (Table 3).

**Variable Cost**

The total variable cost calculated was found to be 18.38%. The direct variable cost amount to 18.31% and indirect

variable cost amounts to 0.07%. Out of variable direct cost radiological investigation amounts to 6.35%. This is followed by medicine (4.81%) and lab investigation (3.83%). The indirect variable cost is least (Table 4).

**Unit Cost**

The unit cost in Medical ICU is calculated by formula depicted below. It was observed ₹ 1132.99 in the present study.

$$\text{Total cost per month/no. of admission days/no. of patients admitted} = \text{unit cost per patient per day } 6199738.25/171*32 = 1132.99.$$

**Patients Characteristics**

Total 32 patients were admitted during the month of January 2014. The maximum no of patients were suffering from cardiovascular disorder mainly coronary artery disease (CAD) (10), followed by neurology, i.e. cerebrovascular accident (CVA). Only two patients were admitted with urinary tract infection with sepsis (Table 5).

**Duration of Stay of Patient**

It was observed that out of 32 patient’s maximum no. of patients stayed in MICU for 1 to 5 days.<sup>12</sup> Only eight patients spent 0 to 1 day in hospital. Rest of the patients stays 5 days and above (Table 6).

**Average Length of Stay (ALOS)**

The total admission days calculated on individual patient’s admission date and time and discharge date and time. The total days of individual patient calculated like this and sum of all 32 patients done. This arrived sum is called as a total admission days. The total admission days calculated were 171. This sum (171) was divided by total no. of patients (32).

**Table 1:** Distribution of cost

Head	Total salary cost per month
Salary	2631400
Equipment	2293875
Equipment maintenance	51525
Building maintenance	83669.25
Diagnostic	929330
Others	209939
Total cost per month	6199738.25

**Table 2:** Distribution of salary component of cost

Staff	Total salary
Doctor (faculty)	550000
Doctor (nonfaculty)	771000
Nurses	954000
Nursing orderly	132000
Safaiwala	28000
Guard	14000
ECG tech	166000
Data entry operator	16400
Total salary	2631400

**Table 3:** Distribution of cost equipment

Name of equipment	Per month equipment cost	Percentage
Ventilator	690000	11.13
Monitors	135000	2.18
Central station	555000	8.95
Defibrillator	180000	2.90
USG	57000	0.92
2D Echo	120000	1.94
X-ray	427500	6.90
Infusion pump	117000	1.89
ECG	12375	0.20
Total cost	2293875	

**Table 4:** Distribution of variable cost

Total variable cost	Percentage
Medicine	4.81
Investigation (lab)	3.83
Radiology	6.35
CSSD	0.24
Consumable	2.7
Oxygen	0.39
Stationary	0.06
Pest control	0.01

**Table 5:** Distribution of patient accordingly disease

Type of patient admitted in a month	
CVS	10
RS	4
Abdomen	4
Neurology	8
UTI	2
Diabetic	4

**Table 6:** Status of patient according to duration in MICU

Days	Duration or stay (days) of patient
0-1	8
1-5	12
5-10	6
10 onward	6
Total	32

The result is taken as average length of stay. In the present study, average length of stay was (171/32) 5.343 days.

## DISCUSSION

The study was conducted in 8 bedded MICU of Government Tertiary Care Hospital, New Delhi. This was a closed ICU. The unit cost was assessed and found to be ₹ 1132.99 which appears to be lower in the present scenario. The various studies conducted in India in this matter. Sumitra Chatterjee<sup>7</sup> had observed in her study that cost per patient in tertiary care government hospital ₹ 614. She also opined that major component of hospital cost is human resources which is true for this study as it consume 42.44% of total cost. Parikh et al in their study showed cost per patient per day was ₹ 1,973. It is also opined that average length of stay less than 7 days reduces the cost per unit, in present study the average length of stay is 5.343 days.

The cost of ICU care in a tertiary care center in India by Udhwdia (in 1991)<sup>8</sup> was reported to be ₹ 3200 per patient (\$167.70). Staffing, intravenous fluids, and drugs accounted for 75% of the cost of ICU care, whereas 15% accounted for laboratory investigations and 6.9% for disposables. The cost of ICU care is rising steadily owing to costly equipment and manpower in better ratios. Dasta et al (2005)<sup>9</sup> have studied daily cost of intensive unit and observed that mean intensive care unit cost and length of stay were 31,574 ± 42,570 dollars and 14.4 days ± 15.8 for patients requiring mechanical ventilation and 12,931 ± 20,569 dollars and 8.5 days ± 10.5 for those not requiring mechanical ventilation. Daily costs were greatest on intensive care unit day 1 (mechanical ventilation, 10,794 dollars; no mechanical ventilation, 6,667 dollars), decreased on day 2 (mechanical ventilation, 4,96 dollars; no mechanical ventilation, 3,496 dollars), and became stable after day 3 (mechanical ventilation, 3,968 dollars; no mechanical ventilation, 3,184 dollars). Adjusting for patient and hospital characteristics, the mean incremental cost of mechanical ventilation in intensive care unit patients was 1,522 dollars per day ( $p < 0.001$ ). In the present study, the average length of stay is 5.343 which support the reduction of cost as the stay increases.

Shweta et al (2013)<sup>10</sup> have studied the total cost per day in Renal ICU. It was observed that total cost per day was Indian rupees (INR) 10,364 (US \$ 222). Hospital has borne 46.4% of the total cost and rest by patients. The mean cost

represented 36.8% of the total cost and 69.8% of the variable cost. Expenditure on personnel salary constituted 37% of the total costs and 86% of the fixed cost. Length of stay in RICU was significantly higher in no survivors ( $14.73 \pm 13.6$  days) vs survivors ( $8.3 \pm 7.8$  days) ( $p < 0.05$ ). The TISS-28 score points in survivors was 30.6 vs no survivors 69.2 per nurse ( $p < 0.05$ ) correlating strongly with the total cost ( $r = 0.91$ ). The finding in this study do not match with the study of Shweta because in this study cost is low (₹ 1133) and average length of stay is less (5.343 days). The expenditure on salary is nearly matching which is (42.44%) as compare to 36.8%.

There is increasing evidence that closed<sup>11</sup> or transitional models<sup>12</sup> has better outcome and resource utilization, than open ICUs, Though ISCCM<sup>13</sup> endorses closed model in general medical-surgical as well as specialty ICUs, Due to closed ICU the unit cost is on lower side. Salaries of other supportive staffs like Technician, ward Boyd, Attendants, Guards are also counted Comparative figures in West quotes a high percentage (about 50%) of the total costs of ICU that can be attributed to this cost block which is a clear reflection of the labor-intensive requirements within critical care as well as high level of remuneration for both medical and nursing staff.<sup>14</sup> On the contrary, Parikh and Karnad<sup>15</sup> reported low staff wages as one of the reasons for low cost of ICU care in India. Despite the growth in this field, this trend continues to persist. On the flip side, high level of attrition and migration to western countries creates an ongoing shortage and demand for support staff, which in turn affects quality of care and hence possibly costs. Parikh and Karnad<sup>15</sup> attributed the high 64.2 TISS points toward the increased workload per nurse due to these reasons various studies carried out at AIIMS showed beyond doubt that it shares major portion of financial resources. Even then from a practical perspective this cost block is unlikely to add toward total ICU costs substantially in India.

The low cost of ICU care in India is partly because of low cost of drugs and recycling of consumables. Though the later still holds true in some Institutes, the costs of drugs have increased enormously. In a study of factors affecting drug use, cost of therapy, association between pattern of drug use and survival in a tertiary care ICU, it was found that although the mean number of drugs in prescription increases at the time of admission till the time of discharge. On the other hand, inappropriate use of antimicrobials especially in the ICU context<sup>16</sup> and the increasing incidence of microbial resistance even to newer generation of antibiotics reported from various ICUs across the country<sup>17</sup> pose greater concern. Considering the fact that the cost of using an antibiotic, such as Meropenem is ₹ 3,000 per day, negative trends like this will add to the overall ICU costs substantially.

The observations made in the present study are supported by the various studies in the past. Though this is true, it

has limitations like not taking land cost, dietary, laundry, procedural cost while calculating the cost per unit hence exact cost is not really assessed. The study duration is only 1 month which is not sufficient to say authoritatively on this matter. It is suggested that prospective study for long duration having consideration of all factors responsible for cost measurement may be undertaken to know the real cost.

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