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Original Article:

Cost - utility analysis of parenteral antibiotics prescribed in medical wards in a tertiary care health facility in southern province of Sri Lanka.

Authors
Lukshmy Menik Hettihewa, Senior Lecturer, Department of Pharmacology, Faculty of Medicine, University of Ruhuna,
Rangika Manamperi, Department of Pharmacy Allied Health Sciences, Faculty of Medicine, University of Ruhuna,
Tharangi Kodikara, Department of Pharmacy Allied Health Sciences, Faculty of Medicine, University of Ruhuna.

Address for Correspondence
Lukshmy Menik Hettihewa,
Senior Lecturer,
Department of Pharmacology,
Faculty of Medicine,
University of Ruhuna.
E-mail: menik@med.ruh.ac.lk

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Abstract: Introduction: Parenteral antibiotic (PA) prescription pattern in a hospital will directly influence the annual budget allocation, development of bacterial resistance and occurrence of unnecessary adverse drug reactions if it is done with poor adherence to the standard guidelines of prescription. As specialist in the field we understand the need of conducting economic studies in relation to the cost and utility of PA prescription pattern. It will be helpful to predict the drug procurement plan for the next year and also to prevent unnecessary complications mentioned above. **Objective:** Our main objective was to analyze the cost/utility relationship of PA drugs which were used in medical wards in this hospital according to the top ten of the cost (TTTC) and the top ten of the consumption (TTCS). **Materials and method:** Aggregate data from the pharmacy record books were collected for year 2010 from indoor pharmacy. Unit prize was obtained from medical supplies division. Total quantity consumed by each medical ward was considered for analysis of the cost /utility relationship. Two top ten lists were prepared according to the cost and the consumption respectively for medical wards and the correlation was analyzed using non parametric testing with spearman test. **Results:** Regarding PA drugs used in this hospital, 7/10 PA drugs in TTTC are not included in the TTCS. Out of the total cost for TTTC, 82.6% of the cost had been spent for the PA drugs which are not in the TTCS and 17.5% of the cost of TTTC was used to purchase only three drugs from the TTCS. But these three drugs had contributed only 28% of top ten consumption. 72% of the PA drugs in TTCS were not costly drugs and highly consumed in medical wards. Correlation was significantly positive between cost and utility of PA drugs. ($r=-0.91, p<0.001$) **Conclusion:** Majority of the consumed PA drugs are non-costly and it indicates the prescriptions had been done according to the rational guidelines including cost, availability and affordability. Correlation further confirms that majority of the PA consumption was low costly drugs. As most of the money had been spent to purchase highly expensive PA drugs for medical wards we suggest to review the clinical indications for these drugs with the microbiological evidence to be compatible with the allocated health budget for the hospital. This further suggests conducting the cost effective economic studies to evaluate the suitable drug alternatives for such indications.
Key Words: Antibiotics; Health Budget.

Introduction:
It is an established factor that prescription pattern of antibiotics in a hospital will directly influence the total budget allocation for drugs in that country.[1] Pointless expenditure on one entity will lead to default prioritization of health expenditure and ultimate poor outcome of government health sector in country. In addition poor adherence to the standard guidelines of antibiotic prescription may give rise to development of bacterial resistance[2-6] and occurrence of unnecessary adverse drug reactions and therapeutic failure.
In our previous research, as the budget allocation for procurement of parenteral antibiotics (PA) is responsible for a considerable portion of the annual government expenditure on health sector, it is highly requires for an analysis on this concept.[7] Though the target is to minimize the allocated cost for drugs it may not contribute to a considerable reduction of allocated total cost for health system in country, as the drug cost reduction might be compensated by other issues as therapeutic failure and prolonged hospital stay due emerged resistant organisms.[8]
Therefore it is highly advisable and essential to review antimicrobial prescribing patterns in everywhere in the world and identify irrational use and strictly adhered to the guidelines to prevent the world becoming pre antibiotic era.

In addition it is obvious that the pattern of antibiotic consumption among various ward setups in a tertiary care hospital (as medical, surgical, pediatric, etc) should display a clear variability as the common indications are significantly different.

To discover all above factors in Sri Lanka and due to the lack of studies done on the topic, we expanded our previous research[7] to a level of analyzing the PA drug distribution in all medical wards in the same study setup. Furthermore we are planning to compare 2010 results with 2011 and held a cost utility comparison. At the end of the comparison it is our objective to discover any significant difference in data on two consecutive years and find the responsible drug groups for it. By further analyzing data we would be able to suggest suitable drug alternatives for indications which currently prescribing drugs are not suitable to the rational guidelines.

Materials and Methods

It is a cross sectional study conducted using aggregate data records from Indoor pharmacy and medical supplies division in teaching hospital Karapitiya, SriLanka. In part 1,[7] Aggregate data from the pharmacy record books were collected for year 2010 from indoor pharmacy. Data was related to initial drug stock, received quantity from medical supplies division (MSD), final drug stock and identification of VEN category for every PA in 2010. Unit prize was obtained from MSD.

Total quantity consumed and total cost spent for each PA by each medical ward were considered for analysis of the cost utility relationship In this expanded part 2 of the research. Total number of ten medical wards in the hospital setup was included to the study. Preformed two top ten lists (TTTC and TTCS) were rearranged according to the cost and the consumption respectively for ten medical wards. Percentage values for common PA drugs in both TTTC and TTCS were obtained and came to several conclusions after interpreting the correlation.

Data analysis: Data sets were distributed in normal distribution curve and within 95% of confidence interval. Therefore the mean, SE and SD were calculated using the parametric tests. All data analysis was done using SPSS package 16 and the microcal origin statistical package.

Results

We rearranged top ten list for cost indicating the number of items (vials and ampoules) issued for all medical wards in study setup, relevant unit prices, cost for each and percentage distribution within total cost. Meropenem injection 1g is in the top consuming highest cost (18.52% of total expenditure for TTTC) in 2010 while the Metronidazole injection 500mg/100ml scored at tenth (2.84% total expenditure for TTTC). But we also paid attention on the high unit price of Meropenum (Rs.1215.06) while the consumption (1252 vials) is not relatively high (mean consumption in TTTC = Rs.6167.60)

Total of 30447 of cefotaxime 1g vials were consumed but it is in the fourth in TTTC list as the unit price is considerably low of Rs.29.10. Vancomycin HCL 500mg is the PA with highest unit price but has been contributed only 9.77 %

Table 1: Usage, unit price and the cost for TTTC drugs

PA	No items	Unit price	Cost	% cost
Meropenem injection 1g	1252	1215.06	1521255	18.52%
Clarithromycin 500mg IV infusion	2447	545.48	1334790	16.25%
Imipenum+ Cilastatin infusion500mg	1020	1200.80	1224816	14.91%
Cefotaxime1g	30447	29.10	886007.7	10.78%
Ticarcillin1.5g+Clavualanic acid injection 100mg	1160	737.56	855569.6	10.41%
Vancomycin HCL 500mg	588	1364.48	802314.2	9.77%
Meropenam injection 500mg	935	622.27	581822.5	7.08%
Ceftazidime injection 500mg	1350	339.83	458770.5	5.58%
Cefuroxime injection 750mg	7953	39.84	316847.5	3.86%
Metronidazole injection 500mg/100ml	14524	16.06	233255.4	2.84%
Total			**8215448**	

Table 2: Antibiotic Consumption and Cost for TTCS drugs

PA	No items	% Consumption	Unit price	Cost	%Cost
Ampicillin injection 250mg	51617	27.40	9.23	1414119.72	42.23%
Benzyl penicillin injection 1mu	45159	23.97	8.87	1082403.76	32.32%
Cefotaxime1g	30447	16.16	29.10	492027.84	14.69%
Cloxacillin250mg	16400	8.70	8.78	142754.02	4.26%
Metronidazole injection 500mg/100ml	14524	7.71	16.06	111962.64	3.34%
Cefuroxime injection750mg	7953	4.22	39.84	33570.87	1.00%
Ciprofloxacin injection200mg/100ml	7518	3.99	24.61	29998.90	0.90%
Co-amoxiclave 1000/200mg	6086	3.23	80.25	19659.14	0.59%
Ceftriaxone injection1g	5803	3.08	45.49	17873.34	0.53%
Gentamicin sulphate 80mg/2ml	2901	1.54	7.89	4466.80	0.13%
Total	188408			3417374.74	

Table 1 indicates the number of items (vials and ampoules) issued for all medical wards in study setup, relevant unit prices, cost for each and percentage distribution within total cost for TTTC drugs

After analyzing the TTTC data according to the cost, we further studied the top ten list according to the degree of consumption. Table 2 indicates the number of items (vials and ampoules) consumed in all medical wards in study setup, relevant unit prices, cost for each and percentage distribution within total consumption and total cost. Ampicillin injection 250mg is in the top of the consumption list (27.4% of total consumption) in 2010 while the gentamycin sulphate 80mg/2ml is at tenth (1.54% of total consumption).It is noticeable that the only few drugs in the TTTC had contributed to the total high cost of the top ten. Figure 1 shows the unit price of the PA drugs listed in the top ten according to the cost and the percentage of contribution to the expensive drugs. Only three drugs were above the 1000 SLR per unit price and four drugs were above 500 SLR and 33% of the drugs in TTTC were above the 1000 SLR of unit price.

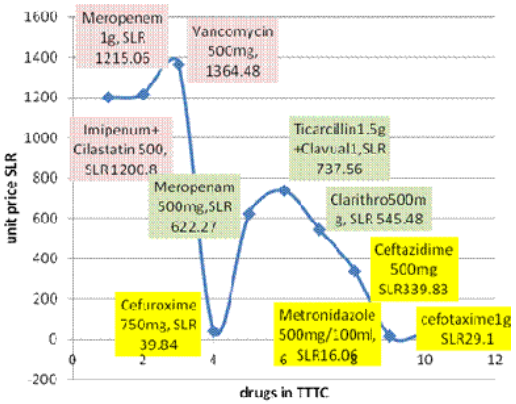

Figure 1: The distribution of PA drugs according to the unit price.

Figure 1 shows three drugs were above the 1000 SLR per unit price and four drugs were above 500 SLR.

After considering the drug distribution according to the unit price we further analyzed our data to see the contribution of TTTC to the TTCS and the contribution of TTCS in TTTC. Only 17% of drugs from consumption list contributed to the cost of top ten. It was Metronidazole injection 500mg/100ml, cefotaxime 1g and Cefuroxime injection 750mg. 83 % of TTTC expenditure is for the drugs not in TTCS. On the other hand, only 3% of the drugs had been contributed to the top ten of consumption list. We further concentrated on the top ten consumption PA drug according to the cost spent; 28% of total cost for TTCS was spent for the drugs which are also included in TTTC, 72% of total cost for TTCS was spent for the drugs which are not included in TTTC.

Above results showed that most of the cost had been spent to the less consumed drug which was expensive (7 drugs out of ten). To further confirm it we did a correlation analysis between cost and the consumption pattern.

The relationship between the cost and the consumption pattern of top ten PA list for year 2010 showed that the cost is positively correlated with the consumption at low cost rates and high cost rates. ($r=0.91$, $p<0.001$).

VEN analysis is a system of setting priorities, in which drugs are classified according to their health impact: vital, essential, and non-essential. Vital drugs are those that are potentially life-saving, or crucial to providing basic health services. We used these categories to see the cost and utility of different VEN category drugs. Table 3a shows the the category of antibiotic according to the VEN classification in 2010 for TTTC. Table 3a shows almost all drugs in TTTC are essential drugs. Table 3b further indicates the relevant category of antibiotic according to the VEN classification in 2010 for top ten antibiotics according to consumption. Table 3b shows that there is one vital drug in the TTCS. Gentamycin sulphate 80mg/2ml is the only drug d under vital category. But it was ranked at position tenth in TTCS. Other nine drugs were classified under essential category.

Table 3a: The relevant category of TTTC for medical wards according to the VEN classification in 2010.

TTTC for Medical Wards PA	VEN
Meropenem injection 1g	E
Clarithromycin 500mg IV infusion	E
Imipenum+ Cilastatin infusion500mg	E
Cefotaxime1g	E
Ticarcillin1.5g+Clavualanic acid injection 100mg	E
Vancomycin HCL 500mg	E
Meropenam injection 500mg	E
Ceftazidime injection 500mg	E
Cefuroxime injection 750mg	E
Metronidazole injection 500mg/100ml	E

Table 3b: The relevant category of TTTC list for total hospital usage in 2010

TTTC for Total Hospital PA	VEN
Imipenum + Cilastatin infusion 500 mg	E
Meropenem injection 1 g	E
Vancomycin HCL Injection 500mg	E
Cefuroxime Injection 750 mg	E
Merapenem Injection 500 mg	E
Ticarcillin 1.5 g + Clavulanic acid Injection 100mg	E
Clarithromycin 500mg IV infusion	E
Ceftazidime Injection 500 mg	E
Metronidazole injection 500mg/100ml	E
Cefotaxime Injection 1 g	E

Following Table 4a and 4b shows TTCS and TTTC list for PA drugs for total hospital consumption. We found TTTC drugs are same for both hospital and medical wards and the 66% of the drugs in TTTC for was above 500.00 SLR both medical wards and all hospital consumption. TTCS list also was same for both hospital and medical wards although the priority had been changed (Figure 4a and 4b).

Table 4a: TTCS and TTTC list for PA drugs for total hospital consumption

TTCS for Medical Wards PA	VEN
Ampicillin injection 250mg	E
Benzyl penicillin injection 1mu	E
cefotaxime1g	E
cloxacillin250mg	E
Metronidazole injection 500mg/100ml	E
Cefuroxime injection 750mg	E
Ciprofloxacin injection 200mg/100ml	E
Co-amoxiclav 1000/200mg	E
Ceftriaxone injection 1g	E
gentamycin sulphate80mg/2ml	V

Table 4b: TTTC list for PA drugs for total hospital consumption	
TTCS Drug for Total Hospital	**VEN**
Ampicillin Injection 250 mg	E
Benzyl Penicillin Injection 1mu	E
Metronidazole injection 500mg/100ml	E
Cefuroxime Injection 750 mg	E
Cloxacillin Injection 250 mg	E
Cefotaxime Injection 1 g	E
Gentamicin Sulphate Injection 80mg/2ml	V
Ciprofloxacin Injection 200mg/100ml	E
Co-amoxyclav Injection 1000/ 200 mg	E
Ceftriaxone Injection 1 g	E

Table 4a and 4b shows that TTCS list for total hospital and medical wards respectively in year 2010. We noted some differences with the TTCS in these two lists.

Discussion

After analyzing the total data of the hospital we found that TTTC and TTCS prepared is different from the total top ten lists in medical ward data. Contribution from cost of top ten consumed to TTTC was only 17% of the total cost. It was for metronidazole injection 500mg/100ml, cefotaxime 1g and Cefuroxime injection 750mg; 83% is for drugs not in TTCS. As a considerable portion of the cumulative cost for TTTC had been formed by purchasing drugs not in TTCS list, we suggest reviewing the clinical indications for these drugs with the microbiological evidence to be compatible with the allocated health budget for the hospital. This further suggests conducting the cost effective economic studies to evaluate the suitable drug alternatives for such indications. This explains the medical wards had used majority of least expensive PA drugs.

In addition to that we also found that 72% drugs are least expensive and only 28% of the total top ten consumed drugs had contributed to the top ten costs (Figure 2b). We also identified that 66% of the drugs in TTTC was above 500.00 SLR in both medical wards and all hospital consumption. This indicates that all these costly drugs are not in the TTCS list. This shows that these second line PA expensive drugs had been less frequently probably when there is a real indication. Taking all these data together, we can observe that inward prescriptions in medical wards had been done according to the standard rational guidelines for antibiotic usage including cost, availability and affordability. Our further analysis also shows that correlation of TTCS with TTTC positively related.

We further compared our TTTC and TTCS lists with other countries. In contrast, we found that the gentamicin (17%), metronidazole (9%) and ciprofloxacin (8%) were the most commonly used PA agents in a research done in Bangalore.[11] But in our country, majority of drugs in our TTCS were penicillins and cephalosporines which are affordable, available and cost effective first line antibiotics against gram positive and gram negative organisms. Metronidazole, ciprofloxacin and gentamicin are at the places of fifth, seventh and tenth respectively in our study. It is established that metronidazole has good anaerobic coverage while gentamicin sulphate cover more gram negatives. Therefore it further proves that inward PA prescription patterns in this hospital for 2010 were strongly rational to the guide lines.

We also compared our findings with some other hospital data. They showed that PA use in many acute-care hospitals (14 institutions) had found a significant difference in PA pattern in two comparative groups of hospital.[12]Group A hospital had used combinations of less-expensive antibiotics (such as ampicillin/ gentamicin/metronidazole) and the other group B hospitals had used broad-spectrum monotherapy with imipenem/cilastatin or timentin/clavulanate). In our study our hospital also had mainly prescribed the less expensive affordable first lien PA drugs unless otherwise indicated. In a study conducted in Nepal, Ampicillin, amoxicillin, metronidazole, ciprofloxacin and crystalline penicillin were the 5 most commonly prescribed PA antibiotics.[13] In the Norwegian study, cephalosporins represented 16% of the use of antibacterials in hospitals, while in the study carried out at a rural hospital, ceftriaxone and cefuroxime together accounted for 30.8% of the total antibiotic days.[14,15]

But still there is a quota of PA drugs which are expensive but not even included in top ten consumption. This shows the urgent need of attention for reviewing the clinical indications for these expensive PA drugs for their justifiable indications or microbiological evidence. It is advisable to make the procurement plan for PA drugs which is usually recommended by drug and therapeutic committees to be compatible with the allocated health budget for the hospital. This will be facilitated significantly by conducting the cost effective economic studies to evaluate the suitable drug alternatives for such indications.

Finally we suggest to do this type of cost utility analysis at annually by relevant stake holders in a drug and therapeutic committees in a hospital to assess the annual consumption and ward wise consumption to assess the relevance and to avoid the unnecessary prescriptions over prescriptions and over usage of expensive second line PA drugs which should be reserved for emergencies.

References

1. Castro MS, Pilger D, Ferreira MB, Kopittke L. Trends in antimicrobial utilization in a university hospital, 1990/96. *Rev Saude Publica* 2002;36:553-558
2. Van der Meer JW, Gyssens IC. Quality of antimicrobial drug prescription in hospital. *Clinical Microbiology Infections.* 2001;7 Suppl 6:12-15.
3. Col NF, O'Connor RW. Estimating worldwide current antibiotic usage. *Reviews of Infectious Diseases.* 1987 May-Jun;9 Suppl 3:S232-243
4. Srishyla MV, Naga Rani MA, Venkataraman BV. Drug utilization of antimicrobials in the in-patient setting of a tertiary hospital. *Indian J Pharmacol* 1994;26:282-287
5. Mylotte JM, Weislo P. Antibiotic use and cost indicators at a rural hospital. a pilot project. *Am J Infect Control*. 2000;28:415-420.
6. Sharma D, Reeta KH, Badyal DK, Garg SK, Bhargava VK. Antimicrobial prescribing pattern in an Indian tertiary hospital. *Indian J Physiol Pharmacol* 1998;42:533-537
7. Hettihewa L, Subasinghe S , Cooray P, Kulathunga N. Evaluation of Cost / Utility of Parenteral Antibiotics Consumption In a Tertiary Health Care Facility: A Cross sectional Study. Publication in progress; *Journal of Pharmacy Research.*
8. Grau S, Rubio-Terrés C. Pharmacoeconomics of linezolid.Hospital del Mar, Pharmacy Department, Barcelona. Available at http://www.healthvalue.org/pdfs/ANTIBI%D3TICOS%205.pdf
9. WHO Collaborating Centre for Drug Statistics Methodology: ATC index with DDDs 2002. *Oslo* 2002
10. Castro MS, Pilger D, Ferreira MB, Kopittke L. Trends in antimicrobial utilization in a university hospital, 1990–96. *Rev Saude Publica* 2002;36:553-558.
11. Srishyla MV, Nagarani MA, Venkataraman BV. Drug utilization of antimicrobials in the in-patient setting of a tertiary Hospital. *Indian Journal of Pharmacology.*1994;26(4):282-287

12. Carling PC, Fung T, Coldiron JS. Parenteral. Antibiotic Use in Acute-Care Hospitals. *Clinical Infectious Disease*. 1999;29(5):1189-1196. doi: 10.1086/313431
13. Shnakar RP, Partha P, Shenoy KN, Easow JM, Brahmadathan KN. Prescribing patterns of antibiotics and sensitivity patterns of common microorganisms in the Internal Medicine ward of a teaching hospital in Western Nepal: a prospective study. *Annals of Clinical Microbiology and Antimicrobials.* 2003;2:7-9
14. Blix HS. Utilization of antibiotics in and outside of health facilities in Norway in 1998. *Tidsskr Nor Laegeforen* 2000;120:1731-1734.
15. Mylotte JM, Weislo P. Antibiotic use and cost indicators at a rural hospital: a pilot project. *Am J Infect Control* 2000;28:415-420.