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Pharmacoeconomic Estimative Study In Orthopedic Operative Cases Of Tertiary Care Teaching Hospital.

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ABSTRACT

Pharmacoeconomics involves the analysis of the cost of drug therapy in the health systems will help to the society. The use of Pharmacoeconomic method can play a significant role in drug product selection for formulary, comparison of alternative therapies, pricing a product and evaluating a drug products and expected quality of life improvement. Hence it plays a major role in two basic areas of decision making i.e., drug therapy evaluation and clinical pharmacy service evaluation and its combination. The scarce data in our country provokes us to evaluate cost in orthopedic surgeries. It is an observational study carried out in 153 patients in an inpatient Department of Orthopedics between November 2016- April 2017. The patient was informed about the study and those showed interest to participate in the study were included in the study by obtaining their consent. The required data was collected in a well-designed data collection form. The obtained data was subjected to descriptive statistics. A total of 153 patients was reviewed, out of which male percentage was more (83.0%) when compare to female patients percentage (17%). Among various age groups, majority were at the age of 40-50 years (24.2%), followed by 30-40 (20.9%), 20-30 (20.3%) and 50-60 years (13.1%), 10-20 years (8.5%) & least were 1- 10 years and below (3.3%).The occupational details of the patients showed majority of them have an occupation (71.9%), but rest of the patients have no occupation. This study showed 88.2 % had no insurance coverage, whereas rest had small insurance supporting/coverage in which 5.9% RSBY scheme, followed by LIC 4.6%, Yeshashwini schemes 3.3% and BPL schemes 2.6 % which was a relief to the burden of economic costs to certain extent. (3.3%); arthroscopic and bone graft procedures 2 (1.30%) and limb salvage 1 (0.7%). The surgery time taken was >3<4h in (59.5%), whereas 35.3 % had >2-<3h; 3.3% had 1-2h and only 2.0% had >4-5h.The mean cost of the surgery are 20,831.43±6,798.74 bony procedure, 1,05,010.30±1,16,268.28 bone graft procedures, 18,467.92±3,483.15 soft tissue procedures, 32,297.38±28,512.40 spine procedures, 31,998.96±5,563.00 arthroscopic procedures, 31,998.96±5,563.00 amputation procedures, 23,013.31 limb salvage and 16,987.38±9,051.04 for implant removal procedures. Cost-of-illness analysis was estimated from the day of admission to the day of discharge. The maximum cost was found to be more in bony procedures with total of 22,91,457.315 and least cost for limb salvage 23,013.31 in rupees. This cost estimation will give the idea that some possible strategies can be adapted to decrease the outcome expenditures in these surgery procedures.

Keywords: Operative orthopedic procedures, direct medical cost, non-direct medical cost, total medical cost.

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INTRODUCTION

Economics is defined branch of scientific study which allocates the limited resources or inputs among alternative uses, to satisfy the output/ unlimited needs. Identification and choice among alternatives, assessment of costs, consequences and decision-making within limited(or fixed) budgets are the three major elements in all economic analysis methods [31] [6]. Rising cost of health care delivery is a major concern in the organizations (i.e. government/private) to the patients and health care professionals. The demand of health care service costs are increasing in all countries due to increasing demand in health care quality / service, technology, standard of living and expectation for increasing/prolonging the life span. Therefore economic/ pharmacoeconomics concept are essential to optimize the cost of the therapy [6, 7].

Pharmacoeconomics involves the description and analysis of the cost of drug therapy in the health systems which may help to the society. The Pharmacoeconomic method can be used in drug product selection for formulary, comparison of alternative therapies, pricing a product and evaluating a drug products' expected quality of life improvement. Hence it plays a major role in two basic areas of decision making i.e., drug therapy evaluation and clinical pharmacy service evaluation [8].

Generally Economic model is routinely used to predict the cost effectiveness of new pharmaceuticals for reimbursement purposes. Cost accuracy estimate depends on the quality of input variable, validity of surrogate end points and appropriateness of modeling assumptions, (like model structure, time horizon and sophistication of the model to differentiate clinically and economically meaningful outcomes)[9].

Pharmacoeconomics is defined as a branch of health economics which deals with the measurement of both the costs and consequences in therapeutic decision making. The various pharmacoeconomic methods generally used are cost of illness, cost benefit, cost effectiveness, cost utility, cost minimization and cost consequences. These PE methods create /give abundant opportunities to assess the efficacy, effectiveness and availability of health care programs, procedure and services based on the various analysis methods [14]. Therefore the concept of pharmacoeconomics is essential to prescribe individualized drug therapy, based on essential drug concept and RUD criteria. Adaption of these concepts improves the cost effectiveness of drug therapy outcome [13].

Cost-of-illness measures the economic burden of a disease and estimate the maximum amount that could potentially saved for disease prevention/eradication. These perspectives help to estimate/measure costs to society, the health care system, third-party payers, businesses, the government and families. Incidence based and prevalence based studies are the commonly useful two methods in cost of illness method. Incidence based studies estimate lifetime costs i.e., measures the cost of an illness from onset to conclusion (usually a year), whereas prevalence based studies measures the cost of disease from the date of onset, covers all medical costs and morbidity costs of disease [10]. A third category, the psychosocial cost of illness includes: direct costs and indirect costs. Generally the costs can be categorized into two basic categories i.e., direct and non-direct costs. Direct cost covers medical cost and nonmedical cost. Medical costs includes the costs of diagnostic procedures, drug acquisition cost, costs of monitoring therapy, costs of adverse events management, hospitalization costs, medical staff cost, costs of specialist consultations, administrative costs. Non-medical costs of a special diet or transportation to and from a treatment centre[11]. Indirect cost is the incapacity for work, reduced work productivity or loss of leisure time. Measuring indirect cost will be performed through either one the three major methods: human capital method, friction cost method and willingness to pay method. Human capital method from the economic perspective the term capital refers to one of the factors of production employed to produce valuable and usable goods or services. Thus this method explains, one of the production factors or inputs that can generate additional values by employing it into a production process [14]. Friction cost method (FCM) estimates the value of human capital when another person from the unemployment pool replaces the present value of a worker's future earning until the sick or impaired worker returns or is eventually replaced. Hence the friction cost (initial disruption costs + training costs) is limited to illness, injury or premature death of the short term period. Willingness method measures the amount that an individual is eager to pay in order to reduce the probability of illness or mortality.

There are various methods to determine and estimate an individual's WTP such as conducting service, examining the extra wages for high risk jobs, examining the demand for products that leads to greater level of health or safety[12].

The COI studies are important and essential measurement technique in health and medical sciences. By measuring and comparing the economic burden to society, healthcare decision makers can benefit in setting up and prioritizing healthcare policies and interventions and implementations. Hence it have different research perspectives in cost estimations.

Generally in operative cases, cost of orthopedic operative is very high, due to usage of more implants, drugs like antibiotics and analgesics, anesthetics and other supplementations, and longer treatment outcomes. Hence this study is carried out first time in our rural hospital to know the cost incurred in orthopedic surgeries with the specific objectives 1 To categorize the type of orthopedic surgeries and its outcome 2.To estimate the overall cost of the orthopedic surgery treatment 3.To estimate the analgesics and antibiotics cost in orthopedic surgeries 4.To evaluate the need of pharmaceutical care services (Drug Interaction ,Adverse drug reactions)

METHODOLOGY

A prospective observational study will be conducted from October 2016 to April 2017 in a tertiary care 1050-bedded teaching hospital (Adichunchanagiri Hospital and Research Centre), B.G. Nagara, Mandya. The sources of data includes Patient case sheets, Prescriptions/ patient care taker interview, Lab data, Hospital administration department. The patients undergoing surgery related to orthopedics along with pediatric cases. The exclusion criteria include outpatient. The consented patients (IEC No. : 1491/2016-1017) details were collected in well designed data collection form. The details includes, patient demographic details, medical history, medication history, and diagnosis/Laboratory data, and microbiological/culture sensitivity report, duration of hospitalization, drug treatment chart, progress report and clinical outcome and along with direct cost, indirect cost, travelling expenses, operation cost and other additional charges . The Patient and care taker were provided verbal counselling about the proper use of antibiotics for proper use of antibiotics. The obtained data were subjected for descriptive statistics

RESULTS

Among 153 cases male percentage was more (83.0%) when compare to female patients percentage (17%). The age wise category of the patients showed majority were at the age of 40-50 years (24.2%), followed by 30-40(20.9%), 20-30(20.3%)and 50-60 years (13.1%), 10-20 years (8.5%)& least were 1- 10 years and below (3.3%).The BMI results of the patients showed 9.2 % were under weight, Interestingly 30.7 % were normal weight, 19.0 % were slightly obese/Overweight, 37.9 % were class one obese category, 2.6 % were class 2 obese category, 0.7 % were class 3 category. In this study majority of the patients were under married category68.6 % . Rest were unmarried 29.4 % and only 2.0 % were widows . The occupational details of the patients showed majority of them have an occupation(71.9) , But rest of the patient s have no occupation.Among 153 patient 91.5% have their self-employment /their own work. Whereas only 2 % had government appointment, and 4.6 % does not have any work. They are still in the kid's stage.Majority of the patients monthly income was between 5 to 10,000(51.0).

Whereas 42.5 % had between 10,001-20,000. Whereas 4.6 % were dependents.Majority of the enrolled patients had an literacy 86.3. Whereas rest had no literacy, they are dependents.13.7. Interestingly 15.0 % had 10 grade. Followed by 13.7% had PUC category..This study showed 88.2 % had no insurance coverage .where as rest small insurance supporting /coverage.In which 5.9 RSS scheme,followed by LIC 4.6 and yeshashwini schemes 3.3 and BPL schemes 2.6 % . The social habit of the patients showed majority of them were nonsmoker (83.0), rest were in the smoker and past smoker category(1.3).Interestingly in the enrolled patients 85.0 does not have any alcohol habits. 96.7 % of The enrolled patients does not have any past history. Rest has DM & HTN and its combinations and 100 % of the patients had mixed diet habits

The majority of the surgery cases belongs to bony procedures 71.9; implant removal procedure 17(11.1 %) soft tissue procedure10 (6.5%); spine procedure 6 (3.9);Amputation procedure5 (3.3%);limb salvage 1(0.7%). The time taken for the surgery showed 59.5% had surgery time of >3<4h,where as 35.3 % had >2-<3h; 3.3 had 1-2h and only2.0 had >4-5h and the site of surgery showed Majority of them had (97.4 %) only one site, Where as 1.3 % had at 2 and three sites .

The clinical outcomes of the enrolled showed Majority of patients 97 recovered and were cured followed by 40 patients who were improved from their condition. A very few were referred for further treatment and 3 absconded from the hospital

Table 1: Distribution of sub costs (ECG, X-ray, MRI, Biopsy, Culture sensitivity) involved in patients at different procedures

Type of surgery	ECG cost	Xray cost	CTscancost	MRIcost	Biopyscost	Culturesensiti vity test
bony procedures(110)	212.27±9 8.42	936.09±48 6.68	133.63±451 .91	81.36±554. 29	9.17±95.7 8	22.27±58.59
bone graft procedure(2)	200.00±	700.00±14 1.42	0.0000±	0.0000±	0.0000±	87.50±123.74
soft tissue procedure(10)	240.00±8 4.32	980.00±40 4.96	200.00±632 .45	425.00±134 3.96	.0000	70.00±90.36
spine procedure(6)	200.00±	633.33±62 5.03	.0000	708.33±173 5.05	.0000±	145.83±280.3 6
orhtroscopic procedure(2)	200.00±	300.00±42 4.26	575.00±813 .17	0.00±0.00	0.00±0.00	175.00±247.4 8
amputation procedure(5)	240.00±8 9.44	880.00±52 1.53	0.00	0.00	0.00	0.00
limb salvage(1)	200.00	1600.00	0.00	0.00	0.00	0.00
implant removal procedure(17)	205.88±8 9.93	464.70±34 0.84	79.41±327. 42	0.00	0.00	51.47±102.87

As shown in table 1, among the 8 commonly known orthopedic procedures amputation procedures has the maximum ECG cost mean 240.00±89.44 followed by the minimum mean in bone graft procedures, spine procedures and arthroscopic procedures with a mean of 200.00. The X-ray cost is maximum in limb salvage procedures with a mean of 1600.00 and minimum is found to be in arthroscopic procedures with 300.00±424.26. CT scan costs are maximum in arthroscopic procedures with 575.00± 813.17 and 0 for bone graft procedures, spine procedures; amputation procedures and limb salvage. MRI costs are only present for bony procedures with 9.17±95.78. The culture sensitivity test costs are maximum in arthroscopic surgeries with 175.00±247.48.

Table 2: Distribution of sub costs (USG, ECHO, Hematology, Biochemistry, Urine analysis, Blood sugar) involved in patients at different procedures

Type of surgery	USG cost	ECHO cost	Total hematolog y cost	Total biochemical cost	Total urine alysis cost	Total blood sugar cost	Total laboratory cost
Bony procedures(1 10)	138.63± 367.27	69.43±1 99.05	504.50±26 0.52	418.40±230.4 3	21.00±16.53	31.59±26.1 6	2576.93±1090.19
bone graft procedure(2)	.00±.00	225.00± 318.19	470.00±49. 49	285.00±.00	30.00±.00	12.50±17.6 7	2010.00±14.14
soft tissue procedure(10)	.00±.00	.00±.00	518.00±97. 67	349.00±151.2 5	9.00±14.49	27.50±7.90	2818.50±1480.57
spine procedure(6)	725.00± 1353.05	150.00± 232.37	665.83±51 5.61	767.50±719.2 2	45.00±31.46	54.16±40.0 5	4095.00±3339.30
orhtroscopic procedure(2)	.00±.00	225.00± 318.19	490.00±35. 35	612.50±24.74	15.00±21.21	25.00±.00	2617.50±449.01
amputation procedure(5)	.00±.00	.00±.00	458.00±10. 95	285.00±.00	24.00±13.41	20.00±11.1 8	1907.00±495.15

limb salvage(1)	.00±	.00±	495.00±	285.00±	30.00±	50.00±	2660.00±
implant removal procedure(17)	.00±.00	.00±.00	483.23±82.87	474.41±304.27	32.35±20.77	41.17±63.08	1826.76±502.66

As shown in table 2, the USG costs for different spine procedures are maximum in spine procedures followed by 138.63±367.27 for bony procedures. Echo costs are more in bone graft procedures and arthroscopic procedures with mean of 225.00±318.19. The hematology cost was found to be maximum in spine procedures with value of 665.83±515.61 and the minimum value of 458.00±10.95 for amputation procedures. The total biochemistry costs was found to be maximum in spine procedures with value of 767.50±719.22 and minimum was 285.00. For urinary cost analysis the maximum value was found to be in spine procedures with maximum value of 45.00±31.46 and minimum was observed in soft tissue procedures with 9.00±14.49. The total cost for sugar analysis was maximum in spine procedures 54.16±40.05 and minimum in bone graft procedures with a minimum of 12.50±17.67. Thus the total laboratory costs was for spine procedures, 2,617.50±449.01 and minimum for 1,826.76±502.66 for implant procedures.

Table 3: Distribution of various implant costs/material costs (Screw, Plate, K-wire, Nail clamp) in different orthopedic procedures

Type of surgery	Screw cost	Plate cost	K wire cost	Nail cost	Clamp cost
Bony procedures (110)	395.50±601.68	810.86±1394.27	97.09±357.15	628.45±1224.49	82.27±460.64
Bone graft procedures(2)	70.00±98.99	.00±.00	45.00±63.63	.00±.00	.00±.00
Soft tissue procedures(10)	42.00±113.31	57.00±180.24	27.00±49.89	.00±.00	.00±.00
Spine procedures(6)	8587.50±14369.63	.00±.00	.00±.00	.00±.00	.00±.00
Arthroscopic procedures(2)	.00±.00	.00±.00	.00±.00	.00±.00	900.00±1272.79
Amputation procedure(5)	.00±.00	.00±.00	424.00±460.73	206.00±460.63	.00±.00
Limb salvage(1)	1230.00±	.00±	.00±	.00±	.00±
Implant removal procedure(17)	38.23±157.64	41.76±172.20	3.52±14.55	446.47±1497.03	.00±.00

Table 3 shows, the various implants used in different procedures of orthopedic surgeries and the mean- standard values for the same. The screw costs are maximum in the spine procedures 8,587.50±14,369.63 and 0 for arthroscopic and amputation procedures. The plate costs are maximum for bony procedures with value of 810.86±1,394.27 and lesser for soft tissue procedures and implant removal procedures with values of 57.00±180.24 and 41.76±172.20 respectively. K wire costs are maximum in amputation procedures with value of 424.00±460.73 and minimum for implant removal procedures with 3.52±14.55. The next category is nail costs which is maximum for bony procedures 628.45±1,224.49 and lesser for amputation procedures and implant removal procedures with value of 206.00±460.63 and 446.47±1,497.03 respectively. Clamp cost is maximum in arthroscopic procedures with value of 900.00±1,272.79 and less in bony procedures with a value of 82.27±460.64.

Table 4: Distribution of various implant costs/material costs (Pin, Cement, Rod spinal needle) in different orthopedic procedures

Types of surgery	Pin cost	Cement cost	Rod cost	Spinal needle cost	Total other cost
Bony procedures(110)	21.09±115.88	29.35±215.72	18.44±123.00	1.16±12.22	22.72±238.36
Bone graft procedures(2)	.00±.00	.00±.00	.00±.00	.00±.00	.00±.00
Soft tissue procedures(10)	00±.00	.00±.00	.00±.00	.00±.00	250.00±790.56
Spine procedures(6)	.00±.00	.00±.00	.00±.00	.00±.00	.00±.00
Arthroscopic procedures(2)	120.00±169.70	.00±.00	.00±.00	.00±.00	.00±.00
Amputation procedures(5)	.00±.00	.00±.00	.00±.00	.00±.00	1000.00±1369.30
Limb salvage(1)	.00±	.00±	.00±	.00±	.00±
Implant removal procedures(17)	.00±.00	.00±.00	.00±.00	.00±.00	00±.00

The above table 4 shows the cost mean- standard values for some other implants other than those given above in table 3. The pin cost is maximum in arthroscopic procedures 120.00+169.70 and less in bony procedures 21.09+115.88 followed by no cost for other procedures. The cement cost for orthopedic cases is maximum in 29.35+215.72 and 0 for other procedures. Similarly the rod cost is maximum in bony procedures with value of 18.44+123.00 and no cost for other surgeries. The spinal needle cost is 1.16+12.22 for bony procedures and no cost for other procedures. Thus the total implant cost is found to be 22.72+238.36 for bony procedures, 0 for bone graft procedures, 250.00+790.56 for soft tissue procedures, no cost for spine procedures, 0 for arthroscopic procedure, 1,000.00+1,369.30 for amputation procedures.

Table 5: Distribution of other material costs (C-arm, THR, Wound debridement, Prosthesis) used in different orthopedic procedures

Type of surgery	C arm Cost	THR_ modular head platonic stem acetabular cup	Wound debridement cost major	Wound debridement cost minor	Prosthesis cost	Total other material cost
Bony procedures(110)	255.80±517.11	460.90±3460.28	18.18±134.22	24.09±145.53	124.36±548.91	2997.37±3810.652
Bone graft procedures(2)	.00±.00	.00±.00	.00±.00	.00±.00	.00±.00	115.00±162.63
Soft tissue procedures(10)	160.00±337.30	.00±.00	100.00±316.22	160.00±350.23	.00±.00	796.00±737.56
Spine procedures(6)	.00±.00	.00±.00	.00±.00	.00±.00	.00±.00	8587.50±14369.63
Arthroscopic procedures(2)	.00±.00	.00±.00	.00±.00	.00±.00	.00±.00	1020.00±1442.49
Amputation procedures(5)	.00±.00	.00±.00	.00±.00	150.00±335.41	.00±.00	1780.00±1477.34
Limb salvage(1)	.00±	.00±	.00±	.00±	2500.00±	3730.00±
Implant removal procedures(17)	.00±.00	.00±.00	264.70±664.21	183.23±342.36	.00±.00	977.94±1494.13

In the above table 5, the c-arm cost is maximum in bony procedures 255.80±517.11, followed by 160.00±337.30 for soft tissue procedures. The THR modular head platonic stem acetabula cup cost is found to be 460.90±3,460.28 for bony procedures and no cost for other procedures. The wound debridement cost major and minor were more in implant removal cases with a value of 264.70±664.21 and 183.23±342.36. The total prosthesis cost was maximum in limb salvage procedures.

Table 6: Distribution of various NSAIDS medication costs (Aceclofenac, Diclofenac, Ibuprofen, Aspirin, Acetaminophen and combinations) used in different orthopedic procedures

Type of surgery	Aceclofenac and paracetamol and serratopeptidase	diclofenac	Aceclofenac	Ibuprofen and paracetamol	Diclofenac	aspirin	acetaminophen tramadol
Bony procedures	234.96±625.22	571.68±683.25	395.62±788.96	.84±7.00	158.25±327.16	.34±3.60	12.87±58.41
Bone graft Procedures	68.00±96.16	1960.00±1187.93	390.00±551.54	.00±.00	25.50±36.06	.00±.00	.00±.00
Soft tissue procedures	213.40±458.87	672.00±607.74	112.49±226.70	.00±.00	70.00±21.35	.00±.00	.00±.00
Spine procedures	57.60±141.09	669.96±607.74	52.60±53.66	.00±.00	443.66±638.91	.00±.00	.00±.00
Arthroscopic procedures	44.20±62.50	.00±.00	.00±.00	.00±.00	.00±.00	.00±.00	22.20±31.39
Amputation procedures	415.13±653.05	1400.00±1009.55	18.19±40.67	.00±.00	82.50±16.67	.00±.00	.00±.00
Limb salvage	129.60±	1400.00±	.00±	.00±	.00±	.00±	.00±
Implant removal procedures	61.21±178.52	337.64±589.95	423.11±595.88	.00±.00	115.36±223.16	.00±.00	10.54±864.39

The above table 6, shows the cost of various drugs used in different procedures of orthopedic surgeries. The drug Aceclofenac, Paracetamol and Serratopeptidase is used more in amputation procedures with the value of 415.13±653.05. The drug Diclofenac was found to be used more in bone graft procedures with cost value of 1,960.00±1,187.93 and the least in implant removal procedures with value of 337.64±589.95. Aceclofenac was used more in implant removal case with a value of 423.11±595.88 and no use in arthroscopic and limb salvage procedures. Ibuprofen and Paracetamol are commonly used drugs for bony procedures. Diclofenac use is more in spine procedures with cost value of 443.66±638.91 and used less in case of bone graft procedures with a value of 25.50±36.06 and not at all used in limb salvage procedures. Aspirin is used more in bony procedures. Acetaminophen Tramadol is consumed more in arthroscopic and implant removal cases with a value of 22.20±31.39 and 10.54±864.39 respectively.

Table 7: Distribution of various NSAIDS medication costs (Paracetamol, Piroxicam, Tramadol and combinations) used in different orthopedic procedures

Type of surgery	paracetamol	Piroxicam	Paracetamol and chlorzoxazone and diclofenac	tramadol	Total cost of analgesics
Bony procedures	2.93±18.66	.00±.00	4.77±50.05	57.86±183.35	1455.02±1248.90
Bone graft procedures	.00±.00	.00±.00	.00±.00	780.00±1103.08	3223.50±334.46
Soft tissue procedures	.00±.00	.00±.00	.00±.00	316.59±530.85	1384.48±786.05
Spine procedures	.00±.00	195.00±477.65	.00±.00	178.25±422.33	1597.08±1057.22
Arthroscopic procedures	.00±.00	.00±.00	.00±.00	245.70±347.47	312.10±441.37
Amputation procedures	.00±.00	.00±.00	.00±.00	47.55±106.33	1963.38±928.60
Limb salvage	.00±	.00±	.00±	.00±	1529.60±
Implant removal procedures	.00±.00	.00±.00	.00±.00	87.74±262.37	1035.63±864.39

The above table 7 shows the cost values of various other NSAID medications. The drug Paracetamol is given in bony procedures 2.93±18.66 and its consumption in other procedures is null. The drug Piroxicam is given in spine procedures 195.00±477.65 and its consumption in other procedures is null. The drug Paracetamol and Chlorzoxazone and Diclofenac is given to patients undergone bony procedures and the total value was found to be 4.77±50.05. The drug Tramadol is used more in patients undergone bone grafts and thus the value obtained is 780.00±1,103.08. Thus the total cost of analgesics was found to be maximum 3,223.50±334.46 in bone graft procedures and minimum 312.10±441.37 for arthroscopic procedures.

Table 8: Distribution of various antibiotic medication costs (Penicillin, 2nd gen Cephalosporins, 3rd gen Cephalosporins) used in different orthopedic procedures

Type of surgery	Cost of penicillin combination	cost of 2nd gen cephalosporin	cost of 3rd gen cephalosporin
bony procedures	419.64±1590.11	.00±.00	1320.31±1536.71
Bone graft procedures	.00±.00	.00±.00	2646.00±2327.79
Soft tissue procedures	7.90±24.98	.00±.00	1824.20±1064.48
Spine procedures	.00±.00	.00±.00	828.15±949.72
Arthroscopic procedures	6061.00±8571.54	.00±.00	5343.70±599.20
Amputation procedures	.00±.00	.00±.00	1843.68±1426.05
Limb salvage	.00±	.00±	2009.44±
Implant removal procedures	434.21±1642.68	.00±.00	1498.11±1471.41

The above table 8 shows the distribution of various cost rates of antibiotic drugs. Penicillin antibiotics and its combinations are more commonly used in arthroscopic procedures 6,061.00+8,571.54 and less frequently used in other procedures and not at all used in bone grafts, spine procedures, amputation procedures and limb salvage procedures. The next more commonly used drug is 3rd generation cephalosporin with 1,320.31+1,536.71 in bony procedures, 2,646.00+2,327.79 in bone graft procedures, 1,824.20+1,064.48 in soft tissue procedures, 828.15+949.72 in spine procedures, 5,343.70+599.20 in arthroscopic procedures, 1,843.68+1,426.05 in amputation procedures, 2,009.44 in limb salvage procedures and 1,498.11+1,471.41 in implant removal procedures.

Table 9: Distribution of various antibiotic medication costs (Quinolones, Oxazolidinones, Aminoglycosides) used in different orthopedic procedures

Type of surgery	Cost quinolones combinations	Cost of oxazolidinone and its combinations	Cost of aminoglycoside combinations
bony procedures	.00±.00	142.19±567.74	41.58±90.67
Bone graft procedures	.00±.00	.00±.00	64.00±90.50
Soft tissue procedures	.00±.00	565.12±1787.06	111.68±113.88
Spine procedures	.00±.00	.00±.00	66.66±128.16
Arthroscopic procedures	.00±.00	.00±.00	1440.00±2036.46
Amputation procedures	.00±.00	.00±.00	173.69±265.65
Limb salvage	.00±	.00±	.00±
Implant removal procedures	5.27±21.74	687.78±1952.67	94.79±347.38

The above table 9, shows the various other categories of Quinolones that are frequently used in different orthopedic procedures the Quinolone category of drugs are commonly given in implant removal case with a value of 5.27+21.74. Oxazolidinones and its combination are more commonly given in bony procedures 68.45+336.97 and are null for other orthopedic procedures. Thus the cost of Oxazolidinone and its combinations is maximum in implant removal cases 687.78+1,952.67, followed by soft tissue procedures and bony procedures with values of 565.12+1787.06 and 142.19+567.74 respectively. Cost of Aminoglycoside combinations is maximum in arthroscopic procedures 1,440.00+2,036.46 and minimum for bony procedures 41.58+90.67. The other procedures have less but optimum values

Table 10: Distribution of various antibiotic medication costs (Beta lactamase, Glycopeptides) used in different orthopedic procedures

Type of surgery	Cost of beta lactamase combinations	Cost of glycopeptide combinations
Implant removal procedures	00±.00	31.24±128.83

The table 10 shows, the various cost of beta lactamase and glycopeptides antibiotic medications for the different orthopedic procedures. The values are zero for the various categories of beta lactamase and glycopeptides, except for implant procedures which has a value of 31.24+128.83 for total glycopeptide combinations

Table 11: Distribution of various antibiotic medication costs (Macrolides) used indifferent orthopedic procedures

Type of surgery	Cost of macrolide combinations	Total cost of antibiotics
bony procedures	3.73±39.12	2030.63±2191.84
bone graft procedure	.00±.00	2710.00±2237.28
soft tissue procedure	.00±.00	2508.91±1561.44
spine procedure	.00±.00	905.35±1067.47
arthroscopic procedure	.00±.00	12844.70±7134.28
amputation procedure	.00±.00	2150.82±1277.24
limb salvage	.00±.00	2009.44±
implant removal procedure	.00±.00	2874.95±3168.16

The table 11 shows the various macrolide and macrolide combinations that are used for different orthopedic operative cases. The macrolide combinations are found to be given only in patients undergone bony procedures. It was found to be maximum in arthroscopic procedures with a value of 12,844.70±7,134.28, followed by implant procedures 2,874.95±3,168.16, bone graft 2,710.00±2,237.28, soft tissue procedures 2,508.91±1,561.44, amputation procedures 2,150.82±1,277.24, bony procedures 2,030.63±2,191.84, limb salvage 2,009.44 and spine procedures 905.35±1,067.47.

Table 12: Distribution of various other medication costs (Anti-emetics, Anti-ulcer, Anti- Anaesthetics, Anti-anxiety) used in different orthopedic procedures

Type of surgery	Total cost of antiemetic	Total cost of antiulcer	Total cost of local anesthetics	Total cost of antianxiety
bony procedures	29.18±38.55	436.23±458.97	36.97±83.68	1.08±2.47
bone graft procedure	30.96±43.78	1277.08±165.57	21.35±30.19	3.24±4.58
soft tissue procedure	23.22±32.83	527.75±472.90	21.33±22.48	.54±.56
spine procedure	10.32±25.27	296.55±318.57	21.35±23.38	.54±.59
arthroscopic procedure	69.66±10.94	297.26±129.73	771.35±1030.46	3.78±3.81
amputation procedure	43.34±79.98	217.08±228.47	25.62±23.38	.64±.59
limb salvage	77.40	1145.52±	42.70±	1.08±
implant removal procedure	30.18±31.12	440.54±411.19	20.09±21.96	.44±.54

Table 12 shows, antiemetic drugs were highest in limb salvage patients 69.66±10.94. The total anti-ulcer cost was found to be maximum in bone graft procedures 1,277.08±165.57 and minimum in amputation procedures with cost value of 217.08±228.47. The total cost of local anesthetics was maximum in arthroscopic procedures 771.35±1,030.46 and minimum in implant removal procedures. Total anxiety drugs were found to be given more in arthroscopic procedures and least consumption was observed in implant removal case with value .44±.54.

Table 13: Distribution of various other medication costs (Steroids, Anti- fibrinolytics, Anti-amoebics) used in different orthopedic procedures

Type of surgery	Total cost of steroids	Total cost of anti fibrinolytics	Total cost of antimicrobial and antiamoebics
bony procedures	17.56±137.33	54.54±339.85	40.28±113.36
bone graft procedure	.00±.00	.00±.00	.00±.00
soft tissue procedure	.00±.00	.00±.00	127.70±174.14
spine procedure	1570.05±3639.23	.00±.00	31.23±76.50
arthroscopic procedure	105.00±148.49	40.05±56.63	76.60±108.32
amputation procedure	.00±.00	.00±.00	281.39±453.68
limb salvage	.0000±	.00±	.00±
implant removal procedure	.00±.00	9.51±39.24	11.04±31.47

Table 13 shows, the distribution of various steroids, anti fibrinolytics, anti-microbial and antiamoebic drugs used in patients undergoing different orthopedic surgeries. The total cost of steroids is more in spine procedures 1,570.05±3,639.23 and less in arthroscopic and bony procedures with values 105.00±148.49 and 17.56±137.33 respectively. The total cost of anti fibrinolytics is more for bony procedures 54.54±339.85 followed by arthroscopic and implant removal procedures with values 40.05±56.63 and 9.51±39.24 respectively. The total antimicrobial and anti-amoebic cost is more for amputation procedures 281.39±453.68 and less in cases of other procedures but the no value was found in implant removal procedures.

Table 14: Distribution of various other medication costs (Anti-hypertensive, Antidiabetics, Muscle relaxants, Bronchodilators) used in different orthopedic procedures

Type of surgery	Total cost of antihypertensive	Total cost of anti-diabetics	Total cost of muscle relaxants bronchodilator	Total cost of other drugs
bony procedures	115.35±1124.84	389.72±2173.61	124.06±725.63	1483.48±1504.82
bone graft procedure	.00±.00	±	290.00±410.12	764.47±614.15
soft tissue procedure	.00±.00	.00±.00	.00±.00	1315.79±1149.50
spine procedure	.00±.00	.00±.00	344.03±676.08	4253.25±4344.79
arthroscopic procedure	.00±.00	.00±.00	4363.43±6128.40	2876.92±2184.14
amputation procedure	.00±.00	.00±.00	25.65±57.35	3054.34±3945.13
limb salvage	.00±	.00±	.00±	.00±
implant removal procedure	485.88±2003.34	1265.69±5218.57	.00±.00	1320.43±937.13

Table 14 shows the cost of various anti-hypertensive drugs, anti-diabetics drugs and muscle relaxants. The total anti-hypertensive cost was found to be more in implant removal cases 485.88±2,003.34 and lesser in bony procedures with a value of 115.35±1,124.84. Similarly the total anti-diabetic cost was more in implant removal procedures 1,265.69±5,218.57 followed by bony procedures 389.72±2,173.61. The total cost of muscle relaxants was more in arthroscopic procedures 4,363.43±6,128.40 and least was observed in amputation procedures 25.65±57.35.

Table 15: Distribution of various other material costs (Syringe, Spirit, Dressing, Lab, Medicine, Hospital, Operation theatre) used and other costs in different orthopedic procedures

Type of surgery	Syringe cost	Spirit cost and dressing cost	Direct total medicine cost	Direct total lab cost	Direct total hospital charges	Direct OT charges	Total direct medical cost
bony procedures	538.41±2 82.5	1290.28±1 031.65	8011.84±39 84.78	2621.11±1 069.40	60.27±29 7.56	5737.86±393 3.64	16511.79±66 67.13
bone graft procedure	652.00±2 .82	1444.20±.0 0	10416.80±3 174.06	2010.00±1 4.14	30.00±.00	3552.50±204 7.07	16009.30±11 12.85
soft tissue procedure	455.51±3 19.88	1455.36±1 018.98	7820.62±26 51.22	2818.50±1 480.57	27.00±6.3 2	3163.80±136 3.97	13829.92±27 26.60
spine procedure	453.33±2 77.58	1478.45±1 098.59	10961.54±9 415.81	4095.00±3 339.30	30.00±.00	11898.33±15 785.37	26984.88±26 845.33
arthroscopic procedure	524.00±2 91.32	1146.60±1 218.48	23431.51±8 42.99	2617.50±4 49.01	30.00±.00	3020.00±214 9.60	29098.96±34 41.68
amputation procedure	583.76±6 56.7	823.88±53 5.28	9169.93±41 65.33	1907.00±4 95.15	24.00±8.2 1	4188.00±236 4.94	15288.93±55 96.17
limb salvage	725.00	5260.00±	10813.31±	2660.00±	30.00±	3730.00±	17233.31±
implant removal procedure	472.13±2 76.02	850.23±91 3.69	8693.27±74 90.43	1826.76±5 02.66	120.00±4 05.93	3257.35±134 9.94	13859.74±79 55.51

As shown in table 15, the total medical cost was found to be 16,511.79±6,667.13 for bony procedures 16,511.79±6,667.13, for bone grafts 16,009.30±1,112.85, soft tissue procedures 13,829.92±2,726.60, spine procedures 26,984.88±26,845.33, arthroscopic procedures 29,098.96±3,441.68, amputation procedures 15,288.93±5,596.17, limb salvage 17,233.31 and implant removal with cost value of 13,859.74±7,955.51.

Table16: Distribution of various non-direct costs (Travel, Food expense,Accommodation) in different orthopedic procedures

Type of surgery	Travel expense	Food expenses	Stay accommodation expenses	Total non-direct medical cost	Total cost in rupees
bony procedures	1425.40±80 6.91	2802.36±1024. 16	128.18±327.66	4356.00±1594.11	20831.43±6798.74
bone graft procedure	1900.00±12 72.79	2850.00±494.9 7	.00±00	4750.00±1767.76	105010.30±116268. 28
soft tissue procedure	1630.00±91 6.27	2928.00±1270. 80	80.00±252.98	4638.0000±1783.59	18467.9210±3483.1 5
spine procedure	1712.5000± 919.20482	3600.00±1714. 64	00±00	5312.50±2446.20	32297.38±28512.40
arthroscopic procedure	1300.00±18 38.47	1600.00±282.8 4	00±00	2900.0000±2121.32	31998.96±5563.00
amputation procedure	980.0000±5 11.85	1992.0000±675 .51	00±00	2900.00±2121.32	31998.96±5563.00
limb salvage	800.00±	4200.00±	780.00±	5780.0000±	23013.31±
implant removal procedure	64.70±890.1 8	2304.11±2302. 72	58.82±242.53	3127.64±2562.66	16987.38±9051.04

The table 16 shows, the total cost was 20,831.43±6,798.74 bony procedure, 1,05,010.30±1,16,268.28 bone graft procedures, 18,467.9210±3,483.15 soft tissue procedures, 32,297.38±28,512.40 spine procedures, 31,998.96±5,563.00 arthroscopic procedures, 31,998.96±5,563.00 amputation procedures, 23,013.31 limb salvage and 16,987.38±9,051.04 for implant removal procedures.

Table 17: Distribution of direct cost, non-direct and total cost in different orthopedic surgeries

Type of surgery	Total direct medical cost	Total non-direct medical cost	Total cost
Bony procedure	16511.79±6667.13	4356.00±1594.11	20831.43±6798.74
Bone graft procedures	16009.30±1112.85	4750.00±1767.76	105010.30±116268.28
Soft tissue procedures	13829.92±2726.60	4638.0000±1783.59	18467.9210±3483.15
Spine procedures	26984.88±26845.3 3	5312.50±2446.20	32297.38±28512.40
Arthroscopic procedures	29098.96±3441.68	2900.0000±2121.32	31998.96±5563.00
Amputation procedures	15288.93±5596.17	2900.00±2121.32	31998.96±5563.00
Limb salvage	17233.31	5780.00	23013.31
Implant removal procedures	13859.74±7955.51	3127.64±2562.66	16987.38±9051.04
Total cost	148816.83±54345. 51	33764.14±12275.64	280605.64±175239.61

Table 17 shows, the various costs related to direct, non-direct and total costs related to orthopedic surgeries. Thus the total cost was 20,831.43±6,798.74 bony procedure, 1,05,010.30±1,16,268.28 bone graft procedures, 18,467.9210±3,483.15 soft tissue procedures, 32,297.38±28,512.40 spine procedures, 31,998.96±5,563.00 arthroscopic procedures, 31,998.96±5,563.00 amputation procedures, 23,013.31 limb salvage and 16,987.38±9,051.04 for implant removal procedures.

Table 18: Distribution of Minor DI

S.no	Drugs	N	%
1.	No	57	37.2
2.	Aceclofenac+amikacin	2	.7
3.	Aceclofenac+Diclofenac	72	47.0
4.	Amikacin+Diclofenac	3	1.96
5.	Aceclofenac+amikacin,amikacin +Diclofenac	3	1.96
6.	Aceclofenac+diclofenac,amikacin+diclo fenac,aceclofenac+amika Cin	11	7.18
7.	Diclofenac+ibuprofen	1	0.65
8.	Piperacillin+amikacin	1	0.65
9.	Diclofenac+metrogyl	1	0.65
10.	Aspirin+amikacin	1	0.65
11.	Cefixim+aspirin	1	0.65
12.	Total	153	100

The above table 18, shows that the maximum minor drug interactions were observed in the case of Aceclofenac and Diclofenac (47%) which is a commonly used drug in operative orthopedic cases whereas other interactions are optimal and minor.

Table 19: Distribution of Severe DI

S.no	Drugs	N	%
1.	NO	64	41.8
2.	aceclofenac+Diclofenac	78	50.98
3.	aceclofenac+ibuprofen	1	.65
4.	alprazolam+tramadol	4	2.61
5.	amikacin+Diclofenac	1	.65
6.	amoxicillin+aspirin,aceclofenac+potas sium chloride ,aceclo+aspirin	1	.65
7.	diclofenac+ibuprofen	1	.65
8.	diclofenac+piroxicam,aceclofenac+pir oxicam	1	.65
9.	linezolid+tramadol	1	.65
10.	linezolid+tramadol,aspirin+Diclofenac	1	.65
11.	Total	153	100.0

The above table 19, shows severe drug interactions are commonly observed in the case of Aceclofenac and Diclofenac (50.98%). This drug is commonly used in operative orthopedic cases as an NSAID thus exhibits both major and minor interactions

DISCUSSION

out of 153 cases Male patients were more (127) when compared with female patients (26). This study was similar with Onche II, Osagie OE, Nuhu SI and Laas K, Peltomaa R, Kautiainen H, Puolakka K, Leirisalo-Repo M and Aviluca FR et al and Virta L, Joranger P, Brox J, Eriksson R ^[1-5] in which the number of female patients were more in contrast to this study. The first study has 47 patients with 20 males and 27 females, the second study has 96 patients 63 female and 33 were males, the third study had 13 males and 15 females and the final study had 103 females and 101 males in a study of 202 patients.

The Age group of 40-50 (24.2%) years patient were found to be more, followed by 30-40 (20.9%) years, 20-30 (20.3%) years, 50-60 (13.1%) years, 10-20 (8.5%) years and least were found in 1-10 (3.3%) years and below. This study was found to be similar to that conducted by Onche II, Osagie OE, Nuhu SI and Laas K, Peltomaa R, Kautiainen H, Puolakka K, Leirisalo-Repo M in which the mean age was found to be 31.6 years and 48 years respectively.[1]

BMI showed 9.2% of patients were under weight, 30.7% were normal weight, 19.0% were slightly obese or overweight, and 17.9% were class 1 obese category. As this study was conducted in rural locality then nutrition was poor. There was not much preference given to weight of patients in other studies.

Majority of the patients were in married (68.6%) category rest were unmarried (29.4%) and only 2% were widows. The patients who were married had increased medical cost due to the increase in the total non-direct cost which comprises of food, accommodation, and travel expenses.

Since the study was conducted in a rural tertiary care hospital, Occupation of patient and monthly income showed 110(71.9%) were employed and 43(28.10%) were found to be unemployed. Among the employed people 91.5% have their self-employment or their own work whereas 2% had government appointment and 4.6% does not have any work as they are minor class that is children and they are dependent. Majority of patient's monthly income was between 5,000-10,000 (51%) whereas 42.5% had between 10001-20000 and 4.6% were dependent. The study framed that the patient's income was less when compared with their treatment costs and this made them for repeated admission.

Among 153 patients 132 (86.3%) were literate and rest 21 (13.72%) were illiterate. Majority of the enrolled patients with literacy rate 86.3% comprised of 15% in 10th grade followed by 13.7% in PUC category. The study showed 88.2% had no insurance coverage whereas rest had small insurance supporting's or coverage in which 5.9% RSBY scheme followed by 4.6% LIC scheme, 3.3% Yeshaswini scheme and 2.6% BPL scheme

Among 153 patients majority of them were nonsmokers and mainly comprised of females and children's. Smoking is also an economic burden to the patient, especially patients with low economic status. The rest were in the smoker (15.68%) and past smoker (1.30%) category. Among the smokers few were counseled to quit smoking. This study revealed that 85% of patients do not consume alcohol 15.03% were still taking alcohol. The patient's adherence on medication was less, and the duration of stay in hospital was prolonged due to decreased therapeutic effect.

In this study 96.7% of the enrolled patients does not have any past history rest have DM and hypertension and its combinations and 100% of the patients had mixed diet habits, undisturbed sleep, and appetite was good.

The orthopedic operative surgeries incurred cost depends on bony procedures, bone graft procedures, soft tissue procedures, spine procedures, arthroscopic procedures, amputation procedures, limb salvage procedures and implant removal procedures. Among 153 cases majority of the surgery cases belongs to bony procedures(71.9%), implant removal procedures (11.1%), soft tissue procedures (6.5%), spine procedures (3.9%), amputation procedures (3.3%), arthroscopic and bone graft procedures (1.30%) and limb salvage procedures (0.7%).

Among 153 patients 59.5% had surgery time of >3<4 hours whereas 35.3% had >2<3 hours, 3.3% had 1-2 hours and only 2% had >4-5 hours. The majority of them had operation only at one site (97.38%) whereas 1.3% had 2 and 3 operations

The clinical outcomes of the enrolled 153 patients. Majority of patients 97 recovered and were cured followed by 40 patients who were improved from their condition. A very few were referred for further treatment and 3 absconded from the hospital.

Severe drug interactions are commonly observed in the case of aceclofenac and diclofenac (50.98%). This drug is commonly used in operative orthopedic cases as an NSAID thus exhibits both major and minor interactions.

COST-OF-ILLNESS ANALYSIS

There were very few articles which concentrated on cost-of-illness studies on operative orthopedic cases. This study was conducted in a rural and service oriented hospital. The prevalence of operative orthopedic cases was not very high in this rural area and the economic status of patients was poor. This study reveals that patient's cost-of-illness in operative orthopedic cases is the sum of direct medical and direct non-medical cost.

Direct medical cost

In this study, direct cost is the sum of medicine cost, lab cost, admission cost and various other OT charges. The maximum direct cost was found to be in patients undergoing bony procedures with the total amount of 18,16,297.115 rupees, followed by implant removal procedures 2,35,615.61 rupees, spine procedures 1,61,909.28 rupees, soft tissue procedures 1,38,299.21 rupees, amputation procedure 76,444.66 rupees, arthroscopic procedures 58,197.9 rupees, bone graft procedure 32,018.61 rupees and finally limb salvage 17,233.31 rupees.

Non-direct medical cost

Direct non-medical cost is the sum of travel expenses, food expenses, and accommodation of patient care taker. The means of transport used by patients were auto rickshaw, bus and car, in which most of the patients used auto rickshaw. So when compared to other studies, travel expenses were less in this study. In general wards food was provided free for the patients. Patients near to the hospital locality had food from their home. No other particular charges were found here. The estimated non-direct medical cost was found to be maximum in bony procedures 4,79,160 rupees, implant removal procedures 53,170 rupees, soft tissue procedures 46,380 rupees, spine procedures 31,875 rupees, amputation procedures 16,660 rupees, bone graft procedures 9,500 rupees, arthroscopic procedures 5,800 rupees and limb salvage procedures 5,780 rupees.

Cost analysis (total cost)

This study calculated the cost-of-illness of patients, from the day of admission to the day of discharge. The maximum cost was found to be more in bony procedures with total of Rs 2291457.31, implant removal 2,88,785.61, bone graft 2,10,020.61, spine procedures 1,93,784.28, soft tissue procedures 1,84,679.21, amputation procedures 93,104.66, arthroscopic procedures 63997.92 and least cost for limb salvage 23,013.31.

CONCLUSION

Orthopedic surgery cases represent an important cause of economic burden in the rural areas of Karnataka. The information gathered should be a pointer to the trends in Pharmacoeconomic studies in different types of orthopedic surgery cases. The present study could serve as a framework upon which further studies on cost-of-illness can be conducted to investigate the scope for economic burden on for the orthopedic surgery patients and their family members.

The orthopedic surgeries are classified into 8 different categories namely bony procedures, bone graft, soft tissue procedure, spine procedure, arthroscopic procedure, amputation procedure, limb salvage and implant removal procedure. The maximum cost was covered by bony procedures followed by implant removal and least cost was of limb salvage[32].

A total of 111 implants, 36 X-rays, 82 operative procedures, 63 CT scans, 20 ultrasound, 6 Echo and 40 laboratory procedures are used. In this the maximum cost expenditure is on implants and surgery procedures.

There are a total of 14 categories of medications that are used in orthopedic surgeries namely antibiotics, analgesics, anti-emetics, anti-ulcers, local anesthetics, anti-anxiety, steroids, anti-fibrinolytics, anti-microbial, anti-amoebics, anti-hypertensive, antidiabetics, muscle relaxants and bronchodilators. The maximum cost expenditure is on antibiotics followed by analgesics. Direct medical costs were more when compared with direct non-medical costs.

Cost-of-illness analysis was estimated from the day of admission to the day of discharge. The maximum cost was found to be more in bony procedures with total of Rs 2291457.315 and least cost for limb salvage 23,013.31 in rupees.

Limitation:

- This study was conducted for a short period of time i.e. 6 months; even this study can be extended and minimization of costs can be done wherever it is applicable to large population.
- Minute changes in cost can occur due to the addition of variables like vat and tax while dispensing the medications.
- The exact operative costs cannot be estimated due to lack of collaboration from the physicians and nursing staffs.

Future directions:

- In pharmacoeconomic studies, it is important to track future economic trends in healthcare delivery, morbidity and mortality patterns.
- Cost-of-illness study can be carried out for patients undergoing other surgery procedures like arthroscopy, biopsy, gastric bypass, cosmetic, replantation etc.
- Cost-of-illness study can be carried out in special departments like ICU/ICCU, emergency and in general wards which will help in minimizing the cost.

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