

# Analysis of Cost of Antimicrobial Therapy along with Cost of Concomitant Drug Therapy in Patients Admitted in Critical Care Unit (CCU) at Charitable Trust Hospital in India

Prakash Rameshbhai Shelat<sup>1</sup> and Shivaprasad Kalakappa Kumbar<sup>2</sup><sup>1</sup>Department of Pharmacology, P.D.U. Govt. Medical College, Rajkot, Gujarat, India.<sup>2</sup>Department of Pharmacology, BLDEU's Shri B. M. Patil Medical College, Bijapur, Karnataka, India.

## ABSTRACT

**Objective:** To study the cost of antimicrobial therapy along with concomitant drug therapy in Critical Care Unit (CCU). **Material and Method:** Study was conducted at charitable trust hospital of metro city in India. Total 270 patients admitted in CCU were included. Daily bill of drugs from patients were taken and cost mentioned in the bill was recorded. Currency was converted from Indian to United States currency (₹54.81 INR = 1\$USD). Data were analyzed by student 't' test,  $\chi^2$  test and Z test. **Results:** Patients were divided according to Group A (directly/first admitted in CCU) and Group B (transferred from ward/operation theatre to CCU). Duration of hospital stay in CCU, patients on ventilator support, mortality were significantly ( $p < 0.05$ ) higher in directly admitted Group A patients as compared to transferred Group B patients. Cost of antimicrobial therapy was significantly ( $p < 0.05$ ) higher in Group A as compared to Group B patients and accounted more than one third to cost of total drug therapy. Cost of concomitant drugs like inotropes was significantly ( $p < 0.05$ ) higher in Group A patients. Cost of gastrointestinal drugs and analgesics were significantly ( $p < 0.05$ ) higher in Group B patients. Cost of antimicrobials like piperacillin+tazobactam, cefoperazone+sulbactam were significantly

( $p < 0.05$ ) higher in Group A patients. Cost of amikacin and metronidazole per patient were significantly ( $p < 0.05$ ) higher in Group B. Cost of beta lactam antimicrobials like amoxicillin+clavulinate, piperacillin+tazobactam and cefoperazone+sulbactam accounted more than 40% of cost of antimicrobials. **Conclusion:** Cost of antimicrobial therapy was higher in directly admitted Group A patients in CCU. Cost of antimicrobials per patient was accounted more than one third of total cost of drug therapy in CCU. In antimicrobials cost of beta lactam antimicrobials was higher as compared to other antimicrobials.

**Key words:** Antimicrobials, Critical Care Unit (CCU), Cost.

## Correspondence :

**Dr. Prakash Shelat**

Assistant Professor, Department of Pharmacology,  
P.D.U. Govt. Medical College, Rajkot, India.

E-mail: dr.prakashshelat@gmail.com

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## INTRODUCTION

Critical Care Unit (CCU) is a designated ward of a hospital that is specially staffed and equipped to provide observation, care and treatment to critically ill patients.<sup>1</sup> Critical care units (CCU)s are a costly resource.<sup>2</sup> Intensive Care Working Group on costing had developed cost block methodology for CCU cost calculation and comparison. According to methodology cost block of consumables included cost of drugs, piped gases and equipment with a life span of less than one year used in CCU. Cost comparisons of different CCU in various countries require a method of converting local currency into universally applicable unit of cost.<sup>3</sup> CCU beds account for 20-40% of all hospital costs and three to ten times the cost of a hospitalization on a regular inpatient unit.<sup>4</sup> Fast technological innovations and improved medical practices in CCU are in large part responsible for both increased patients' survival and rising cost.<sup>5</sup> Udwalia *et al.*, reported that staffing, intravenous fluids and drugs accounted for 75% of the cost of CCU.<sup>6</sup> Antimicrobial agents are widely prescribed drugs in CCU. Yalcin *et al.*, found that cost of antibiotic therapy per infected patient was \$1190.<sup>7</sup> Study conducted from India reported that antimicrobial cost accounted for 50 -70% of the total drug expenditure in CCU.<sup>8,9</sup> Despite the high costs associated with CCU stays, there is a relative lack of information relating to the cost of antimicrobials therapy at CCU care in India. Sometimes patients those admitted to CCU had to borrow money or sell their assets.<sup>10</sup> There is limited data of cost of antimicrobial therapy in CCU in India and from our city. Hence, we proposed to study to analyze cost of antimicrobial therapy along with concomitant drugs prescribed in the CCU.

## MATERIAL AND METHODS

The study was continuous, prospective, longitudinal and observational conducted at critical care unit (CCU) at Charitable Trust hospital, India

for a period of July 2012 to March 2013. A study approval was taken from medical director of hospital before starting the study. All the adult patients were included irrespective of its diagnosis. Investigator collected daily drug bill from the patient and were recorded in previously formed data record form. Cost of antimicrobials and concomitant drugs on each patient were calculated.

## STATISTICAL ANALYSIS

All the data was entered into Microsoft Excel sheet and subjected to statistical analysis test. Currency was converted from Indian to United States currency (₹54.81 INR=1\$USD) exchange rate as per on date on 06/04/2013 available from official Reserve Bank of India's website. The data were analyzed by using Student 't' test,  $\chi^2$  test and Z test.

## RESULTS

### Analysis of demographic data

All adults 270 patients were admitted in CCU studied for a period of 8 months from July 2012 to March 2013. They were divided into Group A (directly /first admitted in CCU) and B (transferred from ward/operation theatre to CCU). Patients age group above 50 years was and male patients significantly ( $p < 0.05$ ) higher as compared to below 50 years age group and female patients respectively. Mortality, average duration of stay in CCU, patients on ventilator support were significantly ( $p < 0.05$ ) higher in Group A as compared to Group B patients. It was observed that average number of drugs and average no. of antimicrobials were significantly ( $p < 0.05$ ) higher in Group A as compared to Group B patients (Table1).

### Analysis of cost of group of drugs per patient

The cost of drug therapy and cost of antimicrobial agent per patient was calculated. Cost of drug therapy per patient and cost of antimicrobial

agents per patient were significantly ( $p < 0.05$ ) higher in Group A as compared to Group B patients. Cost of inotropes, cardiovascular drugs, central nervous system drugs, anticholinergic drugs and respiratory drugs were significantly ( $p < 0.05$ ) higher in Group A as compared to Group B patients. Cost of Intravenous (IV) fluids was significantly ( $p < 0.05$ ) higher in Group B as compared to Group A patients. Cost of gastrointestinal drugs, analgesics, diuretics and corticosteroids were significantly ( $p < 0.05$ ) higher in Group B as compared to Group A patients (Table 2).

#### **Analysis of cost of most commonly prescribed concomitant drugs per patient**

Among most commonly prescribed drugs cost of atropine, adrenaline, dopamine, dobutamine, streptokinase, sodium valproate and midazolam were significantly ( $p < 0.05$ ) higher in Group A as compared to Group B patients. Cost of furosemide, pantoprazole, ondansetron and diclofenac were significantly ( $p < 0.05$ ) higher in Group B as compared to Group A patients (Table 3).

#### **Analysis cost of antimicrobial groups per patient**

Cost of cephalosporins and fluoroquinolones were significantly ( $p < 0.05$ ) higher in Group A as compared to Group B patients. Cost of penicillin was significantly ( $p < 0.05$ ) higher in Group B as compared to Group A patients. Cost of aminoglycosides and nitroimidazole were significantly ( $p < 0.05$ ) higher in Group B as compared to Group A patients. Cost of macrolides was significantly ( $p < 0.05$ ) higher in Group B as compared to Group A patients. Cost of monobactam was similar in Group A and B patients (Table 4).

#### **Analysis cost of antimicrobial agents per patient**

Cost of antimicrobials like piperacillin+tazobactam, cefoperazone+sulbactam, ceftriaxone+sulbactam and levofloxacin were significantly ( $p < 0.05$ ) higher in Group A as compared to Group B patients. Cost of amoxicillin+clavulinate was significantly ( $p < 0.05$ ) higher in Group B as compared to Group A patients. Cost of cefotaxime+sulbactam, amikacin, vancomycin, linezolid and metronidazole were significantly ( $p < 0.05$ ) higher in Group B as compared to Group A patients. Cost of imipenem+cilistin was similar in Group A and B patients. Beta lactam antimicrobials like amoxicillin+clavulinate, piperacillin+tazobactam and cefoperazone+sulbactam accounted more than 40% of cost of antimicrobials in both Groups (Table 5).

## **DISCUSSION**

#### **Analysis of demographic data**

In our study more than 50 years age group patients were admitted significantly higher in both Group A and B. The reason may be due to life threatening diseases are common in this group which may required CCU admission. Mortality was significantly ( $p < 0.05$ ) higher in Group A. It may be due to more no. of Group A patients on ventilator and mortality was higher in patients on ventilator.<sup>11</sup> Mean duration of stay in CCU in Group A patients was higher due to more number of patients on ventilator while Group B patients were admitted for critical care to post operative patients or transfer patients from ward. Average number of drugs prescribed per patient was more than 7 in both Group A and B patients which was lower to study by John *et al.*, where average drug was  $11.6 \pm 2.12$ .<sup>12</sup> In the CCU, due to critical illness and multiple co-morbidity polypharmacy was prescribed Average antimicrobials prescribed was significantly ( $p < 0.05$ ) higher in Group A patients as compared to Group B patients. As more no. of patients on ventilator and average duration of stay in CCU were higher in Group A so they were prescribed more antimicrobials to treatment and prevention of hospital acquired infections.

#### **Analysis of cost of group of drugs per patient**

Average cost of drug therapy was ₹10789  $\pm$  3130 (\$196  $\pm$  57) in Group A patients which was significantly ( $p < 0.05$ ) higher as compared to Group B patients. It may be due to average number of prescribed drugs were higher in Group A patients. Our study report of cost of drug therapy was lower as compared to reported by Biswal *et al.*, where it was ₹19,725.9 The reason may be that in their study the mean number of drugs was 22.2 during the entire stay. Nepal reported that an average drug expenditure was \$33.4  $\pm$  16.2 in their CCU which was lower as compared to our study. Some developed countries reported that drug expenditure per patient per day in CCU ranging from \$208 to \$312 which was higher as compared to our study.<sup>13,14</sup> Average cost of antimicrobials in Group A patients was ₹4054  $\pm$  2014 (\$73  $\pm$  36) which was significantly ( $p < 0.05$ ) higher as compared to Group B patients. It may be due to average number of antimicrobials as well as costliest antimicrobials were prescribed higher in Group A patients. Our cost of antimicrobial therapy was higher as compared to both report by Patel MK *et al.*, and Williams *et al.*, where it was ₹2722 and ₹1995 respectively.<sup>8,15</sup> Shankar PR *et al.*, reported that cost of antimicrobials was \$16.5  $\pm$  13.4 which was lower compared to our study.<sup>13</sup> Study conducted at Belgium and Turkey the mean overall daily antimicrobial cost was €114.25 and \$89.64 respectively.<sup>16,17</sup> Both were higher as compared to our study. Cost of inotropes, cardiovascular drugs and anticholinergic drugs were significantly ( $p < 0.05$ ) higher in Group A patients. These drugs are frequently used in the critical care setting for management of the unstable cardiac patient. Patel BJ *et al.*, reported that cost of inotropic agent was ₹262.31 which was lower compared to our study (₹1237  $\pm$  846).<sup>18</sup> Respiratory drugs cost were significantly ( $p < 0.05$ ) higher in Group A patients as they were commonly prescribed in patients on ventilator and critical care patients to maintain respiration. Cost of gastrointestinal drugs and analgesics were significantly ( $p < 0.05$ ) higher in Group B patients. They were prescribed to reduce gastritis, nausea, vomiting and postoperative pain relief.

#### **Analysis of cost of most commonly prescribed concomitant drugs per patient**

Cost of Adrenaline, dobutamine and streptokinase were significantly ( $p < 0.05$ ) higher in Group A patients. Study by Myburgh *et al.*, reported that daily cost of dobutamine and adrenaline was \$20, \$14 respectively which was higher as compared to our study.<sup>19</sup> Cost of streptokinase was similar in both in our study and study by Patel BJ *et al.*<sup>18</sup> Cost of midazolam was significantly ( $p < 0.05$ ) higher in Group A patients. Study conducted at Canada reported that cost of midazolam per patient was \$180.10 which was higher compared to our study.<sup>20</sup> It may be due to that Canadian study only include those patients who was prescribed midazolam. Cost of pantoprazole was significantly ( $p < 0.05$ ) higher in Group B patients (above \$9). Lin *et al.*, reported cost of pantoprazole was \$20 per day which was higher compared to our study.<sup>21</sup> Pantoprazole is useful in prevent bleeding and stress induced ulcer in critically ill patients.<sup>22</sup> Cost of furosemide and diclofenac per patient were significantly ( $p < 0.05$ ) higher in Group B patients. Furosemide was used for post operative retention of urine or other hypertensive, edematous condition while diclofenac was used for post operative pain management in surgical patients.

#### **Analysis cost of antimicrobial groups per patient**

Cost of cephalosporins and fluoroquinolones were significantly ( $p < 0.05$ ) higher in Group A patients. They may be due to higher number of patients on ventilator in Group A patients which required longer duration broad spectrum antimicrobials. Cost of penicillins, aminoglycosides and nitroimidazole were significantly ( $p < 0.05$ ) higher in Group B patients.

**Table 1 : Analysis of demographic data and drug prescription (n=270)**

CCU	Group A Patients (n=138)	Group B Patients (n=132)	Total Patients (n=270)
Age > 50	94(68.11)**	89(67.42)**	173(64.07)**
Age ≤ 50	44(31.89)	43(32.58)	107(35.93)
Male	86(62.31)**	85(64.39) ##	171(63.33)**
Female	52(37.69)	47(34.61)	99(36.67)
Mortality	63(45.65)@#	35(26.51)	98(36.29)@
Patients on Ventilator Support	78(56.52)@#	47(35.60)	125(46.29)@
Duration of stay in CCU	8.14±1.24*#	6.28±1.42	7.23±1.06'
Average no. of drugs prescribed(Mean±SD)	9.32± 2.36*#	7.62±2.06	8.48±2.18'
Average number of antimicrobials(Mean±SD)	3.52±2.36*#	2.58±2.42	3.06± 2.14'

\*p <0.05 (t test ) significantly higher as compared to Group B patients  
#p <0.05 (t test ) significantly higher as compared to total no. of patients  
\*\*p <0.05 ( $\chi^2$  test) significantly higher as compared to age ≤ 50 group  
##p <0.05 ( $\chi^2$  test) significantly higher as compared to female patients  
@p <0.05 (Z test ) significantly higher as compared to Group B patients

**Table 2: Analysis of cost of group of drugs per patient in CCU (n=270)**

Drugs	Group A Patients (n=138)	% of total drug cost	Group B Patients (n=132)	% of total drug cost	Total Patients (n=270)	% of total drug cost
Cost of total drug therapy	₹10789±3130*# \$ 196±57	100	₹ 9646± 2132 \$175±38	100	₹10230±2413' \$186±44	100
Antimicrobials	₹4054± 2014*# \$73±36	37.35	₹3038± 1934 \$57±35	31.39	₹3557±1876' \$ 64±34	34.59
IV fluids	₹947±546 \$17±9	8.78	₹1180±765** \$21±13	12.24	₹1060 ± 672 \$19±12	10.37
Inotropes	₹1471± 986*# \$26±17	13.64	₹994±568 \$18±10	10.3	₹1237±846' \$22±15	12.1
Gastro-intestinal drugs	₹503±304 \$9±5	4.67	₹1215 ±983*** \$22±17	12.59	₹851±741** \$15±13	8.31
Analgesics	₹575±352 \$10±6	5.33	₹919±458** \$16.78±8.36	9.53	₹743± 542** \$13±9	7.27
Cardiovascular drugs	₹1284±894*# \$23±16	11.9	₹527±134 \$9±2	5.47	₹913±387' \$16±7	8.94
Diuretics	₹333±167 \$6±3	3.08	₹556±238*** \$10±4	5.77	₹442±284*** \$8±5	4.32
Central nervous system drugs	₹726±508*# \$13±9	6.73	₹340±184 \$6±3	3.53	₹537±450' \$9±8	5.26
Anticholinergic drugs	₹230± 186*# \$4±3	2.13	₹164±82 \$2±1	1.7	₹197±105' \$3±1	1.94
Corticosteroids	₹73 ± 34 \$1±0.6	0.67	₹118±56*** \$2±1	1.22	₹95±64*** \$2±1	0.92
Respiratory drugs	₹157±68*# \$2±1	1.45	₹89 ± 28 \$1±0.5	0.92	₹123±34' \$2±0.6	1.21
Other drugs	₹461± 143 \$8±2	4.27	₹516± 123*** \$9±2	5.34	₹487±146 \$7±2	4.77

\*p <0.05 (t test ) significantly higher as compared to Group B patients  
\*\*p <0.05 (t test ) significantly higher as compared to Group A patients  
#p <0.05 (t test ) significantly higher as compared to total no. of patients

**Table 3: Analysis of cost of most commonly prescribed concomitant drugs per patient in CCU (n=270)**

Drugs	Group A Patients (n=138)	% of total drugcost	Group B Patients (n=132)	% of total drug cost	Total Patients (n=270)	% of total drugcost
Atropine	₹144 ±92 <sup>#</sup> \$2±1	1.33	₹106±65 \$1±1	1.09	₹125±89 <sup>†</sup> \$2±1	1.22
Adrenaline	₹98 ±45 <sup>#</sup> \$1±0.8	0.9	₹44± 28 \$0.83±0.5	0.45	₹71 ±32 <sup>†</sup> \$1 ±0.5	0.69
Dopamine	₹582±203 <sup>#</sup> \$10±3	5.39	₹288± 167 \$5±3	2.98	₹438± 204 <sup>†</sup> \$8±3	4.28
Dobutamine	₹581± 298 <sup>#</sup> \$10±5	5.38	₹406±312 \$7±5	4.2	₹495±302 <sup>†</sup> \$9±5	4.84
Streptokinase	₹806±653 <sup>#</sup> \$14±11	7.47	₹442 ±245 \$8±4	4.58	₹628± 209 <sup>†</sup> \$11±3	6.13
Furosemide	₹259± 243 \$4±4	2.4	₹382± 179 <sup>#</sup> \$6 ±3	3.96	₹319± 201 <sup>**</sup> \$5±3	3.12
Pantoprazole	₹288± 146 \$5±2	2.66	₹506± 289 <sup>#</sup> \$9±5	5.24	₹394± 145 <sup>**</sup> \$7±2.66	3.85
Ondansetron	₹114± 46 \$1 ±0.8	1.05	₹298± 165 <sup>#</sup> \$5±3	3.08	₹203 ±102 <sup>**</sup> \$3±1	1.99
Sodium valproate	₹296± 136 <sup>#</sup> \$5±2	2.74	₹119± 64 \$2±1	1.23	₹209± 103 <sup>†</sup> \$3±1	2.04
Midazolam	₹229± 127 <sup>#</sup> \$4±2	2.12	₹154± 78 \$2±1	1.59	₹192± 138 <sup>†</sup> \$3±2	1.88
Diclofenac	₹143± 107 \$2±1	1.32	₹221± 146 <sup>#</sup> \$4.04±2	2.29	₹181± 106 <sup>**</sup> \$3±1	1.77

\* p <0.05 (t test ) significantly higher as compared to Group B patients  
\*\* p <0.05 (t test ) significantly higher as compared to Group A patients  
<sup>#</sup>p <0.05 (t test ) significantly higher as compared to Group A patients

**Table 4: Analysis of cost of antimicrobials group in CCU (n=270)**

Antimicrobial group	Group A Patients (n=138)	% of cost	Group B Patients (n=132)	% of cost	Total Patients (n=270)	% of cost
Cephalosporins	₹1653±1234 <sup>#</sup> \$30±22	40.77	₹851±714 \$15±13	28.01	₹1260±976 <sup>†</sup> \$23±17	35.44
Penicillin	₹1326±1104 <sup>†</sup> \$24±20	32.70	₹914 ±698 \$16±12	30.08	₹1124±1012 <sup>†</sup> \$20±18	31.61
Monobactam	₹168±142 \$3±2	4.15	₹148±102 \$2±1	4.87	₹158±123 \$3±2	4.45
Fluroquinolone	₹236 ±187 <sup>#</sup> \$3±2	5.82	₹80 ±56 \$1±1	2.64	₹159±96 <sup>†</sup> \$3±1	4.49
Aminoglycosides	₹185±126 \$3±2	4.56	₹494±288 <sup>#</sup> \$7±5	16.26	₹336±290 <sup>**</sup> \$6±5	9.45
Macrolide	₹233±167 \$4±3	5.75	₹291 ±202 <sup>**</sup> \$5±3	9.58	₹261±186 \$4±3	7.34
Nitroimidazole	₹131±98 \$2±1	3.23	₹242±103 <sup>#</sup> \$4±1	7.97	₹185±138 <sup>**</sup> \$3±2	5.21
Others	₹122±102 <sup>#</sup> \$2±1	3.01	₹18±16 \$0.3±0.2	0.59	₹62±42 <sup>†</sup> \$1±0.7	2.01

\* p <0.05 (t test ) significantly higher as compared to Group B patients  
\*\* p <0.05 (t test ) significantly higher as compared to Group A patients  
<sup>#</sup>p <0.05 (Z test ) significantly higher as compared to total no. of patients

**Table 5: Analysis of cost of most commonly prescribed antimicrobials in CCU (n=270)**

Name of antimicrobial agent	Group A Patients (n=138)	% of cost	Group B Patients (n=132)	% of cost	Total Patients (n=270)	% of cost
Amoxicillin-Clavulanate	₹483±352 \$8±6	11.91	₹624±432** \$11±7	20.53	₹551±428 \$10 ± 7	15.51
Piperacillin+Tazobactam	₹956±754*# \$17±13	23.58	₹276±146 \$5±2	9.08	₹623±394† \$11 ± 7	17.52
Cefoperazone + sulbactam	₹797±621*# \$14±11	19.65	₹302±142 \$5±2	9.94	₹555±384† \$10±7	15.6
Ceftriaxone+ sulbactam	₹576±456*# \$10.51±8.3	14.2	₹140±62 \$2±1	4.6	₹362±174† \$7±3	10.2
Cefotaxime+ sulbactam	₹58±33 \$1±0.6	1.43	₹162±78**# \$3±1	5.33	₹108± 38** \$1 ±0.6	3.04
Imipenem+ cilistin	₹168±142 \$3±2	4.15	₹148 ±104 \$2 ± 1	4.87	₹158±123 \$3±2	4.45
Levofloxacin	₹191±112*# \$3±2	4.72	₹79±62 \$1±1	2.6	₹136±99† \$2.69±1	3.83
Amikacin	₹184±136 \$3±2	4.54	₹374±286**# \$7±5	12.32	₹276±224** \$5±4	7.78
Vancomycin	₹26±12 \$0.4±0.2	0.64	₹138±108**# \$2±1	4.54	₹80±48** \$1 ±0.8	2.27
Linezolid	₹169± 124 \$3± 2	4.16	₹224±112**# \$4±2	7.37	₹195±132 \$3±2	5.5
Metronidazole	₹131±102 \$2±1	3.23	₹342±103**# \$6 ± 1	11.25	₹232±138** \$4± 2	6.58

\*p <0.05 (t test ) significantly higher as compared to Group B patients  
\*\*p <0.05 (t test ) significantly higher as compared to Group A patients  
#p <0.05 (t test ) significantly higher as compared to total no. of patients

These groups are effective against gram positive and gram negative infection as well as anaerobes to prevent post operative infections.

#### Analysis cost of antimicrobial agents per patient

Cost of piperacillin+tazobactam and cefoperazone+sulbactam were significantly ( $p < 0.05$ ) higher in Group A patients ( $\$17 \pm 13$ ,  $\$14 \pm 11$ ) respectively. Study conducted at Turkey daily cost of piperacillin+tazobactam and cefoperazone+sulbactam were above  $\$8500$  and  $\$4000$  respectively. Both were higher as compared to our study.<sup>17</sup> Both antimicrobial agents were prescribed as broad spectrum antimicrobials in our study. Cost of ceftriaxone+sulbactam were significantly higher in Group A patients ( $\$10.51 \pm 8.3$ ) which was lower as compared to study conducted at Turkey ( $\$197$  to  $\$394$ ).<sup>17</sup> Cost of levofloxacin was significantly ( $p < 0.05$ ) higher in Group A patients ( $\$3 \pm 2$ ) as compared to Group B patients. Study from Germany reported that cost of levofloxacin was accounted for 15 to 30% of total costs which was higher as compared to our study where it was 4.72%.<sup>23</sup> Levofloxacin was prescribed to prevent and management of hospital acquired infection due to multidrug resistant organisms. Astagneau *et al.*, reported that the daily antibiotic cost of multi-resistant bacterial infections was 20% higher than susceptible infections.<sup>24</sup> Cost of amoxicillin+clavulanate and cefotaxime+sulbactam were significantly ( $p < 0.05$ ) higher in Group B patients as both drugs were used as broad spectrum antimicrobial to prevent post operative infections. Average cost of amikacin and metronidazole per patient were above  $\$7$  and  $\$6$  significantly ( $p < 0.05$ ) higher in Group B patients respectively. Study at Turkey reported that daily amikacin cost  $\$796$  and daily cost of metronidazole from  $\$551$  to

$\$1004$ .<sup>17</sup> The reason behind high cost observed in Turkey study is may be due to it was conducted in six adult ICUs among 8460 patients. Cost of vancomycin was significantly ( $p < 0.05$ ) higher in Group B patients ( $\$2 \pm 1$ ) and it was prescribed for methicillin resistant *Staphylococcus aureus* (MRSA) infections. Daily antibiotic cost of MRSA infections was 2-3 times higher than infections with susceptible strains.<sup>17</sup> Cost of linezolid was significantly ( $p < 0.05$ ) higher in Group B patients. It was prescribed to prevent CNS infection in post operative orthopedic and neurosurgical patients. Study by Myrianthefs *et al.*, suggest that linezolid achieve adequate concentrations in the cerebrospinal fluid for management or prophylaxis of CNS infections.<sup>25</sup> Cost of amoxicillin+clavulanic acid, piperacillin+tazobactam and cefoperazone+sulbactam per patient account more than 40% of cost of antimicrobials. Vandijck *et al.*, reported that  $\beta$ -lactam antibiotics accounted for 33% of daily cost of antimicrobial agents similar to our study.<sup>16</sup>

Our study revealed that cost of drug therapy and antimicrobial agents per patient in CCU were higher as compared to developing country but lower as compared to developed country. Cost of antimicrobials was accounted more than 30% of cost of total drug therapy. Our study will help to educated prescribers about cheap and affordable drug and antimicrobials in CCU patients. Our study will also helpful to hospital administrator to know about cost of drug therapy during hospitalization in CCU. It will also helpful to give economic benefits to poor people when they were admitted in CCU particular regarding cost of antimicrobial therapy. In our study limitation we did not calculate laboratory cost, hospitalization cost, CCU equipment cost, staff cost, indirect cost like transport cost, loss of wages.



## CONCLUSION

In conclusion, our study reveals that cost of antimicrobials and cost of concomitant drugs were higher in directly admitted patients (Group A) in CCU. Cost of antimicrobials per patient was accounted one third to

total cost of drug therapy in CCU. Cost of beta lactam antimicrobials per patient was higher compared to other antimicrobials in CCU. This study will helpful for education to prescribers, rational and affordable prescription of antimicrobials and better management of patients in CCU.

## ABBREVIATIONS USED

CCU: Critical Care Unit.

## ABOUT AUTHOR



**Dr. Prakash Rameshbhai Shelat**, is an Assistant Professor at the Department of Pharmacology, P.D.U. Govt. Medical College, Rajkot. His interest is in the area of drug utilization studies, clinical trials and clinical research. He is also done many research paper and presentations.

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